U.S. DEPARTMENT OF TRANSPORTATION

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RESEARCH AND INNOVATIVE TECHNOLOGY
ADMINISTRATION (RITA)

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INTELLIGENT TRANSPORTATION SYSTEMS PROGRAM
ADVISORY COMMITTEE (ITS PAC)

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MEETING TRANSCRIPT

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OCTOBER 10 TO 11, 2012

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ROGER BERG, Vice President, Wireless Technologies, DENSO
JOSEPH CALABRESE, CEO, Greater Cleveland Regional Transit Authority
JOHN CAPP, Director of Global Active Safety Electronics, General Motors
SONNY HOLTZMAN, ESQ., The Holtzman Group
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HANS KLEIN, Ph.D., Georgia Institute of Technology
SCOTT McCORMICK, President, Connected Vehicle Trade Association
RAJ RAJKUMAR, Ph.D., Carnegie Mellon University
BRYAN SCHROMSKY, Director, Federal Government and Public Safety, Verizon Wireless
KIRK STEUDLE, P.E., Director, Michigan Department of Transportation
GEORGE WEBB, County Engineer, Palm Beach County, Florida

ALSO PRESENT:
GREGORY WINFREE, Deputy Administrator, Research and Innovative Technology Administration (RITA, U.S. Department of Transportation (DOT) (by teleconference)
JOHN AUGUSTINE, Managing Director, ITS Joint

Program Office (JPO), RITA
VALERIE BRIGGS, ITS JPO
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JAMES SZUDY, Bendix Commercial Vehicle Systems, LLC
CARLOS VELEZ, Citizant, Inc.

P-R-O-C-E-E-D-I-N-G-S

DAY 1 – WEDNESDAY, OCTOBER 10, 2012

The Advisory Committee met in Room 1122 at the University of Michigan Transportation Institute, North Campus Research Complex, 1600 Huron Parkway, Building 520, Ann Arbor, Michigan, at 8:04 a.m., Robert Denaro, Chair.

OPENING REMARKS BY COMMITTEE CHAIRMAN AND VICE CHAIRMAN

CHAIR DENARO: All right. I want to welcome everybody to our second face-to-face meeting for the ITS PAC. I'm Bob Denaro, Chair of the Committee, and a few housekeeping items.

First of all, maybe quite important, restrooms are out the door to the right, down the hall.

This is a federal advisory committee meeting, open to the public, and you're all reminded of the FACA rules with respect to inclusion and so forth. They apply to this meeting. During the meeting, everything will be recorded, and so I would like to ask that,

if you can remember, before you speak, please say your name. It'll make it a lot easier on our notes-takers to sort out who said what during the meeting.

So just -- I don't want to say a whole lot. Just a couple of comments on the meeting. We worked hard on the agenda. It's pretty packed, as you can see. I'm very excited about the agenda. I think we're going to cover a lot of good things.

Just to give you a perspective on where we are, we had our first meeting and a couple of phone meetings. The first meeting was really for us to get acquainted with the program and get a good overview and look at some of the update on where the program is.

This meeting, our intent is to dive a little deeper, and specifically in technology, we decided to hold it in Ann Arbor because it's the site of the Safety Pilot, which is huge in its importance to the eventual NHTSA decision next year, and I'm sure we'll get an update on that from the JPO and others. And this is our

chance to really dive a little deeper in technology. It's not our last chance. We can continue to have briefings, we can continue to call for outside experts, as well as JPO experts, and we will do that. But I do encourage everyone, first of all, certainly to participate. I would like everyone to participate. And secondly, please leave no question unanswered here in terms of diving into the details that we're going to hear. So we've really arranged the right piece.

I want to thank the JPO, brought a lot of people out here on a tight travel budget. But they knew the importance of what we were going to be discussing for these two days. So I think we've got a good collection of the right people to give us the information we need.

And then today it's a lot of information-gathering for us. We'll ask a lot of questions. We should have a good discussion with the presenters. Tomorrow is more about our subcommittees and breakouts and pulling that together. And I know we've got various stages

for each of the subcommittees, and I think that's okay. Again, to remind you, we've got all of next year to go as well, two or three meetings more in terms of pulling together our final recommendations at the end of our term. So, I feel that we're in fine status with respect to where we are in the committee. Some committees have had a couple of meetings, and even got some initial conclusions and so forth, which is great. Others, like my own, the technology subcommittee, are really getting started in terms of organizing and figuring out what we're going to focus on and that sort of thing, and that's fine.

So we'll use the time productively tomorrow to move the ball forward with respect to the subcommittees, and then after this meeting, I think, is when we'll look to the subcommittees to really dive in, get all the information they need, and start forming conclusions.

We will also talk -- I think on the agenda for tomorrow, we will also talk about

our interim memo, which is something we write at the end of this year. So, given that this is our last face meeting of this year, we're really going to talk about what's going to be in that interim memo today, or I mean this meeting tomorrow. So I want you to be thinking about that also.

Hans and I talked a little bit last night at dinner about some things and we had some ideas, but we're not going to tell you what those are, because we want to hear your ideas and work through that. So that's just another thing I want to highlight for you that we need to talk about.

Hans, do you want to say anything?

VICE-CHAIR KLEIN: Welcome. I think my focus is -- I think today is a listening and learning day. I look forward to doing the listening and the learning, but it's tomorrow that we really face our charge, which is to start thinking about, not coming up to speed, but really what is it that we're going to say, what is it that we're going to produce. So I view

that, sort of from a professorial perspective, tomorrow's a productive day. We get a little nervous. We've got to start thinking about deliverables, doing our homework, producing things.

And we don't really have a topic, we don't have a -- at this point we're not sure what it is we want to say, and that's the real challenge. We have an opportunity, we have a responsibility to add value to this process, to provide advice to the Secretary of Transportation, and we've got about 24 hours to, in broad brush strokes, really think what direction are we going in.

Now, there's the subcommittees, obviously, getting started. I think, as we heard on the telephone conference call, at least one subcommittee came out of the gate fast. I think the other ones will be also, many of you are meeting and really digging into this the first time tomorrow. So tomorrow we'll be getting in, as we meet tomorrow at 10:20, subcommittee breakout meetings. Tomorrow,

10:20 to noon. We'll have a little more than 90 minutes for a meeting of sub-groups. In the afternoon, subcommittee report-outs. We'll be starting the process of adding value, producing outputs. So that's, for me, the real focus.

I'm looking forward very much to learning today and to stimulating the thinking, but by tomorrow already after lunch we're reporting out on what it is we have to say.

Again, there is the interim report that we're going to be producing this year, 2012, and we're already into mid-October 2012. Of course, the final report next year. So I think this is the gelling meeting. This is the gelling meeting. The first meeting, I think, was a -- we got the broad brushstroke learning.

I'm new to this committee. I think the majority of this committee is new to this committee. So there are a lot of folks, I assume, in my situation where we're still kind of getting on top of this thing. And as of tomorrow after lunch, we won't really be new anymore. We'll be the committee and we'll be

starting to say things as a committee or at least as subcommittees. So, keep that in mind.

I will -- or maybe somebody can re-post -- I think the subcommittee compositions would be useful to see that. Let's be honest. I'm guessing that 50 percent of us at least don't remember what the subcommittees are, what subcommittee you're on, what you're really doing yet. That's about where we'd expect to be, and we'll get there tomorrow. So, a little reminder of who's doing what.

I think there's still time for a re-shuffling if you decide you want to do something else or join another committee. I think there's still a lot of fluidity in where we are. So, keep that in mind, and I look forward to today. Today, learning, the deep dive. We'll look forward to tomorrow, producing. Thanks.

CHAIR DENARO: Thanks, Hans. Yes, and just to underscore that, I think when I looked through, there were -- this is Bob again. There were two people who were not on

subcommittees yet, so I would encourage you, if you're one of those two people, to join a committee. And also, there's no problem with being on multiple committees if you feel so motivated. That's okay, too. We have a couple people already who are on more than one committee.

VICE-CHAIR KLEIN: I have an administrative question.

CHAIR DENARO: Yes.

VICE-CHAIR KLEIN: Is there a wireless network in this room?

CHAIR DENARO: Yes. Yes.

MR. McCORMICK: Yes. UMMS.

VICE-CHAIR KLEIN: Will it just pop up?

MR. McCORMICK: It'll pop up, but you have to go out to a web page. It'll ask you -- it's through the Health Systems. It'll ask you to put your name and e-mail address in, and then --

CHAIR DENARO: Yes. When you look in your browser, it's UMMS-Guest. That is the

connection, and then when you go in there, then you open your browser and it will take you to the University of Michigan site and ask you to put your name and your e-mail in there, just for reporting purposes, and then it gets you right in. So that's not a problem.

Okay. And we do have -- one thing we have is at lunchtime we have the drive demonstrations during lunch, and people will be filtering in and out.

Stephen, is there anything we need to know about the logistics for the drive demonstrations?

MR. GLASSCOCK: Mike Schagrin's going to provide further details --

CHAIR DENARO: Okay. Great.

MR. GLASSCOCK: -- in a couple hours.

CHAIR DENARO: Great.

MR. GLASSCOCK: So I'm just trying to get Greg on the phone right now, so --

CHAIR DENARO: Oh, yes. Okay. Great, great. Yes.

MR. AUGUSTINE: We're running a tight schedule, which is a novel concept for a meeting, so --

CHAIR DENARO: The last time in two days that we'll be ahead of schedule, John, I assure you. John, I know you're looking to get Greg on there. Did you have any comments, or Valerie or Brian or anybody else? Okay.

MR. AUGUSTINE: Just maybe a quick thank you to our UMTRI host. I think John Maddox is our representative. So, thank you for the use of the building. Appreciate it.

MR. MADDOX: You're welcome.

CHAIR DENARO: John, will you be with us for both days?

MR. MADDOX: I'll be here, except for the Safety Pilot discussion. Peter will be in and out a little bit this morning.

CHAIR DENARO: Yes.

MR. MADDOX: Jim Sayer will be here for this afternoon for Safety Pilot.

CHAIR DENARO: Yes, yes.

MR. MADDOX: We'll tag team.

CHAIR DENARO: Thank you, thank you. For those of you who don't know, Peter Sweatman is the director of UMTRI, which is managing the whole Safety Pilot activity. So he said that he's flying out to Europe tonight; actually moved his departure later so that he could attend our meeting, so we really appreciate him being available for us as well.

MR. AUGUSTINE: Do we want to do a quick intro or --

CHAIR DENARO: We can do that. All right. Sure. We can go ahead and do a quick intro.

So, Raj, why don't you start us off. Mr. Rajkumar.

DR. RAJKUMAR: Raj Rajkumar. I'm a professor of Electrical and Computer Engineering at Carnegie Mellon University. I also direct our ITS Transportation Center at Carnegie Mellon. It's called Technologies for Safe and Efficient Transportation.

MR. KISSINGER: Peter Kissinger, President and CEO of the AAA Foundation for

Traffic Safety in D.C. We're the research affiliate of Auto Clubs North America.

CHAIR DENARO: By the way, let me just interrupt. There are speakers on the table at various locations. I have a big one. There are other little ones there. Try to speak as close to that when you're speaking, which will help the recording for the minutes as well.

Steve.

MR. KENNER: I'm Steve Kenner. I'm the Director of Automotive Safety at Ford Motor Company.

MR. CAPP: I'm John Capp. I'm Director at General Motors for electronic safety technology work.

MR. BERG: I'm Roger Berg. I'm with DENSO North America Research Laboratories.

MR. MADDOX: Good morning. I'm John Maddox. I'm the Director of Collaborative Programs at UMTRI and TTI, Texas Transportation Institute.

MR. ALBERT: Steve Albert, Western Transportation Institute, Montana State

University.

MR. AUGUSTINE: John Augustine, ITS Joint Program Office.

CHAIR DENARO: And Bob Denaro, Nokia, Location and Commerce.

VICE-CHAIR KLEIN: I'm Hans Klein with the School of Public Policy at Georgia Tech.

DR. ADAMS: Teresa Adams at University of Wisconsin-Madison, in the Department of Civil Engineering.

MR. CALABRESE: Joe Calabrese, trying to represent public transportation. I run a transportation system in the northeast Ohio area.

MR. HOLTZMAN: Sonny Holtzman, attorney, Coral Gables, Florida, past chair of the Miami-Dade Expressway Authority.

MR. KIRBY: I'm Ron Kirby. I'm the Director of Transportation Planning at the Metropolitan Washington Council of Governments, which is the metropolitan planning organization for the Washington metropolitan area.

MR. McCORMICK: I'm Scott

McCormick. I'm the President of the Connected Vehicle Trade Association.

MR. SCHROMSKY: Bryan Schromsky, Director of Technology, with Verizon Wireless.

MR. WEBB: And George Webb, Palm Beach County engineer.

CHAIR DENARO: And around the room, not at the table.

MR. CRONIN: Hi. I'm Brian Cronin. I'm the team leader for research in the ITS Joint Program Office.

MS. BRIGGS: I'm Valerie Briggs. I'm the team leader for Policy and Knowledge Transfer at the ITS Joint Program Office.

MR. LAMAGNA: Hi. I'm Sam LaMagna. I'm chief of staff of the intelligent systems group at Intel Corp.

MR. HARDIGAN: I'm Pete Hardigan. I'm in the Automotive Safety Office.

MR. SZUDY: I'm Jim Szudy. I'm the Engineering Manager for Vehicle Systems at Bendix Commercial Vehicle Systems.

MR. FEHR: I'm Walt Fehr, ITS Joint

Program Office, manager for systems engineering.

MR. GLASSCOCK: Stephen Glasscock, Program Coordinator.

MR. VELEZ: I'm Charlie Velez, Project Director with Citizant, Incorporated, a Joint Program Office contractor.

CHAIR DENARO: All right. Thank you.

MR. GLASSCOCK: Let me see if we can get Greg on the line here.

CHAIR DENARO: So what's our status on Gregory?

MR. AUGUSTINE: We have the conference line and we're going to get him on line now.

CHAIR DENARO: Okay. Great.

MR. GLASSCOCK: Greg? Greg?

MR. AUGUSTINE: So we're about ten minutes early. I would say maybe we just go ahead --

CHAIR DENARO: Yes.

MR. AUGUSTINE: -- with the update

and when Greg --

CHAIR DENARO: Yes.

MR. AUGUSTINE: -- jumps in, we can let him say his remarks. I'm happy to go up front and be in the spotlight or happy to brief here.

CHAIR DENARO: Whatever you're comfortable --

MR. AUGUSTINE: Up front. All right.

MR. McCORMICK: I think you ought to go up front.

MR. AUGUSTINE: Of course. Thank you, Scott.

CHAIR DENARO: By the way, I should note that --

COURT REPORTER: It doesn't amplify.

MR. AUGUSTINE: Can you hear me? Doesn't sound like it's on.

COURT REPORTER: It's not an amplifying mic.

MR. AUGUSTINE: Oh, thank you.

I'll speak loudly.

UNIDENTIFIED SPEAKER: It's a prop. Mostly for her. A prop.

COURT REPORTER: It's just for recording.

MR. AUGUSTINE: Oh, it records for you. Very good. Very good.

COURT REPORTER: If you want to take that out of the mic stand and wander, you may do that.

ITS JPO BRIEFING

MR. AUGUSTINE: I'll try not to wander too much. I'll follow the rules. Thank you.

So, good morning. Welcome. My name's John Augustine. I'm currently the Acting Director of the ITS Joint Program Office. Next slide, please. Thank you. Do a quick overview today. I'll try and keep us on track. I'm not going to spend a lot of time.

Most of the information I'm going to present you'll hear more of over the next couple of days in detail by some of our other

speakers, but I do want to go over some recent activities, talk a little bit about our MAP-21, which is our new authorization. We're moving from SAFETEA-LU to MAP-21. Talk a little bit about some of the international activities, and then we'll talk about our strategic planning effort that's just kicking off.

So, as you can see from me standing up here, one of our most recent news items is Shelley Row has decided to pursue other career opportunities outside of DOT, so instead of seeing her up here, you've been downgraded. You've gone from filet mignon to hamburger, so I apologize for that. We're still feeling the loss of Shelley, but we wish her the best and we expect her to land somewhere in the transportation community over the next couple of years while she pursues her other activities. So we hope to see her more.

The ITS Program Advisory Committee, as you know, you've worked with Valerie Briggs and Stephen Glasscock. They'll continue to support this committee, so hopefully you will

not see a major change from our current change in organizational leadership. And, going forward, the coordination team will go through a series of acting roles for the director position. So I'll be acting this month, Valerie Briggs will be acting the following month. You'll see Brian Cronin, James Pol, and Linda Dodge also fill those roles until they make a final selection on the director position. So you'll see some new faces -- I mean some familiar faces, but in different roles over the next couple months.

Safety Pilot. Obviously we're here at the UMTRI facility. Some of you have been involved in the activities of the Safety Pilot. It's a fairly major activity. We kicked off in August. We had the Secretary here. Ron Medford, the Deputy Administrator for NHTSA; Greg Winfree, the Deputy Administrator for RITA. We had the Federal Highway Administrator and some other officials. I think the Federal Motor Carrier Safety Administrator or Deputy was here. We had pretty good coverage for research

activity at DOT.

I think it was Good Morning America and some of those kinds of caliber media outlets also picked up this. So we had a lot of good press release from this. It's created a lot of interest in the community, and we're actually doing quite well on the data collection effort. Some of our initial findings are that we're getting a lot more car interactions with the technology than we had hoped for, so that's a good thing. So the data collection's coming along and ramping up. It appears to be on track.

We just recently did a connected vehicle public meeting in the Chicago area, and this is where we rolled out our entire technical strategy, our roadmaps, our schedule. We allowed industry and stakeholders to come in and take a look, give us advice on what's happening, dialogue with the community. And so we had a fairly positive reaction back at our September Chicago meeting. Next slide.

NTIA study. For those of you who recall -- I think we talked about it very briefly

at the last committee meeting. The current spectrum that we're using for our dedicated short-range communication, the 5.9 GHz, is an allocation that we currently have, and as part of a previous piece of legislation, NTIA was tasked with looking at allowing additional users in that band, unlicensed users. And currently NTIA's looking at the risks that that would present. So they've just recently done a draft report. We provided comments. I think they've gone to the inter-agency and to industry to assimilate all that data.

They're getting ready to produce the first report from the study, and this will characterize the risks, and I think what we're going to see over the next iteration is an actual detailed test and analysis plan for how NTIA would go about doing the testing of any impacts from that additional users of the band. So that effort's going to be going on in the next year or two, depending on how much testing they do, how much -- how difficult the testing methodology is. We don't know that yet. We'll

see more of those details when they release their plan. But we are participating, and I would expect this report would be the first of several reports from NTIA that the community would have an ability to look at and comment and participate.

CHAIR DENARO: So, John, I have a comment.

MR. AUGUSTINE: Sure.

CHAIR DENARO: This is Bob. Is there a specific point at which they'll make a decision on whether it can be shared or not?

MR. AUGUSTINE: I think they will -- from what we understood -- and I think Walt Fehr is going to give a more detailed --

CHAIR DENARO: Okay.

MR. AUGUSTINE: -- presentation. We'll get into the actual nuts and bolts of what they want to do. But essentially, yes. At some point they will issue their final, final report once they've done their modeling and testing and analysis, and they'll issue their final findings. I believe that's not planned for

another -- you know, over a year. So from now, as that testing rolls out, we'll have an opportunity to see what their specific plans are. The community who are interested in this will have an opportunity to actually look at the details and provide comments into the site.

MR. McCORMICK: Excuse me, John. This is Scott McCormick. Who's the rule-making authority on that, once they finish that study?

MR. AUGUSTINE: Well, I mean ultimately FCC --

MR. McCORMICK: Okay.

MR. AUGUSTINE: -- controls the allocation. Now, NTIA handles all the federal spectrum user requirements, so anytime the federal government is looking at what spectrum do you need and what is your requirements, NTIA will coordinate that across all of the departments and they provide their information. They work pretty closely with FCC, so FCC and NTIA will work together on the final results of whatever happens.

MR. FEHR: John, this is Walt.

MR. AUGUSTINE: Walt.

MR. FEHR: It's probably actually going to be less than a year for this process to work its way out. It's on a little bit faster track.

MR. AUGUSTINE: Okay. Do you believe the first report will lay out some of their timelines?

MR. FEHR: Yes.

MR. AUGUSTINE: Okay.

MR. FEHR: Yes. That's what we're expecting, is that that report-out that we're expecting literally any day now will give detail of that timeline.

MR. AUGUSTINE: Right. I think the legislation requires the report by October 20th. I think that's the official date, but as Walt said, it should be released any day now. And Walt is actually the one that's been in close contact with the NTIA officials, so you'll hear more in that briefing.

Connected Vehicle Reference Implementation Architecture. This research

has been ongoing for the past couple of years. Technology is evolving. The standards are evolving. We have test beds that we have run over the course of the past year. We've done a lot of upgrades to make sure that we're using the current standards. So this is a fairly large effort, and I believe Walt will talk more about that. But we are basically implementing the current standards in our research work.

Okay. MAP-21. I'm not going to spend a lot of time, but I think there's a couple highlights in here that are important for the committee. So currently the MAP-21 is our current legislation started October 1. It's a two-year legislation. And that's significant because of a short time frame. This was not a six-year bill like we've had in the past. I would imagine that we'll start the review process for the next round of legislation at some point fairly soon. So two years is really, in the big scheme of things, almost begin again immediately. So we'll see this continue, but largely the MAP-21 legislation provides a lot

of continuity from SAFETEA-LU. The amount of money authorized, $100 million, our last legislation was 110 million annually. So it's a slight reduction, but still sufficient and in line with what we need to do to accomplish our research.

It continues our advisory committee, so -- and it continues the advisory committee exactly. I mean the exact language as before, so nothing will affect this committee going forward. It still requires that any letter of recommendation we provide to DOT has to be provided -- has to be responded back to Congress, as well as to the committee, so your findings get formally addressed.

CHAIR DENARO: John, --

MR. AUGUSTINE: Sure.

CHAIR DENARO: -- you might just go into that in a little more detail just to remind everybody what that process is, if you could.

MR. AUGUSTINE: Sure. So the role of the committee. When you as a formal body provide recommendations to the Department, you

provide it to the Secretary. So you will lay out your recommendations and your advice. It formally gets presented to the Secretary. The ITS Joint Program Office and the Department have a responsibility to not only respond to each of your recommendations and say whether we agree or disagree, and if we disagree, why, and what is the rationale, how we plan to implement those recommendations, but we also have to provide an accompanying letter to both the Senate and the House, addressing the details of those exact recommendations. So your recommendations really get amplified, because we share the response to Congress.

CHAIR DENARO: Is that letter to Congress, is that from the Secretary?

MR. AUGUSTINE: From the Secretary. So the Secretary will respond both to you and to Congress in one -- essentially the same letter. So that's a -- it's no change from the past, but it's an important point, because this committee's recommendations do reach a fairly important audience.

A couple of things that are new:....

WELCOME REMARKS BY RITA DEPUTY ADMINISTRATOR

That sounds like we have someone joining. Is that Greg Winfree joining us?

MR. WINFREE: That would be me. Good morning, John. Good morning, all.

MR. AUGUSTINE: Good morning. You recognize my voice. Good morning, Greg. Greg, we'd like to go ahead and give you an opportunity to address the committee. So, we've already done introductions. I've been doing a short update on some of our activities, but I'll turn the mic over to you and let you address the committee.

MR. WINFREE: No, I appreciate that, but if it's an awkward moment, John, you can go ahead and I'll just hang on the line. That's no problem.

MR. AUGUSTINE: Oh, I think we're in a good stopping point. We'll go ahead and pause and let you --

CHAIR DENARO: And hi, Greg. This is Bob Denaro. We planned for you to come in

when you were available, so the floor is yours.

MR. WINFREE: Oh, wonderful. Thanks so much, Bob, and good morning, all. I really appreciate the opportunity to visit with you. I wish I was there. I've been doing a little bit of traveling. Just got in from Phoenix last night. I live in Phoenix full time and work in Washington, so there's a little bit of a long commute, and -- but, you know, I'd really like to express my gratitude for all the time and effort that everyone's taking to help move the ITS research program forward, because the key thing is, you know, your participation and especially, you know, your expertise and your voice on the committee is really valued by DOT and principally by RITA and our partners at Federal Highway and NHTSA and Federal Motor Carrier Safety Administration. But the recommendations of the Advisory Committee are a big reason why the program has reached such a critical juncture in the advancement of ITS technology and why the U.S. is closer than ever to implementation. So I'm really excited at

the fact that everyone is there in Ann Arbor.

As you know, we kicked off our connected vehicle safety pilot back on August 21st, and it was a huge media splash, but more importantly it was a huge spotlight on the terrific work that's been going on, and you now have an opportunity to view first-hand the model deployment to see how the technology works and how it can address our safety challenges.

As you know, as I mentioned before, Secretary LaHood and the administration believe that the Safety Pilot will answer many of the open questions and kind of remaining questions about how connected vehicle safety technology can move from research and development to wide-scale deployment in our cities and our communities, and certainly, as you've heard from John and, you know, all of the team members, Brian, Mike Schagrin, Valerie and, you know, all the folks there, there's just no better way to address the technical and institutional hurdles than with a live demonstration in a real-world environment.

And those of us who have interest in the long-term success of the connected vehicle safety applications understand the promise of the technology. The research that we've done shows that it will save thousands of lives and make our roads and highways much more efficient.

So now that we have the opportunity to gather a wealth of data about how vehicle-to-vehicle safety communications and vehicle-to-infrastructure perform under real-world conditions, we're hoping we can lay the groundwork for tangible measures to bring that technology to our vehicle fleet. We think it'll be a great day in America when roadway and vehicle safety is about more than building cars, but help drivers walk away from deadly crashes or promoting safer decisions behind the wheel. And while all this sounds well and good, the actual experience of riding in a connected vehicle simply can't be duplicated, and I'll be the first to testify to that. You know, I was -- the team did a great job getting me up

to speed on what the technology is and how it works. But until you sit down and, you know, you just experience what those vehicles can do and what that communication technology means, it really drives the point home.

So, I hope everyone gets a chance to ride in one of the vehicles so you can see how the applications work in action, and they've got a pretty dramatic and exciting scenario for you. It gets your heart pumping and you'll really be able to see first-hand how this all comes together.

The DOT's leadership is excited about where we are today, as are myself and ITS staff, and I hope you all will share our enthusiasm for where ITS research in the U.S. is headed. I'm looking forward to your thoughts on what the program's next steps should be. You know, we're at the advent of automated vehicles, whether it be in the air with UAVs, whether it be on the ground with Google and others. So it's kind of a broad horizon and we're looking forward as to what the program's

next steps should be. Your recommendations will probably push the future and will be greatly appreciated.

So it's unfortunate I'm not there in person. I understand how crucial your work is. My door, my phone, my e-mail are always open for everyone on the team, and I encourage you to reach out and at least stay connected. So, please feel free to contact me at any time. I wish you all the best there in Ann Arbor.

I don't quite know what the weather is. I was kind of watching the Weather Channel, and I can't say I'm disappointed to have come from Phoenix directly back to Washington, you know, weather-wise, but otherwise I know it's going to be a fantastic couple of days for you all, and I wish you all the best.

CHAIR DENARO: Thank you, Greg. This is Bob. Thanks for your comments, and I can certainly speak for myself and I think I speak for the committee that we do share your enthusiasm about ITS and where things are going. I think we're at a -- as you said, we're at

a really important juncture. This connected vehicle safety pilot is, we believe, hugely important, and we're excited to be up here in Ann Arbor to take a first-hand look at it.

MR. WINFREE: I appreciate that, Bob. You know, and I'll also say, since you are at UMTRI, you know, this is world-class work on making this all come together, so, you know, you've got Sweatman and others on the team and others. It's no mean feat to create something from whole cloth, but I really appreciate partnering with them. They've been a great member of our UTC program and a great partner in the Safety Pilot, so, you know, we've got nothing but positive expectations for the outcome of this significant work.

CHAIR DENARO: Excellent, and I do want to underscore for the committee what you said earlier, Greg, about the -- participating in the rides. We have some time set aside during our lunch break for people to do that. If you haven't ridden in a car or seen a demonstration yet, I do highly recommend it. I know we can

all read about that. We all understand how it works and everything. But it's one thing to be sitting in that car. The scenarios that they've set up are quite dramatic and will get your attention. And for me, it was essential -- I really got it when I did a ride, so I really do encourage you, if you haven't done that ride, to go ahead and do it.

And, Greg, you need to be careful about your offer about a potential meeting in Phoenix as we're looking at the winter. Be careful what you wish for.

(Laughter.)

MR. WINFREE: Well, I tell you, the good folks in Maricopa County have been working on a smart drive program in Anthem, Arizona, and they're working on a signal prioritization and prioritization for emergency and transit vehicles. So, like I said, it was 97 yesterday. It's going to be in the 70s later in the week. You very well may have to go out and see first-hand what's going on in Maricopa County.

CHAIR DENARO: Right. Sounds

good. Anything else, Greg?

MR. WINFREE: I won't hold you folks any longer. Thanks for the opportunity to just to have some good kick-off messages. You're in good hands with the ITS JPO team, and like I said, thumbs up. You know, John and the team are there, and if you need me, I'll be here in the office toiling away.

CHAIR DENARO: Okay. Well, thank you very much for calling in, Greg. We appreciate your comments.

MR. WINFREE: Hey, that's my pleasure.

CHAIR DENARO: All right.

MR. AUGUSTINE: Great. Thanks, Greg.

MR. WINFREE: Okay, all. Take care.

MR. AUGUSTINE: Thank you.

MR. WINFREE: Goodbye.

ITS JPO BRIEFING (CONTINUED)

MR. AUGUSTINE: So, to resume with our update, we were just at the point of talking

about what has changed from MAP-21. We talked about a lot of the MAP-21 provisions are consistent or very similar or exactly the same from SAFETEA-LU. However, we do have a couple new provisions that I just wanted to make the committee aware of.

One of them is a requirement for a report to Congress which is three years after the date of enactment. So that puts us in a 2015 time frame to provide a report to Congress on the path towards DSRC implementation, and I think this is really, because it's in the 2015 time frame, it'll get us through the 2013-2014 decision. Things will be a lot clearer on what's moving forward, what needs more work, are there any challenges or barriers. But that does provide a specific requirement for us to address how this implementation is going forward.

CHAIR DENARO: So, John, if I understand that, then the decision in '13, given the outcome of that decision, you then have like two years roughly to figure out what to do with

that decision --

MR. AUGUSTINE: Correct.

CHAIR DENARO: -- and how that happens?

MR. AUGUSTINE: Correct.

MR. McCORMICK: Well, isn't the 2013 decision just to decide whether to pursue rule-making?

CHAIR DENARO: Yes.

MR. AUGUSTINE: And that is correct as well. So this essentially serves as a backstop to say, okay, we've made some decision in 2013 whether it's to go forward, to stop, continue on with research. We're not exactly sure what that decision will be, but there's a 2014 decision on heavy trucks.

CHAIR DENARO: Right.

MR. AUGUSTINE: So I think the Congress is saying essentially you had a couple milestones and you should be in a situation to say what does the path going forward look like, are there any issues. There's a lot of discussion going on in the building at DOT about

what's needed to get us towards this DSRC implementation. Are there Congressional authority issues? Are there -- you know, a whole host of policy issues, and Valerie's done a lot of work on this. So this is really our opportunity, and it's a requirement, to say here's where we are, here are the challenges, here are the barriers, here's potentially an opportunity for Congress to address some of those. But it puts the pressure on us to make some solid progress over the next couple years to put us in a position to say something meaningful to Congress on how we're doing.

CHAIR DENARO: Okay. And Scott made an important clarification. The 2013 decision is a decision to pursue rule-making. It is not yet a rule.

MR. AUGUSTINE: Correct.

CHAIR DENARO: So, a good point.

MR. McCORMICK: Scott McCormick again. I'm very interested to see what the process is for the 2014 process for interstate trucking, because, similar to the texting bans

which was put out, the DOT has the authority to mandate requirements without going through a lengthy process, and I'm curious as to whether or not what they're going to do with commercial vehicles will be the same type of path as the rule-making or will it be a much -- a more fast-track option.

MS. BRIGGS: Scott; Ray Resendes will be here this afternoon --

MR. McCORMICK: Okay.

MS. BRIGGS: -- to talk about all of that, so he would be the appropriate person to answer your questions.

MR. McCORMICK: Okay. Thank you.

MR. MADDOX: John, one more question on the report to Congress.

MR. AUGUSTINE: Yes.

MR. MADDOX: Does that include DSRC for infrastructure in addition to vehicles?

MR. AUGUSTINE: It doesn't specify. It leaves it broad. I think the path to DSRC implementation is the close, if not the exact, language. But, yes. I think we're going to

address it from an entire connected vehicle footprint; so funding, control, and regional issues will be included. I think it's basically our opportunity to spell out exactly how that implementation's looking, what are the challenges, what are the remedies potentially for Congress to understand and possibly act.

Yes, Peter?

MR. KISSINGER: John, Peter Kissinger. Is there a definitive assessment as to what would happen to the research program if the sequester kicks in?

MR. AUGUSTINE: Good question. The Department -- I mean all the departments are looking at that issue right now. I think the quick answer is our impact would be minimal because we are funded from the Highway Trust Fund, and the Highway Trust Fund has some uniqueness that it is -- I'm not a Highway Trust Fund expert, so I won't say a hundred percent immune, but I think it's -- I think I may be correct in saying it's not affected.

Now, the other sources of funding

that are directly provided by Congress would be affected. So the Department will be affected. We would have some indirect impacts. But in terms of the research funding, I believe that is not affected by sequestration.

MR. KISSINGER: But I've heard -- I mean there is some general fund money going into the Trust Fund, and that would -- the experts claim that that would be affected.

MR. AUGUSTINE: Right, and that's where we get into the details -- it gets very technical. That's why I would say the large take-away point is we would be minimally impacted. I would not say zero impact. But it would not be devastating. Now, some programs would be in a situation. Let's say if sequestration does happen, they would immediately have a large significant budget cut immediately. We're not looking at that scenario at this point. But I think the Department will come out soon with their solid position on what impacts would be.

Hans.

VICE-CHAIR KLEIN: John, Hans Klein. So a decision on rule-making is due December 2013; right?

MR. AUGUSTINE: Approximately, yes.

VICE-CHAIR KLEIN: So rule-making at that point is itself a kind of development process. It's a policy, regulatory development process. Now, parallel with that, presumably technology development is not going to just stop and wait for rule-making development. So you're going to be in a situation where you'll have parallel technology development alongside policy development.

MR. AUGUSTINE: Correct.

VICE-CHAIR KLEIN: Can you talk a little bit about that scenario? Because you'll be rule-making about a moving target at the same time. Will those two processes interact or be separate?

MR. AUGUSTINE: Yes. I say they would interact because largely the regulatory folks would be looking at what performance

requirements would be necessary. In parallel to our research and the regulatory decisions that are being made, as you say, technology is always evolving. So is our -- our standards process is evolving, too. So things are getting updated. The standards looking at what's achievable, what's the current technology that's available. And then, obviously, it's a cost/benefit situation. So, inherently any regulatory decision's going to want to look at what is the available technology to produce the lowest cost. And you say, well, we have this newer technology that's just emerging or it's not out there yet. If you go towards that, you're going to increase your costs. So it's a balancing act, and I'm not a regulatory expert. I'm just giving you my personal opinion about how that technology evolution and regulatory decision would go.

So, clearly you want to, in any regulation, take the most commercially available technology and use it if it can meet your requirements. So there will be some

technology evolution and the standards will have to keep up with that, and the regulatory folks will have to take a look at what is the best cost/benefit solution, if in fact we went down the regulatory path. So it's a challenge.

VICE-CHAIR KLEIN: Okay.

MR. AUGUSTINE: You've correctly identified something that makes these decisions hard.

VICE-CHAIR KLEIN: And ideally, 2015 report to Congress is when we're really getting into implementation.

MR. AUGUSTINE: Well, correct, and I think somebody put some thinking in to say, well, if you require a report to Congress in 2013, they'd say, well, we're just thinking about making a decision. If a decision's made, we're not sure how it's going to go. 2015 is two years out to say, all right, you should be fairly well down that path. What are the challenges, what are the barriers, and how's it going? Is there something that Congress needs to do, some authority the Department

needs, is it not working out at all, have you hit a brick wall? Congress needs to know. So I think that's a fairly good requirement that forces the very concrete thinking on where we are on this situation. It's not easy. If the path towards DSRC implementation were easy, we'd already be there. So I think it's a good requirement to have the legislation, and I think it amplifies the voice of this body, too. If the committee recommends a certain piece of advice with regards to DSRC implementation, that would be highlighted in that report, as well.

MR. WEBB: George Webb. John, the other layer on this is that first line that there'll be new legislation coming out for funding potentially if we can get a long-term bill this time, five or six years or whatever. And I know that the local governments have been looking, at least the last bill, and then we'd be looking to this one, saying if, in fact, DSRC is going to be expected to be out there physically on the roadside, how's it going to get funded? Potentially are the funds going

to come from the federal government? Those thoughts and decisions and dollars might end up needing to be in that new piece of legislation which almost comes about the same time that this report is coming. So it's all coming to a point really quick in that '14-'15 period, because bills will be starting -- I'm sure it's being drafted right now.

MR. AUGUSTINE: Somebody's working on it right now. So, right, I do think you've identified a convergence of a lot of activity. Whether the MAP-21 is extended for a year or two doesn't really affect us. The requirements still would kick in. If a new legislation comes about, clearly the committee's recommendation, in our report to Congress, would address, you know, any recommendations that you have. And I mean, we need to be doing our job. If we don't have a crystal clear, coherent response to how the DSRC is coming in 2015, we haven't done our work. So, regardless if that stays in the next piece of legislation, it's a good requirement. I think it keeps us honest.

MR. McCORMICK: This is Scott McCormick again. We asked last year -- about a year ago -- Peter Apell and Kim to a board meeting to address our concens, and we said, what's the likelihood that they would actually implement a decision one way or the other that close to the 2016 election, and he said it would be very unlikely. Probably the decision announcement wouldn't be probably till the middle of 2016. Is that the current thinking?

MR. AUGUSTINE: Let me just be clear on the question. Are you talking about NHTSA's decision whether or not to --

MR. McCORMICK: If they made a rule in -- if they decided they wanted to go forward with a rule.

MR. AUGUSTINE: You know, I'm a researcher. I'm not a regulatory person. And, you know, it's hard for me to sit in their shoes and say precisely. I guess what I would say is, true, anytime you're getting close to an election, it makes policy decisions somewhat hard in the Congress. Everyone wants to

naturally say, well, if we wait till after the election, the landscape will be more clear. I don't know if it ever gets more clear. It's always a new --

MR. McCORMICK: They'll be less vulnerable.

MR. AUGUSTINE: -- point to say, let's wait till after that point. But I guess what I would say is we would have already passed the 2013 to 2014 decision points. So, regardless of who's sitting in the NHTSA administrator chair or the Secretary chair or what administration, you've had several decision points and a lot of technical data going into that, and a chance for the community and this committee and others to say either we agree or we don't agree, or you're pursuing it in a way that's problematic or right on track. So I think that will give a lot more comfort to whoever is in that policy decision-making chair in 2016, though I will not discount that major policy decisions close to elections can be difficult. So I think there's some political

wisdom to that statement, but with 2013 and 2014 already being water over the dam, if you will, I think it would be somewhat easier than making a fresh, out-of-the-blue determination in 2016 about what's happening.

Okay. So let me jump down to the last bullet here, and a couple things that were previously in our SAFETEA-LU legislation that are no longer in the MAP-21 bill, and that is the Multi-State Corridor Operations and Management and our Road Weather set aside. So specifically there was a requirement in SAFETEA-LU to put approximately 7 million towards Multi-State Corridor Operations and Management and about 5 million in Road Weather.

Now, Road Weather, that research is largely being looked at in terms of the dynamic mobility applications. We're looking at congestion reduction, capacity flow, weather-related issues. You know, a whole host of applications associated with real-time data. So that is not necessarily a major loss. I think that research will be picked up.

The Multi-State Corridor Operations Management (MCOM)-- while that has gone away, we still have one more round of funding left in FY12, so we're going to move forward with MCOM with FY12 money. So once the FY12 money is distributed, that essentially ends that provision.

MR. ALBERT: Steve Albert. John, this group is more than the connected vehicle advisory board, and so I'm really interested in what is encouraging ITS deployment in the sense of some grant funding beyond connected vehicle?

MR. AUGUSTINE: Thank you. Thank you, Steve. I think we did sort of skip over that. So, another new provision. The deployment incentives and grant authority were specifically provided to the ITS section. Now, in all truthfulness, we normally work through all of our modal partners in the Department. So we use their grant-making authority through Highway, FTA, Motor Carrier, et cetera. So largely we were able to do that. This

specifically gives us the authority to do it ourselves, so I'm not sure it's a major change. However --

MR. ALBERT: But you haven't identified what some of those incentives might be yet?

MR. AUGUSTINE: Well, we have some -- obviously some planning, deployment planning incentives to basically give communities an option to sort of put together how they would go about getting ready for ITS, any kind of environmental, engineering, policy discussion that needs to take place. Though, in the times past, we've done model deployment-type initiatives, ICM, integrated corridor management, mobility services for all Americans, congestion initiative, rural safety initiative -- things where we've given competitive grants to localities. So we've seen some pieces of research money being provided to communities to start deployment of ITS technology.

So we'll continue that, but I think

what you're seeing is with these two bullets here, there's been a little more emphasis to say we want to see deployment into the community, and we want to see, maybe from a performance measurement type, how are you improving the national highway system through this deployment. So I think a lot of the local transportation officials can tell what issue they're trying to impact by deployment of ITS, but I think from our research, we've talked about rural safety and congestion reduction. Okay, there was a clear goal there, but are we going to put some quantifiable metrics around that, and then place some research dollars for the deployment activities? I think that's really what Congress is looking at. Let's have some very measured deployment results from ITS and ability to measure what is it really accomplishing and showing in terms of quality and quantity.

DR. RAJKUMAR: John, just a quick follow-up. This is Raj. The question is whether funding could be directed to state DOTs,

localities, townships, and research is a part of that.

MR. AUGUSTINE: I think all of the above and more. So our authority's pretty broad, as long as we're meeting the goals and objectives of our legislation, and I think there are a couple limitations. We have an 80/20 funding match and a couple other small provisions. Other than that, we have pretty broad flexibility. So a lot of our partnerships do include industry, academia, state and local government, townships, research organizations, so --

DR. RAJKUMAR: The 80/20 is 80 from --

MR. AUGUSTINE: From the federal share. Do you want to propose a switch?

(Laughter.)

MR. CRONIN: One of the comments to add -- Brian Cronin -- that encourage ITS deployment incentives. The first priority is for us to actually work with Federal Highway and FTA and maybe to some extent Motor Carrier

on how they would use their existing funding sources and how we would help them identify incentives for ITS deployment. So the first part is really us working with the modes in how they would use their existing funding sources and encourage ITS or other mechanisms to encourage ITS. In addition to that, we have the ability, through the ITS program, to put grants or do other things that also encourage ITS. So our big thing is working with the modes, and we have to do another report to Congress or something, but we have to actually write a report about the progress of deployment incentives.

MR. AUGUSTINE: Our deployment plan. Yes, we have to have a deployment incentive plan on that. So that's a good point by Brian. Not to say that -- as I said, we largely work through our modal partners and their grant-making authorities. As Brian said, we will not discontinue that. We will continue that, but this gives us the authority and flexibility to do it ourselves,

but also continue to promote those other federal sources of funding where ITS deployments are eligible. So, thank you. Good point.

Okay. International update. I just wanted to give the group a quick overview of some of the activity. Recently we signed a memorandum of cooperation with Republic of Korea to do ITS cooperation. We have similar agreements with Japan and the EU, Canada, and so we've continued that, and this provides another formal mechanism to have that cooperative research dialogue. We actually have some folks in Japan this week pursuing some other cooperation activities with Japan, largely on environmental and mobility-related research.

International standards harmonization. I think that's important to one of our subcommittees here. We're proceeding with that. We have ongoing meetings with EU, and this is where the bulk of our standardization work is being done, on the EU/U.S. basis. We have specific harmonization task groups that

are actively working. They have agendas. They're meeting their deliverables. A couple of those, we have the security management, the signal phase and timing, also what we have termed SPaT, it's some of the work that we're doing with our partners on standards harmonization. And we also will be having a joint showcase at the ITS World Congress later this month, showing the work that we've done with our European counterparts. So just wanted to let you know that not only we're doing our domestic research, our international cooperation activities are moving along.

Okay. And the last point to mention here really is recently we just released our update to our 2010 Strategic Plan. That was 2010 through 2014. So we're about two years into that. We've made some progress. We've further defined some pieces of research in that plan. That lays it out. What you'll see there is some more formalization around our 2013 and 2014 milestones, the NHTSA agency decision milestones.

We also have done some exploratory research that's ramping up. I think the most notable research there is our automated vehicle research which we are working pretty closely with NHTSA and some other partners in the building. Federal Highway, as well. Motor Carrier is involved, FTA. So I think you're seeing the Department trying to get their arms around what does automated vehicle research mean and where is it going.

But going forward and as part of MAP-21, we have a requirement for a new strategic plan to be published in 2014 at the end of the -- by 2014, the last year of the authorization. So, starting right now, we're going to be formalizing a new strategic planning effort that will essentially begin a 2014 to 2019 time frame: what research are we going to be pursuing over the next five years. We will start internally in the building to try and figure out what makes sense from each of the modal perspectives. We'll then go out to the stakeholders and we'll undergo a fairly formal, about a year-long

process of dialoguing with the stakeholders and getting input, sharing our thinking, and iterating those thoughts. And then ultimately, in 2014 we would be producing a new strategic plan which would carry forward for the next several years, and obviously the impression I want to leave on this committee is this is a very important opportunity to get your input, get your advice, and we want to do that. So I want to state it and foot stomp it and reiterate it: we need your input, we want to hear from you. So as we go forward, you'll be hearing more about this. We're just kicking this off.

CHAIR DENARO: John, this is Bob. That new strategic plan. That may well probably go beyond Connected Vehicle?

MR. AUGUSTINE: It can go wherever?

CHAIR DENARO: Yes.

MR. AUGUSTINE: Yes. Whatever makes sense. I would assume there's probably some overlap as we head into 2013-2014 --

CHAIR DENARO: Well, sure. Right.

MR. AUGUSTINE: -- and where do we

go from there.

CHAIR DENARO: Yes, but --

MR. AUGUSTINE: But, yes.

CHAIR DENARO: In later years it might be getting into other things that you're getting into.

MR. AUGUSTINE: Correct, yes. Correct. Or, you know, looking at future research. You know, Steve brings up the point, what about current technology? They're working. They're just not out there yet. Really, it's an open book.

CHAIR DENARO: And when you say that advisory committee input is essential, there's certainly an input that we make late next year as our final product. Is there also some desire and value in input yet this year? Is that activity starting yet on that strategic planning effort?

MR. AUGUSTINE: We have started internally to discuss it. I think we're going to have a first formal meeting the 18th of October with our strategic planning group, which

is the associate administrator level across the building. We've let them know the same thing we're letting you know: it's time to begin this process. We're trying to collect our thoughts, figure out what makes sense from a Department standpoint, but also what does the external community think of that. So, yes, we would like to hear from you now. Earlier is better because there really hasn't been much formality into this yet as it -- or we have an outline, we've got some thoughts, some themes that we're looking at that seem to make sense, but we'll formalize that.

And I think you bring up another point. We have 20 members of the committee. We'd certainly like to hear any formal committee recommendations, but if each of you individuals are coming from your own thought leadership and areas of expertise, we would like to hear from individually as well. So this is an open invitation to provide us your comments.

VICE-CHAIR KLEIN: It's kind of related to this, but -- this is Hans. In terms

of we're producing something, but we're putting it out into an environment that has sometimes greater need for information. Sometimes greater need for information, sometimes less. I see in this morning's talk there is a great deal of this -- the strategic planning process is a place where we could probably target really adding some value there with our output. The NHTSA rule-making, where possibly this committee could add value through its outputs. This transportation legislation, possibly we can add value to our outputs. And in terms of the environment that this committee operates in, do you see other places where our outputs are particularly likely to be received?

MR. AUGUSTINE: That's a good question. I think those that you mention are fairly important. Advice that goes to the Secretary goes throughout the building. Our official response to you goes to Congress and throughout the building. Those reports get publicized. There's media and trade press that react to what is said and what the reactions

are. So I'll have to think about what are the other key areas where the committee really provides a major voice, but I would not underestimate the three that you said. Those are fairly impactful. That's a good question. Let me think on that.

CHAIR DENARO: So, this is Bob. I'll throw out a comment to the committee that this is one candidate, possibly, for a focus item for an interim memo also. Now, I don't think we have the time and -- enough time to meet together and discuss and get into a lot of depth, but at some very broad level we might come up with some of our views about what might be in that strategic plan. So I'm just throwing that out as, when you talk about that tomorrow, one thing to consider.

MR. AUGUSTINE: That's a good point. Okay. That is it for my formal points, but I'll open it up for any other questions, discussions from the committee.

MR. CALABRESE: Yes. John Joe Calabrese. As you know, under MAP-21, FTA is

getting more and more involved in public transit safety, and the main impetus for that was two unfortunate train-on-train accidents, one in Washington, D.C., one in San Francisco, I believe. One of the requirements that's been put on public transit is positive train control, and no one really knows what that means, how it works, what it costs, and who's going to be making it. Certainly seems like a lot of the same technology we're talking about here can be used to advance that. Is that somehow filtering up through the process in terms of discussion?

MR. AUGUSTINE: Yes. So, positive train control has a long history. I think you summarized it correctly. The industry has different views on it. At one point there was a push to go to one centralized solution and then the industry sort of adopted an industry best practice approach and then we went to a performance-based rule-making on it. So you're right. It's not clear where that's going.

MR. CALABRESE: But we must have it

by 2015 or '16.

MR. AUGUSTINE: Right. Luckily, I'm not one of the FRA regulators on that one. How it connects to our ITS research, we have had some research cooperation with FRA, looking at DSRC-based safety warnings for train-to-vehicle interactions, grade crossings and the like. The problem with relying on that for train-to-train, as you correctly point out, the real impetus on positive train control is not preventing trains from hitting automobiles, but that's certainly, you know, something that we're interested in, but it's train-to-train, and DSRC is a low, fairly short-range communication, and these trains need fairly long-range communications, because the stopping times are so long. So that's not to say that there are other ITS technologies they're looking at -- you know, track sensors, inertials, direction finding equipment -- and I think that's being looked at.

I think where we're looking at our interaction with the rail environment is at the

railway crossings where the cars and trains have some interaction, and I think that we've actually seen that there could be some warning messages provided to the vehicles of approaching trains, especially in areas where there's not an actual gate that prevents the cars from entering the rail environment when a train's approaching. So that's where we've done most of our research with the rail environment.

MR. CALABRESE: In warning the car?

MR. AUGUSTINE: Correct.

MR. CALABRESE: Not warning the train?

MR. AUGUSTINE: Well, both. But --

MR. CALABRESE: You have the same train stopping issue.

MR. AUGUSTINE: Right. The person who has the likely ability to take a counter measure is the car or the vehicle. If the train knows the car is there it applies the brake, it really can't slow down for them.

UNIDENTIFIED SPEAKER: Or steer.

MR. AUGUSTINE: Yes. Or, right,

take a left turn. So that's where we're looking at now.

MR. CALABRESE: In some ways it seems like it would be easier to control, because you know where that train is that's on the tracks.

MR. AUGUSTINE: Right. You take the initiative.

MR. CALABRESE: You know where it's going.

MR. AUGUSTINE: The positioning solution becomes much easier for the train. Right. And they do have track sensors and they do have GPS, so it's fairly -- they're fairly certain where the train is. And so providing that message to the vehicles is really what we're looking at in the interim. But we have begun our dialogue with FRA, and you're right. Transit safety as part of MAP-21 has really expanded their authority to look at transit safety. One of our key partners, Ben Stalvez, who's leading the research, has been called to lead up that effort. So he's really has his

hands full creating this new authority in FTA to look at transit safety. And we're still working with Vince, and there may be opportunities to leverage ITS technology into the transit safety arena, but that's such a fairly new undertaking. I think this is the first step to get that agency and that office up and running, and then we'll be interacting with them. But I think you're right. There is untapped potential in the rail environment to apply ITS.

MR. CALABRESE: It seems like there's too much going on parallel not to have them work at some point time on a joint venture.

MR. AUGUSTINE: Right. That's a good point, and that could be something the committee looks at to say where are the opportunities for rail to leverage some of the technologies that are available today. So, good point. Thank you.

Peter.

MR. KISSINGER: John, Peter. I think it's safe to say that the last committee,

the advisory committee, there was a lot of concern about the international harmonization, the role of the U.S. in that process. I think we made some pretty strong recommendations. Your report seemed quite positive. Is that a correct read? I mean has there been a lot of developments in the last several months?

MR. AUGUSTINE: Yes. I would say that it has been positive. You know, until you have exact standards precisely in both communities, you know, the ultimate perfection, you know, you're always chasing perfection. But I would say largely the trend's been positive. We've found ways to commonize our standards as much as possible. It's never a hundred percent. Never a hundred percent. There's always regional differences. But really, I think what we've done is we've gotten at least the device-makers, the automakers, the Tier 1 suppliers, to come together and say how can we minimize the need to have multiple boxes in the same vehicle, and really that's sort of what we're going to. If it's a software change

or something that's less expensive, that's what we're driving to, and I think we've been successful in moving in that direction. There's another ETSE meeting --

"ETSE" is one of the European standards development group meetings -- next month or early December. I can't remember exactly when.

And that'll be our next opportunity to say, okay, how close are we getting. We've made progress. We've had challenges. We're overcoming them, but I would say, yes, it has been positive. We're definitely moving in the right direction. We have not found those standards diverging. They are converging.

MR. CRONIN: Thanks.

MR. AUGUSTINE: Brian.

MR. CRONIN: Could we ask Roger to comment on that? If it's okay, his company has been very involved with trying to put our showcase together and actually use the products of our harmonization work, and maybe you have some comments.

MR. BERG: Yes. At the Vienna ITS

World Congress, there will be an exhibit there that actually demonstrates physically in real-time that the same piece of equipment can do the same application, which is an emergency electronic brake light. I mean, I just picked that one because it was easy to demonstrate in a static scenario. But the same piece of equipment and the same -- actually, the same software load, just a switch in configuration, can operate that application for either the European protocol and message set or the U.S. protocol and message set, and we can flip the difference in a matter of seconds. Is that what you wanted?

MR. AUGUSTINE: Yes, I think that's good.

VICE-CHAIR KLEIN: I mean I have a -- this is Hans. The topic of standards often sounds dry and boring, but it's actually the essential part of some of the most strategic high-level questions, like the role of the private sector, the connection between the public sector and the private sector,

standardization of markets between competitive supply markets, things like that. So, to either of you, some of these higher-level issues, are there high-level questions of the relationship between the public sector and the private sector that are being sort of explicitly or implicitly addressed in the standards process?

MR. AUGUSTINE: I would say yes. I'll permit Roger to provide his two cents, but, you know, clearly there's an industry consensus standards-based approach. However, there's a competitive issue there. You know, what is currently the standard? Where is it evolving, or what are new opportunities? How do we either take advantage of what is new, but also have backwards compatibility? So you're always looking at these issues.

I think strategically the U.S. and the EU and other parts of the world recognize that to the degree that we can have the most common standards, we all benefit. So I think there's a very clear commitment to try and achieve harmonization.

However, there are industry interests that sometimes prevent that. Certain industry members are invested in a certain approach. They have market share. So it becomes competitive, too. So, you know, we're looking at how do we balance all of those factors, provide some leadership to try and get consensus -- when you're talking about connected vehicle applications that really aren't deployed yet except for in a research situation, we have the opportunity to really try and achieve some harmonization.

If you're looking at technology that's already out there, you're going to be limited, because you already have customer bases and you have that competition. But I think we have been successful in moving from our initial discussions with the Europeans, because that's where our major focus has been, towards harmonization. Like I said, it's not a hundred percent. I don't think it'll ever be a hundred percent, but it's moving in the right direction. But I'll let Roger give his industry

perspective on that.

MR. BERG: To the extent that the intended outcomes are similar or the same, that means by and large the industry reaches an alignment in terms of the standardization; so, if everyone can work with each other. One of the value outcomes of that standardization process is not so much how you'll do it, which is where the competitive advantage may come in, but that you're actually compatible, not just with Europe and the U.S., but even within, you know, the different equipment suppliers. That's absolutely essential for the whole industry to operate.

So I think the people who are cooperative competitors in assembling these standards understand that and realize that we have to cooperate in order for the industry to move forward. I think to that extent there's been a lot of progress from the standardization in terms of the connected vehicle paradigm.

MR. McCormick: This is Scott. I'm an old standards guy and, you know, I have a

couple of things that I'm waiting to see, and Steve and I have talked about this over the years. To Roger's point, the things you standardize are the things that are non-differentiating to the user, and if there's IP in there that requires a work-around, either -- it's either declarative that everybody knows it's there, like they did with USB, or everyone gets together and creates a work-around.

But the environment we have is not just an automotive standards environment. It involves communication and computation, as well. And I think one of the things that we really have to see before we get too busy harmonizing is what happens in different regions -- that's good for the multinational companies, because they're trying to make a product that they can sell everywhere. But the reality is you're not going to drive to Europe. And the issue is have we -- you know, have we gone far enough down the path between those three areas, between communication, computation and automotive, to have done a GAP analysis?

Because it's on an almost monthly basis I get a call from someone in the auto industry or an OEM or two or one asking about a standard, about whether or not it should be developed. I'm like, "Well, have you looked at what the TIA is using?" And they go, "Well, I didn't know that exists," because -- they had known. And that's kind of what I'm concerned about, is we're overlapping a number of areas, you know, and we have those areas, you know, sitting in this room, which is fortunate.

But until we get done and say that we've done a GAP analysis and we know what we want to standardize and what's not there, harmonizing is going to be just harmonizing the stuff that people are already working on.

MR. AUGUSTINE: That's a good point. I think the subcommittee of this group could have a powerful role in shaping sort of our strategic direction of what we pursue and the activities of the standards in the U.S.-based standards development organizations and what we support in our international

dialogue with other departments.

Walt, do you have –

TECHNOLOGY REVIEW

Oh, yes. Walt's up next. I was on time, Bob. I want to have the committee note that I was on time.

CHAIR DENARO: Emphasis, the word "was." So unless anyone has a critical question to ask now, I would like to get on with Walt, because I'm sure we're going to have a lot of questions for him as well. Everybody good with that?

All right. Thank you very much, John. That was a good overview.

You're on, Walt. Good luck.

MR. FEHR: Yes, while we're waiting for Steve to do a little logistics work here, I'd like to thank Scott McCormick for that kind of left-handed introduction for my particular part.

MR. McCORMICK: It's what I do.

MR. FEHR: Again, for the benefit of those of you who don't know me yet, I'm Walt

Fehr with the ITS Program office, and my particular responsibility-wise below the application layer, I'm the guy that worries about the enabling technology that sits underneath the applications, and I live in that kind of horizontal plane. Most people don't see it, but it's extremely important so that our applications ultimately do work and we accomplish the overall system goals that we have. So, Stephen and Bob are passing out some background or copies of the material I'm going to be talking about, and while everybody gets that, let me give you that. Let's pause for a second.

Okay. Valerie and the organizers of this particular meeting asked me to touch on a couple of particular areas related to the underlying technology that makes all of this stuff that we're working on work, and in particular I'm going to give you some updates in the area of the communication media that we're using and how this thing that we refer to as DSRC kind of fits into the overall

communications scheme.

I'm going to give another update on the positioning technology topic, and I was going to use that as an example of how what we're doing is actually maturing significantly as we move from more research to more of a deployment kind of orientation. And all of the things that have been taken into account is you move from one type of operating scenario to another type of operating scenario, and the positioning technology is a beautiful example, because it permeates everything that we do and is so important to what we do, that people need to understand it. And again, it gives me a good example to show you how we're bridging from the old research days to the new deployment days.

And then the final thing I was going to touch on, again, as John mentioned in his material at the beginning, is this NTIA study that we're involved in, and some of the ramifications of it and how we're participating in it and how we hope to make a contribution to that; that hopefully we'll preserve our

ability to do what we would like to do.

So with that, I'm going to launch into some material related to DSRC and the general topic of the communication media that we're working with, and hopefully these topics I'm going to cover should spark some ideas for the technology subcommittee of this particular activity to dig into and launch further discussions tomorrow and other contexts like that.

We do have a little bit of time yet here this morning, so if there are questions as I go through this material, please stop me, slow me down, back me up, point at things, ask me to explain a little further and we'll make productive use of this next time that we have on the agenda.

Okay. The first thing I wanted to touch on -- the next slide, please -- is this whole notion of 5.9 GHz DSRC, which is the communication media that has permeated a lot of the work that we've done in the past, and our understanding of what's unique about it.

And what we're trying to do now is we, again, mature in our thinking and move from research topics to deployment topics.

One of the things that we need to address is how does this particular communication medium fit into the larger machine-to-machine realm that it's such an important part of. We tend to think of vehicle-oriented communication in isolation, but we all know that it is actually part of the bigger machine-to-machine communication phenomenon that is becoming a very rich topic of discussion throughout all sorts of different industries, and we need to find out and figure out how 5.9 GHz DSRC really fits into that larger scheme of things, because it has a potential of being a very important element in that larger picture if we understand its proper role and how it fits into a larger thing.

We know that machine-to-machine and machines talking with other machines are becoming a very important part of how technology is advancing, and it's no longer humans

interacting with other machines using communication to enable them to do very useful things. Our machines are now starting to talk to other machines and begin performing very useful things for us well before the human actually gets involved in it.

And if you think about what we've been doing over the last 15 years, it's a perfect example of machine-to-machine kinds of communication. The vast majority of stuff that goes on to enable crash-avoidance types of applications is never observed or perceived by the humans involved in the situation. It's only after the machines have assembled enough information and reached a particular decision point that the human becomes involved. You know, you have to put on your brakes now or you're going to crash. Or you need to do something or you're going to crash. But all in the background, the machines have been talking with each other and exchanging information and doing very useful things, and that kind of machine-to-machine kind activity is going to

become a bigger and bigger and bigger part of the overall communication scheme of things.

So what we're trying to do right now, that we've become very comfortable with the notion that this kind of machine-to-machine communication can serve a very useful purpose in coming up with crash avoidance types of safety applications.

How does it contribute to the bigger picture beyond just that? And in particular, we know that it's good for these vehicle-to-vehicle direct interactions that, again, allow crash avoidance applications to become possible. There's another whole class of types of uses where you start to have the vehicle communicating with fixed infrastructure to enable the kind of mobility improvement and environment improvement kinds of applications that we're all interested in as well.

We have this particular medium that's been defined over the last 15 years that has some very unique capabilities and abilities, and has the then larger ability to fit into the

grand scheme of things and make that very significant contribution. One of the things that we have to keep in the back of our mind is that vehicle-to-vehicle communication, which is the focus of the model deployment, isn't the only thing. There are all of these other vehicle-to-infrastructure kinds of things that are very important to us, and as we're finding out, very important to people outside of our particular domain. There are people working on vehicle-to-infrastructure oriented applications that might actually precede us and our vehicle-to-vehicle oriented applications into a deployment.

There's a particular entity out there that we just became aware of that is working on a commercial vehicle-oriented application. They actually have a demonstration site set up in the Midwest, and they're about to hold a press event next week to unveil it to the rest of the world. We, the Department of Transportation, were not involved in that. They're doing it on their own, and

they're very close to having a viable concept that conceivably could be deployed as soon as next year.

And so, understanding how we fit into this larger scheme of things is becoming much more important, because we have to remember that it's not just the U.S. Department of Transportation that's involved in this topic. Private industry and other local governmental agencies and operating entities are working in this area as well, and probably are going to be out there with stuff in the field before we are, so --

MR. McCORMICK: Who is it?

MR. FEHR: Pardon?

MR. McCORMICK: Who is it?

MR. FEHR: I don't know if --

MR. AUGUSTINE: Yes, I wouldn't -- I wouldn't -- because the information they provided was not --

MR. McCORMICK: Was it secret?

MR. AUGUSTINE: Well --

DR. ADAMS: What was the

application? Can you tell us the application?

MR. FEHR: Yes.

MR. AUGUSTINE: It's a commercial vehicle.

MR. FEHR: It's a commercial vehicle-oriented application.

MR. McCORMICK: Oh, okay. All right. Yes. That's who it is.

VICE-CHAIR KLEIN: And it's using DSRC technology?

MR. FEHR: Yes. 5.9 GHz DSRC technology to enable it.

VICE-CHAIR KLEIN: And currently in an unlicensed mode or --

MR. FEHR: They're operating under an experimental license, but we anticipate that they're going to be applying for a real license here anytime now.

CHAIR DENARO: So can we just request, then -- this is Bob -- that when they put their press release out, can someone forward the link to the committee?

MR. AUGUSTINE: We'll take an

action to do that.

MR. FEHR: Yes. So, anyway, that was kind of an eye-opening experience for us when they came to make a presentation and give us some -- kind of a heads up on what they're doing; that there are people out there that look like they have viable concepts and want to make use of this very useful communication medium to do things that benefit, and we're going to have to figure out how to coexist with those other users.

And as well, we know that other people are interested in this particular slice of spectrum that we've been operating in and think that they have useful purposes for it that are completely different than what we're doing. And again, as what John mentioned earlier, we're participating in the investigation for whether or not we could coexist with other users right now.

So, knowing how we fit into this larger machine-to-machine context is becoming extremely important to us so that we can figure

out how we can preserve the benefit that we all feel this -- the applications that this communication medium enable while these other things happen around us that we may or may not have the ability to influence or control.

So it's important to understand what 5.9 GHz DSRC is as it's currently defined is useful for, how it might be improved slightly. There's opportunities to make it much more useful so that it could perform a much wider role within the machine-to-machine context. And having, you know, a very robust, very complete understanding of the usefulness of this communication medium will then help us in this -- answer this question of whether or not we should allow it to be shared, whether other users of completely different media could coexist, etcetera.

The stronger the case that we have for use of this particular medium, the more likely it will be accepted as a robust part of this overall set of communication media that are available to support machine-to-machine

types of applications.

VICE-CHAIR KLEIN: Maybe this is getting ahead of you and you were going to say this. In your own design, the layered design of this technology -- this is Hans, by the way -- do you conceive of your work as designing a platform with a layered architecture, or are you designing and developing -- the Safety Pilot has been presented as an integrated functional system, very vertical.

MR. FEHR: Right.

VICE-CHAIR KLEIN: And yet you're talking on the points -- you said you're the horizontal guy, and that's kind of --

MR. FEHR: Right.

VICE-CHAIR KLEIN: Is this a horizontal system or is it a vertical, fully integrated function?

MR. FEHR: It very much is designed as a layered type of communication medium, following the classic seven-layer model. All of those parts are there and they're not necessarily well known that they're all there,

but it was designed because it is a packet-based medium based on Ethernet and internet protocols, or its origin, it inherently is a naturally layered kind of a medium and it has the potential of fitting very nicely with other layered media, and I was going to touch on that a little bit further into my talk.

So it's something that we tend to forget, because we in the office and our friends at NHTSA and other operating agencies tend to think of the application, and there's this mysterious communication medium underneath of it that enables it.

Well, what I'm trying to bring to light is the nature of what's underneath the application layer so that people can appreciate the flexibility that it does have and how it could fit into a realm where a lot of other layered protocols exist today, and that's the interesting part for me, because if we could figure that out, this medium that we have becomes much more useful and a much more integral part of the overall picture and much more likely that

we would be able to preserve it with its uniqueness, because that uniqueness serves our application so well.

CHAIR DENARO: Well, just -- I'm sorry. This is Bob. Just a quick question. It seems that -- and I don't know if you want to comment on this or not, but it seems that there's a bit of a paradox on this shared use. On one hand shared use causes interference and degrades the capacity or capability of the DSRC and limitations. It's a problem. On the other hand, shared use does, as you indicated earlier, broaden the use and adoption and so forth, and that's a good thing for the program in general. How do you see that paradox?

MR. FEHR: Well, we have to understand that the availability of communications spectrum is a finite thing, and it's something that belongs to everyone as a shared resource, and we have to make a compelling case that the use that we come up with is an appropriate use for that very precious resource, and someone above our level has to weigh our

use of that particular scarce resource with other potential uses, and hopefully we'll make our decision for the best use of that. I guess that's how I view the paradox, and John can -- or Valerie can chime in if they want to contribute to that.

But it's no longer -- there's not enough spectrum out there for every new use out there to have its own little share, and so in the modern world that we live in today, more and more alternative uses of allocated spectrum are going to be identified, and people at appropriate levels are going to have to make decisions of what's the best use.

So, even working in this particular spectrum area for a number of years now, we've come up with what we think are compelling applications that use that medium that contribute to the public good. What are the other possible uses of that medium -- where do they balance out? So it's our responsibility to demonstrate that we are making the best use of this medium that we're giving, and that's

our role in that.

VICE-CHAIR KLEIN: At a certain point DOT could be seen as an application developer and somebody else could be a platform developer? I mean if it's the applications that really matter, the safety applications. Building a general-purpose platform, a low-latency platform, which is currently what's being done, is that -- that's not a core -- has it sort of been backed into, that you're now doing a sort of platform development as opposed to application development?

MR. FEHR: I don't know if the DOT really does any of those things. We rely on people such as the organizations that are represented in this room today to actually do that. We can advocate, we can incentivize, we can suggest, but it's up to, you know, again, this broad spectrum of organizations represented in this room today who will ultimately actually do it.

MR. AUGUSTINE: I would just comment on that, Hans, and say that I think the

DOT's role -- well, let's say the ITS Joint Program Office research role is not to become an application developer. What we want to do is have enough knowledge of how these applications would work for industry and others to really be the developers and the implementers.

But obviously we have to understand what are the benefits of those applications, what are the limitations, and how does it affect the policymakers. So I think it's a nice role for the research group to look at the technology and provide information to the policymakers and the decision-makers on what's possible, what's beneficial. But ultimately we're not the developer and we're not the decision-maker. We're the researcher. So we work in partnership with those groups.

I think Walt answered it correctly. To the degree that we do application development, it's to understand what are the potential application types, and then we stop and we say, hey, we think we have an

understanding of the way the data works and the requirements, but we're not a developer per se. The research that we do, we may develop an application to get an idea, but that's really not our end mission, is to produce apps. We leave it to the application developers to do that.

MR. FEHR: Yes. The perfect example is this outside entity that I mentioned earlier. Some of the members of that entity participated in our proof of concept exercise, which is the last big thing that the Department did prior to the Safety Pilot and model deployment. They learned a lot from that experience and they're off and running with it, and that's exactly what we were hoping would happen, is that people would get that experience and help the community define how this thing we're working on could be used, and then take it upon themselves to take it to the next level.

CHAIR DENARO: Brian, did you --

MR. SCHROMSKY: Yes. Brian Schromsky. I mean I probably have the most

appreciation for this, because I've lived this for my entire life and career, trying to do all the different handoffs that you're trying to do here, which is, you know, really -- I think to your point is, you've got DSRC here, you've got cellular. How many different bands of cellular are there? You know, you have CDMA, GSM and ALTD. You've got -- kudos. You have ZigBee out there, which I don't see much out there. So, RFID, Bluetooth. You know, that's one big modem you're going to put in a car, right, to run all those different protocols. And then I would say for the local folks in the room, I mean this is one the challenges that we've always seen, is the handoff between a macro and micro network and maintaining that IP session; right? Handoffs are a very tricky thing. And then, you know, if I'm in a car driving 85 miles an hour -- or 70 miles an hour, how am I handing off, breaking those connections, and re-establishing those connections and passing all the security credentials and all in real time; right? So I think that's where, you know,

I see the challenges.

MR. FEHR: You're two slides ahead of me.

MR. SCHROMSKY: Okay.

MR. FEHR: Okay. Before we leave this particular slide, I wanted to point out something, and this is probably one of the least understood things about why we like 5.9 GHz DSRC, but it's probably one of the most useful aspects of it, because 5.9 GHz DSRC is one of the few, if not the only one, of the layered communication protocols that support packet-based communications that actually has a useful broadcast mode, and that broadcast mode is what -- it permeates all of our crash-avoidance kinds of applications. Vehicle-to-vehicle or near infrastructure-to-vehicle. It's that broadcast mode that is the extremely efficient distributor of situation information among all of those actors that actually allow crash avoidance applications to work.

Every other kind of peer-to-peer kind of arrangement that anybody's ever thought

of using has so much overhead associated with establishing relationships and getting information from one actor to everything else around it, that it just kind of falls apart when you get more than a couple actors involved.

That broadcast mode is so extremely useful that without it, this model deployment, we wouldn't be here today. We would still be trying to figure out how to get more than three cars to exchange information. So that's one of the things I want to make sure that everybody is aware of. And as far as I know, this 5.9 GHz DSRC communication medium that we have is one of the few that has that ability to do the true broadcast distribution. And of all of the communication media in the vehicle centric realm, it's the one that serves that purpose. So that's the one beautiful aspect of 5.9 GHz DSRC that we very much want to preserve, because that's what makes all these crash avoidance applications possible. That's what you're going to see this afternoon during your demonstrations. That's what's behind the

application.

And we've done a few very rudimentary analyses of all of the packets that are flying around here in Ann Arbor to support this, and probably 99.9, if not 99.999 percent, of those packets flying around are being sent in a broadcast mode. Everything else who do crash avoidance safety applications is miniscule.

So, keep that in the back of your mind as we start to talk about how we integrate 5.9 into the larger machine-to-machine realm and why we think 5.9 GHz DSRC, as it's defined today, serves such an extremely useful niche within that whole machine-to-machine topic that it is worth preserving, and worth preserving exclusively, just simply because it enables that.

DR. RAJKUMAR: Raj. That's a very important observation to answer Brian's earlier question. So most of this stuff is really completely non-connection type. There's no connection.

MR. FEHR: Right.

DR. RAJKUMAR: There's no session. You basically process the data on a packet-by-packet basis.

MR. FEHR: Yes. And that was one of the things that evolved in 5.9 GHz. Even in the peer-to-peer relationship, all of that baggage that's associated with conventional IT peer-to-peer communication media have been thrown off board, because the time scales and the nature of the media as we moved through it, and these very rapidly moving things just can't support all of those notions of connections. So all of that baggage is out and we have extremely an extremely efficient communication media.

So, with that, this next slide --

MR. WEBB: Back on the slide, just trying to follow all your logic. The line coming out of the car going to the back office, does it really go to the back office or is it going to the cell tower?

MR. FEHR: There's actually the

ability -- there's a physical connector in modern automobiles that in certain circumstances you can actually plug a wire into and have a wired connection. Obviously that doesn't work very well in a moving environment, but there is the opportunity. That is one of the connections that cars will have.

DR. RAJKUMAR: So this will be -- too?

MR. FEHR: Yes.

DR. RAJKUMAR: So a data dump

MR. FEHR: Data dump. Okay. So, again, characteristics of 5.9 GHz DSRC. Because of the way it's been defined in order to support the vehicles moving in their environment and the communication needs that it has, it's extremely useful for small data exchanges, stuff that fits into one typical plane, including a signature, including encryption if it's needed. It's extremely good at doing that, very small data exchanges. And we think that the vast majority of mobility and other types of applications like that fall into

that category. It's a request, it's a status exchange, it's a very small data exchange. So that's one of the things that it's very good for.

These urgent data exchanges, the broadcast mode allows you to share situation information amongst a very large number of actors simultaneously, and so it's very good at sharing urgent information, stuff that has to be communicated very regularly that everybody around you gets very good at that.

What 5.9 GHz DSRC is not good for is large file transfers while you're moving. Because we move in and out of opportunities to connect with a fixed-point gateway, trying to do a large file transfer is problematic, and that's kind of alluding to a point that was made over here. It's not good for voice for that reason. It wouldn't support our conventional kind of notion of how voice communications, either radio-like or telephone-like voice communications, simply because of the moving in and out of fixed-point connections make it problematic for that. And

heaven help you if you try to do streaming media. You're not going to be able to use that particular medium to support your video display of real-time whatever as you drive down the highway. It's not good for that.

We know that the medium has some room for improvement, and that's what I was going to touch on in the last part of this particular section of my talk. And again, we're starting to move away from the things that support vehicle-to-vehicle communication, but then start to support the other peer-to-peer communications that involve something in the back office, something in a fixed point. And one of the things that we need to do a lot of work on here is this notion of channel management and channel assignment for all of the other channels of this media that are defined, but are not used for vehicle-to-vehicle, and there's some opportunities to improve the efficiency of the deployment by understanding channel management and channel deployment there.

And the last point that was a big

opportunity is to improve the whole notion of session management to better coordinate hand-offs between either 5.9 GHz DSRC fixed points or other communication media fixed points. Our applications tend to be implemented in such a way that they are session oriented. Something happens that requires a communication and then there's usually a couple of back-and-forth communications that need to take place in order to accomplish the resolution of whatever happened, and this notion of being able to hand off from one medium to another as you tic-tac through all of the different footprints as you drive down the highway is going to be extremely important in order to efficiently accomplish those sessions.

While we're doing all of that, we need to keep in mind that we need to keep the useful aspects of 5.9 GHz DSRC and the way it's implemented to support our applications, and one of the notions in that is that because you don't know where all of the vehicles are located in order to preserve the privacy of the

individuals operating those vehicles, our applications are designed so that they're always initiated by the mobile component. If you think about it, there's no need to place a phone call to the mobile device, so there's no need to know where the vehicle is and you can construct and one of your peer-to-peer relationship applications such that it's always initiated by the mobile device. It's out there hidden, driving around in the environment, and when it decides it needs to surface to communicate, then a situation can be set up to support that communication, and then as soon as it's done, it goes back, it goes dark again and goes about its business. So it's that notion that preserves the anonymity of the mobile element that's being preserved.

And also, again, to preserve the privacy of the individuals involved, one of the notions that's has been baked into 5.9 GHz DSRC is that you never expose a permanent ID. Again, there's no reason to -- for something on the fixed infrastructure to initiate a session with

the mobile, so there's no need for the mobile to present permanent ID. Those are a couple of things we want to preserve in whatever we do in order to accomplish these other things.

So this notion of channel management. This 75 MHz that's been allocated for this particular communication medium has been divided up in the conventional understanding we have right now into seven 10-MHz-wide channels. One of those channels right now is being dedicated for the broadcast mode, vehicle-to-vehicle or near-infrastructure-to-vehicle communication to support crash avoidance kinds of applications. One of the other channels is dedicated for infrastructure-to-vehicle kinds of communication of an urgent or important nature, and then the rest of the five channels are used for other communication purposes.

So, coming up with an effective way of laying out the access points that use those other channels is an opportunity for us to do it -- you know, improve the efficiency of the

overall operation of this, and in doing that, improve the capacity of it, and in doing that, make it a much more important part the whole machine-to-machine communication realm. So we can preserve 5.9 GHz DSRC. We can make the vehicle-to-infrastructure communications a lot more efficient than the current concept that we have so that it becomes a much more important part of this whole machine-to-machine thing, and becomes a real broadband access mechanism. So, again, without changing it, we can make it much more useful, much more likely to be preserved for the purposes that we would like and in the way we would like to support our applications.

And, next slide, please. The last thing is something that, again, one of my people introduced -- one of the people on the committee introduced for me. It's this whole notion of session management. Again, our applications are organized as discrete exchanges of data. They're peer-to-peer communications supported applications, and they tend to be done as a

discrete session. There's a need to communicate. There's a well-known back-and-forth exchange of information, and then the session goes away. So we know that a vehicle moving around in its environment is going to encounter a large number of different communication media. There's the wide area mechanisms, cellular, there's 5.9 GHz DSRC access points, there's wi-fi, there's Bluetooth, there's "X", "Y", "Z". In coming up with a way of maintaining that session so those data exchanges can be accomplished without having to drop and set up and drop and set up as you move from one medium to another is going to be another very useful area of exploration for us in the short term, again, so that 5.9 GHz DSRC becomes just another one of those very useful media in the machine-to-machine realm, and it's identified for its characteristics and its attributes that serve our purposes and becomes a much more integrated and much more useful component of the larger communications scheme.

This is going to be one of the most important pieces that we work on in my particular level. Probably going to be one of the hardest, because we're going to have to break all sorts of rules in order to do this, and that's going to be the interesting challenge for that.

VICE-CHAIR KLEIN: Hans here. Has DOD done any stuff -- this problem, lots of things moving around, needing to communicate in real time under difficult, trying conditions, is this -- are you absolutely at the -- it's a fascinating engineering problem. I really am fascinated by it. Have others encountered it?

MR. FEHR: Others have definitely encountered it. They may not have articulated it this way. I've seen beautiful examples of it operating. They just don't know what they're doing. And so it's a matter of taking what they've learned from that one context and moving it into this particular context. It wasn't a DOD example that I saw. It was a meshed network communication scheme that I saw set up in a large

open-pit mine where they had a smorgasbord of communication media available. They have all these vehicles moving around and they established these kinds of session-oriented things with -- completely independent of the medium. And they were able to accomplish their communication goals by just putting in this session management layer, and the applications don't even know what medium they were using. It all worked. And there's stuff in production now.

So it's a matter of taking what's been learned in some of those other realms, and meshed networks are fertile ground for claiming this kind of stuff, because they've figured out how to take disparate communication media and meld them together, and they tend to be private proprietary kinds of things, but a lot of the ideas that were pioneered in those areas -- DOD, I know, is doing a lot of work in meshed network. Private industry is doing a lot of work in meshed networks. We can get a lot of stuff that we need in order to accomplish it there, and

there's a lot of independent research work going on out there right now in the whole mobile IT area. Mobile IT V6 is another area where people are doing independent research. It's a matter of just corralling all that and applying it to our situation here and making sure people realize it.

MR. SCHROMSKY: To add the equipment -- to answer your question, Hans. My experience is public safety, law enforcement, fire, EMS -- DOT would fall under there -- had really pioneered that, because you would have what is an MDT, mobile data terminal, in the vehicle and he or she, the operator, is driving. So it was a police officer responding to a call. You know, they'll get the broadcast, either voice on their mic or through the MDT, but they're responding. They don't have time to flick a switch, turn on the cellular modem, turn on the land mobile radio modem. Oh, by the way, they have their own in-city wi-fi network; right? So they need -- to Walt's point, it's the session persistence. And most of that is

actually -- it's companies like NetMotion out there that do more of a mobile VPN scenario; right? So if it's Ethernet, if it's wi-fi, if it's cellular, it's LMR on whatever frequency, as they're moving through, it's all hitting it off and keeping that IP session and we'll have like a virtual IP and then a permanent IP. So the applications can still function as they go through the different media of network transmissions.

DR. RAJKUMAR: This is Raj. A two-part question. With regards to the 2013 mandate position, I thought we were looking -- or the DOT was only looking at DSRC as it applies to safety applications.

MR. FEHR: Right. It's that broadcast mode that supports the vehicle-to-vehicle crash avoidance that underlies that particular decision.

DR. RAJKUMAR: And a second part of the question --

MR. FEHR: I'm kind of looking at John Maddox because --

MR. MADDOX: You can't anymore.

MR. FEHR: He can't answer that anymore --

MR. MADDOX: Retroactively.

DR. RAJKUMAR: The second part is with respect to this committee's charter. Are we looking at all these communication technologies or -- that's a very broad topic.

CHAIR DENARO: Well, I don't know about technology per se. I mean our charter is to advise on the JPO program. So, assuming our strong focus should be on the JPO program, which means safety application, DSRC, and so forth. However, our concern is also broader in terms of implementation success and that sort of thing. So if in our discussions we believe that we need to consider other communications as well because they're going to be important to the ultimate success of this, then I would say we weigh in.

So I think it's a balance issue. I think the majority of our focus -- and I think Shelley said this in our last meeting -- let's

focus on what these guys are trying to do and let's help this program succeed. But we may have a broader perspective, too. Some things that they are choosing not to consider or, you know, purposely is beyond their scope of responsibility that we want to weigh in to the Secretary and others, saying, you know, the real success of this program needs to consider a few other things. Does that answer your question?

DR. RAJKUMAR: Yes, sir.

CHAIR DENARO: Yes, okay. And I just wanted to do a quick time check. So, John, Valerie, help me here. I don't know what -- I know there are other people presenting and so forth. We did plan a break at ten. We could let Walt finish his piece. I think you've only got a few more charts.

MR. FEHR: I was intended to present after the break as well, so --

CHAIR DENARO: Okay.

MR. FEHR: -- what I was going to do is set up the next topic, and then people can think about it over the break and then we'll

pick it back up after we return.

CHAIR DENARO: Okay. Does that make sense?

MS. BRIGGS: Yes.

CHAIR DENARO: Okay. Great.

MR. FEHR: Okay. I know there's a lot of interest in this topic and I'm sure we're going to have a lot more discussion about that tomorrow, but I'll keep things moving. I was going to use the next particular topic of positioning technology to introduce this maturation that we're going to as we move the research to a deployment scenario, and how we try to have all those people working in this area to up their game in order to do something suitable for a deployment scenario, and location reporting ability is extremely important for all of the vehicle elements that contribute to the vehicle-to-vehicle crash avoidance types of applications. So that's the example I'm going to be using of how we've done things more -- in a more mature way to support the Safety Pilot Model Deployment than may have been done

in the research activities in the past.

So, Stephen, if I could have just the first slide. What I wanted to point out here was that we needed to come up with and needed to get all of the people involved in this particular project keenly aware of, and actively involved in, the notion of requirements-based definitions. We had to finally come up with extremely well-articulated requirements that can be expressed in such a way that if a device meets this requirement, then it will properly serve its role in the larger application. We no longer have one little team building everything from the ground to the ceiling and fiddling with it till it works. We have a large number of contributors building a large number of parts that don't necessarily know each other and don't know how these things are going to work in the grand scheme of things.

We had to come up with ways of articulating requirements so that individuals could build their parts in isolation and contribute them to the whole, this model

deployment that you're going to see around us in Ann Arbor, in such a way that when they come out of the box, they plug in, they turn on, they work, and they support their role in the bigger system.

So we had to come up with a way of articulating a requirement. We then had to work with device builders to actually make sure that they properly interpreted that requirement and actually could build it, and then we had to come up with an independent way of assessing whether that particular requirement was properly implemented. And the requirement that I was going to use to focus on this -- again, it's extremely important for vehicle-to-vehicle crash avoidance types of applications and support the whole host of other applications that we're interested in, and that requirement is for a moving vehicle to be able to properly record its location at a specific time, and it's that combination, that couple of information that has to come out of the antenna of a moving vehicle being seen by other vehicles around it,

that it's fundamental to all of our crash avoidance applications. So it's that requirement that we're going to talk about and I was going to give you a little bit of that overview of how our device makers -- and I'm looking at Roger -- have matured to the point where they actually understand that requirement and can actually build something that meets it, and we have a process in place to verify that they really do.

MR. McCORMICK: This is Scott. There's one thing I've never understood, and that's those two requirements right there. The second one says the accuracy has to be within one millisecond of the actual atomic time, but then you're giving yourself 1 1/2 meters of actual latitude. And at 60 miles an hour, that's equivalent to three seconds.

MR. FEHR: Let's pick that up after the break.

MR. McCORMICK: Okay.

MR. FEHR: That's what I wanted people to think about, because that's what we

were given as the articulation of this requirement. I was going to tell you after the break --

MR. McCORMICK: By a clock maker?

MR. FEHR: -- how we dealt with it. Pardon? No. Actually, people figured out how to do it.

MR. McCORMICK: Okay.

MR. FEHR: Anyway, that's what we'll pick up after the break.

CHAIR DENARO: All right. Thank you, Walt.

With that, we do have a break scheduled. We're scheduled for, what, 20 minutes I think? Yes, 20 minutes. So if we can be back at 25 after. Thank you.

(Whereupon, the foregoing matter went off the record at 10:06 a.m. and went back on the record at 10:29 a.m.)

CHAIR DENARO: Okay, we're back in session. But, Stephen, did you want to talk now about the drive?

MR. GLASSCOCK: For everyone who's

going to participate in the demonstration, they'll do it in groups of three, starting at 11:30 with our lunch. The lunch will be set up right outside. There'll be a box lunch. So if you'll just divide up in groups of three for 15-minute increments, the staging area is out this door to the right and down the stairs. I'll help -- show you where that is. So, again, starting at 11:30. We'll just do groups of three, and they'll last about 15 minutes.

CHAIR DENARO: So should we get a show of hands of how many are going to participate and see what we have?

MR. GLASSCOCK: Nine. So, it'll be three groups of three. Right, yes. And if that's the case, that's fine, too. So I'll meet the first group of three. Whoever wants to go first, I'll just take you out here right at 11:30 and we'll start.

MR. FEHR: Give people a minute to finish connecting up their gadgets, wired and wirelessly. I see people poking at things on their --

Okay. I'll pick back up on this particular topic, because it is a very good example of the level of sophistication that we need to attain in order to support a nationwide deployment of any of the applications that we're interested in, and this is also a model for all of the other things that need to happen at lower layers at all of the different protocol layers within the enabling technology as well.

There first of all has to be a very clear articulation of a requirement so somebody can understand that if my device does this, it will then contribute that to the overall system, and people have to be able to do this in isolation, not necessarily knowing all of the intended operations of the system.

And this Safety Pilot model deployment was the first time that we really had to force this issue. It was no longer a closed group building the entire system and making it work by fiddling with it after they started to put together. The pieces all had to come together and they had to fit.

So one of the most important things we wanted to make sure we got right was this ability to inform other vehicles around a vehicle of that vehicle's location at a specific time. It's fundamental to all of our crash-avoidance applications. So we had to make sure that all of the devices that were going to participate in this activity understood the requirement, properly built it, and then we had an independent means of verifying that they truly were performing their role properly.

So we started with an articulation of this particular requirement that we got from the principal group developing the crash avoidance applications that were going to operate in that small number of vehicles that drive through the cloud of information provided by all of the other vehicles around it. This articulation was expressed in the words that you see on the particular screen, and this is related to the latitude component of the location. There's a similar articulation for the longitude and elevation, the "X", "Y" and

"Z" component of a location, and the beginnings of an articulation for the time aspect of it.

Because the communications that support these particular applications are asynchronous, there's no relationship between when the location is actually physically transmitted, the bits that are clocked out of a radio, to the time context for that information. The time context is actually sent along and with the location so that the receiving unit can reconstruct where that vehicle was in the receiving vehicle's time context. So, that tuple of information. It's not just the location. It's the location at the time it was at that location. That has to be properly transmitted from one vehicle or another, because we have an imperfect medium, non-deterministic medium, and so the time context has to be transmitted along with the location that is applicable. That was the hardest thing to try to articulate to everyone and the hardest thing to come up with a way of verifying that that was actually happening.

So I'm going to digress a little bit from the background material that you have to show you the first experiment that we did in order to come up with a way of figuring out if that actually was happening. And again, we had the -- have the understanding -- next slide, please -- that the device in the vehicle was going to be built by one party that will transmit this information, and the device in another vehicle built by a completely unrelated party was going to have to interpret that information and make sense out of it. So we had to be in the middle and figure out if the stuff going over the air was right.

So the very first experiments that we run in order to try to figure out if that information was right happened to be run at our sister facility at Turner-Fairbank Highway Research Center, where they just happened to have an installation and a set of equipment that gave us the ability to tell whether that report from the vehicle was right or not, and right under all of the operating conditions of the

vehicle. So the folks out at Turner-Fairbank happened to map their facility down to centimeter level. They knew exactly where this grid pattern on the pavement was down to the centimeter with absolute accuracy. They also happened to have a high-speed video system with the ability to give a time stamp on a picture within a millisecond of absolute time.

So we could construct this experiment where we operated this vehicle in all of the different kinds of modes that tend to excite or aggravate their ability to report their location at a particular time, and we could actually check to see if they were reporting it properly using this particular very crude, but extremely effective way of knowing where a vehicle was and exactly when that vehicle was there.

So we knew that these kinds of abilities to report are affected by, you know, which direction you're traveling, how fast you're going, whether you approach a particular point in a straight line or in some kind of a

maneuver with yaw movement to it. So we created this experiment that excited all of those different kinds of things that tend to aggravate this ability in a given vehicle, and we ran it through the test.

So we took a whole series of photographs. We could tell when a very specific point on the vehicle touched a well-known point on the surface of the Earth. We knew exactly down to the millisecond level when it was there. We could then take the reports out of the antenna. You know, there was -- it'd be just pure coincidence that we would get a report at exactly that time. So we could take a report on either side of that event that was captured in the photograph, do some simple linear interpolation between them, and we could tell if that report was accurate enough to meet the requirements for the system as they had been articulated to us.

So we ran a whole number of these experiments with candidate devices from seven different manufacturers, and this was the first

information that the device-making community had ever been given about their ability to meet this very fundamental requirement. We did that in February a year-and-a-half ago. That was the first instance we've done that, and that was extremely useful information that we fed back to the device-making community so that they could improve their processes for, you know, creating these messages that would be transmitted to other vehicles that would depend on them being correct.

And we ran this particular experiment several different times and gave that feedback to the device-making communities. We had, you know, a number of different discussions with them, going over philosophies of how you could accomplish with the resources that you typically have available in an automotive kind of context and all of the rest of that, and eventually some of them got it.

We've gotten to the point where there are at least three, if not four of those original group of seven device-makers that got

it. They figured out how to do it. And at the same time, we knew that running this particular kind of an experiment would give us these discrete points when that tire -- that hash mark on that tire that touched that well-known point on the surface of the Earth, that this kind of a procedure was unworkable as far as something we could run on a regular basis and give much more rich information back to the device-building community.

So we came up with a better implementation of this that gave us the ability to do this thousands of times during a particular experiment, not just, you know, one discrete photograph with a time stamp and a hash mark on a well-known point on a surface of the Earth.

Next slide, please. We've come up with an automated way of doing this by actually having the understanding of where you are on the surface of the Earth and the time context for where you are, as a piece of equipment that actually rides around in the same vehicle that's transporting the device under test. And so now

we can make a sample of where the vehicle is down to several centimeters in accuracy at a particular time that's accurate to within milliseconds as you drive it around. So now we can collect much more complete data sets as we go through several prescribed maneuvers at different speeds on a particular course that approaches your -- that operates on north, south, east, west, around corners and straight lines and all of the rest of that, and give a much -- get a much more aggregated understanding of a given device's ability to report correct information as far as the location of the vehicle at a specific time.

And if you can show us the next slide, Stephen. This is an example of a good device. If you remember back from the original definition that we were given, we wanted to know where a vehicle was on the surface of the Earth to within a meter-and-a-half longitude and latitude, and I believe it's either a meter or a meter-and-a-half in elevation. And you see the results plotted on this particular plot for

one particular device. This particular plot -- I know it might be difficult to see the gradations on it, but this box is a 1 2 meter rectangle and it's oriented longitude and latitude, north, south, east, west. And within the center of it is a one-meter circle.

And so we had a total of over 1,100 reports that made up this particular experiment that was run, and I forget what speed this was run. I think this was a 60-mile-an-hour example. And on this particular device, it knew where it was on the surface of the Earth and was able to report it correctly 99.4 percent of the time. There was only one or two spots that were outside of that one-meter circle.

So we don't know how this device maker did it, but they got the requirement, they were able to build something using conventional technology, there was no magic, no million-dollar receivers, no other things like that. They understand the equipment they have. They understand the physics of the situation. They're able to create these reports and they

get them all in the bull's-eye.

DR. RAJKUMAR: One question. This is Raj. This is happening in open space, no canopies, no trees?

MR. FEHR: This was run in open space, a clear view of the sky, clear atmospheric conditions. We understand that all of those kinds of things can degrade this ability. But we had to start somewhere and establish kind of a base capability.

CHAIR DENARO: This is Bob. Was there communication with the vehicle for differential correction?

MR. FEHR: No. This was all done in that vehicle. There was Wide Area Augmentation System (WAAS). The receiver -- the GPS receiver that they were using was WAAS-enabled. So there was satellite.

CHAIR DENARO: Okay. Well, that was my question.

MR. FEHR: Okay.

CHAIR DENARO: It did have WAAS.

MR. FEHR: Okay.

MR. McCORMICK: For those who may not know, differential correction corrects where your GPS thinks you are based on real north as opposed to true north. Just, you know --

MR. FEHR: So, anyway, they were able to take commercially-available automotive-grade equipment, and again, we don't know how they did it, because all we have are the reports that come out the antenna. We don't know what's inside of their box. That's their ability to differentiate their product from the next guy's that you're going to see who got very few of them in the box, let alone any of them in the circle. So this particular device maker hasn't got it yet.

But again, we know that there are a number of device makers who do get the requirement and do know how to create a device using commercially-available equipment, and can deliver a product -- and you're going to see them driving around in Ann Arbor -- creating this atmosphere of situation information that our vehicle maker friends are going to drive

through in order to demonstrate their crash avoidance kinds of applications. So there are still a spectrum of companies out there attempting to build equipment in this space. Some of them get it and have -- are, you know, able to do it. Some of them aren't there yet. But we know that people are capable of meeting a requirement like that.

And so what we're doing right now is refining the articulation of a requirement. The wording that you saw on the original slide probably wasn't as clearly stated as it could be, now that we really know what we really need. There might be some refinements that take into account confounding factors like Raj had mentioned that tend to degrade this ability. And so, you know, that's what we're going to be going through over the next several years, as John mentioned, that we were going to be refining requirements, definitions, specifications. We're going to clarify those articulations so that, again, more and more device makers can create a device that gets the

results inside of the box. We're going to be working with potential shops out there that can do this kind of testing independent of the device makers to verify that they truly are meeting these particular requirements so that when they do become part of larger and larger deployments, we have much more confidence in their ability to properly contribute.

CHAIR DENARO: Go ahead.

MR. WEBB: George. Just briefly. Is the good case representative of the three --

MR. FEHR: Yes.

MR. WEBB: -- that you said got it? It's not the best of the three. It's just one --

MR. FEHR: It might have been the best of the three.

MR. WEBB: Okay.

MR. FEHR: This was blind information given to me. I don't know whose information that is, and it hasn't been completely vetted with all of the device makers

yet, but we're in the process of -- we had run this parallel certification trial in order to prepare for the model deployment. We had just run these last set of tests, and this was one of the results. I think I know who it is, but I'm not sure and it hasn't been vetted by the device maker yet, so I can't tell you who it is. The interesting point is, I don't think that particular device was one of the ones in the model deployment, and it may have ended up being the best one of the lot.

MR. CALABRESE: Location and time, but also direction.

MR. FEHR: Yes.

MR. CALABRESE: It goes off that --

MR. FEHR: Yes. If we go back to this particular -- this chart right here, there's a whole series of additional things that are transmitted, and what you see on the second panel there is actually the -- oh, no, that one is the speed. So the time derivative of the location is an important factor. And this -- there's a whole series of these charts that go

through the results report from one of these qualification tests, and I just picked a couple of things almost at random here.

This one relates to speed. We need to know, again, the speed of the vehicle at that time stamp to within a particular performance level, and this particular device maker, you know, regardless of whether it's turning, going straight, whatever, was able to get it into the band that we wanted all the time.

If you could flip to the next one, Stephen. This next one was heading. I picked that one because, again, it's not just location, but it's speed, heading, acceleration, and path history, path prediction are all part of the information exchange, and that chart there is an example of this particular device losing its bearing once in a while and falling out of the required performance level on reporting its heading.

MR. CALABRESE: For path prediction, one must know the road configuration as well?

MR. FEHR: You can make a guess of whether or not you're going to be going straight or whether you're in the middle of a curve based on what you've already done. That's the level of path prediction that you can do. So you can predict the arc that you're going to be traveling on, or you can predict if you're going to be driving straight, and coming up with a best guess at what you're going to do next is one of the most useful pieces of information that you share with the other vehicles around you so that they can, again, begin to build this threat map of possible interactions with vehicles around you. So the best you can do is predict whether you're going to be going straight or whether you're going to be going in some kind of curved pattern.

CHAIR DENARO: Walt, in full disclosure here, I've been involved in GPS for 36 years, so I just embarrassed myself, but --

MR. McCORMICK: Since you were a child.

CHAIR DENARO: Yes. And I don't want to do too deep a dive here because in our

tech subcommittee I think we'll come back to you or others and really get into this, but I just want to show the nature of my thinking right now. Let's say that's a device that ends up in a vehicle, the one there. What problems will that cause in the system if the accuracy is that far off?

MR. FEHR: Probably all sorts of either false positive or false negative --

CHAIR DENARO: Okay.

MR. FEHR: -- warnings in the receiving vehicles.

CHAIR DENARO: Okay.

MR. FEHR: So they flat won't know where that vehicle is, so they can't make proper decisions about whether to alert or warn a driver.

CHAIR DENARO: All right. So my concern is, in all of this data -- and Raj asked the question about the conditions -- I mean you're having your spec with an H-top of five and so forth and I understand that. My concern is about the tails of the distribution. So when

it's bad -- and it will be bad, GPS will be bad at times -- what does that mean and what is the requirement? Are we talking about 5.9's reliability? Is that going to be sufficient? And, you know, how much are we understanding the tails of the distribution, not the peak here?

MR. FEHR: That's one of the things that we hope to learn from this Ann arbor experience, because right now we don't have a good articulation of that.

CHAIR DENARO: Okay.

MR. FEHR: John?

MR. AUGUSTINE: And similar to Bob, I'm going down the same path you're going down. A couple questions just so the committee understands what we're looking at. This is all -- this is a question, not a statement. This is all GPS-based -- or GPS and WAAS-based information in terms of --

MR. FEHR: No.

MR. AUGUSTINE: No. Okay. Does it take the vehicle data and it's fusing GPS plus what the vehicle is -- you said no.

MR. FEHR: It's extremely important to understand that. The device makers that got it understand that they can't rely just on a report from a commercially-available GPS receiver. A GPS receiver has to be a sensor in a larger machine that runs in their device that understands the dynamics of the situation and the vehicle that's transporting it and possibly has access to other information to come up with a much better understanding of where that vehicle is, and particularly where that vehicle is at a specific time. They have to understand what they get from a GPS receiver and how to properly meld it into some kind of an estimator or other sophisticated device within their device in order to come up with that proper tuple of information.

So it's not just GPS and it's not necessarily information that comes from in-vehicle sensors. Again, these devices that we're working with right now typically don't have access to in-vehicle sensors like pulse-per-revolution counters on wheels of the

vehicle or anything like that, but they may have accelerometers or other autonomous sensors like that.

CHAIR DENARO: Yes, and this is Bob. The problem with that, of course, is that vehicles are all different, and if you have a strong motivation to have an after-market device, it would be really questionable about whether it could access. So I think those are all challenges. Is a digital map required in the system? Is it in --

MR. FEHR: No.

CHAIR DENARO: -- the Safety Pilot?

MR. FEHR: No, no. This is all very local, very what's happening just immediately --

CHAIR DENARO: Yes.

MR. FEHR: -- around me kind of things happening in the Safety Pilot.

CHAIR DENARO: Okay.

MR. FEHR: Next view, John. Oh, sorry.

MR. ALBERT: Yes, a comment. You

know, many times in talking with U.S. DOT, we try to promote the idea that in rural areas is really the worst case scenario where trials and demonstrations need to go on, and if 60 percent of the fatalities are rural, I would strongly encourage U.S. DOT to do some type of trial where canopy, shadowing, canyons, mountain passes exist, which is maybe beyond Michigan, and to have some of those field trials in some of those locations where vehicle awareness really becomes critical and life-threatening, not just a rear-end collision.

MR. FEHR: We'll definitely get canopy in spades here in Ann Arbor, but the other conditions you mentioned --

MR. ALBERT: Not necessarily canyons.

MR. FEHR: Not canyons or --

CHAIR DENARO: This is Bob. I've got some free test advice for you. I have a favorite GPS location right here in town. It's on the drive from the airport to the city on I-94. There's this wonderful metal bridge.

Some of you have probably drove under it. And I just love going through there with my GPS on, because the GPS jumps about 400 meters over in a field as I go under that bridge, and then after I come out of the bridge, it jumps back again. And it's amazing how reliable an error that is. I see it all the time. Just throwing that out.

MR. FEHR: I'll keep that in mind. I may drive that.

MR. LUKUC: We actually have that address. We can go without a GPS signal. We can correct for a bad GPS signal in the integrated vehicle for up to two seconds by using on-board sensors.

CHAIR DENARO: Sure.

MR. LUKUC: So we can predict in a remote vehicle's location. Once they get that bad GPS data, it's more difficult. It's more like a half a second reliability.

MS. BRIGGS: Give the reporter your name.

MR. LUKUC: Oh, Mike Lukuc from

NHTSA. So I manage a lot of the CAMP projects.

CHAIR DENARO: Well, and thank you for that. I understand that. Again, my concern is going to be the tails of the distribution. What if that particular instant when something happens is where a report is being interpreted wrong and causes something? So, you know where I'm going.

MR. LUKUC: So we have -- I'll touch on that in the performance or the driver clinic presentation.

CHAIR DENARO: Okay.

MR. LUKUC: -- driver clinic presentation, but CAMP -- during the driver clinics -- maybe I'll just go ahead and mention it now. We had a sub-project where we used the template vehicles. So we took two groups of four vehicles, pre-determined routes, and recorded data for 20,000 miles with multiple GPS receivers on each vehicle. So, actually four receivers, one common. There's a report coming out that's in -- it's in OEM review right now. So we have that driver clinic report and

we have a systems performance test report.

CHAIR DENARO: Okay. Great.

MR. LUKUC: The system performance testing report addresses those specific questions you were asking a little earlier when we did it. So this includes the first geographic and environmental conditions.

CHAIR DENARO: Great. Thank you.

MR. LUKUC: Canyons, mountains, rural highways.

MR. FEHR: Yes. I forgot about that exercise that was run as part of that, the driver clinics. And I was going to touch on one last point that you touched on in the after-market devices. Everybody wants to know whether these things that everybody carries around in their pocket are capable of doing anything close to what we need, and it just so happens that when we ran this last set of experiments last month in New Jersey, there were a bunch of cell phones riding along and were analyzing the capability of that particular class of device, just -- it was a fortuitous

accident that this thing became available, and they went along for the ride and we were testing the location reporting ability of these devices used in the model deployment. So that report is being worked on as we speak and will become available as well. Don't hold your breath, is the early result that I got from that.

CHAIR DENARO: Great.

MR. LAMAGNA: Hey, Walt, it's Sam from Intel. Just one question. Was cubic density a variable at all in this, and if it was, did it have any material effect on its accuracy?

MR. FEHR: No, because this was the output of a given vehicle. So this is what a -- one vehicle would report to everything around it, and contention for the available capacity of the medium is less of an effect for us because the time context of the data is actually transported along with the location, speed, heading and all the rest of it. So it doesn't matter as much about when it was transmitted, because the time context of the data goes along

with it. It's sent as a tuple of information. So we don't depend on any specific performance requirements for the timeliness of the exchange. We transport that context right along with everything else.

DR. ADAMS: Can you go back to the previous slide? There's that one outlier way up there. Was that assuming any particular maneuver or do you have any comments about that outlier?

MR. FEHR: Well, that was one point that occurred in a report that's going out every hundred milliseconds, so heaven knows why there was that one outlier, because it's physically impossible for the vehicle to change that location from one hundred millisecond to another hundred millisecond. So something happened and there was an erroneous report that one time, because it picked back up and the next hundred milliseconds knew where it was again. So it's physically impossible that a vehicle could do that, so it's those kinds of things that, knowing the context of what's going on, the receiving

vehicle would probably just throw that one out, because it knew the one right before it, and then the one right after it were along a straight line or a well-defined curve. There was this one that was off in the weeds. Something happened. Throw that one out.

DR. RAJKUMAR: If I can add to that. This is Raj. GPS is very sensitive to a lot of factors; it is a cloudy day, it is very humid, and basically there are buildings around you that reflection happen. And then time of the day. If that GPS satellite's right above you, that gives you much better data than if it's further down on the horizon. So, lots of variations.

MR. FEHR: That would show up as the difference between this slide and the next one, because you would see a complete breakdown of the ability in that kind of a situation, not one point that's out of line. So we're building up that understanding of how to interpret the results of this. That's all part of the education that's going on amongst a lot of the

different groups around here, so --

MR. SCHROMSKY: Bryan. Walt, are you using this as a GPS in any of this testing, or just standalone eyes in the sky?

MR. FEHR: It's eyes in the sky.

MR. SCHROMSKY: Okay.

MR. FEHR: Any corrections come from the satellites.

MR. SCHROMSKY: Okay.

MR. AUGUSTINE: With WAAS, though. I think --

MR. FEHR: Yes.

MR. AUGUSTINE: That was going to be my comment, is I think --

MR. FEHR: Yes. The WAAS comes from --

MR. AUGUSTINE: -- when we present this information, I think it's important for the technical subcommittee or even the standards group to make sure we're laying out precisely what we're talking about in terms of how many channels -- how many frequencies you're receivers are carrying. WAAS technically is

an augmentation system, so that will cover some of the integrity requirements. It's already baked into the aviation augmentation versus a signal that's using GPS and Galileo or other satellite constellations as they're launched in the future. So I think it's very important that when we're presenting this information, even the requirements that you specify, you know, multi-frequency, single-frequency, WAAS, raw GPS, or fused with the data set from the vehicle, because you're going to get a whole range of solutions, depending on which of those scenarios you select.

MR. FEHR: Well, I'm going to actually take exception to that, because in reality we don't care what the device maker uses in order to achieve that requirement. All we know is that for a vehicle and the device in the vehicle to properly participate in the safety application, it has to meet a performance requirement. So the technology that the device maker uses in order to achieve that performance requirement isn't as important as meeting the

requirement. So the difference between the good case and the bad case may very well be one of those factors that John just mentioned, or it may be just a device maker that flat doesn't know how to use the resources at hand. We had a number of them that took good information and turned it into bad information because they didn't know how to deal with it properly.

We're getting past all of that kind of stuff. But the net effect is that when a vehicle drives past us down the roadway, we don't know what's in it. All we know is that the information coming out of it has met a particular performance requirement, and that's the opportunity that the various device makers have to differentiate their product from the next person's. If they can meet that requirement with an incredibly cheap solution, they will have a significant market advantage. If they require very expensive sensing mechanisms and access to more information than the other guy, they're at a competitive disadvantage. So, try to stay away from dictating how they do it,

allowing, you know, the marketplace and the people who populate the marketplace to differentiate their product within that envelope. And as long as they meet that requirement and properly contribute to the operation and the application, it's up to them, and that's where they're going to be able to establish their brand character.

CHAIR DENARO: I'd recommend that we let Walt move on. I promise you your technology subcommittee will grill these guys nicely.

MR. McCORMICK: I want to make a last point and I want to make sure everybody understands. V2V safety never tells you when you're safe, because it can't discern whether or not the vehicle passing you is either passing you inaccurate information or it's not broadcasting at all. It can only tell you when you're for sure in trouble. So, I mean, back to the point of saying it needs to be commensurable with the 8-S systems in the vehicles and other sensors, and, you know, even

the occupant is an important point. He does certain things. But it doesn't ever actually tell you you're safe. It'll only tell you when you're for sure in trouble.

CHAIR DENARO: Okay.

MR. FEHR: Okay. Next topic. Going into a little bit more detail about the NTIA study that we're participating in. Just going back a few squares here. Earlier this year, language was inserted in the Middle Class Tax Relief and Job Creation Act of 2012 that opens the possibility of spectrum sharing, and one of the areas that this possibility was opened up into was this particular slice of the 5 GHz band that we're operating in, particularly the 5850, the 5925 MHZ section way up at the upper end of the band.

Before this possibility was opened up, there were a couple of other possible users in that area, but from the perspective of the vehicle-to-vehicle and vehicle-to-infrastructure communication, they were relative benign. There, I think, are a

couple of radar systems that may operate in that area that are in specific locations, and there are satellite uplink operations that may use that particular frequency allocation that are in specific locations. But the vast majority of the continental United States are not affected by those other known users.

This kind of throws a monkey wrench into that understanding, because it opens up the possibility of other users of the spectrum anywhere, and that's what we're most interested in, mainly because these other users of the spectrum are quite likely to be unlicensed U-NII devices. For those of you not familiar with that four-letter acronym, most U-NII (Unlicensed National Information Infrastructure) devices are what we think of -- are as wi-fi devices, the 802.11 ABGN and, coming on rapidly, the AC type of devices that are used for all sorts of data communication purposes. They're all built under -- you know, to operate in unlicensed circumstances. So you have some fundamental guidelines that you have

to meet, but the deployment of the devices is up to the individual using them. So it poses a unique circumstance that we're rapidly trying to figure out how to deal with it and whether or not it's a big deal or not. We suspect that it probably is.

DR. RAJKUMAR: Walt, I'm very concerned about this particular topic. I think in that particular technical issue that we're dealing with for DSRC adoption, this throws a huge monkey wrench into the whole process. I think that we as the advisory council, I think we need to put our heads together to come up with a strategy to change the political process involved to try to change this sequence. I really think it could be endangering the operation of the DSRC group.

MR. FEHR: Yes, just -- yes. A little -- sorry.

VICE-CHAIR KLEIN: Is there a risk they're going to consume the -- use finite resources, interfere -- what happens with those?

DR. RAJKUMAR: There will be no

control. Anybody could use basically unlicensed spectrum, just like wi-fi is using unlicensed spectrum. Anybody and everybody can apply wi-fi anywhere they want to. The same thing could happen with the 5.9 GHz. Completely take over with this spectrum.

MR. FEHR: I'll touch on the details of that in the next slide. I just wanted to maybe point out a few more of the timeline elements that we're working toward here.

As John mentioned at the beginning of the day, the NTIA produced an initial reaction to this request for an evaluation, and that initial request was circulated among the potential federal users, and we've been identified as a federal user. Even though we, the Department, aren't necessarily operating this equipment, it's our users' communities that we work with who are the actual users of it. But we were identified as one of these potential federal users of it. So we participated in the evaluation and commenting on that initial draft. All of those things were sent back to the NTIA.

They're working on a final version of that particular document that we literally are expecting to be released any day now. They're meeting again this Friday in D.C. and they have shown a pattern of releasing these documents just immediately before those meetings, so maybe as soon as Friday we'll have the released version of it. And that will give their recommendation as a first step at responding to this particular request, and we're expecting that that response is going to be something along the lines of a very considered analysis and test process to verify that if someone were to share this spectrum, that there would be no adverse effect for the other federal users. So, some sort of analysis, some sort of test protocol would be defined and then allowed to operate, and the results of that testing and analysis are expected sometime in early 2013, and then the NTIA would take the results of that exercise and come up with a final determination.

And I think, John, you were right that the target for doing that and reporting

back to Congress, as dictated by this legislation, is in October of 2013.

So that's what we're expecting to happen next, is that that recommendation for analysis and testing -- they aren't just going to turn it over, but they understand the potential benefit of the other federal users' use of the spectrum, and are going to allow that very considered analysis and testing to take place in order to come up with a final determination.

CHAIR DENARO: Well, I don't want to get into a lot of the details -- this is Bob -- but how does this work? I mean the FCC designated a band for DSRC. That was intended -- my understanding, that was intended for vehicle communications, V2I, the --

MR. FEHR: Vehicle-oriented.

CHAIR DENARO: Vehicle oriented. Then does some like private company come along and petition and say, We want to use this too"? Is that how it works, or how did that happen?

MR. FEHR: I think John is a little

more well versed in what happens.

MR. AUGUSTINE: Well, you know, anyone can petition for the use of any spectrum that they want to use.

CHAIR DENARO: That's my question. Sure.

MR. AUGUSTINE: And in this case, Congress requested NTIA to do a specific study.

CHAIR DENARO: Okay.

MR. AUGUSTINE: So the results of this study would affect and form any future decision by FCC to reallocate or change the allocation or allowing users into it. It's one study. It's not the allocation or reallocation of the spectrum, but it's a federal study about what would that do and could there be coexistence or would there be harmful interference, so this is sort of the process of saying here's how we would systematically go out and answer that question and show you the methodology and testing that we're going to conduct that will give you that answer, and then that answer, then, I think is really what you asked, --

CHAIR DENARO: Yes.

MR. AUGUSTINE: -- how would that be used.

CHAIR DENARO: Well, but my question is, so at this point in time with this study not conducted and no decision made, is this absolutely reserved completely only for DOT vehicle-to-vehicle communication?

MR. AUGUSTINE: Yes. This does not impact the current allocation. The current allocation is what it is, regardless of this study. Now, the outcome of this study --

CHAIR DENARO: Yes, yes. No. Yes, yes.

MR. AUGUSTINE: -- could then be used to say, well, okay, from these studies I propose that we reallocate or use this differently.

CHAIR DENARO: Right, right. So this is a change to what exists or a potential for change.

MR. AUGUSTINE: It's a potential.

CHAIR DENARO: Right.

MR. AUGUSTINE: The results could be used --

CHAIR DENARO: Yes.

MR. AUGUSTINE: -- by someone in the future to say, hey, from this study I propose we change the allocation.

CHAIR DENARO: Okay, okay. That was my question. Okay.

MR. FEHR: Yes, and you have to understand the context that may have caused this to arise at this particular time. At the beginning of the current administration, there was this push to find 500 MHZ of additional spectrum that could be used for broadband communication, and so everybody's been, you know, looking under the sofa cushions and --

CHAIR DENARO: Okay.

MR. FEHR: -- in the back seat of your car --

CHAIR DENARO: All right.

MR. FEHR: -- to find this loose spectrum that might be reallocated.

MR. AUGUSTINE: Yes. I mean this

is not isolated to DSRC.

MR. FEHR: Yes.

CHAIR DENARO: I agree on that. Yes.

MR. AUGUSTINE: Many different bands are going through the same exercise.

CHAIR DENARO: How wide is this band, the DSRC band?

MR. FEHR: Seventy-five MHZ.

CHAIR DENARO: Seventy-five?

MR. FEHR: Yes. And of that 75, we've identified seven 10-MHZ channels within it.

CHAIR DENARO: Oh, great.

DR. RAJKUMAR: Let me add to that. So my understanding of the context, Bob, is a smaller -- this is Raj. So I guess DSRC-3 stands for dedicated? They're allocated or supposed to be used for V2V. But V2V is not supplied out there, so, because of the popularity of wi-fi and so on, people are saying, hey, it is a band that's currently not being used real actively, so people are going to pounce

on it. If they pounce on it, DSRC is effectively done. So that's the big risk that we face.

CHAIR DENARO: Sure.

DR. RAJKUMAR: We're on the verge of massive deployment, and if somebody takes it away, somebody's pulling the rug out from under us.

CHAIR DENARO: I understand. Thank you, Raj.

MR. WEBB: George Webb. Just so the group knows, in Chicago a few weeks ago as part of a safety meeting, there was an off-meeting for a coalition. It's called 5.9 GHz DSRC Industry Coalition. A group of people got together and were having this discussion about what should industry representatives -- sort of where Raj is going, saying this thing is gathering momentum and so forth like that. So there's a lot of interest across a lot of different frameworks. So the people are meeting and talking to each other about what kind of support and what kind of message are we getting out to the various people, including

NTIA, so that is out there. They're just now getting starting and it is very loose and no formal thing that's --

CHAIR DENARO: Great. Okay.

MR. FEHR: Yes, and we all have to keep in mind that, as Raj mentioned, this potential use by U-NII devices is the 800-pound gorilla. It is a huge business opportunity, as I think a lot of you in the room understand, and there is going to be a significant question about which is the best use of this scarce resource. That's why I was kind of building on that particular point and coming up with ways of articulating the usefulness of this medium that we've been working with, and figuring out its proper role in this grand machine-to-machine scheme and whether or not that is more compelling.

MR. KISSINGER: Yes. It's Peter. I mean based on what Roger said, there's a science essentially to say if they were to open this up, that there are circumstances where essentially, you know, we would be --

MR. FEHR: Next slide, please, Stephen.

MR. KISSINGER: You know, we'd be out of business. So it's not a question of --

MR. FEHR: That's exactly what we're trying to come up with. We can't reject the notion out of hand, because, again, they have an extremely compelling reason for wanting to use the spectrum. There's a ton of money to be made deploying 802.11, particularly AC devices which need very wide swatches of spectrum, and it's, you know, billions and billions of dollars' worth of business out there, a potential that is -- you know, the opportunity costs of doing our thing.

So what we're trying to do to support and prepare ourselves for this analysis and study is figure out what it really means to share or coexist with this within this environment so that we could preserve this 5.9 GHz DSRC communication medium that so well serves our purposes and possibly, you know, allowing somebody else to operate.

So what does it mean to coexist? What are the important factors that go into deciding whether or not this other user would be completely benign or would be something that would just step all over us? So these are some of the factors on this last slide of my particular presentation that, again, we're going to offer up to the technical community here to make sure that, as we go into this analysis and test portion of the NTIA study, that we are properly steeled for, you know, doing this analysis and completely understand what it means to share and what it would mean if somebody isn't sharing nicely.

So the things that we've been able to articulate so far is that in our particular context, we have a very good understanding of which of those seven channels that we've defined are going to be used for what. We know that we'd like to dedicate one of this channels for this broadcast mode to support vehicle-to-vehicle and near infrastructure-to-vehicle communication to

enable these crash avoidance applications. We know some of the other allocations of the channels. Now, would this other medium respect that or would it put streaming video on our crash avoidance channel?

You know, as we talk about a packet-based medium sharing of communication medium, there's certain aspects to how you structure the rules of etiquette for that packet-based medium that assures that all potential users get their chance to use it. And these next bullets are some of the articulations of our understanding of that proper etiquette that needs to be in place so that our applications will work the way we understand them to, and if the other guys follow this same etiquette, it's possible that they could coexist with us. Things like respecting the guard interval between packets. We all -- all of our devices know what the interval between packets are going to be so that when the medium becomes available, the next guy has an equal opportunity to use the medium. If this other

medium should elbow in and respond faster to the end of a packet, they would effectively get in there ahead of us, and that would be something we would not like.

We also depend on all of our devices having equal access to this medium. That means not hogging it, using -- you know, small communication, allowing the other things around us to have their fair share at it. So we have specific limitations on packet sizes so that, again, all of the other guys around us have an equal opportunity to use the medium by not, you know, just taking up the whole capacity.

The limitations on packet transmission rates is another aspect of that so that, again, the other devices around us in our context, we need to know -- we need to make sure they all have equal opportunity to use it. If the other guy has some kind of a scheme where they just get the channel and just use it continuously, locking all of us out, that would be something that we would not like.

Limitations on data rate,

limitations on power-level transmissions might be other aspects of what we would need to determine for this proper coexistence. If their transmission levels were such a small amount and they were deep inside of buildings that never emanated outside of the walls of that building to where you would operate vehicles, then maybe. But we can't conceive of a way that you could actually keep that genie in a bottle. And so, you know, things like that are important.

And then, since this is a shared medium and our devices are out there listening to see whether the medium is available, there might be aspects to a modulation scheme that we can't hear. So wouldn't know that they're operating. That would be bad, because we would tend to operate on top of them, which would probably garble our communications and all that kind of stuff, and the net effect is that our stuff wouldn't work anymore.

So, again, we're trying to come up with some very clear articulations of what it

means to coexist so that we can come up with a proper analysis and design experiments to rigorously test whether these candidate alternatives could peacefully coexist with our use of it.

VICE-CHAIR KLEIN: This is Hans. Are there different -- there's an industry coalition coming into place backing DSRC. Presumably there's some industry coalitions backing the U-NII. How similar are these coalitions? Aren't there networking companies and hardware companies on both coalitions? Is there much overlap? Are they really that different?

MR. FEHR: We don't know. I guess, you know -- we don't know, and it's probably not proper for us really to know.

VICE-CHAIR KLEIN: Well, I figured the industry groups have figured themselves out pretty quickly.

MR. AUGUSTINE: This is John. I mean I think having NTIA be the facilitator of this discussion and hearing from all sides is

probably, I think, the appropriate way for there to be a fair assessment of what's possible and what's not possible. But I think Walt's gone through here and listed a lot of technical things that would impact the way we would perceive the vehicle safety message -- you know, V2I and V2V safety message being harmed. You know, I'd say you could do it in a technical manner that would render the V2V solution -- it would interfere with it to a point where our applications wouldn't work.

Now, there are other ways, if you go through all of these different technical approaches, to say if you did a certain packet size with a certain bit rate, a certain channel spacing, there probably are ways to coexist. And so I think the nice part about NTIA doing the study is they're trying to hear all these different viewpoints and come up with a report that's fair in addressing how we might utilize the spectrum more efficiently, and yet preserve what the allocation of the bandwidth was intended for, for safety and transportation

uses.

So I guess the long and short of it is this issue won't go away. All swaths of spectrum are going to be continually asked to say, is this the most efficient way you can operate? Can you change the way you do things? Can you add users? Is there a way to squeeze more efficiency out of this segment? So, I think this is very good. We probably need to have technical answers to all of this so we can say, if you meet these technical specifications, it does not harm our signal and we're happy to coexist. If you do it in another manner, it harms our application and it renders V2V useless so it won't work.

VICE-CHAIR KLEIN: And the interlocutor on the other side in that discussion, who is it?

MR. AUGUSTINE: Well, we've had a couple discussions with a couple companies and we're aware of it, but I -- there's probably more than we're aware of, so I don't know if it's --

VICE-CHAIR KLEIN: IEEE or something like that?

MR. AUGUSTINE: I think there were a couple specific companies.

MR. FEHR: It's more the industry themselves. You know, again, the U-NII device-making industry is huge and they tend to be big players in those spaces. They have the ability to stand on their own two feet.

DR. RAJKUMAR: This is Raj. Is there a formal mechanism by which the DOT can provide input to the NTIA process? Or it has to come from the user community?

MR. FEHR: No.

MR. AUGUSTINE: We have an avenue to provide comments directly to NTIA and they get to decide whether they incorporate our comments or reject them or, you know, have different viewpoints. But, yes, we do have a chance to provide our comments.

MR. FEHR: Yes, and all of the other government agencies that may or may not be affected have that same ability. There are

military radars, like I mentioned earlier, that are operating in this space, and they're going to be participating in that analysis and test, because they don't want their stuff adversely affected, either. And that satellite industry user -- you know, that uses that particular allocation for uplink purposes is going to be participating in it as well, because they don't want their stuff adversely affected, either.

DR. RAJKUMAR: If I might add, I can imagine ITS America, and as part of the conversation, playing a leading role and pushing the process to hopefully affect the decision positively.

MR. BELCHER: Well, given that members of our board are part of the problem and members of our board are part of the solution, I'll leave that to our discussion and not table it here.

DR. RAJKUMAR: Okay.

MR. McCORMICK: I did just receive a report from George Webb on the -- and I'm hoping everyone else got it as well, so --

MR. FEHR: There was a question right behind you there.

MR. LAMAGNA: Yes, Walt. Stan from Intel again. Scott -- I'm sorry -- John mentioned earlier MOUs that we've signed with other countries. Do we understand their position on DSRC, the spectrum, how they want to share it or not? Can you give us, as multinational corporation --

MR. FEHR: That's the next can of worms that's going to get opened here, is the international ramifications of this very same topic, and I don't know if you want to add to that.

MR. AUGUSTINE: Yes. I don't think we have -- we just were talking about it. We're not sure exactly, you know, how the study's going to go. But we have opposing views and there's people who want to allow users of the spectrum, and other people say, no, we actually have products here; we don't want to allow that. I think it's probably going to be similar in the international community. We don't have

real visibility right now into what those views are. As part of the standards sub-group, I may ask Steve Sill to speak to that point:

Have you had any specific with either the Asian or European partners on spectrum sharing? I don't recall that coming up in our international groups.

MR. FEHR: I don't remember it either.

MR. McCORMICK: The Japanese won't share the spectrum. The Koreans pretty much won't share the spectrum because it's allocated differently. The Europeans have the same, I'll call it, commercial pressures right now that we have.

MR. FEHR: Yes. We suspect that the same question is being asked all over.

MR. LAMAGNA: I'm sorry, Scott. So, just a clarification. You're saying neither Japan nor the Republic of Korea will share spectrum with anyone other than for this purpose?

MR. McCORMICK: Correct.

MR. LAMAGNA: They've got it dedicated to this purpose?

MR. McCORMICK: Correct. As a friend of mine in the Japanese ministry once told me, he said Japan is how Communism is done right. Don't record that.

(Laughter.)

MR. McCORMICK: They basically have a different mechanism for vetting it. They're very tied to the auto industry. In Korea it's different, because SK Telecom, although it only has 50 percent of the spectrum, it actually controls off of 98 percent of the spectrum and they do all of their telematics through vehicle replenishment at the gas stations, which SK Energy happens to also own. So it's a completely different -- you know, unless SK decided it wanted to do that, it would just be eating so much. So between those two regions, those are not at all problematic. The Europeans, however, are suffering, are already getting pressure right now.

CHAIR DENARO: So just a quick

comment. This is Bob. Which of our subcommittees -- this looks like a huge and important issue for us to weigh in on. Which of our subcommittees should be dealing with this? Is this technology?

MR. McCORMICK: Yes, I believe so.

CHAIR DENARO: Okay.

MR. McCORMICK: Do we have a policy subcommittee?

CHAIR DENARO: A what?

MR. McCORMICK: Policy subcommittee.

CHAIR DENARO: No.

DR. RAJKUMAR: This is Raj. Technology and policy, I think, too.

MR. McCORMICK: Yes.

CHAIR DENARO: Yes.

MR. McCORMICK: I think somehow it ought to -- I know Valerie's over here clearing it.

DR. RAJKUMAR: So we could expand the charter of that technology committee to include policy.

CHAIR DENARO: Okay.

VICE-CHAIR KLEIN: Policy may permeate a lot of these things.

CHAIR DENARO: Yes.

DR. ADAMS: It is overriding a lot.

MR. FEHR: Yes. With that, I'm going to yield the floor because I think it's -- the second hand just hit the top, and we are at the lunch break.

CHAIR DENARO: It's drive time. So, thank you all. That was a good review and, I think, gave us a good flavor. As I said earlier -- this is Bob speaking -- I'm really looking to the subcommittees to dive into these things. What we're doing as an entire committee is we're getting a good flavor, a layer deeper than we were in the past understanding some of the issues, and now I'm hoping that the subcommittees are going to take these issues and really work them.

Just -- by the way, there was a comment earlier, too, I want to clarify. The subcommittees will not do their own advice memo,

if you will. The purpose of the subcommittees is to bring issues, recommend to the overall committee, and then as an overall committee, we will decide which, all, part, whatever, recommendations we want to go forward with. So, just so everyone understands the process, because the only formal input we'll have will be from the committee as a whole.

All right. So we'll declare lunch starting. I think what JPO asked is that we have three people at a time. So the first three who want to raise their hands and only eat what's left when you get back.

(Laughter.)

CHAIR DENARO: So let's move through that officially. I think, again, I strongly recommend it, but, yes, go take a drive and -- thank you. And we reconvene at one o'clock.

(Whereupon, the foregoing matter went off the record at 11:31 a.m. and went back on the record at 1:01 p.m.)

SAFETY PILOT DEEP DIVE DISCUSSION

INTRODUCTION

CHAIR DENARO: Did everyone who wanted to get to go, I assume? Okay.

Okay. So this discussion this afternoon is -- we called it Safety Pilot Deep Dive Discussion. That's my fault for the title. And we have a couple of hours before our break, and then we have another hour-and-a-half after that. And this was our -- you know, that's one of the reasons we're here in Ann Arbor, was to get a real first-hand look not only at the drive, but be able to talk to some of the team here in Ann Arbor about the Safety Pilot. And again, this is our chance to ask all the questions that we have, make sure that we cover everything that we want to.

I want to really thank Dr. Sweatman and his team for taking the time out. You know, when you think about it, here we swoop in and we're not just the government, we're a government committee, and we're here to help. So, apologies for that. But, no, we're really

thrilled about it. The Safety Pilot is hugely important to this whole process and in this decision, as we know, and so I think getting a chance first-hand to learn about this is really good.

I know, Peter, you have to leave in a couple hours at the latest for your travel, so we appreciate you being here. Whenever you have to take off, that's fine, and thanks for being here.

So, Mike, are you going to lead us off? Okay. Why don't you introduce yourself, Mike?

MR. SCHAGRIN: Sure. Good afternoon, everybody. My name is Mike Schagrin. I'm with the ITS Joint Program Office, and so I'm going to kick things off with a Safety Pilot deep dive. I thought the title was fine.

Last time --

COURT REPORTER: Excuse me. Can you please step up to the mic? I'm sorry.

MR. SCHAGRIN: I'm going to button

my jacket, too. Make it really formal.

So, want me to start over? Mike Schagrin with the ITS Joint Program Office. So last time when we met in May, I had given a briefing overview of Safety Pilot in terms of the model deployment site, what we're trying to accomplish, the fact of these driver clinics to get responses from real drivers in terms of how the safety systems actually operated under kind of real-world conditions, even though they were on test tracks.

So this time we're not going to dwell so much on background, but talk about things that we actually have done. There was a lot of interest on the part of the committee -- at least the questions we received -- that showed interest on like real-world implementation issues and what we're experiencing, how do we know we're getting the data we need to support the 2013 and 2014 decisions, how does this relate to what could be happening moving forward in terms of nationwide deployment.

And so we set up an agenda with

several speakers, actually. I think we have a total of six. Anyway, we have UMTRI talking about the model deployment site in terms of the operational issues and what they've experienced so far with actually getting the Safety Pilot model deployment operational. We'll hear from NHTSA on the driver clinics and the kind of responses we got from the drivers who actually experienced the demos, much like you have today. We'll also hear from VOLPI in terms of the data collection, how the model deployment experiment was established in terms of why we have some parameters, why we felt that was adequate to get the data we needed, and we'll also hear about what we've done to fine tune things as a result of actually selecting Ann Arbor as the site for collecting that data and why we're confident we'll get the kind of data we need to support that decision next year. And then we'll also hear from -- actually, earlier we'll hear from Michigan DOT on how they plan on using the data that comes out of a Safety Pilot type of environment for public agency operations. So

that'll be very interesting as well. And then finally, we'll conclude with another presentation by NHTSA on the process of getting towards that decision point, what's being considered not only through Safety Pilot, but overall in terms of the framework, what's going into making that decision next year.

So that's our agenda for the next couple hours, and then, of course, you guys will have time to talk amongst yourselves about any other issues that come up that you have an interest in.

So there's also, I should point out, questions that were submitted in advance on -- by Bob, and so we did our best to try and answer those as well. And if there's any questions on those, the right people are here to respond to those questions.

CHAIR DENARO: Yes, we appreciate your effort on that. And then, just procedurally, Mike, we have, what, 3 1/2 hours scheduled for this. You know better than I do what presentations you have and everything else.

So if we need to move along or we're getting bogged down, let me know or speak up, and --

MR. SCHAGRIN: Sure.

CHAIR DENARO: So we make sure we get everything in.

MR. SCHAGRIN: I think they're all going to fall asleep.

CHAIR DENARO: Right.

MR. SCHAGRIN: Okay?

CHAIR DENARO: Yep.

MODEL DEPLOYMENT STATUS

MR. SCHAGRIN: So we're going to start things off with Jim Sayer from UMTRI, who will talk about the model deployment site and some of the operational issues that they have encountered.

MR. GLASSCOCK: Just so everybody understands -- there's not a hard copy of Jim's presentation or Mike Luck's presentation. So if you're looking for it, we'll get those copies to you and also be posting to the web.

DR. SAYER: So, good afternoon. I wanted, as Mike had pointed out, to tell you

a little bit of what we've experienced, some of the successes and some of, you know, the challenges that still remain. The good news is that the model deployment launched on schedule August 21st. We have a piece of equipment in the infrastructure that are working and collecting data. You'll see some of that data when my colleague from MDOT gets up, and he'll display some of that. And we've got 1,400 cars out there operating, broadcasting signals and/or listening, depending on the nature of the installation.

Next slide. So, just a quick reminder. Model deployment is a one-year deployment here in Ann Arbor, specifically northeast Ann Arbor, just a corner of the city. We launched on August the 21st. The Secretary of Transportation and a number of dignitaries were present for that launch.

The goal was to have just over 2,800 vehicles equipped with a variety of different types of wireless vehicle-to-vehicle and vehicle-to-infrastructure devices. This

includes passenger cars, commercial trucks, buses. Most of these vehicles are people's personal vehicles. The vast majority of them are personal vehicles. And we're -- eventually we'll have enough equipment in the infrastructure to cover 73 lane miles. Right now we currently have ten sites that are up and operational, kind of strategically located throughout the model deployment area.

So this is the model deployment area. I'll just point out where you are. I mean you literally are right in the heart of it. As you head out, you'll be driving past some of the installations and the infrastructure. You'll be driving past vehicles that belong to residents of Ann Arbor that are equipped and are operating. In fact, we walk out to the parking lot out here and I can point out three or four that just happen to be in the parking lot today, so --

CHAIR DENARO: What were the selection criteria for the citizen cars?

DR. SAYER: It depended on the

nature of the installation. So we have 64 integrated vehicles that were developed by manufacturers, so there were some very specific age and gender groups that we're trying to balance for.

When we get to some of the after-market safety devices, there's also some age and gender that we're trying to balance for, and when we get to the vehicle awareness devices, the simplest of the devices which just transmits, there really weren't criteria other than operate the model deployment area. You know, do you live here, do you work here, or ideally, both.

CHAIR DENARO: Do you also look at -- do you drive -- this is Bob speaking -- a certain number of miles per day or something like that? Was there any kind of consideration that way?

DR. SAYER: Well, one of the strategies we used was to go to the public schools, because people with kids are --

CHAIR DENARO: I see.

DR. SAYER: -- you know, do a lot of trips, the soccer game, the grocery store, you know, the gas station, drop the kids off to school. So we really targeted a good percentage of our population for the VADs to be folks in that kind of -- that age range like myself with young kids in the public school system. But we also had a much broader recruitment, and we recruited from the College of Engineering and from the University Hospital System. So we've got a good mix of people that both commute in and out, and people that live here and commute out, and people who live here and commute within the model deployment area.

CHAIR DENARO: Thank you.

DR. SAYER: So this table is just to quickly describe kind of the range of devices and the different modes of transportation. We also have two different levels of sophistication in terms of the detail of the data that's being collected. In the pale yellow you'll see integrated vehicles and retrofitted after-market safety devices. We have almost

200 of those vehicles that have very accurate, detailed data being collected using data acquisition systems either provided by UMTRI, or Virginia Tech in the instance of the integrated passenger cars. So in those, we'll be collecting video. We're getting information off of the CAN bus. We know -- if they're doing it, we know. So if they get a warning, we'll be able to look to see how they responded, what might have precipitated the warning, maybe -- you know, what the expression was on their face, were they surprised afterwards.

But the vast majority of the vehicles really we're just collecting the basic safety messages that are either simply transponded, sent out, or that are sent out and received. Sent out and received in the instance of the 200 or so retrofit or after-market safety device equipped vehicles. Those vehicles, those drivers are able to get warnings, but we're not collecting a real high level of detail on those vehicles.

So this is one of the successful RSE

installations. It is just on the corner up here before you get to US-23. This one of the ten that's up and running. Matt Smith will show you some data that's coming from maybe even this one. I don't know. He's got a number of clips. As you drive past the antenna, the orientation has changed. We've been adjusting antenna orientation, looking at a number of things.

The one thing that we found out, very interestingly, with this particular implementation is we're seeing vehicles a lot further than we anticipated seeing them, so we're getting a lot more data. We're seeing vehicles -- on this particular site we're seeing almost 1,500 meters, so -- assuming there isn't another vehicle blocking.

So, accomplishments thus far. So there was a lot of work that went into the device specification even, you know, leading up to the model deployment. But, you know, as these systems were starting to roll out, the manufacturers were starting to build the prototypes, there were -- you know, questions

started coming up, and we found that there were areas that needed some specificity, some clarification, and so we worked with the U.S. DOT and the device suppliers to try to get that additional specificity into the standards or the specifications, I should say.

We did a lot of work with suppliers. There was a lot of basically supplier development on the fly. These things were being tested on the bench, then tweaked, and then tested again and then tweaked, and we had power issues. We've just -- they had a whole host of issues that, thankfully, everybody kind of came together. And with their experience in working in the automotive industry and these types of systems, were able to share information and knowledge and get all the different devices operational.

VICE-CHAIR KLEIN: The picture that you showed a little while back, which is the roadside map -- a couple years ago, and it's still going on, there was a big push towards urban metropolitan wireless networks, including

Department of Transportation. And they were going to put wireless routers sort of like those in places sort of like those. They found it was too expensive and they couldn't really do it, so it wasn't a very successful infrastructure initiative.

Now, you guys are up in sort of the same places mounting devices that look kind of similar. Has anyone ever driven one past you and said, "Hey, maybe safety networks and urban wireless networks have some commonalities and we could combine networks into one network," stuff like that?

DR. SAYER: That may be the case. Unfortunately, I'm not the person to be able to address that.

VICE-CHAIR KLEIN: It hasn't come up yet, has it?

DR. SAYER: Yes. But the other thing, you know, we're seeing much further with this technology with the DSRC. We have much greater range than the typical wireless, if you're talking about wireless communications.

MR. SCHAGRIN: Yes, let me just add to that. Not so much the technology you're talking about with the wi-fi that we've talking about deploying in different cities, but one of the things that we need to be -- we are exploring is how can we leverage this capability that might be installed to support a safety environment, which is really our main mission, to support also mobility and environmental and other maybe private sector uses as well. So we are looking at the vehicle-to-infrastructure element and what we can do with that infrastructure to support those services as well. So it is being explored.

VICE-CHAIR KLEIN: Potential. You know, once you've got a wireless connection, a lot can be done.

MR. SCHAGRIN: Exactly, and that's one of the things that we really need to understand better, is what's the upside opportunity? Once you have enabling capability, you know, either in the vehicle or in the infrastructure, what can we do with that

to create a business model?

DR. SAYER: As I mentioned, most of the installations are in personal vehicles, so, you know, we can't drill holes, we can't use duct tape. The systems have to last for a year. We don't want to scratch paint. Things can't come off in a car wash. So we've had to figure out a lot of creative ways to address that. Specifically, GPS antenna placement was really the big challenge, and we tried really hard to keep the HEBS antenna internal in the vehicle, and we just couldn't do it, so --

Other accomplishments.

CHAIR DENARO: Excuse me. This is Bob. You couldn't do it because the performance wasn't --

DR. SAYER: The performance, yes. The antenna was not able to see the satellites. It didn't have the resolution that it needed to be able to then accurately re-broadcast the location of the vehicle. Yes, it had to be on the outside and, you know, most installations that are done by the manufacturer, you're up

on the roof or even on the deck towards the center, but often you're drilling a hole to get the power to that antenna, and we don't have that luxury. So, you know, we had to find creative ways to position the antenna so that it would get an appropriate signal.

MR. SCHAGRIN: Yes, so just to add to that one more time. With the integrated vehicles, with the vehicles that were supplied through the CAMP consortium, the vehicles you rode in today, those are different. Those are not personal vehicles. Those vehicles could, in fact, be installed -- those systems are installed in a very optimal way where you can drill holes and get the kind of optimal kind of placement you need to get the best data. What Jim is talking about are personal vehicles and, you know, once you do that -- I mean you can't destroy someone's vehicle.

So that's kind of one of those things that, moving forward, as you think about how to instrument the existing vehicle fleet, you know, there are issues associated with that,

that are different than something coming off of a retrofit or a production-based system, so these are just kind of real-world things for the experiment that we're dealing with right now which may or may not be reflective of what would actually happen in a national rollout late on.

DR. SAYER: Stage 1 interoperability testing was the first step, basically, to take some of the devices and make sure that they all communicated with one another. You know, were they talking the same language. Were they able to exchange messages. We did quite a bit of work to ensure that there was compatibility in the basic safety message. There was a lot of bench testing done. All the different suppliers and potential suppliers brought devices here for a series of bench tests, and then we installed those devices in vehicles and took them out on the road and actually examined their performance in vehicles in a dynamic situation.

There were a number of things we

encountered. Some of it had to do with, again, the specificity related to standards. There were also some power issues, just ways sometimes people interpreted the specifications, and so they weren't always broadcasting at the right frequency or -- well, the right frequency or the right rate. They were sometimes not right. And -- but all the issues were addressed and we were able to get all those devices up and running and out onto the road.

That was then followed by a second stage. In the second stage of interoperability, we were looking at some of the more -- I would say the more challenging attributes of this wireless communication, and that being security certificate generation. All of the devices had to have an individual security certificate, so we had -- several thousand certificates had to be generated and then are being loaded onto the individual devices. The roadside equipment had to actually start to record the messages from the vehicles as they drove past and then be able

to transmit that via the city's fiber optic network. We had to test the over-the-air security functionality that needs to be deployed.

And some of the other issues we encountered, they were a little more work. Certificate revocation list; the idea that if you had to revoke a certificate, a security certificate from the vehicle while it was out in the field, we had to be able to demonstrate that. That took a bit of work. And the other thing was some of the devices still, despite all the testing we did on the bench, the after-market safety devices, some of them weren't always performing exactly the way we would have anticipated. Sometimes they would warn when they were supposed to, and sometimes they didn't. So again, we worked really closely with those device suppliers to try to get those devices up to speed and operating properly.

Some of the remaining challenges. Internet Protocol version 6. The good news is we've actually been able to deploy it. Right

now we've deployed it in the city's system, so we're using their fiber optic. That's the good news. So as far as I know, this is the first deployment of IPv6 for transportation. The bad news is that not everybody; and the industry isn't necessarily ready for IPv6, and so in some of the more remote locations we're still trying to work with the device suppliers for the remote roadside equipment devices to get them up to speed so they can work with that protocol.

Development and implementation of security management. You know, we're still working on over-the-air security management. Security, obviously, is a very important issue and on the forefront of a lot of people's minds. So we continue to work in that area.

And then just the practicality of keeping the model deployment going. Knowing when, if you have 3,000 vehicles out there, if you don't hear from one, you know, when do you start to think that the device maybe isn't functioning properly? And then, you know, do you wait a week? Do you wait two weeks? People

go on vacation. Is it the holidays? So, just trying to figure out what's the right gain we need to set, how sensitive we need to be about how long we wait until we hear from vehicles.

VICE-CHAIR KLEIN: Hans. When you're doing this -- in the process of this and even prior to the big field test, in using the system in a field test have you had new ideas for new applications and new functions that, in driving around, the light bulb goes off, "We could do this, we could do that, the next step"? For instance, you might want to be able to ping a device to see if it's alive or not. I'm guessing you don't have that functionality. Otherwise, you could check it remotely.

DR. SAYER: Well, so the way we check it remotely, some of the devices that are hooked up to the vehicles that have the data acquisition systems, we can check remotely. The more basic installations that are more like what would ultimately be rolled out, no. But what we do is we listen for those vehicles operating in the model deployment area. If we

don't hear from those particular vehicles, then we suspect that either the vehicle is not being driven or the device isn't operating properly. So that's the strategy we would use with a majority of the vehicles.

VICE-CHAIR KLEIN: And any other applications? Any great -- new games you can play on the system?

DR. SAYER: There's lots of applications. I should be leaving a notebook next to my bed on the nightstand, --

VICE-CHAIR KLEIN: Right.

DR. SAYER: -- because that's usually when I wake up in the middle of the night, and I'm thinking, oh, you know -- Yes, lots, and we're --

VICE-CHAIR KLEIN: Maybe you can write it down and start a company next.

DR. SAYER: Well, yes. Well, I'd better finish this first. Otherwise, I think I'm going to be in trouble.

(Laughter.)

DR. SAYER: Yes, lots of ideas.

All kinds of -- you know, and the U.S. DOT team, Michigan DOT, University, folks as they get exposed to the data and, you know, a really good understanding of what is happening, they start to come up with lots of good ideas. I was just talking with the lead city transportation traffic engineer while folks were out driving around in the demos, and, you know, his eyes are lighting up when he starts to see data. He just can't -- he can't imagine all the things that he could possibly do with it.

VICE-CHAIR KLEIN: Do you collect that data? Those ideas, is there any place to collate people's --

DR. SAYER: Not a formal place, no.

VICE-CHAIR KLEIN: A blog or --

DR. SAYER: Yes. We probably should.

VICE-CHAIR KLEIN: Yes.

DR. SAYER: Yes. I mean some of the things that we think are fairly easy to implement and -- in terms of time and effort, we're trying to do. You know, we have other applications

that we will be demonstrating in the model deployment, things that are not the vehicle-to-vehicle crash warning, for example. So we're looking at a variety of things like warnings at railroad grades -- crossings, is one example. How to manage the data once you get all this data. It's one thing to collect it, but what do you do with it once you have it?

DR. ADAMS: Do you anticipate any problems with the instrumentation on the vehicles due to the winter weather, corrosion, chemicals --

DR. SAYER: No. Everything we're using really is auto hardened. You know, it's all good to like about minus 40 -- minus 30 "C" or minus 40 "C". Even the hard disks. A lot of this stuff is -- are components that are available to automotive manufacturers. Antennas are the same types of antennas --

DR. ADAMS: So you don't have anything, sensors or things that could get clogged or --

DR. SAYER: Well, we -- no. We have cameras that could get dirty --

DR. ADAMS: Yes.

DR. SAYER: -- that might need to be cleaned. We try to position them so that they're located where they won't get a lot of, let's say, like the backdraft and dirt get thrown up. We put as many inside the vehicle as we can.

DR. RAJKUMAR: Yes, yes.

MR. WEBB: Question. George Webb. The anonymity. Are you tracking and know what vehicle is going where, or is this like it's supposed to be in the system? You don't know, vehicle-to-vehicle, is this going down the street?

DR. SAYER: No. This is a research study and each of these individuals knows and has consented to allowing us to put a device that we'll know, if we want to -- if we had the time and the energy to dig into, --

MR. WEBB: Right.

DR. SAYER: -- what particular

vehicle that was. We had to do that because, otherwise, with a prototype system, if there was some kind of a failure --

MR. WEBB: Oh, I understand.

DR. SAYER: Okay.

MR. WEBB: The reason I asked the question was because when you gave the example of the traffic engineer's eyes lighting up with all this data, that's been a big issue about mobility. And with anonymity, you can't --

DR. SAYER: Yes.

MR. WEBB: -- do that. So I understand for this system it's out there and available and --

DR. SAYER: So the kind of information that a traffic engineer wants really is just to understand how long a vehicle is lagging at an intersection; how can I optimize the timing? They don't need to know what kind of vehicle it is, whose vehicle it is. And they aggregate all that information just basically by time of day. That's the kind of things that, from an operational standpoint, the city wants

people to utilize data for.

DR. RAJKUMAR: Jim, my understanding is that about a thousand vehicles out there already have these devices.

DR. SAYER: Yes. Fourteen hundred.

DR. RAJKUMAR: Are they already using certificates for encryption?

DR. SAYER: Yes.

DR. RAJKUMAR: They are?

DR. SAYER: Yes.

MR. ALBERT: This may be a mundane question for the group, but one of the greatest institutional barriers that I've ever run into is dealing with university procurement. How did you get around that to get all this stuff done? Or maybe you need a beer to really --

(Laughter.)

DR. SAYER: Ask me no questions; I'll tell you no lies.

(Laughter.)

MR. ALBERT: Fair enough. It'd be nice to know at some point.

DR. SAYER: Yes.

MR. ALBERT: It's a major challenge and you guys have done a great job.

DR. SAYER: It can be. Yes, it can be. Obviously, we greased the skids very early in this project and, honestly, we get a little bit of preferential attention only because, you know, we've demonstrated to them the importance of it. There's also some creativity.

MR. SCHAGRIN: Just a side note on this, not for anybody in this group, but one of the things we looked at when we were looking at the current process, was that was exactly one of our issues, was how long it takes for subcontracting activities. Sometimes it can take a very, very long time. In Michigan, UMTRI management figured how to, as Jim said, grease the skids in order to do things very expeditiously.

MR. ALBERT: So being able to buy equipment and having to write a performance specification and not manage specific vendors is a huge challenge.

DR. SAYER: We've had a lot of latitude with sole source justification.

DR. SWEATMAN: So, Bob, can I comment on that?

CHAIR DENARO: Yes.

DR. SWEATMAN: So, Steve, in this room yesterday there was an interesting meeting between the newly configured university contracting group and one of the major automakers to look at problem solving; the kind of methods the automakers use to solve problems in contractual strings and so on. And so they're the kind of links we're going to. So, in answer to your question, don't assume we have solved the problem, but we've had to go a long way and that's having quite an impact on the whole university. So we're getting some help from the auto industry.

DR. SAYER: Anything else?

(No response.)

DR. SAYER: All right. I think Matt's up next.

MR. MADDOX: Jim, can you go back

to the table with the vehicles real quick?

DR. SAYER: Yes. I can't, but he can.

MR. MADDOX: All right. So one comment I wanted to make is we have the trucks out back, and so we've arranged for tomorrow at noon, anybody who wants to see the trucks -- I don't think we're going to drive it, but if you want to go and see the equipment in there -- and I don't know. Is it the retrofit or the integrated?

DR. SAYER: Most of them are integrated. I think there's also a retrofit there.

MR. MADDOX: Okay.

DR. SAYER: I'm not certain on that, though.

MR. McCORMICK: What kind are they? Are they tractor-trailers? Are they --

DR. SAYER: Yes, Class "A".

MR. McCORMICK: Class "A"? Okay. Cool.

MR. MADDOX: And then I don't think,

but if there's strong demand, we can look into it. I don't think we can get the bus over here, but it's very similar to the --

(Laughter.)

DR. ADAMS: Strong demand?

MR. MADDOX: I asked and, you know, the bus is in service, so -- but we can make some calls, but I think right now the buses that are in service only have the awareness devices on them. Is that --

DR. SAYER: Correct. Well, there's some early deployment of what will be integrated or retrofitted systems, but they're not operating. There's some equipment installed, though.

MR. MADDOX: I think the last time we talked about the different applications of these different -- what all the different people have, predominantly they're the same as the late vehicle ones, but transit and truck have some different things. So we can go at noon tomorrow and see the trucks. So I just wanted to point that out.

CHAIR DENARO: We'll give Joe a box lunch and buy him a bus ticket.

(Laughter.)

MR. CALABRESE: I've got my buss pass.

MR. GLASSCOCK: While we're doing that, we're doing a little switch-out for video capabilities on the other computer.

MR. SMITH: Anyway, I'm Matt Smith with the Michigan Department of Transportation, ITS Program Manager. Great questions. It was a fantastic segue for what I want to spend a little bit of time about, which is using some of the data generated by connected vehicles from a DOT operational standpoint.

Over the past couple years we partnered up with the U.S. DOT, auto manufacturers, and a lot of different connected vehicle initiatives. One of the big things we've always set our goals on, set our sights on is the fact that there is expected to be a wealth of information that comes out of connected vehicle systems, and this

information, this data we see as obviously potentially having huge impacts on how we do business as an organization.

Going back to 2005 with the 2005-2006 time frame with the U.S. DOT proof of concept testing in Novi, Michigan not too far from here, we undertook an initiative to say, okay, let's take all the data being generated from this proof of concept and see what it can do, see what data is there that can be used. Well, actually what we found is that there is so much data, we could do just about anything we -- oh, excuse me.

(Pause.)

``What we found is that there is data for just about anything you could possibly imagine from a vehicle, from onboard vehicle systems, from what's being generated by the roadside equipment, to what's being generated by equipment installed on the vehicles. There's tons of information out there, almost to the point where, if you really look at it, you're overwhelmed.

So we started parsing through some of that data, and then from there we went a little bit further, saying, okay, obviously with the connected vehicle initiative, safety is hands down, everyone agrees, is the primary reason for deploying this. But let's take some benefits forward, some other benefits we can get from such technology.

So we implemented on a second phase of what we affectionately call our data use analysis processing program, which is basically taking all the data, seeing what kind of applications we can use, and this time around, instead of just taking the data and saying, what can we do with it?, we're taking a different approach. We're saying, okay, as an organization, as a state organization at DOT, what are our different business processes we have? What applications in a perfect world, assuming you have data available in a perfect world, what would these different business units, business processes want? And then, you know what? Chances are we could probably

develop applications to support it through data generated by connected vehicles.

That's the process we're going through right now. Kind of not totally by coincidence, we planned out that it could kind of coincide with the Safety Pilot, because we know there's a lot of data that's going to be generated from, obviously, the Safety Pilot. We want to support NHTSA's decision, but we want to see -- take that data and work it into our state program and see what we can do with it.

What we found through this process so far, looking at our business processes, are the four main areas where we've already identified where we can see a big impact with the data generated from an operations and mobility standpoint. Jim mentioned it, and I'm going to have some visualization of some of that information that Jim mentioned. From a winter maintenance operations standpoint, from our winter maintenance operations, snowplow driving, keep the snow plowing, keeping the roads clear, we see a huge potential benefit

from the technologies that are with the connected vehicle system.

From an asset management, pavement asset management system, pavement asset management area is where we've already actually developed an application using connected vehicle technologies to potentially take millions of dollars off of some of our processes.

And then our, obviously, data where we can look at from a traffic analysis, transportation planning standpoint, any data we generate they can use, and those groups are certainly salivating over some of this data and applications we can provide.

So one of the things we're doing, too, from a DOT perspective is we're actually independent of the safety pilot. We're going through the process of instrumenting some of own fleet vehicles so we can -- you know, fleet vehicles are our state DOT vehicles. They can be -- travel thousands of miles a month in all different areas. So we feel we can have a lot of great coverage with some of this technology.

To help generate data and, in addition, taking the data from the Safety Pilot, we take the data from these fleet vehicles, work in partnerships with some of the OEMs to see if we can get some data from their vehicles. Put them all together, take all this data, put it all together, and do -- and start developing these applications.

So one of the successful applications we have, what I mentioned is from the asset management standpoint, because we're able to -- for those that don't necessarily know state -- or how a lot of times pavements are rated or pavement conditions are rated, a lot of times they're rated subjectively. You go, you take a highly trained expert that knows exactly what he or she is doing, drive along our freeways or shoulders or roadways, and they can qualitatively take an analysis of what condition is your pavement in. And that's what we do. It's what a lot of state DOTs do. It's what we're required to do, and that's -- we start putting that into the hopper of, okay, how can

we best use our money for improving pavements.

But what we did is we developed an application through that first phase -- through the data we were generating from that proof of concept testing. We were able to develop an application that we tested further that actually uses a combination of cellular phone use with the onboard data, the CAN bus data from the vehicles, and we're able to replicate pretty accurately what these trained observers were doing. So, basically what we can do is we can take this equipment, install it on vehicles, on a daily course of business, and have these vehicles drive around the state roadways doing the same thing that some of our trained observers could do, and potentially that could save about two to three million dollars a year of staff time of having to specifically go around driving these roads to do this qualitative analysis. This is just one example we saw that is definitely one of those little hanging fruits we want to grab and go further.

What I'm going to show you now --

yes.

VICE-CHAIR KLEIN: Hans here. Has it ever occurred to you that this could become a profit center for the DOT; that actually there's so much value here, instead of being a cost, it's a benefit?

MR. SMITH: Yes. Yes, sir. There are examples of -- and UMTRI actually happened to be teamed up with MDOT to develop this application. It's not unprecedented. Field managers are a one that comes to mind where it's not unprecedented where MDOT or a state organization has developed a program and turned a profit center. So there's always that potential that's there, certainly.

So what we wanted to do now is -- that's generally what we're looking at from a DOT perspective, from a state DOT perspective. We're still early in that data use processing. We're putting together all the white papers for the different areas to detail out the applications. We're going to tailor the applications to the data that's being generated

by Safety Pilot and the rest of our programs.

But in the meantime, we want to show you examples of some visualizations of what some of this data does. You know, you hear everyone say, hey, we're generating this data that shows what the vehicle's doing. We want to be able to visualize some of that information, and so a picture's worth a thousand words. So that's what we'll do here for the next -- I've got four really short video clips I want to show you guys.

Would you mind -- oh, no. Going back to the other one and using --

This one, like Jim had -- Jim had mentioned that we were able to go ahead and see visually --

Just hit "okay" with that. There you go.

We're able to visually see where our roadside equipments go. All these big circles across this study area map actually represent where we have one of our pieces of roadside -- one of our roadside equipment installations. And what we're seeing through here -- this is

not live. This is a video capture of an application. But what we're showing there is remotely from a computer you can access the whole RSE network. You can monitor the whole RSE network, see how it's working. You can start seeing things out of the security system. You can start seeing if there's security certificate exchanges, so there might be some potential for helping with the security certificate management through there. But you can monitor the health of your whole roadside safety equipment just from your computer screen, and that was an early application, too, that we had folks developing to support this.

Go to the next one. The next video clip we're going to show is basically -- it's demonstrating two things. One thing, the item that Jim Sayer mentioned, saying, hey, you know, everyone always assumed that the DSRC applications have a good range of about 300 meters, detecting up to about thirteen or fourteen hundred meters. I mean you've got a visualization of how that plays out.

And we also want to show through this another potential application that we have with -- we have that's showing you how vehicles interact with each other. Those two blue blips right there are actually vehicles that are equipped. They're part of Safety Pilot. They're equipped. If you saw them real quick --

Would you mind replaying that real quick?

If you saw them real quick, as they come to the intersection and they start approaching each other, inside the vehicles obviously all the warnings you saw are going to be going on. But the information that we have from an engineering standpoint goes back to what Jim was saying. From a traffic engineer's standpoint, there's a lot of good information that could come out of here. There could be some alerts and other messages that come out from vehicles crashing or near misses that in an engineering world, traffic engineering world, we might have to wait one,

two, three years to get better information back in order to accurately do that analysis. If we can start getting real-time alerts of where we're seeing clusters of crashes or near misses, we can be much more proactive as a state organization for addressing those issues. So that's one of those other low-hanging applications that we think we can jump on and save a lot of time and effort.

This next slide -- just go ahead and arrow down to the next one. There you go. Yep. This next slide shows the range where we start picking up the vehicles here. Now, these -- the vehicles are taking data samples once every ten seconds, but we're aggregating all these demonstrations or aggregating them over one second apiece. What you see in this application is we start detecting the vehicles out to about thirteen or fourteen hundred meters, but you also notice there's some gaps, especially as they're closer within that thousand-foot range, 300-meter range. So one of the applications that we can already use the data generates are

how are our DSRC, how are our roadside equipment units operating, is there gaps in coverage that we need to fill in. Now, that's pretty -- if you noticed, that was pretty detailed information, too, on the vehicles. This kind of shows the accuracy of -- and another way of just visualizing and showing people, hey, this is how accurate the data that's being used to generate all the in-vehicle warnings. When it zooms up, you can see that the accuracy is obviously to the lane. And like you were saying, George, one of the key components here that we've got to worry about, too, is obviously this is for test purposes. We're tracking individual vehicles. This certainly wouldn't be an application that's generally used without some kind of opt-in of feature to it.

MR. STEUDLE: And it would be important to note that that's a parking lot with lots of people going into it. They weren't just kind of driving around in circles in the parking lot, that they were wandering their way around to find a spot.

MR. SMITH: Looking for a spot.

MR. WEBB: You've got the two circles.

MR. SMITH: Yes.

MR. WEBB: You divide them? They're not in the actual broadcast range?

MR. SMITH: They were the expected -- they're 300 meter and a 1,500 meter range.

MR. WEBB: Right. Okay.

MR. SMITH: They were just plopped on there. Feasibly you could, if you knew what the ranges are, feasibly you could put the application on. But they're just the 300 and 1,500-foot radius to show where we can get it.

Now, as a traffic guy, this is probably the one I'm most interested in, and this goes directly back to what Jim was saying about how the city folks, traffic engineer folks, are looking at this information. What this animation shows is tracking a vehicle going along Plymouth Avenue, and then you see it slow down and queue there. That's probably, you know, at least a thousand, 1,500 feet back from

the intersection before proceeding again. Now, again, this is just one vehicle. But if you think of a much more denser application of vehicles and the technology on vehicles, you start aggregating that data, you really have a real-time use of what traffic flows are doing. Feasibly you could use that to real-time adjust traffic signals, so you could have adaptive traffic signals systems that don't necessarily rely on in-pavement detectors or roadside detectors. You can mainly be relying on vehicles and actual traffic flows.

So these are a couple of the real quick examples that we have. It's very early, obviously, in the program. As the program goes on and we continue generating more and more data, we're going to have better applications and actually a lot more to show you than just one vehicle traveling around, driving around the --

VICE-CHAIR KLEIN: To get this system running, all vehicles essentially have to cross -- in an ideal world, everyone

simultaneously gets the technology installed on their car and it works. That's for the vehicles. Let's say once we're at that stage, the vehicles have been equipped. The public sector roadside infrastructure doesn't face that threshold, does it? So let's say the City of Ann Arbor decides -- all the vehicles are equipped. At this point the City of Ann Arbor says, hey, this is a pretty attractive deal. We're going to install it just in our locality. That would still -- that's okay. You don't have to have perfect coverage on the roadside once you do have perfect coverage on the vehicle.

MR. SMITH: It really depends on the applications you're looking for.

VICE-CHAIR KLEIN: Depends on the application.

MR. SMITH: Yes. There's still a lot of unknowns out there about what's going to happen with the deployment, you know, from a security management standpoint where we're talking roadside equipment.

VICE-CHAIR KLEIN: Right.

MR. SMITH: But if you're talking specific applications, that is one of the questions: What comes first, the car -- you know, what comes first, the chicken or the egg?

VICE-CHAIR KLEIN: Well, sort of assuming the car.

MR. SMITH: Yes. Do you have the cars first and then do you build the infrastructure around that, or do you need infrastructure to support the cars and to support what's being built on the cars? Obviously, that's one of the big questions, but --

VICE-CHAIR KLEIN: I wonder, if it was possible for localities to make an autonomous decision, could they then sell the franchise and have a private -- maybe a private company would find this so beneficial that they would pay Ann Arbor to be able to install the roadside infrastructure. You guys get the free roadside infrastructure, and they get a certain amount of rights to the data, and it looks like a cable TV franchise.

MR. SMITH: I would imagine it's all feasible. I would imagine. I'm not aware. Certainly from a state DOT perspective, I could say we really haven't had those discussions. I can't speak from the U.S. DOT's standpoint, but I would imagine anything's possible, so --

MR. ALBERT: This is a question for yourself --

MR. SMITH: Sure.

MR. ALBERT: -- and maybe JPO, and even Kirk. Most of what I've seen, both the Advisory Board and even presentations like yourself at NRITS, or National Rural ITS conference, have predominantly been on reducing congestion on the supply side with very little focus on the demand side, TDM strategies like peak spreading or load shift or things of that nature. Have those types of applications that might help in telling the motorist when is really the best time for you to leave, because now the peak has been spread, or arrival times, things of TDM strategies rather than TSM strategies?

MR. SMITH: Theoretically, I think

it might be possible, you know. When you have --

MR. ALBERT: Is it in your thought process of looking at demand management strategies?

MR. SMITH: It can be. It can be. I have not seen that from our planning folks and analysis folks. That might be one of the options they've come up with. I'm actually going to be talking with them next week to see how they're working through our data use process. If not, I will certainly bring that up, because I mean that is a valid point.

MR. ALBERT: And I don't -- I mean, Kirk, maybe this is for you or John, but I don't even see the board talking about more TDM side of things. It's more on the how do you manage an incident, how do you -- dah-dah-dah.

MR. SMITH: If there's a way to display the information that helps the travelers make better decisions, I think that's probably very feasible. You know, much more -- a much richer database to display information. That's

certainly a possibility.

MR. McCORMICK: Actually, most of the work that's been done on that has been on the commercial side. To your point, the corporation availability really isn't -- is more of a business entity. There's only one highway that takes the tourist from the Denver area out into the ski area, and they were trying to get people to come at different times when there was less load on the lifts, you know, when there was less optimal weather.

And so they -- what they did was they went to a process of saying, well, why don't we broadcast what the traffic conditions are and then give them, sort of like a loyalty program, a couponing thing that says, And if you come now between four and six, you know, we'll give you credit for your lift on -- you know, and it wasn't anything that -- it just had to do with when you showed up. But essentially they were doing that. They were trying to manage their demand by -- and it was, again, for very commercial reasons, because they

realized that that allows them to move those things. So there is some reference models out there. But again, it really has to be largely around event activities, like games or concerts or things like that where you have a motivation for people to actually adhere to that change in schedule.

MR. STEUDLE: I do think there is an opportunity when that information is readily available and pretty reliable that you could see some shift happening. So if people knew, if they checked their computer and said, all right, if I leave now, and now they have the predictive tool that says, all right, your normal route is this, so it's going to take you this long, and if it had the ability to say if you wait 20 minutes, historical data will say that you'll reduce this. I think they can get there. I don't know that anybody has that developed yet.

MR. ALBERT: But if you're looking --

MR. STEUDLE: I mean the data would

certainly be there, and I think that was something people would grab onto --

MR. ALBERT: Well, I think of all these connected vehicles who are probes out there collecting that data, and that data then can be collected and transmitted back to the users, we have an opportunity for peak spreading, which is a much cheaper solution than some other things.

MR. SCHROMSKY: Well, on the same point, one of the questions I have on your study is obviously we're looking at the connected vehicle; right? And then once you develop that and get the device and everything else, then from that point on you'll start building them after market. But I've got that today. (Holding up cell phone)

So are you developing an app that you would get volunteers that actually do this? So if we bring the bus, if I'm a commuter on the bus, I could see based off my app, because I have GPS information with the same cellular infrastructure you're using, I could -- Google

does that today -- actually track my plot and tell me -- I don't have to drill holes or anything else. So, you know, between the two, you just want access to the data; right?

So, is it easier to get this (holding up cell phone), you know, taking -- Because I look at your paving. We were talking on the side. You know, it's almost like a 3-1-1; right? So your inspector didn't come until four weeks, but then the citizen walked, took a picture from his smart phone from their app, uploaded, and you're just -- you just want the data; right? So how do you aggregate it? I'm just curious if you're looking not just the vehicle, but developing an app that I would put in my car or take a bus or take a train.

MR. McCORMICK: Well, that's what happened in Boston. Boston had all of this data on where their buses were. Okay. And they didn't have any funding to somehow deliver that to their customers. Well, somebody had the brilliant idea. He said, well, let's just put the data out online. We'll just stream it out

online. Within two weeks there was an Android app that allowed people to, on their phone, get it. Went out and harvested that data of it, and it would tell them how far away their bus was, and within three weeks there was an iPhone app for it. And it was one of those things that, you know, independently neither this business that was crafting this or the public entity had the funds or the wherewithal to do it, and they weren't even aware of each other until it became -- you know, they were actually surprised when the Bostonian entity found out that the data was being harvested and used that way, because that was really what they wanted to do, was provide better service for their customer base.

MR. CALABRESE: And back to your point. When people know the real-time information on the bus or the train, even though it might not be any more on time than it was two weeks ago, they're more likely to use it.

MR. SCHROMSKY: Right.

MR. SMITH: And to answer your question, too, I guess for a lot of the

applications we've been -- or in a perfect world, we'd like to see -- I guess there -- it's kind of communication technology agnostic. That's kind of the terminology I've been throwing around. It really doesn't matter, because other than a safety aspect, most of the stuff we're talking about doesn't have to be right then, right there. I mean obviously for the safety it has to be. One of the benefits, hey, if this infrastructure is going to be put out there for safety purposes, well, then how can we benefit it. But that's not by any stretch of imagination to discard other communications methodologies or communications means, because I think there is value in where we're looking at our applications. It's how it's communicating back and forth is actually one of the -- I think the last steps we're going to take. We want to see what we can do. And you're right. In some instances, especially non-DOT specific business processes, I'd be willing to bet that there are other sectors than state DOT that could develop them quicker and

cheaper and get it out the market faster than we ever could, so good point.

MR. WEBB: George Webb. Just a real quick one. How difficult is it to develop the software to start harvesting the data?

MR. SMITH: For -- well, what you saw right now was sort of difficult, but if you noticed, it's very simple information. Where the challenge is going to be -- right now it's just -- it's taking the information and tracking it. I think of it almost as a glorified AVL system with data coming back that we can visualize. The challenge is going to be, and what we're going through right now, is processing that data and doing applications processes to give us more useable information than just, hey, here's where the vehicle is, this is where it's been, that's what it's doing. That's really -- I should say, but that's where the brunt of the work is in.

MR. WEBB: And what I want my fellow committee members to think about is the federal government stepped in when they were putting

a lot of traffic management centers around, and they developed uniform software that you could take and put into your computer system so you didn't have to, you know, it came with the hardware type stuff. So, as this thing is starting to be developed and so forth, I would think and hope, rather than each government entity trying to re-develop the wheel or whatever to try and pull this information out, that we think about pulling something together to have initiatives to have something that we could then distribute to allow governments to do that.

CHAIR DENARO: Peter.

DR. SWEATMAN: Just going back to Steve's question, he started, I think, an interesting conversation and generates a lot of excitement. So here at the university, this project is having a galvanizing effect right across the university in industry transportation research and deployment. And so we have folks from engineering, obviously, who are interested in energy. We have folks

from urban planning who are interested in urban form and how it affects transportation decisions and all that kind of thing. We have folks like Sue Zielinski with the SMART program who are interested in multi-modal use in large cities and how that all works together, that connectivity.

So all of that, this project and this data and this capability is having a tremendous galvanizing effect on something that's dear to your heart, and that's transportation research. In the past, transportation research has been mainly about trying to list some problems, and now we see a glimpse of the future. We can actually create the future with this kind of program. So the excitement you're hearing here today I hear everywhere when we go and talk about it, and I'm very excited with what's happening around the university, that there's so many faculty who want to get involved in this and so many students who want to get involved in the developing applications. So this is a tremendous platform from that point of view.

MR. SCHAGRIN: Bob, I'd like to suggest we try to move on, because we have three more speakers.

CHAIR DENARO: Yes.

MR. SCHAGRIN: And this is actually going to be covered in more detail tomorrow on the agenda. So, I'm not trying to cut it off or anything.

CHAIR DENARO: No. Thanks, yes.

MR. SCHAGRIN: There is time to have this discussion tomorrow.

CHAIR DENARO: Adds a very interesting dimension to this. Kirk?

MR. STEUDLE: Bob, just as Matt's stepping off equipment, it's important to note what he said in the beginning. We started this data use process five, six years ago before the rest of this stuff was developed. We said, well, what could we do with this? So that's the premise, you know, and the charge of that committee was, well, if you had this data, how would you operate differently? And, you know, Matt said we're agnostic about where the data

comes from, and that we really didn't -- we weren't looking at this is an application for the Safety Pilot. We're saying, if this information's coming, how do we make different decisions, and that's really what you were seeing, a different decision, and now there's other devices that are sending information differently. Different work.

DRIVER CLINIC RESULTS

MR. LUKUC: I'll try to figure out how to do this without blocking everybody -- Yes. Good idea. That's a little more awkward, but, okay. So my name's Mike Lukuc. I'm with NHTSA, and I'm going to talk to you about the light vehicle driver acceptance clinics.

This is a slide we had in for Chicago, and it just shows you where the driver clinics fit into our safety research framework. I won't go through all these, but they're there for you guys to look at at a later time.

Next slide. So in the light vehicle driver clinic project, we had three objectives, and the primary one that I'll talk to you about

is the top one, which was to obtain feedback on the connected vehicle technology and the safety applications from a representative sample of drivers across the U.S.

The second one is the one I touched on earlier when we had the question about the positioning, and it was to assess the performance and reliability of the 5.9 GHz DSRC communications technology and the GPS in diverse geographic and environmental conditions. So at each of the clinic locations, we did eight hours of driving, or had professional drivers do eight hours of driving off property on real roads and different conditions and gathered data, and I touched on that earlier. We do have a report coming out that I'll point out later on in the slide deck.

And then the third was to promote the technology to the industry and the general public, and we did that through the demos.

Next slide. So this shows you the project team, the Crash Avoidance Metrics Partnership, Vehicle Safety Consortium III.

So it's eight OEMs. I'm not sure if you guys are aware of them. So it's GM and Ford, Mercedes-Benz, Toyota, Honda, Nissan, BW-Audi, and Hyundai-Kia, and then with their subcontractors, DENSO -- Roger, I'll give you a plug -- Virginia Tech and Automotive Events. We couldn't live without Automotive Events. They really did the bulk of the work on all the logistics. And then the U.S. DOT agencies.

So, the next slide. This shows the six locations. We did one clinic a month for six months, which was pretty aggressive, and we started out in Brooklyn, Michigan, and then we went down. So we went from -- sorry. Let me get this right. We went from Brooklyn to Brainerd, then down to Orlando for the ITS World Congress, and then up to the Virginia Tech, where we did it at the Smart Road, to Texas, and then over to Alameda, California. So we started out in August of 2011 and ended -- and finished in January of 2012.

This shows you the vehicles we built for the project. So for this particular

project, there were 16 vehicles built to use in the clinics, and then eight additional vehicles, which we call template vehicles, which were used for the performance testing. There are also spares, and they'll be used for further research and to diagnose any problems with model deployment. And so you'll see in the last bullet these are -- the vehicles are 16 of the 64 vehicles that we have and have deployed in model deployment. This is an old slide. Says "will be deployed," but -- so these -- the clinic vehicles were refreshed and then put into the model deployment environment.

This goes through the safety applications, and I hope that all of you have been exposed to the demos in one location or another at this point. We do have some DVDs that we can provide to go through these in detail. The important thing is to look at the acronyms.

So, EEBL is Electronic Emergency Brake Light, which is a forward-looking application. If somebody does a panic brake,

it warns the cars behind. It sends a warning, it puts an identifier up or a flag up that warns the cars behind.

Forward Collision Warning and Blind Spot Warning are fairly common production applications today with other sensors.

Then we have the Left Turn Assist, which is really a vehicle turning warning. If your vehicle's turning left across the path of another vehicle which you can't see, it would warn you.

Intersection Movement Assist which is the cross-path application.

And the Do Not Pass Warning, which is a head-on type of scenario on a two-lane highway, for instance.

So with those same acronyms, you can see in the far left column, this breaks it down by OEM what the vehicles contain. So you'll see that on OEM's vehicle, none of the eight, had all six applications, but we had three with five, a couple with four, and primarily five, four and three applications each. We had a few

with two applications.

The bullet at the top, you can see in the bottom line this shows you the number of scenarios we ran in the clinic. So there was one EEBL scenario. Four Forward Collision Warning, which includes an out-of-path rejection, so it was a false positive test. The Blind Spot and Lane Change had two, and Do Not Pass Warning and IMA had two. Left Turn Assist, one.

So, that next slide. This shows you a sample of eight of the vehicles, one for each OEM, what the visual driver vehicle interfaces look like. So every OEM had visual and audible. There were a few applications that only had visual warnings, or one in particular. Some of the OEMs implemented the blind spot warning and lane change warning without an audible tone; visual only. But for the most part, they all had audible and visual. And then a few OEMs chose to include haptic, which is a vibrating seat and in this case could be a vibrating steering wheel and implementation, production

implementation.

The next slide. This gives you an idea of what the participants went through. So, the important thing, we've had a lot of questions on recruitment. We went -- used a professional marketing research firm to recruit the participants, and they used regional databases for people who've signed up for various types of research experiments. Then so we narrowed down or came up with a pool of people using the databases, and then there was a professional phone screening process to get to the final selection.

The onsite experience, important things to note. We had a pre-drive questionnaire. We had a briefing, which was an educational briefing for the technology. There was orientation at each station for each application exposure during the clinic. And then after the participants experienced each application, they were given an in-vehicle questionnaire, and then there was a post-drive questionnaire which encompassed the whole

experience. And a few -- some of the -- a small subset of the participants went through a focus group.

Then the next slide. This just kind of gives you a breakdown of the safety application exposure. We shot for 112 participants per clinic, and I'll show you how many we actually ended up within a minute. Four sessions per day. Important thing is we split the participants equally by gender and equally into three age categories, so you'll see we have 20 to 30, 40 to 50, and 60 to 70-year-old age categories. So they're separated by a ten-year band. And so the demographic, the split was really directed by the independent evaluator. And then I think I've covered the rest of those bullets already.

This shows you what we ended up with. So the upper left, that shows you for each age bracket on the rows, and the genders in the column, how much we ended up with. We had 688 participants total. The next one at the bottom, it shows you how it broke down by application.

The important thing to note is four of the applications in the bottom row, we had a hundred percent of the participants in. Two of them, we only -- we got 37 percent and 25 percent. So those were -- you know, if you go back and look back to the original chart that showed the applications by OEM, you'll see there were a few applications that were only offered by a few of the OEMs.

So I'm going to show you now an example of kind of the big picture, how the drivers tend to desire the V2V technology. And so the important thing to note, all the questionnaires were on a seven-point scale. It's a Likert scale. Very common for subjective experiments. We lumped 1 to 2 -- the responses of 1 to 2 in this instance would be "disagree"; 6 to 7 would be "agree"; and then 3, 4 and 5 would be "neutral."

So the question here is, "I would like to have this V2V safety communications feature on my personal vehicle." And you'll see that overwhelmingly people agree with this.

Very few disagree.

Okay. So this is the exact same question, but it breaks it down by age group just to show you that there's really no difference across the age categories, with 90 percent agreeing. Okay. So --

DR. RAJKUMAR: Mike, do people -- some people just simply regard the technology foreign?

MR. LUKUC: I could draw a few conclusions in the report that show -- I think the important thing to note is, you know, it's like -- go back. We're talking three or five people. That's really almost in the noise. You know, some of the people in some of the locations thought that this would be a great feature for other people to have, "but I don't really need this in my personal vehicle because -- you know, because I -- you know, I'm a good driver."

Okay. So, go back one. So now we'll show you driver acceptance as a function of the safety feature, so this is just a few

examples. So you'll notice the rows break it down by safety application. Right. The question is how useful. So this is usefulness. "How useful do you think the safety feature that alerted you to the presence of a specific threat ...," so whatever the threat was, depending on the safety application, "... would be in improving driving safety in the real world?" So you'll see that for the most part, we're right around 90 percent. There are a few, like Left Turn Assist and even the second one, the Do Not Pass warning, where people have a little harder time relating to that because they don't really experience those scenarios on a day-to-day basis. And the, you know, the other, like the Intersection Movement Assist, is really the most compelling of the scenarios, and a lot of people know people that have been in serious accidents or they've experienced a near accident themselves, so you see a higher response on that.

Next slide. So this one is desirability. The question is, "I would like to have a safety feature that alerted me to the

presence of a specific threat on my personal vehicle." So you see generally the same trend, and again, the Left Turn Assist and the Do Not Pass warning, people tend to not relate as well with those and so they don't think that it'd be as desirable.

The next slide. So, intuitiveness. This is one -- I guess it's important to note that we intentionally did not structure the experiment as a human factor study, so all the participants -- in general, most of the participants only experienced one vehicle. There were a few that had to switch because they were in the vehicles that only had two or three safety applications, so we did a car swap. But no participant experienced the same safety feature in two different vehicles. All right. So when you think intuitiveness, it gets into the driver/vehicle interface, but, you know, all the drivers experienced different interfaces, and we're lumping this into one summary, so take it for what it's worth.

So, the question is, "How effective

was the particular safety feature at alerting you to the presence of the specific threat?" So, again, the safety applications are the individual bars, and you can generally see the same trend with this. Overwhelmingly positive, everybody above 80 percent in this case, every application.

DR. ADAMS: Therese Adams. What was the sample size?

MR. LUKUC: Go back. So here are the samples for each.

DR. ADAMS: Okay. All right.

MR. LUKUC: So, you know -- and that's good to point out. The one with the -- one of the lowest percentages or the lowest -- we only had 171 participants and -- okay.

MR. LAMAGNA: Sam. So was there any concern at all that this was almost done in a vacuum? I mean what I get from this is that, yes, people are hungry for safer cars as opposed to there's this type of means to achieve safety in vehicles or the type, the way to achieve to safer vehicles; which would you

rather have? Because to me this is, you know, would you like to eat when you're hungry? Yes, I would.

MR. LUKUC: Yes. Well, you know, this was really aimed at trying to understand if the general public would accept these, given what we taught them going in.

Ray, I don't know if you want to speak to that one. You know, we may have other research at NHTSA focused on comparing V2V to other safety systems, but that wasn't the intent. This was really to look at short-term acceptance, or acceptance on a very short exposure. And then we, through the Safety Pilot, the I.E. will also be looking at what's the acceptance over longer exposure.

DR. RAJKUMAR: This is Raj. So to me, I guess, even various technologies, DSRC is the only one that gives you the latency that can meet all these safety applications, for one. Number two, the other factor that the automotive industry actually support us, are people willing to pay for safety? Yes, I want

safety, but will I pay for it. Which is where I think the DOT mandate comes into play: Look, spend under a hundred bucks. You have a DSRC block installed. Because as a mandate, and we know it saves lives.

MR. LAMAGNA: I believe everybody in this room would be shocked if the results were anything different than what they're now.

MR. LUKUC: Yes. We had to show it, so it's a piece of information that's necessary.

MR. RESENDES: Well, when we went into this, we were about to spend a lot of money on Safety Pilot, which was providing crash-related technologies to drivers of light vehicles, most Americans. The vast majority of most Americans have never been in a vehicle with a crash warning system, even the ones that are on radar-based systems. So we needed to know and get an understanding of, do they find this technology useful and acceptable. And going in, we did not know the answer to that. There's a strong -- a lot of our human factors studies on across the board safety technologies

showed most drivers think they're better than they are at driving; they don't need help avoiding crashes. So I actually was very surprised at how positive this is. And we didn't know going in how strong generally the drivers were going to react to this technology. So this really was a gate we needed to go through, was do the average American driver across a variety of demographics across different parts of the United States find this technology useful and acceptable.

DR. ADAMS: Yes. Therese Adams. What I think interesting here is the negative, the section of people that are negative, because it is like a "Are you hungry, would you like to eat?" But somebody would not say, "No, don't give me any food," or come out negatively, even if they thought they were good a driver. They'd say, you know, "Maybe for other people, but, you know, I probably wouldn't get it, too." You'd think they would be more in the neutral area, but not --

MR. LUKUC: Well, a lot of these

were structured as, "Would you like it on your vehicle? Would you --" You know, "How useful would it be for you?"

DR. ADAMS: Oh, that's the question.

MR. LUKUC: Yes.

DR. ADAMS: So they would say, "No, not on my car"?

MR. LUKUC: Yes.

DR. ADAMS: Okay.

MR. LUKUC: And there were a couple locations -- Blacksburg was one -- where most of the participants thought that this would be great for somebody else to have, but they -- you know, it really wouldn't help them a lot, so --

MR. McCORMICK: I mean, yes, that's kind of one the things we -- what we've found, is that all the studies showed that 20 percent of the people, when an idiot light or a warning light comes on saying your oil's too hot, do nothing. They just do nothing. They keep driving. They just ignore it. So they don't

find any utility even in the things they have, and it's -- whether it's psychological or behavioral, they really don't know, but I mean there's always going to be a group of people who, you know, are Luddites.

DR. ADAMS: Yes, but they wanted you to take that out? They want to not even have that even on there, then?

MR. McCORMICK: They just ignore it.

DR. ADAMS: They just ignore it. So you think they'd be neutral?

MR. McCORMICK: Well, except for the fact that it always drives cost.

DR. ADAMS: Yes.

MR. McCORMICK: You know there's no free lunch. Somehow it has to be paid for, and eventually you have to pay for it. So, you know, it's a question of whether or not value it.

MR. SCHAGRIN: Just want to say one thing. We also have focus groups --

MR. LUKUC: Yes.

MR. SCHAGRI: -- in which, you know

-- and I have observed some of those focus groups. And the kind of conversation you have among people is much like you'd have in any kind of fixed population. There are people who are going to be positive all the time, there's those people that are just kind of generally neutral, and there are people that are just going to be negative, and I think you have to -- you know, from a common sense --

MR. McCORMICK: What are you looking at me for?

(Laughter.)

MR. SCHAGRIN: Why are you so sensitive, Scott?

(Laughter.)

MR. SCHAGRIN: No, there's going to be a kind of mixture. So I think that there's some random element in here based on kind of a general population type of thing that you're going to have that kind of stuff no matter if you can say the sky is blue and they say, "No, I don't like blue skies." You know, there's going to be some of that. But the fact it's

so small is also a good indicator.

DR. ADAMS: Yes that makes sense.

MR. LUKUC: Do you have anything to add to that? You've done a lot of the studies.

MR. AUGUSTINE: I was just going to make one comment. I think the other thing we've seen in prior research is the performance of the systems also impact whether the individuals said it was beneficial and they liked it. If there's a lot of false positives, you get a much higher negative result. So somewhat you're seeing a little bit of performance versus personal preference versus effect -- you're getting a lot of data in sort of that positive result, and I would echo Ray's comment. We've seen very minor technical things causing a very large negative response that sort of shocked us when I thought that was a very minor thing. People feel very strongly and they'll say, "No, I don't want that in my vehicle for this one little reason. I didn't like the sound of the bell," or, "It was a chirp that I didn't like." And you go --

DR. ADAMS: That's the interesting stuff.

MR. AUGUSTINE: Yes. I was surprised by that, so --

MR. LUKUC: That's important, yes. And along that point, we have a few vehicles that actually have voice, so, "Slow moving vehicle" or "Danger" kind of thing. So, you know, people might not like that particular feature.

CHAIR DENARO: Yes. This is Bob. First of all, a question. Did you give a questionnaire to people before they experienced it and then after?

MR. LUKUC: We did, yes. We had the pre-drive questionnaire. So after they were educated, they watched the video. It was an earlier version of the video that we've been showing for the last year. And then they were given a presentation by Virginia Tech researchers that described the technology, the fundamentals. So, yes, they -- going in, then they had a questionnaire. So they -- and we

-- most of these are post-drive responses. There's really a very small difference between pre-drive and post-drive. They skewed a little bit more towards the negative pre-drive, but, you know, very small, almost in the noise.

CHAIR DENARO: Well, and I'll just comment on Sam's comment on this. I've reviewed a lot of automotive safety reports over the last ten years, and I didn't -- I don't know the -- you know, I haven't reviewed this report and everything else, but I'll say these results were way higher than anything I've ever seen before.

MR. LUKUC: Yes. That's okay.

CHAIR DENARO: You look at adaptive cruise control, lane departure, you know, lane keeping assist, whatever. These systems will vary between, I want to say, 50 and 80 percent acceptance. A surprising number of systems will rate pretty low, in the 50 percent, 40 percent, something like that. So it's not a foregone conclusion that people accept this. So if this stuff is reliable, these are remarkably high numbers.

MS. NODINE: Mike, I have something. I'm Emily Nodine with Volpe. I'm doing the evaluation. So something to keep in mind. Anybody who has done or seen the demos, the scenarios in these clinics and in the demos, they really show the system in all its glory. You know, they have an obstruction, so the vehicle comes out from behind something. So we're very much expecting that the results are going to be skewed towards the positive, and that's sort of partially why after the model deployment we want to compare and see in theory do people like this, or do they actually like how it's --

MR. LUKUC: That's right and that's what I was going to say. You know, in deployment we have the penetration level to deal with, as well, so it's not every vehicle that you're reacting on. But you will see the questionnaires in the model deployment are very similar to the questions here. They're based off of these. So we'll be able to compare the results. Short-term exposure versus long-term

exposure.

DR. RAJKUMAR: Mike, this is Raj. Is the feedback for the driver visual, audio, tactile, combination?

MR. LUKUC: It depends on the application and the OEM implementation. Almost all except blind spot warning, all the other applications had audible and some sort of visual. Some of the visual was in the heads-up, you know, forward and the inner forward line of sight. Others were on -- more of an icon on the dash. So, "I heard a sound. Now, what was that sound?" You go back and look, you know, after the fact. It holds it for a few seconds, and then a couple of OEMs had the haptic, the vibration in the seat. Okay? Any more?

I think we have to keep moving, according to Mike. So this is an example of system limitations. So we asked a market penetration question just to see, you know, with what we taught them and what they've seen, what the people thought. So the question was, "What percentage of vehicles would need to be

similarly equipped before you believed the benefits would be noticeable?" And so the red line is a cumulative distribution, so if you look at -- if you look at, say, the 50 percent mark, we'll say 20 percent -- 26 percent of the respondents thought that if somewhere between 50 percent or less of the vehicles were equipped, you'd start to see noticeable benefits. So that gives you just kind of an idea of what the people are thinking out there. So they did rate it highly, but they still understood that there was a limited value early on in deployment.

All right. Next slide. So this is kind of -- these are examples of self-reported understanding of V2V. So, how well do they think they get it? This is one that changed a little bit from pre-drive to post-drive. So we saw a few in the "I don't understand it" column. The question is, "After experiencing one --" well, this is a post-drive question. So, "After experiencing these vehicle-to-vehicle safety features first-hand, please tell us how well you think you understand

this technology and how it works." So you can see that 530 of the 688 respondents thought they fully understood it, and then 153 in the middle, and nobody said that they don't understand it. And I think we had a handful that thought they did not get it in the pre-drive questionnaire, so it shifted a little bit, but, you know, in the noise level.

So the overall -- so, go to the next one. So this is the same question, and it's broken down by age group. So here you'll start to notice that the younger drivers, which is the lowest row, seem to get it more or believe they get it more than the older drivers. Okay.

CHAIR DENARO: Hey.

MR. LUKUC: It's a self-reported understanding for being honest.

(Laughter.)

MR. LUKUC: So, and then we asked also an example on how much the drivers seemed to value the technology in terms of monetary value. So, "At what price level would you begin to feel that the collective group safety

applications is too expensive to consider purchasing?" So each individual -- most all of them experienced four of the six, and some of them experienced some of the others. So this -- again, the red is a cumulative distribution. So if you look in the middle -- you guys probably have a hard time reading it, so it's "More than $50" is the farthest left, "More than a hundred," "More than 150," "200" and "250." So if you look in the middle, it's an easy point. We'll say 91 percent of the respondents thought that the collective group would begin to be too expensive somewhere to the right of $150, and then 58 percent somewhere more than $250. Okay.

VICE-CHAIR KLEIN: Is there an estimated cost?

MR. LUKUC: Well, we're working on that. That would be part of our -- we are. I mean, you know, we can throw out some numbers. Roger can -- if Roger wants to throw a cost out there.

MR. BERG: No way.

(Laughter.)

MR. LUKUC: All right. The cost we estimate will be a little different than what he would estimate.

Sorry to put you on the spot.

MR. BERG: I've seen all kinds of price points services formula. Looks like Bob is in safety applications --

MR. LUKUC: It's going to be considerably lower than what people are paying for a single radar-based system, and that's the important thing. So you have -- you know, you have the systems that have a very limited field of view, radar, camera. They can see, you know, maybe 20 degrees, a generously wide path field of view. These can see 360 degrees and, you know, I would say it's going to be less than half of the price of those systems. Probably considerably.

MR. CALABRESE: What is one of those systems?

MR. LUKUC: It depends on the OEM.

(Laughter.)

MR. LUKUC: And the Tier 1 supplier.

It really depends. They're mostly bundled with other applications. But I would say, you know, those -- I don't know. $700, $500. I don't know what those systems -- we're not throwing any dollars out there, so -- You can go out and do some searches on the OEM websites and price your cars and figure out what they cost.

A couple examples about unintended consequences. So this is another one that we need to throw some caveats out there. You know, again, it wasn't a DVI study, so, you know, we're asking -- the question is, "Monitoring or interpreting the information provided by these safety features is no more distracting than using my car's radio." One thing to point out is, you know, we're bombarding these individuals with more warnings than they're used to, other than blind spot warning, probably more than they'll ever experience in a lifetime with their vehicle. You know, they're getting instant forward collision warning, they're going through four different scenarios, sometimes

multiple times. So they're seeing a lot of warnings in a period of an hour, hour-and-a-half. So when you start asking about distraction, you have to take it for what it's worth. They've seen a lot more than they will ever see in that hour or hour-and-a-half driving in the real world, so this is where it tends to get a little more negative. But again, we're still above 70 percent in all cases. This is broken down by location, by the way.

MR. McCORMICK: Is there a gender difference looked at in all of these?

MR. LUKUC: Yes, we do and we break all that down in the report that's under review right now.

MR. McCORMICK: I mean in general did you find any significant difference?

MR. LUKUC: No.

MR. McCORMICK: Okay. Thank you.

MR. LUKUC: Not that I'm aware of.

CHAIR DENARO: So this was one of our pre-questions -- this is Bob -- also, and you stated that DVI investigation was really

not a focus of this effort. Is the intent ultimately to leave DVI, then, up to the manufacturer to do as they please?

MR. LUKUC: We have a human factors for Connected Vehicle Program that's looking at that kind of stuff, and that would be weighed in our decision. I don't know if Ray wants to talk about that, the question about, you know, are we leaving DVI out of it. You know, would we leave that up to the OEM or not? I don't think that's necessarily the intent.

MR. RESENDES: We have not made that decision, and we're actually looking at that right now on the vehicle-based systems as well.

MR. LUKUC: So with the whole distraction thing out there, yes, but --

MR. RESENDES: Right. But this wasn't -- you know, that wasn't addressed in this project, but that is being addressed in the Connect Vehicle Program.

CHAIR DENARO: Yes. I can see where that could be debated. I mean I think, you know, these days that OEMs are doing a pretty

good job of this, and very creative -- I think there's been very innovative, very creative stuff. The danger, of course, is that if you don't create standards, then you have a potential, going from car to car, that you do create distraction and that sort of thing.

MR. LUKUC: You know, we even heard some of that in the focus groups. In the open-ended questions that we had in the questionnaire, there were some people out there that thought standardization would be good. You know, it was by no means the majority of the people.

So, the next slide. This is interesting. To this one's centered around complacency. So the question is, "Availability of these safety features would cause drivers to pay less attention to the driving environment." So if you remember back to the younger people understanding the technology here, the younger are on the bottom, and they seemed to think that they would be a little more complacent or other people would be more

complacent if they had this technology on the vehicle, versus the older two age groups. Okay.

MR. AUGUSTINE: So the colors -- back to that slide.

MR. LUKUC: The colors. Yes, the colors again. So --

DR. ADAMS: Red is bad.

MR. AUGUSTINE: So red is still bad.

DR. ADAMS: Yes.

MR. AUGUSTINE: Orange is sort of going at it from a different --

MR. LUKUC: Yes.

DR. ADAMS: Right.

MR. LUKUC: Yes.

MR. AUGUSTINE: So the more green is good?

MR. LUKUC: Green and yellow are generally good on this one.

MR. McCORMICK: You know, that's interesting. Nissan a number of years ago -- I think Roger knew about this -- they put in the haptic vibration seats. You drive outside the lines 100 percent of the time when you drive,

and not by much, but every time you drive you'll drive outside the lines. And so they outfitted -- I believe it was a Bluebird, which is extremely equivalent of the Altima here -- with a haptic feedback using cameras, that said, if I go outside the lines, I'm going to feel this irritating vibration. When they originally started out, they ran it for -- I believe it was for three months. By the end of three months, 90 percent of the people drove without crossing the line. Subconsciously, they adjusted their driving so that they were somehow not consciously more attentive. They were just more attentive to not having that happen to them. So, the reality is that depending on how it's implemented, it may actually improve your driving capabilities.

CHAIR DENARO: Before we leave that -- this is Bob -- is there planned additional research on complacency and its impacts?

MR. RESENDES: We have just kicked off a field operational test to look at long-term exposure, putting -- in Safety Pilot, people

that have cars for six months. We're looking at longer-term exposure. We'll be using vehicle-based technologies which are a good enough surrogate with that issue. So that project's just about to get awarded --

CHAIR DENARO: So by its nature, then, long-term, the results of that would not come in if the rule-making decision is on track. It would come after the decision to intend to do rule-making, but maybe prior to actually executing everything. Is that correct?

MR. RESENDES: Correct.

CHAIR DENARO: Thank you.

MR. LUKUC: Okay. So, moving on. I mentioned the focus groups. So I'll just show you the lower view of those. We have 12 focus groups conducted, two at each site. So each had eight participants, so 96 total, and we had the -- tried to hit the same mixture of gender and age groups. At each focus group we had one participant from each OEMs vehicles.

Okay. And, you know, the focus groups are really hard if you try to summarize,

do a thematic analysis and come to something you could show on a chart, so this is really just showing you how the discussion went in each of the focus groups. So we had a professional moderator, and they had -- she had topics that she would guide them toward, and this little seesaw, teeter-totter, shows you the benefits. The benefits of saving lives. Preventing or mitigating accidents. That type of discussion far outweighed the discussion on dependency and complacency and over-reliance. We'll have that summarized in detail in the report.

This just kind of tells you that we have two reports coming out, one on the system performance testing and one on the driver acceptance clinics, and they are under OEM review and then they'll go through a NHTSA U.S. DOT publication review.

So the next -- I threw a few extra slides in here, and I know we're short on time. We had a question on the -- how --

CHAIR DENARO: Excuse me. So on that, when should we expect those reports,

roughly? 2012? 2013?

MR. LUKUC: Twelve months? I don't know. Six to 12 months.

CHAIR DENARO: Six to eight months?

MR. LUKUC: You know, up to 12 months.

CHAIR DENARO: Twelve months.

MR. LUKUC: You know, it just depends. It could be shorter, but it's probably a good --

CHAIR DENARO: All right. Thanks.

MR. LUKUC: All right. So I had a -- we had a question from some of the questions you guys submitted early on. One of them was related to how representative are the systems in terms of production components, so I threw a few slides in here to cover that and some other stuff. So this is going through the sister project to this, and we built 72 cars total. Sixty-four were for model deployment. This shows you what they look like on top of UMTRI's parking structure.

The next slide. So this is a wiring

diagram, and it's a generic diagram. Applies very well to 48 of the 64 vehicles. The things to point out: so we had -- at the top you see the system. A couple of the OEMs had a side radar. So 16 vehicles, I think, or 14 we have with side radar. This is used only for data acquisition and for the -- to indicate the presence of vehicles in the blind spots, more for analysis. The vehicles had -- you know, had driver -- a data acquisition system which had six cameras, and I'll show you pictures of those. So we had rear-ward driver and dash cameras, left side, right side, and forward-looking cameras, as well as forward-looking radar that's used only for data analysis, and then a camera on the driver's face with infrared eliminators.

So, hit the -- what I've shaded here are components that are really only needed for the experiment.

And then one more. This shades the components that are needed for data acquisition. So if you look at what's left really at the

top, and I don't know if this will -- so this stuff up here, you know, we have the vehicle can going into the onboard equipment. So if you look at the important components, so the first would be really the DSRC radio which is inside the on-board equipment. There isn't a production -- mass production DSRC radio right now, but what we have are mass-production 802.11 "A" chips, home wi-fi chips, not the -- you know, so it'd be the chip inside a home wi-fi router. And those are modified to the 802.11 "P" standard. They haven't been subjected to the automotive level validation, so they're not certified as automotive grade. There's no reason to believe they wouldn't pass. That's probably -- that is the primary thing that's not automotive grade, but we feel really comfortable that it's a representative.

The other would be the -- you know, the software. The software, you know, it's really not optimized production-intense software. It hasn't been through the rigorous validation process. But we have thousands of

hours of research with this software. So we're pretty comfortable that it's -- you know, that it's pretty good and representative. You know, we're showing automotive-grade receivers. So what we have are evaluation kits that allow us to pull more data off the GPS receiver than you would need in a production implementation, but the chip itself, it's just standard automotive-grade chip. It's used in a lot of the navigational devices.

The antennas are production. For all intents and purposes, built production representative, built on a -- maybe not mass production, but a production line. This includes -- so that's the dual band DSRC GPS antenna. And then we have the single DSRC antennas which are in the same case, the same situation.

The on-board equipment itself. So for 48 of the cars we have a controller that really is representative of production intent. You know, it's a printed circuit board. It has soldered components. You know, standard

can transceivers. It has some inputs and outputs that are there for data acquisition purposes, for research purposes. Also has a 400 MHz automotive-grade processor, so it's a standard representative processor for what you have in the ECUs in your vehicles today.

So hopefully that -- did that answer the question or are there any other --

CHAIR DENARO: This is Bob. So functionally there should be no differences, but a lot of it's in production, hardware, software, that sort of thing?

MR. LUKUC: Yes. I mean, you know, functionally the applications may change a little bit if people -- when they implement them for production?

CHAIR DENARO: Yes.

MR. LUKUC: But, yes, you know, this is functionally no difference.

Roger, do you --

MR. BERG: Correct. Functionally representative of production like --

MR. LUKUC: You know, for the stage

of research that we're still in, this is actually more representative than normal. Pretty impressive, the level that we have.

Would you agree, Walt? All right.

CHAIR DENARO: One functional question I have -- this is Bob -- is that right now everything that you're doing is planned to be driver warning only. Is automation completely ruled out --

MR. LUKUC: Well, actually --

CHAIR DENARO: -- or is that door still cracked open?

MR. LUKUC: I don't think automation's ruled out. We're looking at V2V as a standalone feature, you know, in V2V -- you know, only in our 2013 decision. But we have research that -- one for intersection applications and for forward collision warning applications with certain OEMs -- not all eight -- that have signed up to give us vehicles to put through objective tests in a controlled environment to understand the effectiveness of those applications in many cases when they're

combined with other sensors, so radar and camera. So, but, you know, we think, from listening to the OEMs, if control were brought in, you would always fuse it with a second sensor, and that's no different than what you see in production today. You very rarely see a system that uses a single radar, yet will put on the brakes fully. They might brake to a moderate level, but when they brake fully, then they bring in a camera or a second radar or a LIDAR, something else to verify. And that's all driven by the ISO 26262 standard or the equivalent that each OEM lives by.

CHAIR DENARO: Okay. Because I think, you know, this investigation of V2V and V2X started years ago. In the intervening time, there are more and more automated braking systems, controls, steering, everything else. It seems to be coming more rapidly than a lot of us expected. So I can see where this might, by the time it gets to production, want to go that way for certain functions.

MR. LUKUC: Right, and you'll see

more -- the price of those sensors are going down, so you'll see more and more of those sensors on some of the lower-class vehicles. It's not a stretch to say that you would see fusion with this if it makes it to deployment.

CHAIR DENARO: You make an interesting point. So you're convinced that implementation of control would require a dissimilar sensor --

MR. LUKUC: Additional sensor. You know, at the very least, the way the OEMs --

CHAIR DENARO: Yes, yes.

MR. LUKUC: You know, in terms of liability, you need a second piece of data.

MR. CAPP: John Capp. If you just take -- that it'll take 10, 15, 20 years -- pick a number --

CHAIR DENARO: Right.

MR. CAPP: -- to get everything equipped.

CHAIR DENARO: Yes.

MR. CAPP: So in that time -- period

of time, you cannot rely on that sensor to make automated types of decisions.

CHAIR DENARO: So if you're going to do your part, you've got to have other sensors.

MR. CAPP: So, yes. It's a foregone conclusion that we're going to have multiple types of sensors on the vehicle, and we're going to exploit the benefit out of each of those. Initially, this one's going to have comparatively low value to some of the other sensors, and over time it accrues value. That's the whole challenge here.

CHAIR DENARO: And by that time, that radar is 25 cents --

MR. CAPP: Well, and it's --

(Laughter.)

MR. CAPP: -- a little bit to the cost question, quite honestly, as the other sensors, the costs come down, the features grow, people are starting to like them. We do a lot of market research. People like all this stuff, quite honestly. Whatever this cost and its

comparatively low functionality at the beginning will compete in a consumer's mind as, I've got this other feature that works right now. So the bar is kind of getting raised in terms of what it needs to do, but, you know, we've got to get on with it, because that's going to happen. We've got to get on with it, make it happen, and so we can compete, too. But initially it'll be at a pretty big cost disadvantage initially.

MR. LUKUC: So, I think we're short on time. This just gives you an idea of what the DAS looks like. There are some -- kind of some marketing points that Virginia Tech put in here for their DAS. We won't go through each of those. This shows you the examples of the camera. So, the rear-ward looking camera on the left and the forward on the left lower. We have side-view cameras that are in the wheel housing, and they actually will show the blind spot as well as the intersections, so this is a good addition. Cameras on the face of the driver with the IR eliminators and over the

shoulder.

The forward-looking radar, this shows you some of the benefits of that, but really, you know, we have it fitted into the front license plate enclosure on each of the vehicles, other than the Ford, and it's in a production location behind the grill. So that just gives you a sense of what that looks like.

We did validation testing for all 64 vehicles, which included communication-based verification, safety application verification, and DAS verification. So that was fairly lengthy, seven-day rigorous testing that we did, and -- that's fine.

There were questions about how do we know if things are working. So we have a remote monitoring tool in these vehicles. It displays the trip information for each of the vehicles through a cell link. You can get real-time DAS information and, you know, it gives us a way of quickly identifying any V2V safety system or DAS issues, and we have somebody monitoring these every day from Virginia Tech

full time.

Okay. Data collection. You know, we're doing data harvesting every month on the 64 vehicles. This just kind of outlines the process for pulling hard drives and sending that data to servers, and that'll ultimately go to the independent evaluator, and we always have a backup copy somewhere. We don't need to go through all that.

Okay. But, any questions?

MR. ALBERT: Silly question.

MR. LUKUC: Yep.

MR. ALBERT: Steve Albert. Did people complain that they got the Hyundai versus the Mercedes --

MR. LUKUC: So actually Jim Sayer would be a good person to ask this. I don't think anybody complained, because the way it was presented, nobody knew that we were giving vehicles away. It was all, "Would you like to put a device ... And somebody will talk about the devices. We have the vehicle awareness or after-market safety device. "Would you be

willing to put this device on your vehicle for the duration of the experiment?" And then, you know, we contacted -- or UMTRI contacted the 64 and said, "By the way, we have a vehicle if you're willing to drive that for six months." And then we'll switch out for six months and get another 64 drivers.

DR. RAJKUMAR: Mike, this is Raj. Is the project ongoing or is it wrapped up?

MR. LUKUC: Yes, it's ongoing. So it started August 21st at 1 p.m. -- or 10 a.m. I'm sorry. So we're --

DR. RAJKUMAR: And that project is for how long?

MR. LUKUC: It's a year long. We'll switch drivers of the integrated vehicles after six months, and I think some of the others we'll talk about as experiment. All right.

CHAIR DENARO: Thanks, Mike.

MR. LUKUC: I'm being kicked off the stage.

MR. SCHAGRIN: There's supposed to be one at three after the speakers, but we're

running a little over because of all these great questions going on. So it's up to you if we take -- at what point we take a break or we don't, but the next set of speakers are from Volpe, and they're going to talk about the experimental design, what went into the crafting, the different parameters, why we picked so many vehicles, how we structured the experiment. And so we did that prior to even contracting out the test site. So before we even knew that UMTRI in Ann Arbor were going to be the site, we scoped out the size of what we needed for an experiment like this to get the data we needed, and then once we got into that and we selected Ann Arbor, then we started optimizing things a little bit in terms of the specific site.

So you're going to hear about that next from Kevin Gay from Volpe, and then you'll also hear about how we're taking that data and then turning it into the kind of information we need to help inform our decision next year, and we will talk about that. So --

CHAIR DENARO: So, judging by the number of standing people already, do we want to take a break now and come back? I'm open. Yes? I see some nods. Okay. We'll break now for 25 minutes. So, ten after three.

(Whereupon, the foregoing matter went off the record at 2:44 p.m. and went back on the record at 3:08 p.m.)

EXPERIMENTAL DESIGN

MR. GAY: So my name is Kevin Gay. I'm from the Volpe Center, and I actually am going to talk to you today about the experimental design of the Safety Pilot, and I'm going to answer the question: How do we know if we're going to get enough data out of this experiment?

So I'm going to jump through slides and I'll skip over a couple of them where it's not maybe pertinent here, but if you have any questions along the way, as always, definitely stop me here.

So what we're looking at now is, on this slide what I'm talking about is two things. One, we're thinking about what the full

deployment of the connected vehicle environment is going to look like, and at full deployment we're going to have lots of cars equipped. So getting interactions is not an issue. What is an issue is in the model deployment, only a subset of the vehicles, as we talked about earlier -- somewhere on the order of 3,000 vehicles -- are going to be equipped. So getting interactions among those 3,000 vehicles is vital. It's important. That's exactly what we need in order to get the data for evaluation purposes. So how do we know that the model deployment will obtain enough data that we'll be able to use for evaluation purposes?

So this is where I'm going to walk you through the entire process that we used from start to finish to understand how we scoped the model deployment, and by scoping the model deployment, what I mean is test participants, test subjects. How many of those do we need? What duration do we need of this test? And then, finally, how many cars do we need? How many integrated vehicles and how many equipped

vehicles that can communicate by sending out a basic safety message? How many of those do we need in this? So this was really the starting point for this analysis.

So, how did we get to there? Well, what we said was, "Let's look at prior field test work that was done and let's establish sort of a performance measure or performance goal. So that goal was, we want three forward collision warning alerts during the treatment period in Safety Pilot. That's our goal. What do we need to do to get there? What do we need in terms of test subjects, duration of time, and vehicles? And so this is how we started with scoping the model deployment.

Well, what did the analysis come up with? We recommended about 108 test subjects with five months duration for each test subject. This included 55 integrated vehicles. It's 54 integrated vehicles, plus one spare. So it would basically be 54 integrated vehicles, and then you double that, so you get the 108 test subjects. And the idea was to have 2,500 to

3,000 equipped vehicles in the environment, creating sort of the seed for the integrated vehicles to interact with and generate warnings and interactions.

So how did we do? This was the recommendations come out of the analysis. What we actually have in the model deployment now is 128 test subjects. Because there are 64 integrated vehicles, each driver gets six months in the integrated vehicle, and then we rotate another full set of 64 drivers in. There's also 2,700 equipped vehicles in the model deployment. So pretty much everything we're seeing here is that the actual deployment is exceeding or within the recommended ranges that the scoping analysis originally prescribed for generating those three forward collision warning alerts for each driver during the time they have the vehicle.

Now, these numbers are enough -- these numbers by themselves are just not enough. It's really important to carefully select the test area, which we've done with the Ann Arbor

area, and the concentration in the northeast Ann Arbor where you have a lot of vehicles, a lot of trips, and a lot of trip generators with work and schools, and we'll talk about that a little bit more shortly. It's also really important how you select your test participants. You want to make sure the people you're picking are the people who are driving, are using the major roads, and they've got lots of trips.

So this leads to sort of the next step in the analysis, and it really drills down to the test participant level. Yes.

CHAIR DENARO: Just a quick question, Kevin. This is Bob. Was forward collision alert the only metric that you used for designing this?

MR. GAY: It was used as a representative application, and so we said, well, if we've got more applications, we would have the same performance measure for those additional applications. So if you've got three, four, or six, you would want about three alerts for each of those applications.

CHAIR DENARO: I see. Is there a reason why forward collision is less likely than some of the others, for example?

MR. GAY: Are you saying should we have different metrics for the different applications? Because they're --

CHAIR DENARO: Are all of the five -- is it five different case -- use cases? Are all five equally likely to happen?

MR. GAY: I don't really think so. Not really. I mean if you think about blind spot warning, for instance, --

CHAIR DENARO: Right.

MR. GAY: -- you would have -- you could potentially have more of those.

CHAIR DENARO: Right.

MR. GAY: I don't think so, but for the level of the analysis that we were doing here, it was at such a high level, we said if we can get this volume, we'll be in good shape.

CHAIR DENARO: Okay.

MR. GAY: Anything above and beyond that is great. So if you get 300 of them, fine.

That's more than three, so we're happy. So it was really a -- it was a baseline, a floor, I would say.

So the next step is, we looked at the test participants, because this was really sort of the 30,000-foot view of the analysis. What Jim talked about earlier is the driver recruitment, and UMTRI has structured the driver recruitment in a very creative way that we think will lend itself well to generating interactions. The University of Michigan Hospital on the edge of the downtown area attracts a large number of participants who are driving in each day and driving out each day. They're using the major roads in Ann Arbor to get in and out. At the same time, we have the recruits from the high schools and the middle schools and elementary schools in the northeast Ann Arbor area, and they are actually going to be taking their kids to school, they're going to be going to sporting events, and all these other events in this area which will generate lots of cross traffic with the other

participants.

So what we really like about this is it creates a real variety of interactions of vehicles, not just all vehicles leaving from the medical center in the morning or coming to the medical center in the morning and leaving in the afternoon and you get very structured interactions that way. In this environment, you've got people who are going to different -- they're going to different locations and they're potentially going to be crossing paths, they're going to be adjacent to each other, and it creates a great opportunity for additional interactions and really collecting the data we need.

So what else did we do? What we ended up doing from this is we contacted the Washtenaw Area Transportation Study. They were actually able to provide us detailed trip tables for a typical day in Ann Arbor, and what this really was, was the origins and destinations of travelers in the Ann Arbor area, and we took that information and ran it through a simulation

model. So in taking that data, we had to manipulate it a little bit and we tagged vehicles as being either equipped or integrated so we could track them in the simulation. Once we put them in the simulation, we ran it for 24 hours and we were at that point where it had second-by-second output of where the vehicles would be in the Ann Arbor area. So we had a good idea of, well, here's where an integrated vehicle's going to be as it goes on its trip from home to work at the medical center, or from home to school or home to other.

So this information really gave us a good estimate, and these are all just estimates. It's a simulation here. It's estimates of where we thought people would be at any point in time in the day, whether they had equipped vehicles or otherwise. So, the little graphic you see there, we've got circles for some of the integrateds and then the smaller circles for just the equipped vehicles, and then all the other traffic is just the dots that don't have any circles around it. And so this was

just a visual representation, but we got just tons of data on this.

So what we ended up doing with it --

DR. RAJKUMAR: There were no traffic lights on this in the model?

MR. GAY: Sorry?

DR. RAJKUMAR: No traffic lights in the model?

MR. GAY: No. It does -- the TRANSIMS models of this open-source simulation model, that does have traffic light modeling in there as well, and timing and signal time. So that was all included in there, and capacities on the roads and all of that. So we didn't have a chance to do a full validation of the model because of the timing of it, but we took the trip tables and ran it through and we did some basic tests to make sure that the data coming out of it looked reasonable.

Okay. One of the things that we had to do post-process, since TRANSIMS wasn't set up to do this, was to identify, well, what type

of interactions are we getting? When are two vehicles communicating with each other in close proximity? So this is where we analyzed the data that came out and we said, okay, well, we've got two equipped vehicles. They're within 30 meters of each other. That's an interaction. And they happened to be going in the same direction, so that would be, you know, a forward interaction. Or they're adjacent to each other and they're traveling in the same direction, so that would be sort of a lane change adjacent interaction. Or they're on crossing path.

And what this really was useful for was just seeing, okay, are we going to have sufficient number of opportunities for participants to have the ability to experience potential warnings from the applications? For instance, if there were no intersection interactions there, it would be very hard to experience warnings from an intersection warning application.

The good news is, looking at all of this and looking at the results from the

simulation, all of this seemed reasonable with what we expected. There were pretty similar numbers across all three groupings here, so it wasn't clustered and just, well, we only saw forward interactions or adjacent interactions. So that was one of the checks we did to make sure it made sense intuitively.

Another thing we did is we looked at a whole day, what the interactions looked like on a whole day. This is pretty similar as to what a lot of people would expect for a daily distribution of traffic. You've got a sharp peak in the a.m. You've got a lot of interactions happening there. Everything quiets down a little bit during the middle of the day, and then in the p.m., things don't peak quite as hard as in the a.m. The traffic's a bit more spread out. And this kind of makes sense with our recruitment strategy as well, in that you've got the participants that are driving their kids from school to activities. So it's really spreading out the traffic a bit more in the afternoon, and we can see that in

the interactions is pretty much the way that we were looking at this and analyzing the results. So this is -- again, gives us a good feel that the data coming out of the model makes sense.

So what did we end up estimating? About 250 interactions a day is what we thought would be -- and an interaction is really defined as just good communication between two equipped vehicles, one being -- one having the ability to generate alerts. So it's really the integrated vehicle and the other -- the ADs or other vehicles in the environment.

DR. RAJKUMAR: Kevin, this is Raj.

MR. GAY: Uh-huh.

DR. RAJKUMAR: Question.

MR. GAY: Yes.

DR. RAJKUMAR: Your assumption is that data's covering 30 meters of the antenna.

MR. GAY: Right.

DR. RAJKUMAR: But I thought in the real experiments, the range is much longer than that.

MR. GAY: Oh, it absolutely is.

DR. RAJKUMAR: So that should be much better.

MR. GAY: Exactly. The thing that we took into account was interactions at 300 meters are very unlikely to generate any type of safety alerts or safety warnings in the applications. It's very unlikely at 300 meters you're going to be in a crash imminent situation with another vehicle. However, within 30 meters of each other, there's a real -- the possibility exists that there could be. So we did not want to report the larger numbers because we didn't feel it was a fair representation. Sure.

What did we estimate in terms of safety alerts? Because, as I just said, the number of interactions is really just a possibility for an alert to occur. So what we ended up doing is we looked at the relationship between interactions and safety alerts and said, how often are people going to potentially get into -- or have alerts generated if they are

in proximity to another vehicle that's equipped with this technology? So we used historical data and we identified really an exposure rate. We said, if you're exposed to another vehicle for this amount of time, here's how many alerts we'd expect to generate. So, given what we had there, again, what we were pretty much estimating, based on what came out of the simulation model, is that drivers would more or less see about three alerts per safety application over the length of the test. And again, these are really just baseline numbers. If we can -- these are our performance goals. If we get this baseline, above it is great.

So what did we see in month 1? Month 1, we had 64 integrated light vehicles deployed and 700 VADs. The model estimated -- we adjusted the model for those levels. Our numbers I showed earlier were at full deployment. As you all know, this is to ramp-up deployment. So what does month 1 look like? We expected about 1,400 interactions in month 1 and about 24 safety alerts generated. The

raw data -- and again, I'll caveat this with this is raw. It hasn't been analyzed thoroughly and in depth. These are just raw counts. We're seeing about 1,200 interactions in month 1 and about a hundred safety alerts. And again, these alerts haven't been analyzed to look at the specifics of how -- were there two in rapid succession of each other, or what the other specifics really were. And the number really isn't the thing to key on here. It's really that we're seeing a volume of data here that will give us the information we need to conduct the evaluation. It's not that important if it's 110 or 105 or 75. The key is we're not seeing zero and we're seeing a good volume here, and it will give us data to analyze as we move forward to the evaluation, which Emily will talk about next. Yes.

DR. RAJKUMAR: Kevin, this is Raj. Do you have a sense for the geographic distribution of interactions? Is it at the origin point? The destination? Somewhere in between?

MR. GAY: We plotted a few different things and looked at them. Most of the interactions do seem to be occurring. I don't know about the trip, of whether it's at the beginning or the end, but of course, a majority of the interactions are really occurring in that northeast Ann Arbor area. It really is concentrated in that area. We see a few that are outside of that area and maybe the southern end, the western part, and it just really drops off really quick once you go out of there. So I think, you know, UMTRI's done a fantastic job in getting participants who are driving a lot in this target area, and so far that's what the data is showing in our geographical.

DR. RAJKUMAR: So somebody from this area, could they say northeast Ann Arbor is kind of a traffic area where people live? Because I don't know the region.

MR. GAY: Yes. I don't know specifically what the distribution is in terms of work versus home in Ann Arbor and northeast. It looks pretty well mixed, but maybe Jim knows.

DR. SAYER: I think we have a better sense on the people who are actually participating. I'd say probably about 20 percent are people that commute outside of northeast Ann Arbor to go to work. Another 20 percent are people commuting in from other locations, and 60 percent of them are -- they could be people that are stay-at-home, they don't commute, or they're commuting from within northeast Ann Arbor to northeast Ann Arbor. That's more a rough estimate.

DR. RAJKUMAR: So these numbers are very promising, at least. As the number of vehicles go south, interactions will really go up, I guess, super linear, like that?

MR. GAY: That's correct.

DR. RAJKUMAR: Okay.

MR. GAY: That's correct. And I mean that's exactly what we're thinking here. So, so far we're very pleased with the numbers we're seeing. They're in line with what we had estimated from the model, which in and of itself is actually a very good finding as well that

we can use these tools, because we have not proven this out before that you can use simulation models to estimate the volume of the interactions that you'd expect at a deployment scenario, which you could certainly expand on this work and do more with it now. But so far, the estimates are very reassuring and we feel like data is coming in and we won't -- we'll know more about it once it gets into evaluation.

MR. WEBB: Kevin.

MR. GAY: Yes.

MR. WEBB: George Webb. Any results in any accidents so far in the first month?

MR. GAY: I don't -- not that I'm aware of. I don't know if UMTRI has information.

DR. SAYER: Yes. No, not that we're aware of, no.

VICE-CHAIR KLEIN: People are supposed to self-report presumably if they felt their lives were saved?

DR. SAYER: He mentioned that that

data from the integrated vehicles is stored onboard in the Virginia Tech DAS, and so that data will eventually come back and we'll actually be able to quantify that. But we do -- we are in contact on a monthly basis with these drivers just to schedule data downloads, and we've not had any self-reports yet.

CHAIR DENARO: This is Bob. I lost you someplace. You started out saying you were looking for three alerts in forward collision.

MR. GAY: Um-hmm.

CHAIR DENARO: And I see you've estimated for 1,400 vehicles in one month, 24.

MR. GAY: Right.

CHAIR DENARO: What am I missing here?

MR. GAY: There's six safety applications, --

CHAIR DENARO: Yes.

MR. GAY: -- and we were looking for about -- or, actually, there's a bit more. What we were looking at was actually -- we were -- the model was more or less estimating that we

would get four alerts in the first month, one from each of the six safety applications, --

MR. McCORMICK: So that's a simulation.

MR. GAY: -- which would give you the 24 total that we were looking at.

MR. McCORMICK: The simulation was forecasting that?

MR. GAY: It was actually analysis that we did afterwards using the output from the simulation. So it's analysis the Volpe team did based on prior field studies that were done. And so this is just -- this is cumulative overall safety applications at this point.

CHAIR DENARO: Right, but for six applications, if they're all the same, that's four per application; correct?

MR. GAY: Uh-huh.

CHAIR DENARO: But wasn't the design to be three over the life, the entire period of the effort?

MR. GAY: Yes, yes. The benchmark was three.

CHAIR DENARO: Oh, okay.

MR. GAY: That's what we were hoping to hit.

CHAIR DENARO: So you did the analysis and it came out a lot higher.

MR. GAY: That's our goal. Our analysis is showing it to be a bit higher, yes. That is more or less what it's showing it to be.

MR. McCORMICK: Well, and on the observed alerts, were those -- I mean observed interactions, did those fit into the categories that you expected or has that analysis not gone that far, yet?

MR. GAY: That hasn't gone that far yet.

MR. McCORMICK: Okay. Thank you.

MR. GAY: These are, again, just very raw numbers of how many times did the application generate a warning to the driver, an alert to the driver.

MR. KISSINGER: This is Peter.

MR. GAY: Uh-huh.

MR. KISSINGER: The issue there about repeat warnings. I mean I understand --

MR. GAY: Right.

MR. KISSINGER: -- what that may be, but I'm -- I mean what is the -- I mean how do the systems -- how do you count typically and how could you miscount? I mean I'm --

MR. GAY: Well, right now what we're getting are just very raw numbers that says, you know, an alert was issued at this date and time at this exact second at this location, and it's very possible that a few seconds later another exact same alert is generated from what someone may consider the same scenario. Right. You can think of a forward collision warning where someone gets an alert, maybe they put on brakes, and it stops, but then they get another subsequent alert for whatever reason a few seconds right thereafter, again, as they're decelerating, and they've decelerated to a plateau and then they need to decelerate again if you're at a high speed.

And so the analysis really hasn't

been done on all that, so the real point of this is, you know, again, the number's not that vital, the exact number. We know there's cases where these will be combined or the evaluator's going to look at this and determine, well, here's the actual number alerts we're going to look at for analysis purposes or conflict situations or other work that's going to be done. We're just really using these as benchmarks to determine, are we getting what we think is enough data that when we hand it off for evaluation purposes it's going to be sufficient to do the analysis.

MR. McCORMICK: So are you thinking for month 2 now you're going to re-estimate something closer to whatever your analysis tells you? I appreciate what you just said about the combination, because you could be getting, you know, the side awareness at the same time you've got a forward collision in heavy traffic. But how do you use that, the observed data, going forward in the next month? Do you re-forecast? Do you re-evaluate?

MR. GAY: Yes. There are monthly

estimates that we have, and we plan to track the collection of data on a monthly basis. And the real idea behind this was really a risk approach that, suppose you were not getting sufficient amount of data. How would you know you're not getting sufficient amount of data? And if you're not getting sufficient data, what are your risk response plans to that? And that was really the intent behind all this. It wasn't really to give a good look into what we're going to have for evaluation purposes. It was more of a risk management perspective of let's make sure we get enough data. If we're not getting enough data, we want to know about it in time that you can take action on that and introduce other events into the environment or do other things to make sure you're generating the necessary data for analysis.

MR. McCORMICK: Thank you.

MR. GAY: Yes.

DR. ADAMS: One real quick question. This is Therese Adams. Is there a -- are there any markings on the vehicles so

that one driver would know whether or not they were in the vicinity of another vehicle that was similarly equipped? Did they look like --

DR. SAYER: It's really hard to decipher.

DR. ADAMS: Okay.

DR. SAYER: You have to look --

MR. GAY: The only visible thing is going to be the antenna on the trunk lid or on the -- wherever you've placed that at.

MR. SAYER: But there are similar antennas that other people install for XM radio or --

DR. ADAMS: Yes.

DR. SAYER: -- their own navigation systems, so --

DR. ADAMS: Okay.

MR. McCORMICK: So you can't go out and create an incident, then.

DR. ADAMS: Well, I was wondering, all right, because you might -- some people -- I mean, you know -- well, at least kind of you could turn to see -- well, to see if it was

actually going to work, you know.

MR. GAY: You had one more question?

DR. RAJKUMAR: Yes. You talk about how GPS accuracy will affect the performance of your classifications, because GPS errors could be a few meters.

MR. GAY: Again, that's an issue for the evaluation team to deal with and what we're dealing with here is really just looking at the volume of data being collected, and is it where we think it's supposed to be at this point.

MR. SCHAGIN: You know, we have done a lot of work with GPS positioning accuracy to ensure that when we're in the model deployment site, that these are within the bounds of what the requirements are. That actually required a lot of work on our part to make sure. That's why the antenna is where they are; to ensure we have that kind of accuracy and that kind of positioning function that we need in order to -- because you can't put in -- inside the car necessarily, because it creates the distortions that peak outside the bounds. So we did a lot

of work prior to actually launching the model deployment to make sure that they're okay.

DR. RAJKUMAR: Thank you.

MR. GAY: So, in conclusion, here's why we really think we're on a great track as far as collecting the data. What you just saw is the observed results from the field are in line with our simulated estimates, and that's great for a lot of reasons. One, we're collecting data, we think, and two, the simulation so far has proved a decent tool for estimating this.

Now, second, the simulation model estimated that if you collect data at this level, you're going to hit those performance benchmarks of three alerts per driver per application over the life of this experiment. So at this point, you know, where we really feel is that we are collecting sufficient data and that this is only going to increase and we're going to have enough data to hand off to independent evaluation and do the analysis. That's really the goal of this whole experimental design work that I've been

working on for the last year or so, I guess.

Okay. If there's no more questions, I'm ready to -- one more?

DR. RAJKUMAR: Is there a notion of a conference of control estimates?

MR. GAY: We did not build that into this, no. Okay. Thanks very much.

MS. NODINE: I've developed this reputation for myself for being the one that always gets us back on schedule, but I don't think -- I don't think I'm going to be able to make it happen today.

MR. McCORMICK: We just came up with extra questions.

DATA AND EVALUATION

MS. NODINE: So I'm Emily Nodine, and I am leading the team that's going to be doing the evaluation of the data that's produced during the model deployment. So, per the -- oh, this is not my presentation.

MR. GLASSCOCK: Oh, I'm sorry. That's not yours?

MS. NODINE: It is, but it's not the

one I sent. It's on the stick. If you can't, it's -- I can run with it.

Anyway, so I'm going to be telling you about the data that's going to be produced in model deployment, and I'm also going to tell you about the evaluation that we're doing to provide support to NHTSA for the 2013 and 2014 decisions.

MR. McCORMICK: There goes your schedule.

MS. NODINE: I know. They're trying to sabotage it.

CHAIR DENARO: Emily, did you say you're from Volpe?

MS. NODINE: Yes.

CHAIR DENARO: Okay.

MR. ALBERT: And there hasn't been a question yet.

MS. NODINE: There we go.

MR. GLASSCOCK: No?

MS. NODINE: Did you unplug this?

MR. GLASSCOCK: Huh?

MS. NODINE: Yes, thank you.

So I'll start talking about the data. I'll tell you a little bit about the way that we prepared for collecting the data, and then also Mike Lukuc touched on it, but exactly what that data includes.

So before we could even start thinking about collecting data for this program, there was a lot of coordination that had to go on between us, as the evaluator, and also all of the teams that are going to be producing data. This evaluation was different than any evaluation we've done before in that rather than having our entire evaluation database be supplied by one team, it was being supplied in part by four different teams. Virginia Tech and CAMP are providing us with the data from the integrated vehicles. University of Michigan is providing us with the data from the after-market devices; one of the sets of retrofit heavy trucks, the integrated heavy trucks, as well as the vehicle awareness devices. Southwest Research is going to be providing us with the data from the other set

of retrofit trucks, and finally, Battelle will be providing us with the data from the transit vehicles.

So keep in mind that all of these four teams have their own method about the way they go about collecting data, they own equipment, their own native data formats. So really, each of these data sets are going to look very different as they're collected off the vehicles.

So this is a challenge, because each of these data sets cannot just stand alone. All of the vehicles are communicating with all of the other vehicles, so we're going to need to find a way to link them together so that we can map each data set to the others. And the way that we went about that was to work each of the four teams with the evaluator to sort of decide on what we called database guidelines. So we figured out exactly which elements of the databases need to be standardized across the teams and then which elements of the data it was sort of okay if everybody just did their

own thing. So we all agreed on those guidelines and that gave everybody a lot of flexibility to sort of do their own thing. But at the end of the day, we're going to have enough commonality that we can then merge the data into one common data set.

So this is a great thing not just for us as the evaluator, because it'll reduce a lot of our headaches, rather than having to learn four completely different data sets. But part of the goal of this program is when all is said and done, to make this data available for future research. So this is going to help anybody that's using the data in the long run to, you know, just have a nice sort of tied-together final package, rather than just a bunch of data haphazardly thrown together.

And we're not exactly sure how large the data will be at the end of the field test. We've projected somewhere in the realm of 200 terabytes of data, which is the equivalent to enough iTunes to play for 450 continuous years, so in my mind that's pretty enormous.

So what exactly is in the data? Mike Lukuc touched on this, but we have two primary types of data.

The first is numerical data. So in the numerical data we have four different categories. We have in-vehicle data, and that's the data that comes pretty much right off the vehicle's can bus. So, speed, acceleration and also the driver's input to the vehicle. So, braking and steering.

Of course, we have GPS data; the vehicle's location and heading.

The V2V data is all the logs of communication between the vehicles and also some of the logic of the applications and when the drivers are getting alerts.

And then we also have external sensors, and the external sensors just give us an idea of the surroundings of the vehicle and the environment. We have radar units, we have lane-tracking cameras, and we have vision-based ranging sensors.

So in the end we're going to have,

you know, I would consider a very comprehensive data set of numerical data, and to some extent it's really pretty much anything anybody could ever want, although I'm sure somebody could find a loophole for that one.

So the second kind of data that we'll be working with is the video data, and the video data is used to both validate the numerical data and also provide context. So what you're seeing here is just a screenshot of what the video data looks like from the integrated light vehicle. So there's actually six different video views. In the upper left, that is the forward scene. Then on the upper right you can see the driver's face, and --

MR. McCORMICK: They flagged out in our version.

MS. NODINE: And on the lower left, this is what we call the cabin camera, but it shows the instrument panel. And then on the lower right we actually have three different views. We have the left side, the right side, and the rear view.

And this video data is being collected continuously the entire time the vehicles are out in the field. So at the end of the day, we're going to have video data for every record of numerical data that's in the database.

MR. WEBB: Emily, George Webb. Just a quick one. When I'm hearing "data," just the integrated, or is this coming as integrated, RSE, wherever you grab it?

MS. NODINE: So, yes. I should have mentioned -- Jim talked about the vehicles with the data acquisition system. All of those vehicles will have video. They all look a little bit different. Some of the UMTRI data is -- it's black-and-white. So everybody does their own thing. That's why I specified that.

MR. WEBB: All right.

MS. NODINE: Yes, and the camera views depend on which specific applications those vehicles have.

MR. WEBB: But I'm going back to just the massive that you talked about as far

as all the information and so forth. Not just cameras and so forth, but that's from all the vehicles.

MS. NODINE: It's 100 and --

DR. SAYER: It's a hundred passenger cars that are UMTRI staffed, 64 passenger cars VTTI, and there's 8 trucks and 3 buses.

MS. NODINE: So those are --

MR. WEBB: So the information from the RSEs are not --

DR. SAYER: No. Well, that's collected too, but that comes by the back hall, the fiber optic system of the city.

MR. WEBB: Right, but is that part of that data pool --

DR. SAYER: Yes.

MR. WEBB: -- of stuff that you're getting in? So even though it's vehicles that are just transmitting the "here I am" message or whatever, you know, you're picking up that they're going by an RSE?

DR. SAYER: Well, and that's

exactly what Matt Smith showed earlier.

MR. WEBB: Right. Okay. Sorry.

MS. NODINE: Are there any more questions about data specifically before I move on?

DR. RAJKUMAR: Just a question. The steering wheel is on the right.

MS. NODINE: Yes. I don't have the answer to that question. This was provided to me from VTTI. I assume it's just that they're --

MR. McCORMICK: There's a function that you can set on the camera, recording software itself, that mirrors.

MS. NODINE: But this is a sample from some of the performance tests, so it's not going to be like that. Any other data questions? Sometimes everyone wants to know everything about the data. Sometimes people don't want to know any of the details about the data, so --

Okay. So, moving on to data analysis or evaluation. Our evaluation has

three primary goals. Everybody knows we're trying to look for safety benefits of the technology, but we're also looking at system capability, and system capability just means do the devices work as they were intended to. So, can they issue application alerts accurately, and can they communicate with all the different types of devices?

And then we're also going to look at driver acceptance, and this is really important with the introduction of any new technology, because if drivers either don't understand how to use or they don't like the technology, it's not going to be effective.

So today I'm going to focus on safety impact, because that's the area of our work that contributes most directly to the 2013 and '14 decisions.

So before I get into that, I want to take a second to go over the crash statistics, because really this is precisely what our safety benefits work is addressing, and these stats have also been misquoted, so I feel like this

is my chance to set the record straight.

So, every year in this country there are 5.4 million crashes with unimpaired drivers, "unimpaired" meaning that the driver's not drunk and the driver's not asleep and they could theoretically respond to the event.

MR. KENNER: What year is that? Is that for 2010?

MS. NODINE: No. I believe this is 2004 through 2008, but I would need to look at the report.

MR. KENNER: Okay.

MS. NODINE: So a combination of vehicle-to-vehicle and vehicle-to-infrastructure technology could address 81 percent of these crashes. And by "address," what we mean is potentially it could help the driver avoid the crash altogether. But for those crashes that it can't help the driver avoid the crash, it can at least reduce the severity. So it could potentially prevent fatalities or it could reduce the amount of injury in the crash. So the remaining 19

percent are primarily just single-vehicle crashes, and really what we're trying to do with this safety impact analysis is look at, how would these statistics change if connected vehicle technology were implemented.

MR. CALABRESE: Is the 81 percent simply the non-single-vehicle accident number? Where'd the 81 percent come from?

MS. NODINE: The 81 percent is 81 percent of all crashes with unimpaired drivers. So if it's just a vehicle on its own driving off the road, vehicle-to-vehicle and vehicle-to-infrastructure can't prevent that.

MR. CALABRESE: So 81 percent's simply the multi-vehicle accident?

MS. NODINE: Yes, 81 percent is made up of multi-vehicle accidents, yes. Yes.

DR. RAJKUMAR: And this is maybe a question for Kevin. Given the video image data, is that a mechanism for you to correlate that with your DSRC interactions to evaluate?

MS. NODINE: I don't understand the question.

DR. RAJKUMAR: So you have a forward-looking camera and then if the DSRC interaction says these two vehicles were within 30 meters, you should be able to conform that to the parameters.

MS. NODINE: Yes. Well, so that part of our system capability work is to look at the accuracy of alerts. So in the case that there's an alert, we can say, you know, this vehicle says they're here, this vehicle says they're here, it provided an alert. Is that really the case? So that's really what the video is primarily used for, for validating what the numerical data is saying.

DR. RAJKUMAR: And the accuracy of the time stamps would be okay with operating on different clocks. That's part of the issue.

MS. NODINE: Yes. And that's where all -- like the lining up of the data from the different data sets went in, because, you know, we want to actually look; this is the time that this data set says it was issued, and this is the time the other vehicle received it, and are

those aligned with each other.

MR. GAY: Yes, and the teams are working now to coordinate to make sure they understand what they're using for reference time and to make sure that everyone's aware of what's being --

MS. NODINE: Yes. That was a lot of our -- part of our coordination work, was to get everybody on the same page with respect to time coordinates and that kind of thing.

MR. KENNER: So could you provide to us the data analysis that shows which specific ones were single vehicle versus --

MS. NODINE: Yes.

MR. KENNER: -- the remaining 4.5?

MS. NODINE: So this is the reference, and I have -- and the notes of this slide I can get you after I have some of the breakdown of --

MR. KENNER: Okay. That would be great.

MS. NODINE: But, yes, if you want to -- I can get that for you.

CHAIR DENARO: This is Bob. I'm not sure I understood this. Eighty-one percent is all multiple-vehicle accidents; is that correct?

MS. NODINE: No. So it's -- so it's 81 percent of the 5.4 million crashes, --

CHAIR DENARO: Right.

MS. NODINE: -- which is all the crashes.

CHAIR DENARO: Okay. So I'm trying to understand the single vehicle. I know it's come up, but I haven't understood yet.

MS. NODINE: So what I said was primarily single vehicle. I think there's a couple random crash types that involve multiple vehicles that we can't address, --

CHAIR DENARO: Oh, okay.

MS. NODINE: -- but I would have to look back into it.

CHAIR DENARO: All right. That was the answer I was after.

MS. NODINE: Yes. For the most part, they're single-vehicle crashes.

DR. ADAMS: There might also be like animal-vehicle crashes.

MS. NODINE: That's another example, which is a single-vehicle crash. We can't put VIDs on a deer quite yet, you know.

DR. ADAMS: Not yet. Okay.

CHAIR DENARO: And another question is, are all vehicles -- I'm not sure how you describe it, but all vehicles capable of receiving information? Are they all also generating and emanating messages, VSMs?

MS. NODINE: Yes, at this point.

CHAIR DENARO: Okay. So is there a way to search the data -- I don't know actually exactly what you're storing, but is there a way to search the data and look for missed opportunities?

MS. NODINE: Yes. I'll get to that. Is that okay?

CHAIR DENARO: Thank you. Okay, yep.

MS. NODINE: So my next bunch of slides are about what we call the safety benefits

estimation methodology, which is a methodology that was developed by my group at Volpe, and it's been used over the years in a number of evaluations on this type of technology. So I'm just going to walk you through sort of the process, and then I'll get into some specifics of the methodology.

So first, the first step. Our final point is looking at fatality and injury reduction, like I mentioned. So the first step is to actually take the technology, put it out there in the field, and collect data, and that's precisely what we're doing with the model deployment.

So then from that data what we're looking for is how do drivers' behaviors change when the technology is introduced? So are they actually driving more safely, and if so, to what extent?

So then from there, based on those changes in behavior, we can figure out how many crashes would be avoided, and for those crashes that couldn't be avoided, the amount of harm

that was reduced, and from there we get to fatality and injury reduction. So this is just the general flow of our process, and I should also mention that with the introduction of any new technology, there's always the potential that in some ways drivers drive less safely with the technology. This is, of course, something we all know that we try to avoid, but it is something that needs to be considered when looking at the net safety impact.

So then we get to the math. These are just the basic equations that we use to support our methodology. So first, crashes prevented is equal to the crashes without the technology minus the crashes with the technology. That's very easy. And it's the same thing for harm. Harm crash production is equal to the harm without the technology minus the harm with the technology. So if we do a little bit of algebra and rearrange, what we get is crashes prevented is equal to crashes without, multiplied by the system effectiveness. So that's ultimately what we're

trying to boil this down to, and it's the same thing for harm. I just didn't put the equations up there again.

So this piece of the puzzle, the crashes without the technology, that's pretty easy, because that's just the state of the world today and we can actually measure that, and we get that data from the national crash databases.

So what we're left with is just crashes with the technology. In an ideal world, we could just put the technology out there, then we could measure the number of crashes that occur, then we could measure the before and after. But crashes are very, very rare events, so even in a field test of this size, we don't expect to see any crashes. And if we do, we don't expect to see enough that we could analyze statistically.

So we need to come up with another way to measure the numbers of crashes with the technology. And we do that through something we've developed called "driving conflicts." A driving conflict is, in essence, a very-high

risk, near-crash scenario that the driver had to intervene to avoid getting into a crash. So in one of these situations, it's how the driver responds to the scenario that will dictate whether or not a crash occurs. If they don't respond at all, they'll crash. If they don't respond in a timely manner or if they don't respond in the right way, they'll also crash. If they respond in the right way, they can still at that point avoid the crash.

So what makes these conflict scenarios great is that while most drivers will not experience a crash during a field test, most drivers will experience at least a handful of these high-risk conflict scenarios. So that allows us to see how they're behaving in high-risk situations.

So what we're looking for is with the introduction of the technology, do they potentially -- do they brake sooner when an event occurs? Do they brake harder? Do they make more effective steering corrections or potentially do they get themselves into fewer

of these situations to begin with?

MR. KENNER: Let me ask a question, though. This is Steve Kenner from Ford. Right now you're talking about the numerator "crashes with". Are you trying to take "crashes with" and make it "crashes with" that's applicable to the United States database, or Michigan or Ann Arbor?

MS. NODINE: So ultimately -- so the independent evaluation in itself does not extrapolate to that situation, but we're -- we have what we call a simulation tool that's going to be taking national crash statistics, combining them with our results to attempt to project the entire country as a whole with a hundred percent deployment, how could this affect our crash statistics.

MR. KENNER: Okay.

MR. McCORMICK: And this is Scott. So what you essentially end up doing, then, is you take the behavioral metrics that you get from this test and these series of tests to create a probabilistic model that you can apply.

Okay.

MS. NODINE: Yes. So we can see that the shift in the distribution of how drivers are behaving.

MR. McCORMICK: And do you map that? Do you matrix that against rural versus urban versus expressway versus -- or does it just kind of apply to the high level?

MS. NODINE: I want to say it's applied at a high level. However, we do break down the different -- you know, based on the vehicle dynamics, we put them into various bins, and I think those might map pretty closely with rural versus urban, the kinds of crashes that you see. So maybe to some extent, but not directly.

MR. McCORMICK: Well, then that would make -- the vehicle model type also has a direct bearing on weather conditions.

MS. NODINE: Yes. And I do not know if we're taking weather into account.

MR. McCORMICK: Okay. Thanks.

CHAIR DENARO: I didn't understand

something you said earlier. You said you wanted to determine if they, for example, braked earlier. How do you determine that --

MS. NODINE: Well, so --

CHAIR DENARO: -- if you're only looking at -- with cars equipped?

MS. NODINE: So keep in mind we have -- for the forward collision, that's easy, because we have a forward radar. So we can tell the exact vehicle dynamics and the time to collision and the distance between the vehicles, so we can see, you know, when they get an alert compared to when they don't get an alert, at what point in that situation are they reacting. So maybe they're braking, you know, with more distance before the vehicle or maybe -- does that make sense?

CHAIR DENARO: Well, so are you saying that you are looking at cases --

MR. McCORMICK: If they don't brake, they crash. If they don't brake in a timely manner in a situation, this is how I understood how she's describing --

CHAIR DENARO: No. I'm getting to the point, do they brake earlier. How do you know how they would have braked without the system? That's what I'm not understanding.

MR. McCORMICK: Oh, I see. Good point.

MS. NODINE: Because what we're doing is comparing the vehicles -- the interactions with vehicles that are equipped with V2V to the interactions with vehicles that are not equipped. So there's no way that the driver's going to get a warning in that scenario. So really, it's how does the application warning change their behavior?

CHAIR DENARO: So is this back to my earlier question, that you are looking at cases where you didn't have an alert, but you're finding a case where there would have been one, and then you're analyzing how they braked?

MS. NODINE: So this is -- it's changing the topic, but that's fine. So what we're -- the way that we're going to handle missed alerts is that -- I'm going to get to

the data mining next. Data mining is essentially, you know, like digging into the data to try to find -- so what we can do is mine for these situations that are identical to the ones where alerts were issued, --

CHAIR DENARO: Yes.

MS. NODINE: -- but that we didn't see an alert happen.

CHAIR DENARO: And that's what you're going to do.

MS. NODINE: Yes.

CHAIR DENARO: All right.

MS. NODINE: And then we can go to the video and say, well, why didn't -- why wasn't an alert, you know, issued?

CHAIR DENARO: That's all I'm asking. I didn't understand.

MS. NODINE: Yes. And a lot of times it's not that the alert was even missed. It's that suppliers will build into the algorithms like certain situations where they suppressed the warnings. So sometimes it's an intentional --

CHAIR DENARO: Oh, really?

MS. NODINE: Yes.

CHAIR DENARO: Wow.

MS. NODINE: Like if -- for example, if the driver braked within two seconds.

CHAIR DENARO: Yes.

MS. NODINE: They assume that then the driver's engaged in the situation and that they know what's going on.

CHAIR DENARO: Yes. I see.

MS. NODINE: So that's the way that they help prevent issuing lots of not necessarily false alerts, but unnecessary true alerts.

CHAIR DENARO: Okay. Thank you.

MR. ALBERT: While I recognize your statistic about urban versus rural and single vehicle, and I know most rural folks are out driving drunk and looking for deer to hit --

(Laughter.)

MS. NODINE: I'm from a rural area, so I won't take that very --

MR. ALBERT: And I'm the rural guy

in this group, so I can say that.

MS. NODINE: Okay, okay.

MR. ALBERT: I would be helpful in that we know that 60 percent of the fatalities are in rural areas and you could extrapolate this to urban versus rural. Could be very helpful.

MS. NODINE: Okay.

DR. RAJKUMAR: And, of course, Steve was really suggesting that groups of deer would be accessories.

MR. ALBERT: We're not getting into smart animals now.

MS. NODINE: Someday. Is this clear? It took me four years to figure out how to explain conflicts, and I feel like I'm starting to get to the point that people are getting it, but --

MR. McCORMICK: The picture's helpful.

MS. NODINE: Really? I won't admit how long it took me to create those little skid marks there. And then, of course, the first

thing somebody said was, "How's the vehicle have brakes? They don't have skid marks."

So anyway, the last thing I want to say about conflicts is the way that we define, for example, an intersection conflict is very different than the way that we would define a rear-end conflict, which I'm showing here. So our entire safety benefits methodology is broken down by individual crash test, and then at the end we can compile it to look at the safety benefits as a whole.

So the great thing about conflicts is everything I just said, and the bad thing about conflicts is that they're really hard to find, because we're going to have this giant pool of 200 terabytes of model deployment data, and how do we go in there and extract only the little bits of information that we want to use in our safety benefits work? And we do that with something we've developed called "data mining algorithms," and really the way that they work, we start with the raw data, which is represented by the yellow circles, and that's

the data that's provided to us by the teams. And from there we calculate a number of intermittent steps that define the vehicle's dynamics, the relative dynamics between the vehicles, and also the driver input to the vehicle. And then from there we can set our thresholds of intensity that we're interested in and we can extract our conflicts.

And really what this process does is, it creates an entire new database from the original data, and that's what we use to do our work. And these algorithms, of course, we do a lot of refinement, but everything that's going to be used in the safety benefits work needs to be validated, and we do that with the video data.

So what you're looking at here is just a screenshot of the tool that we used. It's an older version, but the tool that we use in all of our video analysis validation work, and what it allows us to do is pull up all of the views of video simultaneously with the numerical data. So we can look at the conflict,

what is -- you know, what is the numerical data saying that we're seeing, and is that really what we're seeing in the video. So it's sort of just a second check to make sure that everything we're using is kosher. And then on the right you can see there's some input fields, and those allow us to, as we go through, catalogue certain elements of the conflicts or of the alert, and that goes back into the database for part of our work.

CHAIR DENARO: Have you run that data mining algorithm yet from the data?

MS. NODINE: We have not run it for this program. We've done it many times for other programs. You actually have to calibrate for -- you can't just take a canned thing and apply it to new data, because it really depends on just the distribution of everything you're seeing.

CHAIR DENARO: Okay.

MS. NODINE: So, and also, you know, the data that we're using in this project is just completely new to us. So we still need

to go and program for all of this new data and --

CHAIR DENARO: Yes. Okay.

MS. NODINE: Yes. And that'll happen. Actually, I'll get to that.

But I have a little video. Just to sort of show you what is the value of this video analysis work, because it is really tedious and it's really time-consuming, but just to set this up --

It's right on the upper left.

MR. GLASSCOCK: Yes. I was trying to find that.

MS. NODINE: Well, it'll run through a couple times. But what you're seeing is a driver who is driving and texting, and you can see here on the lower left both of his hands are off of the wheel. And then the face view, you can see that he's looking down, and then he'll get a forward collision warning right there and he's very surprised and he's --

(Laughter.)

MS. NODINE: Yes, you can play it

through again.

MR. CALABRESE: What did he say?

(Laughter.)

MS. NODINE: Yes. The audio track on that one was good, as well. But, yes, ten seconds in is when he gets the alert, and he looks up and he avoids the crash, so --

DR. RAJKUMAR: And this is not an actor?

MS. NODINE: No. This is from a previous project, a forward collision warning. He was an aggressive driver, to say the least. And all his stuff slides on the floor.

So what I'm trying to get at is if all we had was numerical data, we would know that the driver slammed on the brakes, we would know that an event had occurred, but we would have no idea the events leading up to that event and what caused it to happen. We would have no idea how the driver reacted to the alert, whether or not they were actually surprised by it. So this does add a lot of value for us.

So, for my next slide I'm just going

to walk you through our next steps for specifically the light vehicle evaluation, because that's what's on the horizon with the 2013 decision.

MS. NODINE: Yes, yes. Anyway, so the model deployment is going on now and the light vehicles in the model deployment are equipped with a hundred after-market safety devices. I'm sorry. With DASes, 300 after-market safety devices total, and then we had the 64 integrated vehicles. So halfway through the model deployment, which I think is about March, the first 64 integrated vehicle drivers that are out there now are going to be finished, and the new drivers are going to go into those cars. So at that time we're going to take that chunk of the data and we're going to use that to run our data mining algorithms and do preliminary safety benefits analyses, and we're also going to look at that time take any ASD data that's out there in the field and we're going to use that as well.

So that data will be used to provide

preliminary safety benefits results for the 2013 decision. Then as the rest of the data comes in, we're going to be continuing to validate, see if there's anything new that we can learn from those extra set of drivers, and essentially validate our results.

So, thanks for listening. That's all I have, but questions?

MR. WEBB: George Webb. This slide, you did have the category of distractions. I know it's an older study, but what kind of percentages maybe came out of that as far as saying other events or whatever were attributed to distractions?

MS. NODINE: So that's really hard to answer, because you can say what percent of events included secondary tasks, but it's really hard to tell if just because they were eating, that actually caused them to -- so, you know, this one I showed. But, you know -- but there's a lot of stuff that's really in a gray area where they're eating something, or maybe they're thinking about something when they got into a

conflict, but you can't always map it that correctly. But we do catalogue, you know, if we think a distraction was contributing to the event or just that it happened in general, because sometimes the fact that people are doing more or less stuff in the vehicle can be representative or explain something.

MR. KENNER: Have you ever used this methodology before, and do you have a study that then correlates your projection to the actual data?

MS. NODINE: Yes, I've been asked this before. We don't, because the results that we have are fairly recent and the crash statistics usually take a while to come out. So we -- so now that -- you know, are you asking like there's forward collision warning systems in the field and do our results map to the benefits we're seeing?

MR. KENNER: Well, or -- yes, or even if you were looking at, you know, older technologies right in the past. Do you have anything that was published that shows the

methodologies studying stability control or maybe something older?

MS. NODINE: We don't at this time. I think part of the reason is that the crash statistics aren't so detailed as to say this is what helped prevent a crash or this is what -- or, you know, these cars have this technology and they didn't get in a crash and these did, and, you know, that type of thing. So, and I'm also not super familiar with the way that the crash statistics look, so the answer's no, we have not done that yet. People keep asking me that, so we probably should do that.

MR. KENNER: Yes. Okay. Thanks.

DR. RAJKUMAR: A very similar question to Steve's. The question is after you do the data mining, do you have a sense for what the false positive ratio to false negative ratio would be?

MS. NODINE: So the false positives and the false negatives are very -- they're a completely separate thing from the data mining. That's part of our system capability, so we'll

actually go through and watch a video of every single alert that's issued in model deployment. So then we'll have a really good idea of the false positives. The false negatives, again, are a little more subjective, because sometimes even when it looks like a miss, it might not truly be a miss. But we will have a general idea of the amount -- you know, the extent to which those kind of things happen.

DR. RAJKUMAR: And do you expect that to be 5 percent? 10 percent?

MS. NODINE: Well, for false warnings or misses?

DR. RAJKUMAR: Yes, for false positives.

MS. NODINE: We don't have an expectation. We've never evaluated any vehicle-to-vehicle technology before, so --

DR. RAJKUMAR: In looking at it from the mandated position perspective, then all this data and conclusion is submitted, I guess, to Congress or whoever else, the public could come back and say is this data valid or not, our

conclusions valid. So it would be useful to have some expectation --

MS. NODINE: Oh, you mean like what percentage of false alarms is acceptable? Well, that's really tricky, because -- I mean that's really depending on the driver, too. I mean just from past experience, we've had systems that have an exorbitantly high rate of false alarms that I would think would be completely unacceptable. But drivers are actually okay with it, because if they see that one time it helped them, they'll put up with a lot of false positives. So it's really sort of a personal thing and it's also, I think, dependent on exactly what the application is. If it's a lane tracking system and it's warning you all the time and you're not leaving the lane, that's much different than a rare event where, you know, every once in a while you'll get a false warning. So I don't know that it's as cut and dry as that, but we will -- we will be able to see some metrics and compare that with the driver acceptance and see where we stand.

DR. RAJKUMAR: In that case, maybe John and Steve could probably say more. I think - I've heard that we want 90 percent accuracy for something to be deployed or something along those lines.

MR. KENNER: Right, right. I would say -- I was mentioning this to Valerie. Right. I think it's the -- Infinity is now -- there's an open ODI investigation at NHTSA because of two false positives on their autonomous braking system. So I would suggest that, you know, 90 percent or 95 percent is not okay, not even close to okay, and the acceptance of customers to things like false positives is pretty close to zero. So if you look at a J.D. Power type survey, they're not going to tolerate it. Right.

So I think that's one of the biggest concerns we have, and so if you look at the warning systems that we have, if there's a lot of false positives. I think it's going to be a risk for us, right, because then it's going to give customers some concerns and, you know,

generally our experience has not been that they're tolerant of the systems if there's a downside. Right. They want everything, and we're supposed to deliver it to them, everything.

So I think it's going to be really careful. And that same false positive if it's in autonomous braking scenario, right, it's also even worse because you've got 0.4 to 0.8 Gs all of a sudden applied that you didn't want to have applied, and, you know, that's something, again, customers are, you know, not tolerant of and, you know, there's the open government investigation on it as well, which means we as a society wouldn't tolerate that, either.

So I think we have to be really careful as we go forward here and we've got to all be comfortable that the customer acceptance of the system when we launch them is going to be good. We've got to be really comfortable because it's going to set, you know, everyone's expectations. It's going to be how people view this technology from that point on. Right.

If we get off to a wrong start, it's going to be something that's going to really influence, I think, the acceptance, and so it's going to be really important for us to understand that and maybe do, you know, a variety of studies on that beyond, you know, just this model deployment analysis.

MS. NODINE: Yes. I was going to say there's not -- as far as I know, there's not a ton of data out there with respect to like what threshold drivers will and will not tolerate, so -- but keep in mind, I mean nothing in this program is automation. A false alarm with automation is a much bigger deal than a false alarm with --

MR. KENNER: Agreed. But even at that, I think you'd find that most of us, all the OEMs that have the -- I think each one of the eight manufacturers have, you know -- none of them have the same, you know, driver alerts relative to what they see or what they hear, and so -- but I think almost all of us also developed those using a lot of customer

research. So we would say we used our Vertex driving simulator with hundreds of people and all kinds of scenarios to be able to develop the specifics of what they see and what they hear to a point where we think it's going to capture their attention. It should be a distraction in that you want them to say, hey, you're doing something dangerous and you need to do something. But you want to then make it so that if there are some amount of false positives, it isn't to the point where they would then just reject it outright.

And so I think there's a lot of research that it's not in the public forum is the issue. So as we go forward, though, we need to just, you know, make sure that we do the studies and we have high confidence that the way we're going to put these things into production is something that is going to make people want this technology more than want to avoid the technology.

CHAIR DENARO: Steve, I think you raised a very important point -- this is Bob

-- in passing also. J.D. Power is a great amplifier of all of this.

MR. KENNER: Yes, and Consumer Reports.

CHAIR DENARO: And Consumer Reports, yes.

So, regardless of the perception or the reality out there, if they go ahead and report on it, this just raises it and maybe makes you guys, you know, be even more cautious. So that's a -- I think this is an institutional issue that's very important to this whole discussion.

John, did you -- do you --

MR. CAPP: Well, that's not necessarily unique to the V2V aspect of it, --

CHAIR DENARO: Sure.

MR. CAPP: -- but in general with the technology. Customers are not that tolerant, we find.

MR. KENNER: Yes.

MR. McCORMICK: I just wanted to add something to Steve's original point. Your

basic framework that you have for doing the model, it is -- essentially that's been the first 26 years of my career in aerospace. That's the same basic one that we did for all of the threat assessments, so fundamentally it's correct to that aspect. Not addressing the trust and quality of service parts of it, but that part of it, I think, there's a lot of stuff that you can probably get from the FAA and the aerospace industry that has direct relevancy in those analyses.

CHAIR DENARO: Are you going to attempt to analyze the root cause of the false positives, or is anybody going to --

MS. NODINE: The false alerts?

CHAIR DENARO: Yes.

MS. NODINE: Yes, yes. Maybe not the root cause, because we don't dig that far into the software, but we can at least categorize them as, was it out of lane, false alert, or was it just completely sporadic. So, yes, we will get into that.

I know I'm out of time, but I wanted

to mention when Mike was talking, we were talking about the over-reliance. We are going to get into that with our work as well, because we'll see, you know, with our driver distraction work, are they more likely to be distracted or -- you know, this kid I showed you the video of, he actually admitted in his questionnaire in his exit interview that he was much more likely to text because he knew the system would give him an alert. So, you know, that's the kind of thing that we will get at, at least anecdotally.

CHAIR DENARO: How are you going to get it? Oh, anecdotally.

MS. NODINE: Anecdotally potentially, but we'll also try to quantify driver distraction. And if you start to see more secondary tasks in driver distraction with the technology, you could -- that could suggest that we're seeing some sort of a --

CHAIR DENARO: And when you say "anecdotally," you mean people reporting, admitting.

MS. NODINE: Yes, right. Not

necessarily something we can quantify, but just comments that we hear that we know that it exists.

VICE-CHAIR KLEIN: Can I ask one quick question before your time is completely up? Do you have any sense about how NHTSA regards this? What evaluation outcome would NHTSA receive and say, "Oh, this is a green light"?

MS. NODINE: I think this is a great segue.

MR. SCHAGRIN: You know, that's a great segue to our next speaker.

(Laughter.)

CHAIR DENARO: While we're switching, a question for our OEM guys. Do you believe that the consumer or the driver will have the option of turning it off?

MR. CAPP: John Capp. All the features we're currently deploying provide a way for the driver to turn it off.

DR. RAJKUMAR: As opposed to opt in?

MR. CAPP: That's right. So the

system is delivered on, and then the customer can turn it off, with the exception of the Ford system -- that is, the My Key System -- where parents can control what the kids can or cannot do. We don't allow, then, any of the safety features to be turned off.

CHAIR DENARO: Just like my ESC button.

MR. KENNER: That's right, unless your dad gave you the key and didn't allow you to do that. Right.

NHTSA DECISION SUPPORT

MR. RESENDES: Good afternoon. I'm Ray Resendes with NHTSA, and I don't know what Emily was talking about. I have no idea.

(Laughter.)

MR. RESENDES: We actually have been working very closely with the Volpe Center and the Joint Program Office and the car manufacturers on this program for over ten years since the FCC first awarded the -- or designated the frequency for this. And it was in 2009 our research from working with the Crash Avoidance

Metrics Partnership and others had shown that this DSRC, coupled with GPS, looked like it could be very effective at helping drivers avoid crashes.

So we put in -- an important document to NHTSA is our rule-making and research priority plan that in 2013 we would make an agency decision, and the exact wording is pretty vague here. "The agency will assess the research data, technologies and potential countermeasures to decide on next steps."

So to roll back, the reason I think I was asked here today were two questions. One, how's NHTSA going to use this data from Safety Pilot to help inform this decision? And then there was another question about do we think we need other data to help inform this decision.

So the answer. I'll explain the first one, and the answer to the second one is no. We've been working on this for ten years. In 2009 we laid out the V2V program roadmap and that lays out all the research. That's

where the 81-percent number came from. We looked at the target crash problem and worked all the way through for all the data we would need, and I'll walk through that in a second. And we complemented that with Safety Pilot to give us some real-world data to look at how -- the effectiveness.

So a question I often get is, so what are these decisions? What's an agency decision mean? And it could range all the way from a regulatory decision; a consumer information program like NCAP; it could mean this looks pretty good, but we're missing data, so we need to do more research; or, heck, this doesn't work, never mind. But so at this point all decisions are on the table. We're going, as NHTSA does, where the data drives us. So we've -- no pre-decisions have been made.

But when we laid out the roadmap for the vehicle-to-vehicle program, it was designed to feed all of the information we would need to support a regulatory decision. FMVSS is Federal Motor Vehicle Safety Standard. That's

a NHTSA regulation. The regulation on regulations requires these pieces of information. It has to address a safety need. It has to be practicable, which is a word I've never heard anyone use except by people from NHTSA, which means "practical," and the technology, more important, basically the technology has to exist. We can't imagine a hovercraft and say, "Ford, go build this."

Compliance. We have to be able to objectively measure compliance with the standard. And then it has to address a specific vehicle type, and this can range all the way from light vehicles through motor coaches, heavy vehicles, motorcycles.

So I can tell you where -- how we're filling in all of these bins through the vehicle-to-vehicle research program and the Safety Pilot program.

So, no decisions have been made except one. The 2013 decision will address light vehicles. In 2014, assuming things go well in 2013, we'll start to make decisions on

heavy vehicles. If you're familiar with heavy vehicles, there's a whole range of those. 2014, we'll look only at Class A. That's your large tractor-trailer, the heaviest vehicles, which also would probably extrapolate to motor coaches, as well.

MR. BERG: So is there going to be additional data for heavy duty, or why is the date different?

MR. RESENDES: There is -- everything you need to make the heavy vehicle decision, you need everything that's in the light vehicle program and then a little bit more.

MR. BERG: Okay.

MR. RESENDES: And then, as is common with safety systems such as electronic stability control, light vehicles are kind of easy, and then you have to look at every single type of heavy vehicle and you have to start filling in all the data, so there's just a lot of -- it's a lot more work to just sort of wrap everything up.

MR. McCORMICK: But since you can

regulate interstate heavy vehicle requirements in a much more efficient fashion than you can light vehicles, do you think the process will be accelerated?

MR. RESENDES: That would be Federal Motor Carrier --

MR. McCORMICK: Okay.

MR. RESENDES: -- Safety Administration. That's more on the operational side. So we would only be addressing basically new vehicles.

MR. McCORMICK: Okay.

MR. RESENDES: The safety need. This was the early work that the Volpe Center did for us at the beginning of the program that got initially to the 81-percent number. So that is of all crashes, what does vehicle-to-vehicle technology address? By this time next year we will have completed a preliminary benefit estimate: How effective are we at each of those crash types? That will be based on the Safety Pilot data, the vehicle-to-vehicle program where we're running test track work and

simulation work, looking at both crash warning applications that are in Safety Pilot, as well as forward collision avoidance, which has braking and a much more -- a more -- not effective, but a more comprehensive intersection collision avoidance application, which is not in Safety Pilot. That's being developed with the car companies and it will be tested on a test track and simulation to see how effective that is.

We will have a preliminary cost analysis. This is far more complicated than anything NHTSA's ever done before. We've got the equipment on the vehicle, and that's kind of easy. That's just costing out those pieces that were on that diagram that Mike Lukuc showed you earlier today. But also with this, even though we're saying vehicle-to-vehicle, there's the "I" part. There's the infrastructure required for security, and right now we're trying to figure out what is the minimum infrastructure we need to support the security system, and that's all the back office

infrastructure you need to make sure that you have the security certificates and certificate revocation list operating for the program. So we'll have that done by this time next year as well.

And then on to practicability. Typically NHTSA likes to do performance requirements, so for the application side, the applications are things like forward collision warning. That's pretty straightforward. We've done that for vehicle-based systems already in our NCAP program. We'll have that information done. Actually, we have most of that done already. Through our human factors program, we're looking at driver-vehicle interfaces, trying to see how far we need to go in providing guidance on what is the modality, display type, warning timing for the -- for the driver-vehicle interface. Does it need to be visual, audible or haptic, something you feel like the rumble seats someone mentioned earlier.

So we're getting some experience, real-world experience with that from Safety

Pilot, and we have the entire research program going on for human factors for connected vehicles. And that also takes into account, once you open this information portal into the vehicle for safety systems, what are the impacts going to be when the mobility guys and the guy with the burger coupon is trying to force information into the vehicle.

The infrastructure requirements. How do we specify those? NHTSA's never -- NHTSA does not have the authority to specify that somebody go out and build a security infrastructure. We can only specify the equipment that is on a vehicle. So we're looking at, do we need to do that, how far do we need to go, and how do we do that? That also has to be done by next summer.

The after-market is an interesting area where we do have some authority, and this really deals with the market penetration issue. You know, as Steve said earlier, we're going to see -- or we're only going to -- or I think it was John, actually -- we'll have limited

benefits in the early deployment because of low penetration levels in the entire fleet. Is it worth it and is it needed for us to really try and force the after-market so that we get existing vehicles out there with safety applications?

You know, the first issue is, is it -- can it be done effectively? We had a very hard time in Safety Pilot getting effective after-market systems from the technical standpoint. So if we can get past that, NHTSA does have the ability to say if you decide to be an after-market device manufacturer, the deviece has to perform at such a level. We're looking at right now our ability to require how those pieces of equipment would get installed into vehicles, and more importantly, how they are maintained. You heard their issue earlier. The ideal situation is -- the DSRC antenna's pretty easy, but the GPS antenna really needs to be on the outside of the vehicle, dead smack in the center of the roof. For after-market, there's no federal entity that really has the

ability to require that they get installed and maintained that way, and if they're not, they're not providing useful basic safety messages for the integrated vehicles. So we're working through that issue right now.

Standards is how we interface with the voluntary standards that are already in place. This is the SAE standards for the basic safety message, the IEEE standards, the 1609s, that specify basically the radio. NHTSA, if it decides to go to FMVSS, has to decide how much of those do we need to include. Some of those, touch mobility and non-safety applications, which we don't have authority over, and we also don't like to stick in a regulation, "Go look at a standard that you have to go buy." So, we're working through that issue.

The security system is probably the big pole in the tent right now, trying to figure out how can we practically and affordably implement that, and then the user acceptance, looking at do drivers like the system. We saw

in the driver clinics, when they see how effective they are in a situation, they like that. Safety Pilot will tell us how they like it in a real-world situation, and when they start seeing false negatives and false positive. And we also have some side work on this as well, looking at the whole false positive issue, what causes them, and drivers' tolerance of them.

CHAIR DENARO: Okay. This is Bob. How does the OEM community engage in this process with you?

MR. RESENDES: Very heavily. They have been working with us on developing the applications that we're testing. Remember, these are basically reference applications. So if these went to regulation or even if the car companies decided on their own to deploy these, they're going to go and make hopefully better versions of them, more complicated ones. They are -- I think the driver -- the human factors work is primarily being done with human factors contractors, but there's a peer review effort going on there.

CHAIR DENARO: Did you say peer review?

MR. RESENDES: Well, peer review's probably not the right term, but we've been talking with their counterparts about how we do it, what we should do. So there's been some public meetings on that.

The whole security system is being developed with CAMP, as well as with Booz Allen, who's our contractor on the infrastructure side. The OEMs are sitting on all the standards committees feeding into that, and they did the driver clinics principally for us. So they're very much engaged in this.

Okay. Compliance. Two things here. The straightforward side is testing the safety applications. We have the objective test procedures for all of the applications that are in Safety Pilot done right now. If we were to -- you know, and they're voluminous, complicated to run, and the important thing here is trying to figure out how to condense that down to a few test procedures for NCAP for

forward collision warning. We have that down to three test procedures.

And the other issue is making this repeatable so that you don't have to go to the government's test track in Ohio to run this. Any OEM, any supplier should be able to run these on a test track using readily available equipment. So that's writing the procedures in that fashion so that they're repeatable.

The big issue here is on developing a technical target. For collision warning systems, you can run these with -- where you're following a vehicle, because if all goes well, you're not really supposed to hit the vehicle in front of you. For collision avoidance systems or collision mitigation systems, which by definition you're hitting the vehicle in front of you and you want to be able to run that test more than once, you would rather not use a vehicle in front of you, since they're kind of expensive. So we're developing a -- what we call a guidable -- key word -- soft target, which can be hit many times and hopefully will

be used for other charts as well.

MR. McCORMICK: I'm just curious. Why isn't that just performance-based compliance test? Why would you want to test applications and hardware? Unless I'm misreading that.

MR. RESENDES: It's two different things here. Applications is very performance --

MR. McCORMICK: Okay.

MR. RESENDES: -- is performance based. Does the forward collision warning -- does the warning go off at a timed collision of "X".

MR. McCORMICK: Okay. So it is performance. It is performance.

MR. RESDENDES: Okay. The other part that I haven't gotten to yet that we're just trying to -- it's taking a lot of thought on our part, is we have all the technical requirements for the DSRC radio, the GPS, the security system. It is how far does the government need to go on specifying those?

Because unlike a performance requirement, everybody's got to be using the same radio, and so we're working through that right now and that's an issue where we will do a lot of peer review, because --

MR. McCORMICK: And why do you say they all -- I mean they all have to be using the same communication protocol and they all have to be operating within the same bandwidth limitations, but physically they don't have to all be using the same range.

MR. RESENDES: We don't normally go to that level of detail.

MR. McCORMICK: Oh, okay, okay. Thank you.

MR. RESENDES: You know, and then for the security system, as I said, the issue of we can require that the vehicle use a public key infrastructure or security system, but we can't require that somebody go and stand up a large server farm to develop the certificates and distribute them. So we're figuring out our authority and how we would implement that.

VICE-CHAIR KLEIN: Question. Hans here. If the system becomes somewhat of a generic platform and there's safety applications that are crucial and they're subject to regulation, but additional applications start to run on this platform and there's risks of cross-application interference, suddenly there's latency that was never seen before because of this commercial application, are you anticipating how to test for those or set standards for those? Would there be a firewall function or some kind of separation standard?

MR. RESENDES: The way -- the original concept for DSRC was we had all -- we had full bandwidth, we had a control channel in the middle that normally you were talking on that, and then you would go to one of the other channels for -- you keep going to the safety channel. And then if you wanted to pay a toll or some other application, you'd be told on the control channel to go talk to another channel. For latency purposes, we realized

when you're in a crash warning situation, you don't want to be on the control channel when you miss that, "I'm going to run into Bob Denaro."

So the way the system's going to work, you have a security -- a safety radio. You're always on that. Those other applications will require you to be on -- have a second radio which NHTSA does not -- the government does not have the authority to mandate or regulate that you have.

VICE-CHAIR KLEIN: Physical device.

MR. RESENDES: Somebody may be clever and figure out how to integrate those, but we don't have any authority on that mobility side. We may want to encourage it to expand mobility in environmental applications, but we don't have that authority.

VICE-CHAIR KLEIN: So on the one hand it's absolutely designed in to have additional applications, and the other hand you've got also a physical separation.

MR. RESENDES: Right.

CHAIR DENARO: But -- okay. So there's no path for someone to develop an integrated solution where there's one radio. It's going to have to be two? Is it open that somebody could prove --

MR. RESENDES: In software somebody could develop a radio that had multiple antennas and it would be one box. But my guess would be that if NHTSA was to mandate it, it would be that the vehicle had to have a radio that broadcast on Channel 117.

CHAIR DENARO: It's dedicated.

MR. RESENDES: And then if you could do other things with that, that's -- you'd have the ability to do that. And if you go back to the beginning, we have to show that we are addressing a safety need. So, to move forward, we probably have to say -- you know, we have to say which safety problems we're addressing. So we'd have to somewhat specify those applications. Mobility applications, environmental applications don't support that,

so we can't include that.

And that's it.

MR. KENNER: So, Ray, a quick question on the cost analysis. So you're really going to just analyze the cost of the incremental equipment and not make any assumptions about the elimination of any other sensors or anything that may pre-exist on the vehicles?

MR. RESENDES: Right.

MR. KENNER: Okay.

MR. RESENDES: Yes. There's no - yes, we can't -- you know, one, we can't give any -- can't give you any leniency that you only have to have three tires because you did this.

But also we can't presuppose that you're putting forward collision warning or something else on there.

MR. KENNER: Yes. Okay.

MR. CAPP: And, Ray, John Capp here. Those benefits that will go with those costs somehow will be benefits that will accrue into the future; right, I assume? I think it's one of the challenges, too, is figuring out --

MR. RESENDES: Yes. You know, the work that the Volpe Center is doing is helping us identify at the various penetration levels the benefits, some of the applications. Electronic emergency brake light, for instance, requires lower penetration levels for effectiveness than something like intersection movement assist. So we --

MR. CAPP: But some vehicle that may be required to have some equipment for "X" number of dollars in year one may have no benefit, and yet for that same vehicle, add some years and add some penetration, and it'll have "X" benefit, and somehow you have to have the -- it's like calculating an annuity or something; right?

MR. RESENDES: Yes, very much.

MR. CAPP: Net present value, yes.

MR. RESENDES: Yes. I mean we are -- I mean this is unique. We've never had to do anything like that before. Typically we've always had to say just sort of at the end state what's the benefit there. But even if we said

-- you know, even if we do that, we're going to get asked that question, well, what happens in years one through 20? So we will document that.

VICE-CHAIR KLEIN: So just -- not to flog a dead horse, but definitely a step-wise implementation is very much in the cards, even with low up-front benefits until you hit critical mass.

MR. McCORMICK: What do you mean by step-wise?

VICE-CHAIR KLEIN: So short of hundred percent, everyone as of January 1st of next year must have this device.

MR. RESENDES: We only have authority over new vehicles, so we can't go in and require that you retrofit your old vehicle.

VICE-CHAIR KLEIN: You can't even -- I thought the authorities -- okay. So this is -- it's not even on the table to mandate a hundred percent implementation because nobody has that authority.

MR. RESENDES: No. All the

after-market is looking at do we need to and will we encourage after-market.

VICE-CHAIR KLEIN: Right.

MR. RESENDES: But that's -- if you look at -- you know, other examples have been the digital TV conversion where the government gave out coupons. That's really the -- that you'd have to go down to the state level where Michigan could require to renew your vehicle registration, you'd have to go buy this box. But at the federal level, we don't have that authority.

VICE-CHAIR KLEIN: So that's on the table. That's a big parameter.

MR. McCORMICK: Except for interstate commercial vehicles.

VICE-CHAIR KLEIN: What's that?

MR. McCORMICK: Except for interstate commercial vehicles.

VICE-CHAIR KLEIN: Right. They can do a hundred percent, but I mean it makes it a little more urgent when you have to get some other consumer apps passed that might give

people the incentive to pay their own money and get up and going for consumer reasons, and as a byproduct, they get safety functionality.

MR. RESENDES: In the aftermarket.

VICE-CHAIR KLEIN: Yes, in the aftermarket.

CHAIR DENARO: Ray, you introduced a couple of infrastructure kind of things like even for V2V there's a certificate, infrastructure fees, there's this -- be it type of pool or certification or whatever it is. Where are you guys in figuring who runs that? Who's in charge of that piece?

(Laughter.)

CHAIR DENARO: What's that?

MS. BRIGGS: That's for tomorrow.

CHAIR DENARO: Tomorrow. Great.

MS. BRIGGS: Tomorrow.

CHAIR DENARO: We're going to get the answer tomorrow.

MR. RESENDES: Valerie knows it.

CHAIR DENARO: Apparently.

MR. KIRBY: You know, in doing your

benefit assessment, and you're going to take this data set and then look at all kinds of different traffic conditions, rural, stop-and-go urban, and that's how you do it.

And, you know, given the fact that you can only affect new vehicles, isn't it going to take a long time to get any benefit? Because you've got to have two vehicles interacting to get a benefit; right?

MR. McCORMICK: Six-and-a-half years.

MR. KIRBY: Yes. I mean -

MR. McCORMICK: The numbers that were run basically said it's going to take six to seven years before you'll get reasonable benefit --

MR. KIRBY: That doesn't mean -- because it takes so long to get this before you run into another car that can even pass useful information.

MR. RESENDES: Yes. It will take time. After-market will make it happen faster. There's nothing on the table right now, even

if you go to full Google automation, which I believe still requires this, that's going to get us to that level of safety, and just putting my advocate hat on right now, is we need to get started on this, start putting them in the cars on the road.

MR. KIRBY: Because eventually it'll be worth it.

MR. RESENDES: This is the building block that complements nicely with vehicle-based technologies for collision avoidance, collision warning that's already on the market, and it would enable automation, levels of automation.

MR. HOLTZMAN: So with all the false positives, and those things that are a concern to me, this timeline that you have should give us enough time or should give them enough time to at last work on these false positives to make sure it's more accurate than it is today.

MR. RESENDES: We'll see less. The expectation is if you just looked at a DSRC-based system versus a just forward collision warning

-- if you looked at a DSRC-based system versus a radar-based system for collision warning, not braking, you should see less false alarms with a DSRC-based system and at full penetration. Partial penetration, remember, it's only a warning system. So the drivers are not -- so the driver's still in -- for a warning system, the driver's still in control of the vehicle. The driver still has to identify the crashes himself. So the false alarm situation, positives and negatives, isn't as critical as it would be for a collision avoidance system. So we -- you know, I think we really have an effect --

MR. McCORMICK: Well, I guess one thing I'd like to say is that you can't look at it in a linear fashion. When anti-lock brakes came out -- first came out, they braked in a straight line. You couldn't steer when -- because I had the first one that came out, and it was great. It went perfectly straight, but you could not steer. There has to be -- back to Steve's point, there has to be things

that as the system evolve, that they understand where the inadequacies are, how we gain trust, how these systems become more robust. It's not going to happen the day they launch it and nobody's going to expect it to, which is why you only wanted it as they come out, because the industry, the users, you know, the government entities can figure out, oh, we should have thought of this, let's put it in now. So over time everything evolves in a more parabolic fashion.

MR. RESENDES: Yes, and we've made just huge gains working with the auto industry on this. To go back to the early '90s, we thought within five years we were going to have vehicle-based collision avoidance systems deployed, because we were just going borrow from the defense industry, and that didn't happen. And ten years ago or 15 years ago now, when the FCC gave us this frequency, nobody had any working applications. There was no such thing as a DSRC radio. Today we sit here, and working with CAMP, they've developed a common radio,

improved the standards work. Today, for Safety Pilot we now have compliant DSRC radios from multiple manufacturers, applications from different OEMs. This whole industry has risen up, and Safety Pilot will give us the effectiveness data.

CHAIR DENARO: Let me just reply to what Scott said. This is Bob. I agree with you, but as long as you don't hit some showstopper in there that you're -- be it public opinion or whatever, you know, you've forgotten something that now sets you back ten years, because you have to pull it out.

MR. McCORMICK: Right.

VICE-CHAIR KLEIN: But we do have -- so for the initial six years, is there a scenario, if not in the -- you're saying it takes 6 1/2 years before you get sufficient level of penetration for the safety applications to work. During those six years --

MR. RESENDES: That number's still being worked on. I'm not sure.

VICE-CHAIR KLEIN: Some number.

During those six, whatever those years are, are there commercial applications anticipated by automakers? Is there any scenario on the commercial side to get value from this investment?

MR. CAPP: The applications would be the ones you're talking about. You just wouldn't see them very often at the beginning. So that's the value. Those same applications, they won't change. You get a car that's got a first-generation system. It does emergency brake light or something and you may not see that feature very often when you first get your car. Maybe in five, six years you'll start to appreciate it more often, so it'll have more value then.

VICE-CHAIR KLEIN: I was just wondering, maybe so we've often conceived of initially there'll be these safety applications and, oh, by the way, there is a possibility of commercial mobility applications as well. But maybe some of those commercial mobility applications could be up-front winners and

eventually be dwarfed by safety --

MR. CAPP: In reality, there's lots easier ways to do the commercial applications. You have Wi-Fi, so all these other ways you get information into your car or to your cell phone, why would we need to do all this to get a coupon?

MR. RESENDES: And there's a cost associated with that. If these commercial applications were free because you put the safety equipment on the car, then, you know, that would make sense to a commercial entity, not for government. But anytime you go into the mobility applications, you're requiring new equipment, maybe new infrastructure above the security and there's cost and somebody's got to run that. So, you know, I'm not sure if the cost benefit is there to carry the weight.

MR. McCORMICK: Understand they can always choose not to mandate. I mean there's always a no answer, is always the alternative.

MR. FEHR: I was just going to remind everybody to remember the things I

mentioned earlier this morning about the non-light vehicle use of this particular communication medium. Commercial vehicle-oriented applications that might actually be significantly farther ahead than anything related to light vehicle. So they may be small in number, but they may be some of the very first users of the vehicular communications and there's some viable concepts out there that definitely pre-date anything that you would ever see in a passenger car.

VICE-CHAIR KLEIN: And are those less -- the key parameter is the percentage of penetration; right? That affects the functioning of the system, the utility of the system, and those numbers, we know how fast the automobile fleet turns over in the United States. That's where you're getting the six year --

MR. McCORMICK: Plus the math that Andrews and I ran over the last few years, yes.

CHAIR DENARO: Walt, since you're back in the room -- I think you were out at the

time, but we were talking about dual use of DSRC for safety, but then potentially for some commercial applications, consumer applications, whatever, and Ray made an interesting comment that their approach right now would pretty much say you need to have two radios; that you're not going to be able to use that.

MR. FEHR: Operate on two different channels. I'll quibble over the number of radios. That's all --

CHAIR DENARO: That's what I'm trying to get at.

MR. FEHR: It's the ability to --

CHAIR DENARO: So it's not necessarily two physical radios?

MR. McCORMICK: Could be software-defined radio; right --

CHAIR DENARO: Yes.

MR. FEHR: I don't know how people build radios, but the ability to communicate on two different channels simultaneously.

CHAIR DENARO: Right. And that

essentially creates your firewall between the two applications; correct?

MR. FEHR: That's the crudest way we've thought of, of separating the crash avoidance thing from all of the rest of it, is operate them on different channels.

CHAIR DENARO: Thank you.

WRAP-UP

MR. SCHAGRIN: So this is now the pilot program where you guys have your own separate, I guess, discussion among yourselves. But in terms of formal presentations, that's everything we had to talk about. I don't know if there's any more questions or not. Some of us are leaving after your questions are finished for us, so I don't know if you have any more or not. But now would be a good time to ask.

MR. McCORMICK: Will we get these presentations electronically?

MR. SCHAGRIN: I believe so, yes.

MR. McCORMICK: Okay. Thank you.

MR. SCHAGRIN: They're posted on the website; right?

MR. McCORMICK: Oh, okay, okay. Thank you.

MR. SCHAGRIN: On your advisory board website.

DR. RAJKUMAR: Mike, is it factual to say that given your plans and what you have seen from customer data, that you feel good about the data?

MR. SCHAGRIN: Do we feel good about the data? Yes. I think what Kevin tried to convey is that we're getting, in terms of quantity of data, we're definitely exceeding our expectations for the percentage of fleet that's actually deployed. The quality of the data still has to be analyzed and so there's still some determination as to whether it's sufficient enough. In terms of quantity, we're actually very happy with the quantity that we're getting, yes.

DR. RAJKUMAR: And I don't mean to put you on the spot. So far you don't see any showstopper?

MR. SCHAGRIN: No, no. We're

ramping up. You know, it's happening over time. We should have the rest of the fleet ramped up in the next couple months. We're getting the data, getting the interactions. The infrastructure is getting deployed. Everything is working. Yes, everything is working. So, as Ray said, really it's about getting the data at the end of the -- you know, we're going to analyze it. I guess someone said halfway through, maybe six months of data. We'll do our analysis and the decision that happens in 2013 will be data driven. So, you know, we're waiting to see how the data turns out, but I don't think there's anything at this point we need to do that's different in terms of the experimental design to change things, but as Kevin had said, if for some reason in month 2 we find interactions dropping off, we're not getting the quantity of data we think we need, then we have to start implementing other techniques in order to try and drive that interaction data up more.

DR. RAJKUMAR: So, looking ahead,

if the mandate is planned to be put in place, what kind of criticisms or attacks could be expected on the outside?

MR. SCHAGRIN: I'm sorry?

DR. RAJKUMAR: Clearly if there's a mandate in place, there'll be a bunch of critics out there.

MR. SCHAGRIN: So the way it works -- and Ray is still here, but the way it works is if we do anything from the Department in terms of kind of a proposed regulation of some sort, there's a very open process that we go through in terms of an open docket and vetting what our plans are. So that's very open, very public. The car companies certainly know all about that, and so there's definitely opportunities. It's not something that happens right away. Next year's not going to be a decision that starts and says, hey, now we're regulating, it's a decision to say what we're going to be doing. And then even then, that takes a while before you actually get to the point where we've solidified that position, because we want to

hear public input.

CHAIR DENARO: Any other questions for the team?

VICE-CHAIR KLEIN: What percentage of cars on the road in Ann Arbor are outfitted with any -- or what's the percentage of penetration at this point?

MR. GAY: I can tell you what our model said it would be, if that's helpful. The numbers that the model was estimating was between 5 and 10 percent at full deployment on the roads of Ann Arbor. That's what the simulation model was.

VICE-CHAIR KLEIN: And so this will be an opportunity for an empirical test of 5 to 10 percent deployment. You might see -- you expect to be able to detect some difference in actual accident statistics?

MR SCHAGRIN: Well, yes. I mean that's what the data is all about, is how effective these systems are, and it's better to set our objective based on how these warning systems might affect driver behavior; right?

VICE-CHAIR KLEIN: Right, right.

MR. SCHAGRIN: Now, of course, 5 to 10 percent is kind of a very rough ballpark. You can have variations, fluctuations depending on what's going on at the time. But it's just kind of a range. So it's not 50 percent --

VICE-CHAIR KLEIN: Right, yes, yes.

MR. SCHAGRIN: -- and it's not 75 percent. It's lower. But as Ray had said for his presentation, that there are in fact some of those applications that you see benefits during early penetration levels. I think he said 6 percent or something like that. You don't need to have 50-percent or 75-percent penetration in order to get benefits from some of these safety applications.

DR. RAJKUMAR: As a sanity check, what is the population of greater Ann Arbor?

MR. GAY: A hundred and ten thousand.

DR. RAJKUMAR: So it's like 3,000 would be a 5-percent --

MR. STEUDLE: It depends if it's a

Saturday in the fall and there's 100,000 in one spot.

(Laughter.)

MR. LAMAGNA: Will there actually be a study that determines whether or not incidences of car crashes decreased?

MR. SCHAGRIN: Will there be a study of whether -- if the incidence of car crashes that have decreased?

MR. LAMAGNA: So take last year's number and compare it to a number from two years from now.

MR. SCHAGRIN: Well, I think what -- I think what Emily had said was, you know, given the kind of sampling that we're doing -- well, hopefully we're not going to see any crashes at all. It's all about these near misses and these conflicts that occur and the kind of driver behavior -- how it's affected by the warning system. And we have those videotapes and the sensors in the cars to show what the situation was surrounding the vehicle at the time of the event and how the driver may

have been affected by the warning system coming up. But hopefully we're not going to see any crashes. I think Scott --

MR. LAMAGNA: So you think they'll go down, then?

MR. SCHAGRIN: I think Scott did an analysis earlier which was saying based on the kind of one-year study and the sample size, there might be like -- what'd he say, one or two that might --

MR. McCORMICK: One or two, yes.

MR. SCHAGRIN: Based on statistics. Given the -- the reason the vehicles are so heavily instrumented is because there's this entire strategy that Volpe goes through looking at crash conflicts, near-crash conflicts, so that we can extrapolate those to crashes, but we don't expect many crashes and not nearly enough to impact the statistics in the Ann Arbor area.

MR. KISSINGER: Just a comment. I suspect you've already done this, but if you haven't, I would think you should give some

priority to thinking about hailing some special studies out of the SHRP data which is already coming online on the same scenarios that we're looking at for this technology. There could be some great baseline information about why these situations are occurring.

CHAIR DENARO: SHARP data.

MR. RESENDES: Yes.

MR. SCHAGRIN: I thought we did something with that.

MR. RESENDES: No. The SHARP 2 is the big thing --

MR. SCHAGRIN: SHARP 2, right.

MR. RESENDES: -- that's going on right now. So, yes, we're engaged with that.

MS. NODINE: Yes, if I'm understanding what you're saying correctly, we're actually doing that with a data set -- the integrated vehicle-based safety system data set, which is really just agiant naturalistic -- so it's not the same as SHARP 2, but it's the same kind of idea. So we are relying on other sources of data just to sort of look at

-- you know, in general what's our baseline.

MR. KISSINGER: I mean they're already seeing crashes -- they're seeing crashes already in the crash data, and they're just now in position where they're developing some of the special studies, and I haven't seen any that have been announced that match up with, you know, the things that are most relevant to this project, so I think that's an opportunity.

MR. RESENDES: The other -- NHTSA runs something called a Special Crash Investigations Program, and so what they do is they have these teams around the country that go to crash sites to, you know, take really good data on crash investigations. So the one in the Michigan area is keyed into that and is hooked up with UMTRI so that if any crashes happen, we will get SCI investigations on those crashes.

MR. STEUDLE: Bob, this is Kirk. If I can answer your population question, the city of Ann Arbor has 114,000, and the statistical area has about 350,000 population.

And that came right off of Wiki.

(Laughter.)

MR. GAY: Yes. The other thing to keep in mind is the area that most of the interactions are happening in is very concentrated in northeast Ann Arbor, so I don't know exactly what that is, but that's going to heavily skew things toward increasing the deployment percentage in that particular area as well versus if you look over a larger area.

DR. RAJKUMAR: I think it's greater than 1 percent, because that's the population. So imagine one car per two people, something like that. So it should more than 1 percent.

MR. SCHAGRIN: Yes, going back to population percentages, I mean we picked drivers specifically tailored towards trying to -- well not trying to create an unnatural environment. It is naturalistic, but we picked drivers that would kind of help increase the concentration levels.

MR. McCORMICK: I got real nervous when you said something about using the IVBSS

as a database, crash database, because it has about 30 times the national average with the flood of the signals coming into the drivers in that test. Seems to be a skewed database.

MS. NODINE: Yes. I mean I wasn't fully capturing what -- you know, what you were suggesting with the SHARP 2. I'm not saying we're using it -- first of all, there is -- we had a baseline period. And maybe you know better which portions of the IVBSS data we're using. But we do have a chunk of data that's just, you know, when left to their own devices, how do drivers drive. And then the other stuff is not necessarily that we're using stuff that has to do with alerts.

MR. McCORMICK: Oh. It was the pre-data, before they put all the signaling in?

MS. NODINE: Correct, correct.

MR. McCORMICK: Oh, okay, okay. Thank you.

MS. NODINE: Yes. So I'm not involved in that. I don't know exactly what's being used for what, but --

MR. McCORMICK: That's the right part of the data to use.

CHAIR DENARO: Any other questions?

VICE-CHAIR KLEIN: I'll ask one. For the car makers, you guys will end up bearing quite a significant burden in these early years. That kind of falls onto the car makers. There'll be hundreds of dollars of money put in, and the consumers, but at the lower end economy model, that's a pretty big chunk of change, even if it was 350 bucks, with the promise that a few years out it's really going to pay off some dividends. So you're -- that's been discussed in the auto --

MR. CAPP: Yes, yes. That's a big --

VICE-CHAIR KLEIN: That's nothing new to you guys.

MR. CAPP: Yes, yes. Yes, we're with Ray. This is a real technology that's going to have real benefit, but we've kind of all got to get off the ground together because the investments to get it going are not

insignificant.

CHAIR DENARO: No one in a car company gets promoted for raising the price of a car.

Let me just give you a quick overview of tomorrow of what to expect, and the first is we have a good discussion of security, and I think Mike and Valerie are probably going to lead that tomorrow. So we're going to get into that in a good amount of depth. And then the bulk of tomorrow, starting in the mid-morning to the afternoon, is subcommittee work.

So I want to encourage the subcommittees tonight, as you're having trouble getting asleep because you're so excited about the work of the committee here, to be thinking about what we've heard here and how you're going to assimilate that in your subcommittee work, because this was an attempt to get everyone up to a certain level, maybe for some of you more than you ever wanted to hear about technology in some of the depth here, but to get us all to a certain level.

The heavy lifting is up to the subcommittees to really pull together where we're going to, you know, dive deeper and make recommendations and that sort of thing, eventually bringing that back to the whole committee. So I just want to set that perspective for you as to what the expectations are for tomorrow.

DR. ADAMS: So, Bob, can you remind us of what subcommittees we're on so that --

CHAIR DENARO: Yes.

DR. ADAMS: -- we can have this vision as we're --

MR. McCORMICK: As we're sleeping?

CHAIR DENARO: Yes. We will --

VICE-CHAIR KLEIN: We will post some stuff tonight.

DR. ADAMS: Okay. I was wondering. Okay. I'm good.

CHAIR DENARO: Yes. It turns out there is a summary of that in the minutes from the last meeting, but we will start tomorrow in the beginning of that to summarize that.

MR. KISSINGER: There's a 9-21 e-mail on it, as well.

CHAIR DENARO: There you go.

VICE-CHAIR KLEIN: And I think there's -- some of the committees have written up -- some committees have already generated, I guess, their final report, from what I've heard. Others have got some notes going. I think it would be fine if committees have some product already, including tentative stuff, to post it up to the group so that others could see and see what's going on because I think these committees right now are still fairly flexible, fluid, and we might find that we need another committee. We might find that two committees consolidate as we're moving here. But unless people know what the committees are and what they're doing, we're not going to have much movement. So tonight, if you've got something, post it up.

(Simultaneous speaking.)

CHAIR DENARO: So, logistics for tonight. Those who are going to dinner, shall

we meet in the lobby?

MR. GLASSCOCK: At 5:45.

CHAIR DENARO: 5:45. Okay. All right. Thank you, everyone.

DAY 1 ADJOURNMENT

(Whereupon, the foregoing matter was adjourned at 5:00 p.m.)

DAY 2 – THURSDAY, OCTOBER 11, 2012

The Advisory Committee reconvened at 8:00 a.m., October 11, 2012, Robert Denaro, Chair.

OPENING REMARKS BY COMMITTEE CHAIR AND VICE CHAIR AND AGENDA REVIEW

CHAIR DENARO: I need actually to make, actually, a personal announcement, and the reason I'm saying this is because I don't want to have to send you an e-mail later, have you hear it through the rumor mill or whatever else. But I'm going to leave Nokia at the end of the year, and I'll be continuing in the industry as a consultant and that sort of thing.

A little more personal time in there and that sort of thing, a couple of projects lined up and that sort of thing. But I just wanted everybody to know that. It doesn't change. We serve as individuals on the committee, so I'll keep serving. Like I said, I'll still be in the industry and everything else, but just so you don't hear it through the rumor mill or anything else. Thank you.

All right. What's that? More time on the committee, yes. The pay isn't great, but I am having fun.

All right. So I guess we can get started. Hans is going to guide us through today, but just, you know, a summary. Yesterday, we have lots of discussion. We continue with information this morning in terms of the security discussion, which we thought was a very important topic. We wanted to focus on it. And then we have our breakout meetings in the afternoon.

So, Hans, I'll turn it over to you.

VICE-CHAIR KLEIN: Okay. Well, we

all have the agenda in front of us here. Basically, up until the morning break we'll sort of have a continuation from yesterday in terms of our format. A lot of presentations, learning, discussion with the presenters and so on, and dealing with security implications and issues, data needs, et cetera.

After break, from 10:20 to noon, subcommittee breakout meetings; lunch, 1 p.m. to three; subcommittee report-outs. So those are, including lunch, a four-hour, four and a half hour block of time there, and I think that this is the time when our subcommittees, we're going to have a kind of, hopefully, a gelling process here. All right? We had some discussion at our first meeting, subcommittees were formed. People have seen, at least the May subcommittees, the initial signup memberships from our May meeting, but I think there's going to be a process, hopefully a process, a little bit of an open discussion and coming together of what these committees are, what their function, what their topic area will be, who's

going to be on them. I think there's still some fluidity here, and I invite fluidity. I invite folks to join a committee as they re-think it to participate on a committee and defining its mission.

I think that some of the -- I know that some of the committees have momentum from previous ITS PACs, and I know some of the members of the committee have momentum from previous ITS PACs, and that may be evident on some of the committees, some of the subcommittees. Some of the other subcommittees, I think, are new, the topic, probably new in their membership. So we'll just -- there's a mix of old and new. Some of us are learning. There's a mix of still deciding what committee to be on. So as of from the 10:20 or 10 a.m. to 3 p.m., we will -- I think we're going to start off not by breaking immediately into subcommittees, but by the different subcommittees talking about presenting their topical area.

And I know that even before we do

that, Bob at 10:20 will give us a bit of an introduction. A very brief review of some of the outputs of previous ITS PACs. If nothing else, the format, the length, the kind of thing we're doing, how to have an impact, to get us all thinking about our final outputs.

Then the various subcommittees, there'll be some presentation by the heads of the various subcommittees, and we can then self-organize and go into our breakout meetings and later do the breakouts.

Come 3 p.m., again there is the interim memorandum discussion, led by Bob. We will be producing by the end of this year -- we are in mid-October. There's frost on our windshields. We're producing our first of two memorandum outputs, and Bob will talk about that and put that in perspective, and we'll wrap up.

Now, there's a 3:30 to 4:00 summary and wrap-up. I know that a substantial number of participants are looking to get out as early as 3:30, so if we can, we're going to actually tighten things up and finish around 3:30 so

that folks can make it to the airport. That, again, will -- if we can maybe scrunch it a little on our subcommittee work, that'll gain us the time to move the interim advice memorandum discussion and the subcommittee wrap-up. Push those forward 20, 30 minutes. Would enable us -- some of us to make it to the airports. Others of us, I know, are staying a little later. I've got a later flight. Others do, as well. So if some subcommittees want to have some more discussion between 3:30 and airport departure time, that might be a good opportunity to do that as well.

So, without further ado, I will now -- actually, any questions, comments?

(No response.)

VICE-CHAIR KLEIN: Okay. Well, then we're running ahead of schedule again. We can go right into security and implementation discussion, and I pass the floor to Mike Shulman. And as we've all been told, make sure to speak into the microphone for recording purposes.

SECURITY/IMPLEMENTATION DISCUSSION

TECHNICAL DESIGN

MR. SHULMAN: Okay. Good morning, everybody. I'm Mike Shulman. I'm from Ford Motor Company, but I'm also the CAMP VSC3 Program Manager. CAMP is -- VSC3 is a collaboration between the OEMs that you see on that slide: Ford, GM, Honda, Toyota, Nissan, Mercedes, VW/Audi, and Hyundai/Kia. And the work that I'm going to talk about is done as part of a cooperative agreement with the U.S. DOT, and what we're going to talk about is the V2V security system.

So when we look at vehicle communications, I guess you got a demo of this stuff yesterday, so you all should be familiar with it. We're looking at vehicle communications as a safety sensor to let us do some new functions that we can't do otherwise, or improve existing functions. But as you see, it's really a cooperative technology, so it only works if your vehicle is equipped and the vehicles that you're in conflict with are also

equipped.

There's one message that we use for all the applications you saw yesterday. It's called a basic safety message. We try to send it ten times a second between vehicles. Part 1 has things like position and speed and heading and yaw rate, and Part 2 is an optional part that we only send on an as-needed basis. It also has event flags for things like hard braking. So the idea is that we would want to send that message, and we can do things like forward collision warning, blind spot, lane change, intersection warnings, things like that.

On top of that, we need security. As a car maker, we're not going to issue warnings or take control of the vehicle on a message that we don't trust, so we need to know a couple of things. We need to know that that message was sent from a legitimate source, and we need to know that the message wasn't changed from when it was sent to when we received it.

And so how do we do that? We use something called PKI, and it's a crypto thing that's used all the time. So it's not something we invented. PKI stands for Public Key Infrastructure, and the idea is that the vehicle would get something called a certificate. And for those of you that know internet stuff, you probably know X.509 certificates. These are different kinds of certificates, but the certificate says here's a vehicle that's been certified to send a message, here's the validity time of that, and here's the signature of something called a certificate of authority or CA. And there's also something in there called a public key, and that's -- we're using something called asymmetric cryptography. So you sign a message, and by signing means you're running an algorithm over a message, called ECDSA, or Elliptical Curve Digital Signature Algorithm, and you sign it with a private key which you keep secret, and then the public key is in the certificate, and when you get the message, you can check if the signature is proper and if it

was changed.

So the idea is that you -- from this -- something called the Security Credential Management System, or SCMS, issues certificates. That goes to the vehicle. The vehicle, when it wants to send a message, sends the certificate. It also sends the signature of the message, and when you receive the message, you go through two reverse crypto processes. You verify the certificate using the certificate authority public key, so every device in the system has to have the CA's public key, and you also check that the message was signed properly using the public key that's in the certificate. So that's a lot of new stuff for the car guys.

So, how does it work? You've got two vehicles driving around somewhere in the middle of the night and they're exchanging basic safety messages, and somewhere off to the side there's this SCMS that the vehicle makes contact with on an infrequent basis, and it's issuing and renewing certificates and it's also revoking certificates. And so the idea is that if people

have certificates, but are sending messages that are not good because the vehicle is out of compliance or somebody has hacked in and is intentionally trying to send bad messages, the SCMS needs to identify that and tell people that even though that certificate looks valid, it's not such a good certificate anymore.

So there has to be messages between the vehicles and the certificate authority to send what we call misbehavior reports, messages that lead to warnings, messages that are flagged by local misbehavior detection. Local misbehavior detection are algorithms we run on our vehicle that basically say, I look at this message and it doesn't look right to me. It's jumping around all over the place or it's defying physics or something. And so the vehicle itself has the ability to do local misbehavior detection.

And from the back end from the SCMS to the vehicles, new certificates are provided, and also we update vehicles with a certificate revocation list. So that means certificates

are like your passport, and once in a while if somehow a passport is misused, it goes on a list and that's notified to the vehicles to say, even though this certificate is still in the validity period, don't trust it because it's been reported to be bad. So that's a lot of stuff going on in this system for security. So, you know, when you did the demo yesterday and you saw these cars whizzing by, this all has to be happening in the background for this system to work.

So we formed a team of car guys from the CAMP VSC3 consortia -- security experts, suppliers. Roger Berg from DENSO was part of the team. DOT was involved. And we said, how can we kind of deploy this system in a practical, feasible way to make it work? So, the first thing we looked at is, if you focus in on that center column, the on-board elements. We're talking about a FIPS 140 Level 2 or equivalent processor. That means a tamper-resistant processor, because I'm storing security credentials onboard the vehicle and I don't want

it to be easy for somebody to get in and extract those and use those to send bad messages. So FIPS 140 is a federal information processing standard that we reference. We also store the certificates on board in an encrypted way. So that's all very new to the auto industry. You know, we don't do this kind of thing before -- you know, this would be new technology for us, FIPS 140 on the vehicle and encrypted certificates.

We talk about using different options for certificates, maybe -- the idea is if you used one certificate all the time to send your message, that would work from a crypto point of view. It would be easy, though, for somebody to track you where you were going, because that certificate would be like an electronic license plate, and every time you sent a message, that certificate would be attached and somebody could just listen to those messages because they're not encrypted, and be able to say, okay, I saw your car here and now it was here and now it was here, and suddenly we've set up a national

tracking system.

So we don't want to be able to use one certificate all the time, so we talk about different options, how many we can generate and store. So maybe 3,000 non-overlapping certificates that might last for three years to get started with. That's one approach. Another approach is maybe you'd get a pool of certificates for a week and your car would keep rotating through those. That's the way the Europeans are approaching it. The Europeans are doing something really something really similar, except the European system is a -- it's not a regulatory system. The Europeans are talking about deploying a system like this that would be customer option, that customers would opt into, kind of like your cell phone contract. And here, we're talking about a system where the customer has no choice. It's just mandated if NHTSA develops a regulation. So, we want to protect people's privacy.

So the onboard is doing that kind of work. The Security Credential Management

System or the SCMS has different pieces inside of it, and I'll show you some of those in a little bit. And SCMS stuff is well known. It's used in healthcare, it's used for the Department of Defense. PKI systems are understood, but nobody's ever built a PKI system this big. And so if we were to deploy this thing, it would be like 250 million vehicles potentially getting thousands of certificates a year. So the scale of this thing would be unprecedented. But in principle, the SCMS is well understood because it's used in other industries.

And the other thing that's new for this is that thing that says communication between the SCMS and the vehicle. OBE is the onboard equipment. Normally when you buy a car, that's your car and you drive it away and, you know, you need to change the oil once in a while and maybe do other service on it, but there's no requirement that your vehicle check back in to a security system. And so if we did this, the would have to be some new way for vehicles to connect up to that thing to get new

certificates, to do misbehavior reporting, and that's just a new -- it's a whole new concept for the auto industry.

In full deployment, it looks like the initial deployment system, but it's just grown. It still has that same vehicle that we deployed initially needs to work under full deployment, so the memory size and the processing capability is all there. It's just that we anticipate that the vehicle's connected more often under full deployment, and the lifetime of these certificates is less because there's more vehicles out there, there's most need to get an update of certificate revocation list. Certificate revocation list is like your virus protection on your computer. It's just telling you that there's bad stuff out there that you need to be aware of.

So there's a graceful evolution, and the connectivity options. Cars have to be able to connect up, and then you ask the question, how are they going to connect up? And there's obviously -- you know, customers can opt in and

do things like -- you know, I have an OnStar system or a Sync system that give me connectivity and I choose to connect up. Some customers will do that; others won't. At some point Federal Highway may deploy a roadside network that has back-end connectivity that will let cars do it, or there may be other options. And so the next thing, in a little bit I'll show you the other options that people are thinking about for connectivity.

But in terms of how much connectivity you need, the connectivity is really telling you here's what's going on in the system, and it all depends how it goes. You know, if this system is really attacked a lot, either by devices that are out of compliance, either OEM devices or after-market devices, then you need a lot of connectivity to keep the vehicles updated. If the system is pretty benign, then you don't need nearly as much.

And the closest analog that we have right now is tire pressure monitoring system

on cars. Tire pressure monitoring is a sensor on the tire that tells you the pressure is low, and it provides a wireless signal to the instrument panel, lights up a light. And in principle, you could hack into that system, and people have done it, and generated false warnings on cars, but nobody really invests a lot of time or energy doing that except, you know, just to show that it could be done. So there's no financial gain, there's no real benefit.

So, you know, the question is, are people really going to invest a lot money and time and effort to get into this box and get into the tamper-resistant certificates and generate false warnings? We don't know, but -- and are there going to be a lot of devices out of compliance that are going to send bad messages that can't be detected by onboard diagnostics? We don't know, but in principle, you know, we need to get experience. You know, we look at a -- we did a model that said, you know, imagine I was willing to accept one false

alarm per every equipped vehicle per week. Then this would be the kind of connectivity you would need in a benign case maybe every -- once every three years would be kind of okay. So, you know, you change your oil more frequently than that. But in an extreme case, if this thing really becomes something that people really tap into, you'd need a lot more connectivity. And so the hope is that we're going to design it in a flexible way that lets the system kind of grow and respond to threats as they appear.

We worked with the DOT in looking -- doing a risk assessment, and one of the things we looked at in the risk assessment was privacy and tracking. Mary Wroten from Ford, who's in the back there, was part of a VIIC effort and led this study with the DOT.

We looked at a couple of different threats. The first threat is, could you use these certificates to track cars and would a company who wanted to do targeted advertising be able to kind of sniff these messages and be able to see where the cars are going and do

targeted advertising. And we kind of agreed that, you know, if we used something like five-minutes duration certificates, the number of sniffers you would need becomes generally prohibitive, and there's other ways that people can track, if they want. And so the feeling was that that risk is not a high risk with short-duration certificates.

The other thing we looked at was, would a government organization use this as a tracking system, like an Amber Alert system to find vehicles? Let's say there was a terrorist activity or a kidnapping. would they know which certificates were associated with which vehicle and be able to use that in a way that would make our customers uncomfortable to know that something was mandated in their car that was going to allow them to be tracked. And, you know, we looked at it.

There's a star there under "high" that says the OEMs generally felt that that was, you know, potentially a high risk that we needed to be concerned about. The DOT thought maybe

that, you know, it would only be used in a good way and it was really something that government could be trusted to manage. But we basically said if that back end is going to be a public SCMS, a government-run SCMS, we shouldn't really link the VIN numbers to the certificates, or we should require some legal process, like a warrant or a subpoena. And if it was a privately-run -- like if the OEMs ended up running it and the government came to us for that information, there should at least be some judicial process, so that our customers know that it was really a valid request.

And then the last one is really for law enforcement. Are we putting something in our cars that's sending out speed that people are going to use to give traffic tickets? And if that's true, then people are just going to turn the system off and we're going to lose all the potential safety benefit we could get. And so, you know, there's other ways that people do traffic enforcement, photo enforcement and radar stuff, and would they really use this

system if it became deployed? We don't know, but if it is, then there's no technical way to overcome that. There needs to be some policy put in place to prevent that.

MR. McCORMICK: Michael, what's BSM?

MR. SHULMAN: Sorry. BSM is the basic safety message.

MR. McCORMICK: Oh, okay.

MR. SHULMAN: So this message that we looked at way back here is the basic safety message.

MR. McCORMICK: Okay.

MR. SHULMAN: That's this ten-times-a-second "here's my state" that I'm sending out to every other vehicle.

MR. McCORMICK: Okay. Thank you.

MR. SCHROMSKY: So also, Mike, when you're looking at CALEA basically for that, communication for law enforcement assistance, so carriers --

MR. SHULMAN: Right.

MR. SCHROMSKY: -- get a request for

court-ordered subpoena or if it's a FISA case, for wire-tapping, so there's a process, a judge will sign off on it. You're looking to do what's similar to or recommending CALEA, I guess, Valerie, or --

MS. BRIGGS: I mean we've looked at CALEA and --

MR. SCHROMSKY: Okay.

MS. BRIGGS: I mean, I think there are some differences in opinion between what the government thinks and what the OEMs are concerned about in this instance.

MR. SCHROMSKY: Sure.

MS. BRIGGS: I mean there are -- even in government-run processes, there are protections for the information that's collected. In fact, stricter protections than the information that's collected for the private sector. So I think that that's why we don't necessarily see the same level of risk that the OEMs see in terms of information collected, and the government doesn't intend to run the system. So it'd be -- I mean, I think all of you who

have ITS systems recognize that the government puts in place protections for any system that it has.

MR. McCORMICK: Plus, as long as you're not running it, we don't have a lot of FOIA concerns.

MS. BRIGGS: Well, right. If the government is not involved, then FOIA is not an issue.

MR. McCORMICK: Right.

MS. BRIGGS: But even FOIA -- PII, personal information, is protected from FOIA requests. So I mean you can't request someone's PII under FOIA.

MR. SHULMAN: So we're getting into some new territory for, you know, the auto industry. And we worry about it not so much for ourselves, but what are our customers going to think and are customers going to want to buy new cars if this stuff is on there, you know. If you know the history of EDRs, there was a lot of reaction, and so this is kind of something that gives us pause.

MR. SCHROMSKY: Well, it is a hot topic, I mean, from license plate recognition to subpoenaing Easy Pass to something else; right? So it's --

MS. BRIGGS: I think there are also two things to consider here. What we've looked at is, would this system make it easier to track people's trips than existing systems, and I think, you know, there are a lot of systems out there today, and so you have to compare it to what's already out there. And, you know, secondly, we have to consider -- well, I guess that's the main thing. I mean, the main thing we're looking at here is just that -- I mean, clearly, we're very concerned about privacy, but does it really make it easier than existing systems that are out there?

Oh, I know. The second point was that under a mandated condition, you know, we have to be more protective of people's privacy than if they're opting into a system. So that's our main -- our other main concern. It has to have protections for people.

MR. SHULMAN: Yes. I should mention that, you know, I'm from CAMP, the CAMP VSC3. There's another organization maybe some of you know called VIIC, the Vehicle Infrastructure Integration Consortium, and that's where the OEMs come together to talk about these policy issues like funding and governance and privacy, and so that's -- they helped on this study, and that was -- that slide came from their work.

Okay. So the first summary I'll show you is that, you know, the feeling is that when we looked at it, the onboard equipment requirements are feasible, but the automotive hardware to do what we're trying to do is not yet available. There's no FIPS 140 Level 2 automotive-grade hardware, but we think it's possible. It's just a matter of getting the supply base cranked up. And people -- suppliers estimate that the cost of doing this wouldn't really enormously increase the cost of the whole system. It's less than 20 percent additional cost to do security on vehicles.

With secure hardware, we think connectivity is likely not required for the first three years of deployment, and after that, more frequent connectivity is going to be required. But it's hard to estimate. We just need to be flexible because it depends how the system is attacked.

The SCMS, the back end is a complicated system, as you'll see in a sec, but it's well known, it's used in other places, and --

The privacy and tracking --

MR. CAPP: Mike?

MR. SHULMAN: Yes.

MR. CAPP: John Capp here.

MR. SHULMAN: Hi, John.

MR. CAPP: So for follow-on study, what specifically is that follow-on study?

MR. SHULMAN: I'll get to that.

MR. CAPP: Okay.

MR. SHULMAN: So after the summary, there's some more stuff.

MR. CAPP: Yes. I wanted to make

sure you covered that. Okay.

MR. SHULMAN: Yes. So this summary was really just the first study we did, and then I'll show you -- so the one -- the last one was privacy and tracking can most likely be addressed, we think, with short-term certificates, so this pool of five-minute certificates and having appropriate policies and procedures in place will prevent people from thinking, well, you've put something in my car that's going to be a Big Brother system and if it's going to get used for traffic enforcement, that's a problem that we're going to need to kind of think about.

MR. McCORMICK: Before you go on -- so the three years is great, but let's say that my cars are, because of equipment malfunctions or bad programming or whatever is determined to be a bad actor, is that envisioned that I go back into the dealer to get a new set of certificates, or is that a warranty issue, then, for the auto makers?

Okay.

MR. SHULMAN: That's the idea. You know, I know how much you talked about yesterday, but the idea is that this system would work for after-market devices, as well as OEM devices, that would be able to send and receive these DSM messages. And so the after -- in terms of security, the after-market devices are no different than an OEM device.

MR. McCORMICK: Well, the security subcommittee addressed all of that, but we haven't had that presentation to the group yet.

MR. SHULMAN: Okay. So, you know -- but the idea need is that, you know, devices need to have -- you need to send not the whole DSM, but you need to send critical elements of the DSM as a minimum and you need to have enough onboard diagnostics that you yourself can say, you know, I think there's something wrong here and I'm not going to send messages. But if you can't, then you -- the system will identify you and you'll need to kind of be indicated that, you know, you're no longer functioning properly and you need to get replacements.

MR. McCORMICK: So the system's going to know if I stop sending messages?

MR. SHULMAN: The system will tell you that --

MR. McCORMICK: I mean I know, but the question is --

MR. SHULMAN: If you know yourself, then you stop sending messages. That's one thing. If you keep sending messages, then the -- if you stop sending messages, the system won't know.

MR. McCORMICK: Okay.

MR. SHULMAN: But if you keep sending messages that are bad, you'll be reported and identified, --

MR. McCORMICK: Okay.

MR. SHULMAN: -- and you'll be put on this list, called the Certificate Revocation List, and then you'll receive that list and you'll say, hey, I'm on the list, that's not a good thing, and your car will stop sending messages and tell you that you need to kind of --

MR. WEBB: Mike, George Webb. So if I had one bad certificate of that 3,000, --

MR. SHULMAN: Right.

MR. WEBB: -- are all 3,000, then, going to be invalidated?

MR. SHULMAN: It's not that the certificates will be bad. It's that your sending bad messages.

MR. WEBB: Okay.

MR. SHULMAN: No. You're sending position and speed and heading and yaw rate, and all those things that go into that DSM, and that's what people will look at to say, you know, I see your data's jumping around all over the place, or you're telling me you're going, you know, a hundred miles an hour and you're in park, or you're telling me that you're a thousand feet above the ground, or something that says, hey, there's something not right here. Nothing personal, George, but it's just not right.

(Laughter.)

MR. SCHROMSKY: So, Mike, to your point, --

MR. SHULMAN: Yes.

MR. SCHROMSKY: -- so the certificates are tied to the device, not to the individual that actually purchased the vehicle or after-market. So if the car turns over less than three years, a year-and-a-half, I sell it to Kirk, whatever may be, I'm not required to do anything as long as the certificates are still valid, regardless of switching titles?

MR. SHULMAN: That's right. Yeah.

MR. SCHROMSKY: Okay.

MR. SHULMAN: One of the big -- I skipped over this here, but there's something here that says certificates are linked to a VIN, and that's a big discussion topic that's going on between the United States government and the automobile manufacturers. You know, for the system to function, there needs to be an identifier on the device, but it doesn't have to be a VIN number. It can just be what we call a Certificate Signing Request, something in the device itself that -- the government is thinking that, you know, it should be linked to a VIN

number in a database somewhere, and the car guys are saying, you know, that raises a lot of concerns for us; it's not necessary from a security point of view.

MS. BRIGGS: May I just --

MR. SHULMAN: So it's a subject that we're going to have to discuss.

MS. BRIGGS: I have to jump in here.

MR. SHULMAN: Valerie, please, why don't you say something.

MS. BRIGGS: The government is not thinking anything. The government is trying to leave options open because we don't know who's going to be the operator of the system. So, frankly, I don't think the government has any strong opinions one way or the other on how this is ultimately done, because it will be up to the system operator. So all we're saying is one should not close off options at this point, so I just need to make that correction.

MR. SHULMAN: Okay. Yes, thanks, Val.

VICE-CHAIR KLEIN: You may be aware

of this, that in the element of internet protocol, IP version 6, a similar debate happened, whether IPv6 should be linked to a physical device address, a MAC address, and it was decided not to make that linkage and it was seen as a very important privacy technology policy decision relating identifiers to fixed devices or not. So there is some precedent to this in networking that might be relevant to your --

MR. SHULMAN: That's right, yeah. So I'll get to that in a second, but that's a good point, and Valerie's right. You know, it's not -- I shouldn't -- I said it a little too strongly. It's just under discussion between the OEMs and the government.

MR. McCORMICK: And who's going to be the system operator, Valerie?

MR. SHULMAN: So, yes, let me show you that.

MS. BRIGGS: We'll get to that point later.

MR. McCORMICK: You did that to me

yesterday and we never did get to it.

(Laughter.)

MR. SHULMAN: Was there another question, --

MR. McCORMICK: We'll get to it tomorrow.

MR. SHULMAN: -- or can I move on? Oh, yeah.

MR. KISSINGER: Yes. Peter Kissinger. I guess I'm just - technically, are you saying that this system will only work if, I mean, the operator at some point has to do something, like take the car in? I mean can't that be -- can't you just do that transparent to the owner?

MR. SHULMAN: So let's get to that next --

MR. KISSINGER: Okay.

MR. SHULMAN: -- and then let me see if I answer your question.

DR. RAJKUMAR: Mike, this is Raj. Is there a concern that the CRF, the revocation list, could get very long?

MR. SHULMAN: Maybe. Let me show you --

(Laughter.)

MR. SHULMAN: So we finished this study and we said, let's look at alternative connectivity options, how -- what are different ways cars could connect, and let's look at the SCMS itself and what OEM role we would want in it. You know, does Ford or does CAMP or does -- you know, who -- do we want to roll in that, too? So I'm just going to -- I know we're kind of running over time, I guess, but let me kind of show you a little bit.

So we started talking to wireless people about what kind of wireless device we could put in our cars to enable this kind of connectivity, and the three main topics we were trying to understand is what's the roadmap? So, cars have to connect. That's a fundamental thing. And, you know, you bought the car, but you've got to connect up somehow. And so there's always the option of you're going to take it in to a dealer. There's always the

option of, you know, Federal Highway deploys a roadside network all around the country and you just kind of connect up. But what are the other options that a car maker could think about?

One of the things we worry about is long-term technical stability of the technology. We don't want to get into a situation where we put something in our car and the wireless technology is turning over real quickly and three years later it doesn't work anymore or the carriers don't support it, and that's not good. We don't want a subscription service, and it's not like you get a car and now you've got to pay a monthly fee to connect up on a wireless network. We need something else. And we don't want people, again, to get into this feeling of there's a mandated tracking system in their car. So, with cell phones, the carriers know where you are, but you've opted in to that, but now how would it work under this situation?

So the people we spoke to are the cellular carriers, people like Verizon, the

device manufacturers, people like Qualcom, the satellite radio and IEEE 802.22, which is the WiMAX stuff.

And so we're doing that study. It's not done. It's underway. We're trying to just kind of get everybody up to the same level of understanding. But LTE is the new technology for data that's proliferating, and LTE shouldn't be confused with 3G or 4G or 5G. It's just an evolutionary standard that's being worked on, and it -- the feeling that we're getting is that it's going to be around for a long time and it's just going to keep growing, so there'll be a 3G version, a 4G version, a 5G version. And so that was good to know.

The network management systems are evolving to the point where we could think about separate billings for data and voice and other services, and they're talking about, you know, the possibility of like an 800 number kind of a thing where the car would -- could call, but the billing would be done not by the car itself, just the way an 800 number works.

And satellite radio is a real interesting one, because satellite radio, if you know, is a one-way broadcast, but it's -- about 65 percent or more of all the new vehicles have satellite radio hardware, whether you pay the subscription or not. It's a national system. They have plenty of capacity to broadcast things like CRLs on our cars, but you don't have to have a subscription. All it needs is power to the radio. And so it looks like, you know, a possibility that --

In terms of the back end, I want to just spend a minute on this slide and kind of show you. When we start to dig into the back end, there's something called a system oversight. That basically sets policy and technical direction for the whole system, and the OEMs, you know, are thinking about what role, if any, they want in that, but that's the people who are going to own the system and set the policy and set the technical direction, which crypto standards are going to be used.

The other thing to note in this

system is that -- it's a complicated system, and I don't expect you to understand it, but there's certain boxes that will have a single instance, like a root CA. What that means is there has to be one and only one for the system to work. Everybody has to be able to reference that.

There are other boxes, like this thing called an "RA" here. That's a registration authority. And there's multiple opportunities for that, which means that like Ford could run one and GM could run one. That's the place where the devices talk to the system, and so there's potentially a motivation for the car guys to get involved in that.

There's another piece of it called this LTCA. That sets the long-term certificates that are the device identifiers, and that's how you initialize the system. The OEMs may want to roll in that. That's what we're trying to think through.

There's another box over there called "Misbehavior Authority," and that's the

box that's going to say, I got all these bad reports, I'm going to revoke somebody. So it's like your credit card company, when they call you and say, we have these transactions and there's something here; are they really okay? But there's all kinds of issues with, you know, revoking people off the network so that people no longer are able to send trusted messages, and what happens when they get in an accident and all those things that have to be carefully thought through. And we look at it as a central function of the architecture, which means that, you know, each -- there shouldn't be one for each company. The whole system should have one, and who's going to own that and govern it and run it. The policies will all be set by the oversight, and the devices down here will all be cars or after-market devices or trucks or buses. So it goes beyond, you know, just the automobile industry to other units.

So that's the thing we're trying to get our hands around to work with the DOT on the technical side, on the policy side, to try

to understand how this whole thing is really going to happen and if we really understand enough to go forward with a regulation decision next year. Scott.

MR. BELCHER: Mike, is it agnostic as between onboard in -- built in on OBEs and after-market devices?

MR. SHULMAN: Pretty much, yes.

MR. BELCHER: Yes.

MR. SHULMAN: Pretty much. I mean we talk about something that I was saying before, called "local misbehavior detection." And local misbehavior detection says, I've gotten these messages and I kind of -- it's like your body has, you know, white blood cells that can filter out, you know, bad things up to a point, and every once in a while you need to get like, you know, a flu shot because there's new stuff it hasn't seen before. So there's local stuff going on, and the cars may have more capability because they have more information than an after-market device to do local misbehavior detection. But in principle, from the system

point of view, they all look the same.

MR. McCORMICK: Well, Mike, if the OEMs decide they want to be part of the registration authority, would the after-market manufacturers be part of that, too?

MR. SHULMAN: The way the system works is there needs to be -- every vehicle needs to have a registration authority. Every device --

MR. McCORMICK: Every device. Okay.

MR. SHULMAN: -- needs to have an RA, and one of the questions is, you know, from Ford's point of view, either we have to run it ourselves or we would have to know who was going to run it for us, and we need to know, is there a single provider or -- but our cars need it, and either we do it ourselves or we've got to know who that is. And it's the same for the after-market devices, that there would have to be somebody who would step up and say, we'll provide this for the after-market units. And so if somebody wanted to enter the market, it

can't be an anti-trust thing where you say --

MR. McCORMICK: Right.

MR. SHULMAN: -- It's a closed system and because you're not able to access the security system, you're not able to participate in this market. So it needs to be set up on that kind of a basis. Does that make sense, Scott?

MR. McCORMICK: And where does the certifying authority come in?

MR. SHULMAN: The certification lab is up here, and you need to -- your device needs to be certified before it gets security credentials. And so that's the gateway for the whole system. So you need to show that in some way you've met all the applicable standards, the IEEE standards, the SAE standards. All the things that you need to do to get certificates is -- has to be done by the certification lab, and that's where you get this CSR that lets you kind of participate.

MR. McCORMICK: Okay. Thank you.

MR. SHULMAN: Yes. In the back.

MR. SZUDY: Has there been any special consideration, security considerations for heavy vehicles and all hazardous materials?

MR. SHULMAN: Right now it's really pretty much focused in on just these basic safety messages, and so if these vehicles -- you know, there's -- I don't know how much you know, but there's seven channels that have been assigned for DSRC, and we're talking here just about 172. At some point roadside units would need to get certificates if they're going to send things like signal phase and timing messages so that the car says, you know, I trust it. And how roadside units would participate and how states and local governments and all that stuff -- the first step was, how can we get the vehicles to make this Channel 172 work, and then we would grow the system to those other capabilities.

Walt.

MR. FEHR: Yeah, if I could step in for just a second. It's expected that there's going to be a logical extension for this to provide the same kind of ability to establish

trust relationships in peer-to-peer data exchanges, like I think what you're referring to. And also --

MS. BRIGGS: Can you use a microphone?

MR. FEHR: It can be extended to encryption processes that may be needed in order to protect the ownership or privacy or sensitivity of data that's exchanged. So the same underlying processes that are developed for this particular context would then be extended to those other peer-to-peer organized communications.

MR. SHULMAN: Did I answer your question, John, the one you asked before about, you know, where are we going next? I mean, so it's the wireless study and it's this study, and then the next study we would like to do --

MR. CAPP: And kind of the reason I asked, Mike, was just to make sure that -- and this is a great explanation -- is just so that some of the other members of this committee, as we're getting into it -- I mean we've heard

a lot of issues as we get up to speed. We're learning about some of the technology limitations and we're all going to wring our hands a little bit about the cost or reliability, are people going to like it. Quite honestly, you know, we've all been working on this for a long time. We're going to sort those things out, just like we do with other devices and technologies. This is the piece of the puzzle that -- I'll just speak for myself, but I think it largely is the industry perspective -- this is the roadblock: Who owns these pieces? Who's in charge of it? If this map can be figured out -- and this is what we've told DOT leaders, too -- then we're ready. You know, we're ready to do this technology and we'll solve the little problems. But these are the tricky things that we've wrestled with. So that's why the next-step studies are so important.

VICE-CHAIR KLEIN: Can I make a comment on that, just --

MR. MADDOX: A question, though. Did you guys consider complexity? It seems like

an extremely complex design. If somebody's going to oversee this design, how can that be done when it's so complex, so many different --

MR. SHULMAN: Yeah. I mean, you know, when we -- that's a good question, John. You know, when we looked at this picture, in our mind this was really a major complexity reduction from where we originally started. You know, we talked about -- when we first started, we were going to have unique five-minute certificates for every time period, whether the car was driven or not, and, you know, we were going to have connectivity all the time. And it looks a lot more complicated than it really is, and my -- you know, we've built this thing. There's a version of this running in the model deployment that we built at CAMP, and it doesn't have all these elements. There's no misbehavior authority going on in the model deployment. But there are certificates between messages, and in the second phase of the model deployment, we'll do updates of the vehicles

in the field. And so we're testing out pieces of it. We haven't built the whole system, but it's not -- I would say the technical issues are not the problem. Technical issues are more what John said about, you know, what role the OEMs are going to take in the oversight. Are the OEMs going to really run the RAs? Are we going to run the LTCAs? Who's going to run the central elements, like misbehavior authority? Who's going to fund that? What are the liability issues around that? All those kind of things are really where we're going to grapples in the next several months.

VICE-CHAIR KLEIN: Yeah. This is Hans. The institutional issues around this are potentially explosive. This is really from other networks as well. So what happened -- you may or may not know it. Every time you send an e-mail or go to a web page on the internet, you use a numeric address and you use an alphanumeric name, and the assignment of names and numbers, they're called, who gets what address, who gets what domain name, sort of

deepen the plumbing of the internet. Very obscure. Not many people knew about it. But when it came time to create an authority to do assignments of names and numbers, it led to a ten-year-long policy fight that involved the entire communications industry, the entire computer industry, the European Union. The United Nations held conferences on this. The company that ended up managing, administering the significant chunk of that had an anti-trust challenge which was turned down, and sold for $22 billion after five years in the business, as it did this business of assigning names and numbers. So there is -- I'm not saying that this will have to bring quite so many policy issues.

PARTICIPANT: What are you saying?

VICE-CHAIR KLEIN: I'm saying there's probably more than you expect. That this could be explosive from the anti-trust perspective, from a policy perspective, from a "everybody's after the pot of gold" perspective. There's just potentially a lot

going on here. Not only is the technology complex, but the institutional issues are potentially very --

MR. SHULMAN: Yeah. I mean I look at it kind of the other way, too. I mean you're right, but, you know, this -- $300 billion a year is what it costs the U.S. for these V2V crashes, and NHTSA's first estimate is there's an opportunity to address 80 percent of those for unimpaired drivers with this technology. So, somehow there's an awful lot of, you know, less trips to the emergency room and less trips to the repair shop and insurance companies, and so there's a real opportunity to do a lot of good if we kind of get this right.

VICE-CHAIR KLEIN: No, absolutely. Therefore, getting it right --

MR. SHULMAN: Right.

VICE-CHAIR KLEIN: -- is absolutely important, and being aware of all the dimensions --

MR. SHULMAN: That's right.

VICE-CHAIR KLEIN: -- that'll be

coming to play.

MR. SHULMAN: That's right. But it's a -- you know, the auto industry is a big industry and it doesn't move that quickly, and we're talking about some pretty revolutionary things, not evolutionary things. And so it's going to really be an interesting ride the next couple years.

VICE-CHAIR KLEIN: Has Verisign Corporation started to talk with us? They're kind of in this business. I would guess they'd be --

MR. SHULMAN: Yeah. I mean Verisign provides a root CA for the internet, and so when your browser -- when you go to an https website, your browser is checking the certificate from that website. That's signed by Verisign, and your browser has the Verisign public key in it. So it's similar to what we're doing here. Verisign plays that role, and so would Verisign get involved in doing the root CA? We don't know yet, but that's the kind of company that -- you know, they understand how

to manage a root CA and how to protect it and all the organizational and operational things you need to keep the trust in that system.

MR. McCORMICK: If I can kind of add a historical perspective here. Back in 2004 when they formed the VII Consortium and originally put together the cooperative agreement between the federal government and the OEM consortia, this was one of the fundamental things that they all would have to be addressed, and where they've gotten to now after eight years is a substantial improvement over -- it's hugely researched. That's one of the things that the security subcommittee did, was to bring in William White, bring in Scott Andrews, give a history of how we got to where we are so we knew what they were looking at, what had been considered and what hadn't been considered. And they're getting there. They're getting there. The problems aren't all solved, but it's one of those things that when you look at it, it's kind of like, how to digest an elephant, you know. And in this case, if you

take it one bite at a time, you're going to devolve into questions that have already -- people have spent years already looking at.

MR. SHULMAN: Yeah. I just wanted to come back to one thing. Excuse me, Valerie.

MS. BRIGGS: Go ahead.

MR. SHULMAN: Somebody asked about a large CRL, and I was going to mention that these linkage authorities are an encrypted stamp that goes on the certificates. So if a vehicle gets 3,000 certificates a device and you want to revoke that device, you don't have to put all 3,000 on the CRL. You put these linkage IDs, the decryption for these identifiers, on there. So there's a stamp on all of them that's encrypted, but can be published so that that's the way you manage the size of the CRL.

Yep. Valerie.

MS. BRIGGS: Oh, do you have a follow-up question for that? Go ahead if you do.

DR. RAJKUMAR: Go ahead. I have another question.

MS. BRIGGS: Okay. Can you go back to your summary slide? At that first bullet, suppliers estimate that the cost for the security portion is less than 20 percent of the total cost for the OBE." I think you need to specify what you were including in those costs for the security portion, because I think it differs depending on, you know, whether you include the communications cost or the -- you know, all of the back-end processes.

MR. SHULMAN: Yeah.

MS. BRIGGS: So I'd like to -- I think it's --

MR. SHULMAN: I mean -- and so, you know, we looked at just the onboard module.

MS. BRIGGS: Okay.

MR. SHULMAN: It wasn't the communication costs. And, you know, the cost of an electronic module depends a lot on what year and what -- how much -- what the volume is. You know, if I go to DENSO and I say I need, you know, one of them, it's a lot different than if I need 10 million. And so we didn't really

want to get into specifics, but we just kind of -- it's just a rough order of magnitude that says in volume -- in some time when this thing might go to product, like 2020, we don't think that adding this FIPS 140-level hardware to encrypt these certificates is going to really drive the cost up to something astronomical.

MS. BRIGGS: But that is just the cost of the security on the hardware.

MR. SHULMAN: That's right.

MS. BRIGGS: So I think that's an important point, because there are other system costs here that --

MR. SHULMAN: Right. Yeah. This study was really meant to look at what are the red flags that would kind of say, you know, there's some major issue here, and it was just to say, you know, it's an issue, but it's not a red flag.

DR. RAJKUMAR: I had a quick question. This is Raj speaking. This question maybe is for the DOT. The question is the security administration must be in place are

defined before the management decision gets made.

MS. BRIGGS: Well, what we're trying to do is understand what the needs are to understand whether it's practicable. Remember yesterday, the presentation? It has to be practical. It has to be possible to implement it. So that's what we're trying to do with the research in the next year.

DR. RAJKUMAR: A second question for you, Mike. Does the attack models include a denial of service attack?

MR. SHULMAN: No. I mean denial of service is --

DR. RAJKUMAR: I mean it just starts blasting DSMs out there.

MR. SHULMAN: I mean if somebody, you know, with a SmartGit transmitter just starts to send out -- and we lose GPS and you don't even have to worry about security if the cars don't have a GPS signal. The whole system stops because GPS is the fundamental thing that, you know, you've communicated in the VSM is my

position. And so denial of service is beyond, you know, what we can protect --

DR. RAJKUMAR: So if some law enforcement aspect application comes to play.

MR. SHULMAN: Yeah. You know, our feeling is that -- there isn't a lot of financial gain or other kinds of gain that people would get by sending out bad messages or denying service here, and that's a very local thing. You know, the range of this thing is about 300 meters at the most, and so, you know, if you were going to do a denial of service, you'd have to kind of have the Occupy people all around the country sending out, you know, stuff. And so it's possible, but, you know, right now we're not seeing it as a real big threat.

DR. RAJKUMAR: Okay.

MR. McCORMICK: And if it did that, all it does is give you less information. The system doesn't tell you if you're safe. It only will tell you if there is a known potential hazard. So I can't tell the difference between knowing whether he's not transmitting or he's

not there.

MR. SHULMAN: Yeah.

MR. McCORMICK: So, I mean the reality is that in a denial of service, the more likely scenario is that someone's going to corrupt one of the certificate authorities or the revocation authorities.

MR. SHULMAN: Yeah. I mean that's a good point. I mean we're not doing control. This security system was not designed to do a control application based on V2V. It's warning only, and the assumption is the customer's always in control of the vehicle. The customer, when they get a warning, can look up and say, oh, that's -- there's nothing there. I don't know why that happened or -- and we have experience with that with our current radar-based systems. We're not -- if we were doing control based on V2V only, it would be a much, much more stringent requirements on the security system than what we're talking about here.

DR. RAJKUMAR: Thanks.

MR. SHULMAN: Yep. Okay.

MS. BRIGGS: Thank you, Mike.

MR. SHULMAN: You're welcome, Valerie.

IMPLEMENTATION AND INSTITUTIONAL ISSUES

MS. BRIGGS: Mike and I are used to doing the tag team.

So I'm talking about the second part of this, which is the CAMP team comes up with the technical solutions, and then they turn it over to the policy team to evaluate how much the solution costs, and then we tell them that, and then they go back and they revise their solution. So it's been a back-and-forth process throughout and, you know, one reason we haven't been able to release any documents recently is because we keep improving things, and so we keep driving down the complexity.

As Mike mentioned, it was a -- we thought it was a pretty major breakthrough that they had this summer when they came up with the re-use of the certificates, because that really simplifies things. And then we've also been

able to identify some of the other big cost drivers in the system so that we can address them.

But, so I'm not going to be presenting to you actual costs, but I'm going to be talking through what we've learned about potential options, and so I think that will help you understand the system a little bit better.

So, next.

MR. GLASSCOCK: With that, Valerie, just to let everybody know that all these presentations will be on the web page. We have to make them compliant, so it may be Monday before we have them posted, but you have hard copies of most of them, and the others, we promise we'll get them on the web page.

MS. BRIGGS: I think most of these are posted. Mike's is not, but mine is, so --

MR. GLASSCOK: Right.

MS. BRIGGS: Okay. So we have, you know, four different needs in this system. We need the security back-office function. So that's all of the entities in Mike's complicated

diagram that are actually performing the functions.

Then we need a communications network. So they've looked at the first three years that you may not need to communicate back with the vehicles, but after the first three years, you're going to need to refresh those certificates and have some means to communicate with the vehicle, and you don't want the customer to have to initiate that. You want it to be automatic. So you need some way to communicate with the vehicle.

You need the applications infrastructure for the V2I applications, but that's really a separate issue than the communications needs for security, because communications needs for security can be done by pretty much any communications mechanism, whereas the application needs for the infrastructure are specific to the applications themselves. And Brian's going to be talking about that, and so I'm going to leave that to him.

Then you need the onboard equipment that is capable of accepting, you know, performing the communications needs. So if you need -- we know we need DSRC for the safety applications, but you can have a secondary communications -- you're going to have to have a secondary communications means for security, whether that be a second DSRC radio, cellular, satellite, Wi-Fi, all of the above. You need a secondary means for communication to the vehicle, and that equipment has to be on the vehicle.

So those are the costs that we've been estimating.

This is just the same thing that Mike already showed you. This is the security system, and so I'm going to skip this.

What we've learned. We separated out, looking at the back-office functions versus the communications needs, and what we've learned about the back-office functions is the original design made this system far more complex and hundreds of times larger than any existing

system. But that's been greatly simplified by the re-use of certificates.

So, the major cost drivers for the organizational aspects of this are the security -- I'm sorry -- are the hardware and software needs, the processing power that's needed for creating those certificates. And then secondary, the number of physical locations for all of those organizations, and then the choice of the organizational model, and how much oversight it needs.

The various ownership options are being analyzed. As I mentioned earlier, there's -- you know, we're really focusing on the public-private option or the all-private option, because, you know, I think all of us see the writing on the wall. Government doesn't want to take on new functions. And so this is -- we're really looking at the other options.

And then, you know, the ownership options do have some impact on the organizational models and cost, and ultimately it will be up to the system owner how this is

done. It's not up to us, the researchers, to figure out how it's actually done. What we researchers are trying to do is figure out whether it's possible to do it and what are the general costs for this so that we can feed those to NHTSA and the OEMs and others who are involved in this so we all understand what it really takes to do this.

How PII -- I should say, if and how PII is collected is still a point that we're looking at. As Mike mentions, you need to be able to register legitimate users on the system to know that a device is legitimate, but how that is done is still an open question that we're examining.

And then internal controls and policies are needed to protect security and privacy, and that's being analyzed also. Ultimately, any system that is developed will need to go through a comprehensive privacy review, and we see privacy really as a process. It's not just designing a technical solution or designing a policy solution. It's a whole

process of how you address privacy.

On the communications side -- so that was the organizational side. I should note that the organizational sides are a much smaller cost than the communications needs in our cost estimating. On the communications side, we've been looking at really four different scenarios of communication. One is doing communications primarily through cellular, because many vehicles already have cellular on them, mostly through cellular, with some installation of DSRC as DSRC is installed over time, and then an all-DSRC scenario, putting a second DSRC radio on the vehicles and how it would be done through all DSRC. And then we're also analyzing the CAMP solutions as they -- as CAMP comes up with new solutions in this next phase of the analysis, we're analyzing those. And so that's why we've not put out any documents yet, because we want to analyze the latest and greatest and get that out to you.

CHAIR DENARO: Valerie, when you said "cellular," do you mean -- you said

something about most vehicles have cellular. Do you mean embedded cellular phone or it could also be a handset?

MS. BRIGGS: As this point we're looking at embedded cellular phones, but I guess it -- I should qualify, also, that our consultants have said that you'd need a different cellular radio than what's necessarily on there today, because it has different needs, and I don't completely understand that. But I think that it's --

MR. SCHROMSKY: You just need a multi-band --

MR. McCORMICK: Yeah.

MS. BRIGGS: Okay. So you guys are the experts on that. But we did a --

MR. McCORMICK: But I'm curious about the statement that most cars have embedded cellular. I mean I've never --

MS. BRIGGS: Well, I mean we're looking at five years from now or six years from now or -- you know, I think there's -- I should, you know --

MR. McCORMICK: I'd like to ask the OEMs, is that what you're seeing, is five years from now most cars will have embedded cellular? Forget the OnStar cars. I mean, just talking in general.

MR. HARDIGAN: Yeah. At Ford, no. You know, we're -- our system relies on brought-in devices.

MS. BRIGGS: So I might have misspoken, but we have estimated the cost of adding a cellular radio, so it doesn't really matter. The point is that --

MR. McCORMICK: Okay, okay.

MS. BRIGGS: -- we could add a cellular radio to most cars. So that's probably the better statement.

CHAIR DENARO: So the answer is there's no way to have a handset do that function.

MS. BRIGGS: What's that? I think that the problem with handing a handset is that if this is a mandated system, you can't guarantee that a person is going to put their handset into

the system to enable this to work. So, while it works -- a handset, you know, could potentially work for a non-mandated system, if you have a system that's mandated and you have to have security and you want it to be there a hundred percent of the time and you don't want the user, the customer, to have to interact with the system, a handset -- relying on them to put the handset in is not the -- you know, not really what we want.

MR. McCORMICK: Well, but if it's an opt-in system, whether you're using MirrorLink or any of the tethered mechanisms of combining -- you know, your carry-in transceiver, I'll call it -- and again, if we're looking five years out, if you look at the evolution of the handset over five years ago from five years from now, I don't think that ought to be -- I don't think there ought to be a presumption that there's an embedded cellular system in the car. I think that's a high-risk scenario for deployment.

MS. BRIGGS: Yeah. As I noted, I

think what we -- we have estimated the cost of adding a cellular system to the car.

MR. McCORMICK: Right.

MS. BRIGGS: So not -- you know, I don't think we're presuming that there's a piggyback on any system.

MR. McCORMICK: Okay.

MS. BRIGGS: So the point is that if this is a mandated system, you have to know that the technology is in there.

Yes, John.

MR. AUGUSTINE: I was going to say, I think, Scott, you pointed out an important point. Obviously, if you're talking about an opt-in system, if this is a voluntary end cap and the consumer says, "Oh, I like this option so I'm going to, you know, use my own handheld," that's different and that's actually easier. I think this security scenario that we're talking about is, let's -- if you're thinking through sort of the hardest scenario, a mandated system, getting back to Peter's comment about, you know, are we really going to rely on the

driver or the consumer to be using their phone and driving in and getting updates and doing all the -- we really want to make it practical. We want the system to be invisible to the consumer, you know, when they purchase the vehicle. If it's a mandated system, all of these things work as invisible as possible. So, if you get to the voluntary situation, sure, that opt in using their own handset -- that may actually be what we're -- you know, an option. But we're looking at the hardest scenarios.

MR. McCORMICK: Well, but mandating whether or not an OEM puts something in their vehicle doesn't necessarily mean that is going to require the consumers to use it. That's why all devices that are in vehicles you can turn off.

MS. BRIGGS: So I don't think -- I mean there's no one from NHTSA here, and so getting into what NHTSA might mandate or not or how it works, I don't think, is helpful to us right now. Practicable. But I mean --

MR. McCORMICK: You can't use the

NHTSA words that no one else uses.

MS. BRIGGS: Probably not. So, but yeah, the considerations that we've made for this study are that, you know, under a mandated scenario. The other thing that Mike talked about was, we don't want any monthly subscription fees for this. Now, that's -- under a mandated scenario, you don't want the user to have to pay for that on a monthly basis. But, you know, if it's not a mandated system, then, you know, any options are on the table because the government's not involved. So that was the basis of Mike's statement in his presentation, too. It needs to be seamless.

VICE-CHAIR KLEIN: Can I ask you -- Hans here. What entity is performing the SCMS function? Who is the SCMS administrator or operator for the Safety Pilot?

MS. BRIGGS: That is the big question. We don't know.

VICE-CHAIR KLEIN: I mean it's out there running. There is an SCMS --

MS. BRIGGS: Oh, for the Safety

Pilot? Well, the Safety Pilot is a government test, so --

VICE-CHAIR KLEIN: Yeah.

UNIDENTIFIED SPEAKER: Walt? Is Walt?

MR. FEHR: Yeah. I'm running it.

VICE-CHAIR KLEIN: You are the certificate for it. Okay.

MR. FEHR: Yeah.

MS. BRIGGS: Okay. And I should note that all of these are based on preliminary consultant analysis, not final government findings.

DR. RAJKUMAR: So, Valerie, if I could quickly follow up? So given that the Safety Pilot is using certificates submitted by one system, so you're able to encrypt, decrypt real-time messages going through the system, and then through-put is not a problem or --

MR. FEHR: If you're talking about what's actually happening in the vehicles, you'll have to talk to the gentlemen over here, because they've come up with a scheme to deal

with that computational complexity.

MR. SHULMAN: Yeah, we -- I missed the beginning of your question, but we're using something called verify on demand, and basically there's a lot -- you know, if you remember what I said, you have to first kind of verify that the certificate is valid by checking the signature of the certificate, and then you have to verify that the message is valid by checking the signature of the message, and if there's many cars around you sending ten messages a second, an automotive-grade processor would choke really quickly. And so we use a scheme called verify on demand that says, I only really need to verify those messages that are reading the threads that would potentially be a warning to the driver, and so if a vehicle is moving away from me or not on a path, then I don't care about the message anyhow, because I'm not going to use it.

MR. McCORMICK: And the Safety Pilot's not revoking any certificates; right, Walt? It does go -- you don't have a process

to test certificate revocation, do you?

MR. FEHR: We have a process for distributing --

MR. McCORMICK: You do?

MR. FEHR: -- a revocation list and the devices out in the field will have a process for using that revocation list.

MR. McCORMICK: Okay.

MR. FEHR: So we could test the concept. We don't have a misbehavior detection of that yet, so that's the piece that's missing.

MR. McCORMICK: Oh, okay. Thank you. Sorry about that.

MS. BRIGGS: So --

PARTICIPANT: So you just say, Scott, it's the misbehavior, Scott, and see if the system works.

MS. BRIGGS: Okay. So I'm moving on. So, major cost drivers for the communication system, the onboard equipment, is one of the major costs. So, you know, every vehicle has to have the right onboard equipment.

Also, the communications costs are

substantially greater than the -- appear to be substantially greater than the costs of operating the certificate management entity. So that's what I noted earlier, that these are -- the communications costs are the major costs compared to the back-end processes.

Onboard equipment costs. The interaction with the security system requires different cellular modems in the vehicle than exist today. That's what I already noted. The DSRC network requires two DSRC radios, because, as Ray noted yesterday, you need one just for safety, plus one for the other stuff. The costs vary slightly for each scenario due to the differing subcomponents needed.

VICE-CHAIR KLEIN: Can I --

MS. BRIGGS: Yes.

VICE-CHAIR KLEIN: Didn't we have the two DSRC radios? Didn't that come out in two channels? Or maybe that's open still.

MR. FEHR: It's radios capable of operating on two channels simultaneously. So whether that's one radio, two radios, it's up

to the people that design radios.

MS. BRIGGS: But there will be an added cost for this. That's the point.

MR. SCHROMSKY: But I would also assume, if this is a mandate, that the OEM manufacturers today -- pardon me, Walt -- they're using multiple physical radios, right?

MR. FEHR: Right.

MR. SCHROMSKY: Something that's large, you will get a multi-load device. That would be cellular, LTE, different bands, and DSRC built into it and whatever, Wi-Fi.

MR. FEHR: -- system on a chip that's on it today.

MR. SCHROMSKY: Right. Exactly.

MR. FEHR: You know, that they just add that to something bigger.

MR. SCHROMSKY: Okay.

MS. BRIGGS: Second, in the all-cellular scenario or the scenarios that rely on cellular at all, the cellular is a significant cost and it is significantly greater than the other scenarios. But the primary cost is the

distribution of the certificate revocation list. So if there are ways to do that more efficiently, that drives down the costs. So, the cellular costs are highly sensitive to changes in the misbehavior rate, the data size, and the peak pricing. So that's the problem. It's very sensitive. And so we don't know how big that certificate revocation list is, we don't know how many bad actors there will be on the system, and those really have an impact on the costs, and so that's a challenge for us.

There's also insufficient coverage in rural areas and some other areas, but, of course, there's no coverage of DSRC, so insufficient is better than none at this point. There appears to have -- appears to have significantly higher costs than other scenarios, which I already said.

MR. McCORMICK: Well, you have a fundamental difference because when you go to an all-cellular system, you give up an awful lot of privacy to use this, to use this protocol, and talking about privacy concerns with an

embedded chip system is substantially different when you start talking about it's an all-cellular system, because --

MS. BRIGGS: For security. That has been something that the OEMs have talked about and are --

MR. McCORMICK: Walt stood up.

MS. BRIGGS: -- looking at.

MR. FEHR: I was just going to challenge that assumption. If you had to use that type of a data modem for this kind of a purpose, you're making an assumption that it has to be the same as it's done today, and I'm asking if that's a valid assumption.

MR. McCORMICK: No. The presumption is that right now when you talk about privacy and you talk about data privacy policies, the difference is that the analogy would be I buy a television set and I don't want the government or the television maker or my wife to know to know what channels I'm watching. But that doesn't give me the rights to the data that comes out of that remote, because that's IP that drives

a lot of things in the system.

But the "X" of byte of data that's captured by a typical car over the course of a year, a very miniscule part of it is actually personally attributable. So when you talk about doing something on a cellular basis, the privacy issues that are being addressed are being looked at a device-centric level, rather than, okay, well, I've got this in my pocket, I'm carrying it around with me, I get in my car with it -- notice I'm pulling out my phone. This captures -- you know an awful lot of information that -- in that context that I can now derive if I'm using a cellular protocol.

MR. FEHR: Right. If you're using a cellular protocol. But just as the 802.11-P and 1609 are different than Wi-Fi, couldn't those same kind of differences be put into this thing, since I'm not accepting an incoming call or an incoming text message?

MR. McCORMICK: Well, they haven't been able to yet, so --

MR. FEHR: It hasn't been able to

yet, but is that a valid assumption? Because there are roughly going to be the equivalent number of handsets as vehicles, so something to that large of a magnitude would give you the ability to change some of this stuff around. That's what I'd like people to make sure they keep thinking about. You don't have to assume that it's the same business model.

MR. McCORMICK: Well, I'm not looking at business model. I'm looking at the ability to access and corrupt or acquire information over a certain protocol.

MR. FEHR: Right, but there's no reason why that protocol couldn't be adapted, just as Wi-Fi standards were adapted to create what we have now for 5.9 GHz DSRC.

MS. BRIGGS: So I think those are -- that's a good discussion for your technical committee.

So the major advantage of cellular, of course, is that there's already network operators out there. It's already out there as compared to other systems that are not already

out there, and that's a major advantage. So there are pros and cons of each of these options.

CHAIR DENARO: And, excuse me. The cost -- significantly higher cost, that's due mostly to hardware? To utilization?

MS. BRIGGS: That's the network time. That's the, you know, payment for the transactions.

CHAIR DENARO: Okay.

VICE-CHAIR KLEIN: If I can't refresh my certificate list, is the downside that I lose privacy, or is the downside that we no longer have a functioning system?

MS. BRIGGS: So that means if people can't get that, they don't know who are the bad actors on the system, so you don't have a way to, you know, who might be trying to hack into your system or who might not have a valid certificate.

MR. McCORMICK: Well, you can still see the information. Your car can still --

MS. BRIGGS: Right.

MR. McCORMICK: -- get hazard

warnings without the cost.

VICE-CHAIR KLEIN: But I can't transmit.

MR. McCORMICK: Right.

VICE-CHAIR KLEIN: Because it's not just that I'd be -- I can't recycle my certificates. Once they are gone, they are gone. Because if I was recycling events where people could figure out who I am, I would lose privacy. But it's worse than that, I think.

MR. FEHR: Well, I think you may have veered off a little bit on your first point. The revocation list is a mechanism to remove people from the system. So if you don't get the revocation list, you would continue to accept messages from devices that have been removed. That's the danger of not getting the revocation list.

MR. AUGUSTINE: But running out of certificates is a different issue. You know, if we're talking about a three-year start-up phase, once you run out of certificates, then your system no longer is transmitting at some

point.

VICE-CHAIR KLEIN: Or could it recycle?

MR. AUGUSTINE: Well, those are the options we're looking at, you know. And I think there's another point that was made in Mike Shulman's initial briefing was that they're looking at five-minute certificate times. That's also under discussion of can you lengthen that and how long can you go and how -- can you refresh? All those options are still open for debate, actually.

MS. BRIGGS: Okay. So, roadside equipment. On the DSRC scenario, the major cost driver is, of course, installing and operating the network, and the thing here is we don't actually know how much it's going to cost to install and operate a DSRC network. But the estimates from our consultant are that this is -- well, and the other thing I should note is that one of the things that drives the costs for the RSE network is knowing how many RSEs you need, and it all comes down to, you know,

at what point do you -- how much of the population do you need to reach and how frequently? So, do you need to have contact with every vehicle every day? Do you need to have contact with 50 percent of the vehicles every week? Do you need to have contact with a hundred percent of them every month? So the frequency of contact and what percent of the vehicles need to have contact really drive how many RSEs you need, which drives the cost. Yes.

MR. SHULMAN: I just wanted to make a point that they don't need to be roadside units. They just need to be --

MS. BRIGGS: That's true.

MR. SHULMAN: -- units that have DSRC. So, in an oil change location, you could -- if they have an internet connection -- there are these devices called My-Fis that take a cellular signal and road test out Wi-Fi. You could have a little device that takes an internet signal and broadcasts out DSRC, and when you're changing your oil, you could connect. They don't necessarily need to be at the roadside.

They just need to have some internet connection.

MS. BRIGGS: That's a very good point that we've -- you know, we've talked all along about DSRC on traffic signal cabinets. But for security, it doesn't matter where these RSEs are. They could be on private property, public property. Doesn't really matter.

Our consultants are doing estimates based on what percent of the population you reach by putting RSEs at various locations, so the 1,300 estimate was if you put RSEs on major highway entrance ramps. The 150,000 RSEs was based on putting it around local communities at key intersections. So at this point we're just -- we're running a lot of models to see what percent of the population you reach by what strategies, and so -- so that's ultimately a policy decision by the operator as to what -- you know, how you deploy this and what strategy you use and how often you need to meet the -- you know, interact with the vehicles.

CHAIR DENARO: And, Valerie, how

are you going to answer the unanswered questions?

MS. BRIGGS: You guys are going to come up with the answers for us, right? I mean, like I said, I think it's ultimately -- there are several things. You know, what -- how secure does the system need to be by when, and, you know, whether that becomes -- I mean, like I said, it's really up to the system operator and the major stakeholders to figure that out.

CHAIR DENARO: It is. Okay. So that's not your job to --

MS. BRIGGS: Well, it's not my job as a researcher, but I think it's certainly a question we're asking and what we're trying to do right now is really get the information. I mean we're trying to understand, how secure are you with various levels of communication with the vehicles, how could this be done? And, you know, ultimately it's going to be up to the individuals who are implementing the system to decide what makes sense, I would think.

CHAIR DENARO: Okay. But -- so

there is still a research question, though, --

MS. BRIGGS: Yes.

CHAIR DENARO: -- saying, --

MS. BRIGGS: Yes.

CHAIR DENARO: -- given that you want this level of security, here's what you need. Given that -- and so forth.

MS. BRIGGS: Yeah.

CHAIR DENARO: So you can do a parametric study.

MS. BRIGGS: Exactly. We're trying to study the issue to show what the options are and what that means.

CHAIR DENARO: Okay.

MR. AUGUSTINE: Okay. And we may have a recommended option, but that may not be what's adopted by the industry.

CHAIR DENARO: Yeah, okay. That was really my question.

MR. McCORMICK: The minimum RSE is actually zero.

MS. BRIGGS: Well, that's a good point, because there could be no -- there could

be a different system.

MR. McCORMICK: Because all if you need is the internet connectivity, I can do that in my garage. Through my car I can connect up to the system, you know, to those old protocols or through the cellular.

MS. BRIGGS: So, like I said, we -- what I'm presenting was based on the options on the table a few months ago, and now CAMP continues to come up with new options that we're analyzing, which is why we haven't put out a report. But we are analyzing all these other ideas, too. Yeah.

MR. SCHROMSKY: So one of the things I keep hearing is we're looking at a number of 250 million. We're looking at the vehicle having certificates for a quarter of a billion. One of the things that just got me going through this is, obviously we're focusing on the vehicle. But then you go to V2I.

MS. BRIGGS: Yes.

MR. SCHROMSKY: Who's going to manage all the certificates for all the little

nodes that the vehicles want to talk to?

MS. BRIGGS: That's -- yes.

MR. SCHROMSKY: And it has to be one and the same, because you can't have --

MS. BRIGGS: That's the same question George keeps asking us.

MR. SCHROMSKY: Yeah, because that's --

MS. BRIGGS: Yes.

MR. SCHROMSKY: -- where it gets it down to a point. You know, the My-Fi's a modem, --

MS. BRIGGS: Right.

MR. SCHROMSKY: -- for lack of a better term. But that DSRC device is more holding the certificate and it's more of telling the modem what to do. So, just curious to see how that plays out.

MS. BRIGGS: Yes.

MR. FEHR: You saw Mike's chart of the organization. Well, we expect that there would be an extension to that very same organization, because you're right. All of the

root has to be the same for all of the devices participating in a communication scheme as a whole. Not just the vehicle-to-vehicle communication, but all of the other communication, peer-to-peer communications that support all of that. And so there needs to be, you know, the same kind of logical extension to that diagram to accommodate all of those other communicating elements in the overall system.

MS. BRIGGS: So, yeah, it could be a lot more than the 250 million. But, I mean, you look at the numbers here. That's 150,000 versus 250 million, so they're much -- and you don't have the privacy concerns of -- you know, a traffic signal doesn't move and it doesn't care if you know where it is, so it's -- they're less complicated, but they're still significant issues.

MR. SCHROMSKY: Understood, but --

MS. BRIGGS: Yeah.

MR. SCHROMSKY: -- you had to start somewhere, but --

MS. BRIGGS: Yeah. Right. Yeah. No, that is part of our thinking, too.

MR. SCHROMSKY: -- be cognizant that, you know, if we really want to take the benefits beyond, --

MS. BRIGGS: Yes.

MR. SCHROMSKY: -- you could see infrastructure being updated fasted, in some cases, then turning over the fleets, right?

MS. BRIGGS: Yes. Well --

MR. SCHROMSKY: So, do you want to take advantage of that? It's in some --

MS. BRIGGS: Yeah. Great, great, great.

MR. SCHROMSKY: -- certain cities, certain locations; right?

MS. BRIGGS: Yes.

MR. SCHROMSKY: Maybe Ann Arbor might jump on board more than other cities, right?

MR. McCORMICK: -- malicious threat at a roadside equipment is much higher probability than it is to an individual car.

MR. FEHR: Yeah. I was going to say that actually you're very right on point with that particular item. The fixed elements of this system are just as vulnerable, if not more vulnerable than the mobile elements of the system. So people tend to think that they're less vulnerable, but in actuality they may actually be more vulnerable, so the same kinds of changing security credentials and all of the rest of that are very much going to have to be applied to a lot of the fixed elements of the system for those very same reasons as being done in the mobile apps.

MS. BRIGGS: Okay. Raj.

DR. RAJKUMAR: Many states require annual inspection of vehicles, so could that be a way to recognize the elements?

MS. BRIGGS: There are lot of ways that could be done, but not all states -- that's all done by state law. So our challenge here is that it's done differently in every state, and that's a state requirement, not a federal requirement. So if this is a system that has

to be on all vehicles and it has to be done, you know, the same way nationally, it becomes a challenge to rely on systems that are different at every state, so --

CHAIR DENARO: So, Valerie, I'm missing something. Let's assume it's a mandated system. There are going to be some vehicles who are not participating due to various problems or whatever else. So I guess my question is something like, how much do you care about cars that are not participating, even though it's mandated? And the direction of my question is, so if you had, let's say, four different mechanisms for communicating to the vehicle -- cellular is one, but in rural areas that's a problem. Doing it through dealership, doing it at the oil change, whatever, the gas station, whatever -- and you do miss some number. How much do you care?

MS. BRIGGS: That gets back to the exact same issue of how many.

CHAIR DENARO: I see.

MS. BRIGGS: I mean it's the -- how

much do you care.

CHAIR DENARO: Okay, okay.

MS. BRIGGS: How frequently do you need the --

CHAIR DENARO: Okay.

MS. BRIGGS: -- cars to interact with the system, and, you know, how many false warnings is acceptable. It really gets back to the reliability of the system and how reliable does it need to be.

CHAIR DENARO: Well, reliability of the system, but it comes down to protection of the individual. You know, the mandated system says --

MR. AUGUSTINE: And the benefits you get.

CHAIR DENARO: Yeah.

MR. AUGUSTINE: So I think if you make the assumption that, for whatever reason, people will turn it off or they --

CHAIR DENARO: Right.

MR. AUGUSTINE: -- won't connect or they lose connectivity and they don't do

anything about it, --

CHAIR DENARO: Yeah.

MR. AUGUSTINE: -- that's going to decrease the benefit, which makes the regulatory decision that much harder on NHTSA because it's -- you have to factor in how much benefit you're going to get and you're going to have to wipe those benefits off the table. And, you're right. It ultimately comes down to a safety benefit where you're less safe on the road. People that should be getting messages and safety warnings won't. So I think we care. It's just there is --

CHAIR DENARO: No, no.

MR. AUGUSTINE: -- a level of reality. You'll say --

CHAIR DENARO: Yes.

MR. AUGUSTINE: -- there's certain people that never get their car inspected and they don't change their brakes --

CHAIR DENARO: Right, right.

MR. AUGUSTINE: -- and they're on the road, and what do you do about those people?

CHAIR DENARO: Yeah, and one of them is my kid, but anyway --

(Laughter.)

MS. BRIGGS: That was a joke.

MR. CALABRESE: Totally off subject, but, you know -- but not on. You know, we're trying to enhance highway safety and we want to impose or require all these electronic stuff, but we feel we can't impose "you must have an annual motor vehicle inspection."

MS. BRIGGS: Well, it all comes down to what NHTSA has authority to do.

MR. CALABRESE: And has anyone done research to see, if more states require that, would it result in less accidents and less fatalities?

MS. BRIGGS: I mean it comes down to the authority questions. You know, what does the federal government have authority for versus state government. So that's --

MR. CALABRESE: And we think the federal government has authority to require this, but not require --

MS. BRIGGS: I have a slide on that.

MR. CALABRESE: -- annual physicals for your motor vehicle?

MS. BRIGGS: Oh, it's several slides forward, but I'll get to that.

So, as we've already talked a lot about the certificate revocation list and that it is really one of the drivers of the complications in all of this. Other big challenges. If you're relying on the DSRC, how does that network get installed and who's owner and operator? You know, the challenge with placement on public rights-of-way versus placement on private rights-of-way. It's going to be challenging regardless.

So -- oh, no -- okay. So a couple other notes. That I've not talked much about the V2I safety applications, but, like you said, that the system would need to be extensible to those. Brian's going to talk a lot more about the applications shortly.

Also, AASHTO is doing -- is kicking off a new study to look at how infrastructure

for applications could be done. So they're not focusing on the infrastructure for security. They're focusing on the infrastructure for applications and, you know, what are their priority applications and how could those be installed, where would it make sense to install them, and what could be an installation strategy for state and local agencies. So that's a big study that they're really excited about that's just getting started, and what is the value to public agencies.

Okay. So here --

CHAIR DENARO: Valerie, excuse me.

MS. BRIGGS: Yeah.

CHAIR DENARO: Just one quick question. This is Bob. I know the focus is on V2V right now. You still have a roadmap with some possible dates and so forth where V2I gets implemented?

MS. BRIGGS: Oh, yes.

CHAIR DENARO: Yeah.

MS. BRIGGS: We do. It's just a longer-term roadmap.

CHAIR DENARO: Yeah.

MS. BRIGGS: But, yes. We're working very hard on the traffic signal applications, --

CHAIR DENARO: Right, right.

MS. BRIGGS: -- the SPaT applications, SPat interface. They have concepts of operations and designs. The milestone for that is really 2015. They're trying to have basically all the guidance, all the design guidance and everything that a state or local agency would need to implement the V2I --

CHAIR DENARO: Oh, okay. Great.

MS. BRIGGS: applications, so --

CHAIR DENARO: All right. Thanks.

MS. BRIGGS: So this is -- oops. Okay. So this our authority slide. I have to say that NHTSA doesn't like me talking about authority other than exactly what's on the slide because I'm not a lawyer. So I'm going to stick to what's here on the slide, but NHTSA has authority to support key aspects of the V2V

communications. They also have authority to support regulation of critical equipment, messages and applications if related to safety. And they also have authority to support provision of the security required to support a V2V rule by a non-federal entity as through a procurement or other form of agreement or indirectly via a V2V regulation. So I will let you digest that. And the other important point here is that Federal Highway does not have authority to require installation of roadside equipment. So I think that's important. I mean often people assume that they do, but they don't. They can't go and tell Kirk that he has to install all of this stuff or George, for that matter, or the toll operators. So that's important.

CHAIR DENARO: So, Sonny, this chart's for you.

MR. CRONIN: Nor does FTA.

MS. BRIGGS: Okay. Good point. Nor does FTA.

VICE-CHAIR KLEIN: This is Hans. Is

there a focus working group focused on these --

MS. BRIGGS: Oh, yes.

VICE-CHAIR KLEIN: And what's it called?

MS. BRIGGS: There are about 40 people in our department who are focused on the issue. We have three policy teams.

VICE-CHAIR KLEIN: Okay.

MS. BRIGGS: I lead the implementation policy team that's really looking at all the security stuff and working with the contractors on the nitty-gritty details of that.

Dana Sade from NHTSA leads the legal team, and they're the ones who are really looking at the authorities, privacy and other issues, other legal issues, and they've been quite active.

And then we have a technical policy team that's really digesting what does it mean to be part of the security system, what would be -- what would it mean to agencies like Kirk's

and George's to be part of our -- part of this entity, and really looking at some of the technical elements of the security system as well.

VICE-CHAIR KLEIN: Okay. And I think I know your -- from the website I think I've found the tech policy and probably your --

MS. BRIGGS: Yeah.

VICE-CHAIR KLEIN: -- policy stuff. Is there a NHTSA website or any -- are they leaving any --

MS. BRIGGS: We don't publish the legal stuff. That's why you don't find anything on it. I mean we have some presentations. Dana has done a few presentations that are public and I can send you the links to those, but we don't have any reports out on the legal analysis.

VICE-CHAIR KLEIN: What's Dana's last name again?

MS. BRIGGS: Sade, S-a-d-e. She spoke at the last advisory committee meeting.

VICE-CHAIR KLEIN: Yeah, I remember

that.

MS. BRIGGS: Yes.

MR. ALBERT: Valerie, two comments. One, I know a couple years ago for the National Science Foundation we looked at the issue of -- what do you call it? -- sorry, one moment -- coverage or acceptable coverage for connected vehicle, as well as kind of the frequency from a rural perspective and propagation models, if that would be abused. The second thing is, I mean this morning it seems like we've heard far more negative and real challenges than we heard yesterday.

MS. BRIGGS: I know. We should have reversed it, huh?

MR. ALBERT: I know.

MS. BRIGGS: You know, give you the hard stuff yesterday and the exciting stuff today. Sorry.

MR. ALBERT: I feel like the committee that I'm on with Hans, the market-driven committee, that you guys have raised so many issues, my head is spinning in

terms of how the market might -- these things might affect the marketplace and how we might be able to leverage that. Is there any summary that you guys can kind of give us for major challenges? I mean it's really been --

MS. BRIGGS: There are a lot of major challenges.

MR. ALBERT: Yeah, okay.

CHAIR DENARO: There's your summary.

(Laughter.)

MS. BRIGGS: Sorry. That's my last slide. Well, question for you. I think we're very interested in kind of what is the value of the system for commercial purposes. Is there a value of a security network, security into the vehicles for commercial purposes, or is it primarily for safety; what factors influence that value and are there business models? I think those are questions that government's not real good at answering. In fact, government can't answer those. So those are challenges for us.

CHAIR DENARO: Thanks for raising those, Valerie. I think that's very helpful for us for you to raise questions like that when you have them.

MR. McCORMICK: Well, I think it's not just the government. I don't think in a telematic space, from my last 12 years of experience, that anyone does a good job of articulating the value proposition. And in terms of what he was just pointing out in terms of marketing it, I think that's really going to be the fundamental issue, is to make sure that we can communicate, you know, what the value is, real or perceived.

MS. BRIGGS: Well, and I'm not just talking about value proposition. I'm talking about, is there value that is sufficient that someone would want to build and operate this network? I mean is there value for building and operating a network beyond its need for safety? So I think that's what we have to understand, because, as I noted earlier, we're really focused on the public-private or the

all-private options to this, and that -- you know, there are costs, so there have to be sufficient value to have someone want to build that network.

VICE-CHAIR KLEIN: You mean, is this last bullet proposing or even entertaining the notion of a fully-private security system?

MS. BRIGGS: Oh, we are entertaining that notion.

VICE-CHAIR KLEIN: All right.

MS. BRIGGS: Yes. I mean I should note that all options are on the table, --

VICE-CHAIR KLEIN: Yeah.

MS. BRIGGS: -- but we really want to understand the public-private or the fully private, because, you know, I think that that's --

MR. McCORMICK: Well, I certainly hope they haven't taken operating it as a non-profit off the issue. I have major issues about having -- and I don't --

MS. BRIGGS: I mean a non-profit is really a private entity.

MR. McCORMICK: Yeah, but there's a difference between -- you know, the real history of all of this going back eight years is where we had a whole bunch of -- what's the best term to use for them? -- felt like patriots? That all thought they were going to be the entity running it under some IDIQ, you know, and we suffered years of struggling with getting those people out of the mix of proposing architecture that were only beneficial for their business models.

MS. BRIGGS: So I think the important message here is we just don't know. I mean we don't know who the operator is, so we can't take options off the table. But what we have to do is do our best to understand what the practicable options might be. So that's what we're trying to do.

I'm going to turn it over to Brian, because he also has a really interesting presentation for you that's a little more positive.

PARTICIPANT: We don't want to let

you get away so fast, Valerie.

CHAIR DENARO: Okay. I've got to ask one last question. In general for this -- and this might be too early for you to be doing this, but we talked about the need potentially for marketing to communicate the privacy concerns and handle that. On the positive side, there's probably a need to market to citizens on the benefits and that sort of thing. Have you guys started looking at that at all, had those discussions about how that --

MS. BRIGGS: I mean the way we've seen it so far is this is, we need to understand what the benefits are. We need to --

CHAIR DENARO: Yes.

MS. BRIGGS: Safety Pilot's going to be key to telling us --

CHAIR DENARO: Yeah.

MS. BRIGGS: -- those safety benefits.

CHAIR DENARO: Sure.

MS. BRIGGS: There's also an NCHRP study going on right now to look at what are

the benefits to public agencies.

CHAIR DENARO: Right.

MS. BRIGGS: And so that's wrapping up here, actually, this winter. And so we have been taking chunks of the benefits. We're also doing an analysis of what are the benefits to trucking and what are the benefits to transit. So it's really looking at the individual benefits to different user communities. We have focused primarily on the transportation stakeholders --

CHAIR DENARO: Yeah.

MS. BRIGGS: -- as opposed to the general public, because we assume that the general public is really served by the private sector. Our interest is in the safety applications and the public sector mobility. As government, our primary interests are the safety applications and the public sector mobility applications.

CHAIR DENARO: Yeah, but my push-back would be that I can see some value in a marketing -- a nationwide marketing

campaign to handle all of the issues around this as it gets towards implementation. Not now, but as it gets there. Just like Europe went through this huge thing on ESC. You know, choose ESC and -- but I don't know how effective it was, but it was certainly impressive.

MR. McCORMICK: It was impressive.

CHAIR DENARO: Yeah.

MS. BRIGGS: Well, I think we also -- that would certainly be -- right now we're at the research stage.

CHAIR DENARO: Yeah. Right, right. Okay. But -- so it's too early to talk about that. Yeah.

MS. BRIGGS: Well, it's a good point.

CHAIR DENARO: Yeah. Well, if you look at all the dimensions of successful deployment and implementation, I kind of think that might be one that's important.

MS. BRIGGS: Okay.

CHAIR DENARO: Just my personal opinion.

MR. McCORMICK: What is your schedule?

MS. BRIGGS: For what?

MR. McCORMICK: To address those issues. I mean if we're talking about getting to a deployment decision --

MS. BRIGGS: Right now. I mean what we have to understand is whether these can be addressed by the 2013 decision milestone. So we are -- we've really been on a fast timeline.

MR. WEBB: Valerie, --

PARTICIPANT: I'm sorry. Go ahead.

MR. WEBB: -- George Webb. Valerie, your first slide had a -- one more important thing -- all requires sustainable funding.

MS. BRIGGS: Yes.

MR. WEBB: Can you give us some sense of the kind of discussions, maybe, that you guys have been kicking around as far as on that committee?

MS. BRIGGS: Well, like I said,

number 3. So it does require sustainable funding. I know what we've taken off, what's in it. It's different if it's a mandated versus a non-mandated system. You can't have subscription fees for a mandated system. So, you know, I don't think we want to speculate as to how the system might be funded at this point, but it has to be -- somehow it will have to be funded, so, yeah.

MR. SHULMAN: Under any scenario you can think of, the majority of the costs are going to be borne by the OEMs if there's a regulation. Putting the equipment on our cars is going to be where the cost is, and security and roadside units and everything else is a fraction, a tiny fraction of the total cost of putting a device on every car.

MR. McCORMICK: Well, but as altruistic as all OEMs are, it'll eventually be borne by the consumer.

MR. SHULMAN: That's right. Yeah, that's right, but I'm just saying that's how it'll be paid for.

VICE-CHAIR KLEIN: Valerie, one last question, and this is a big picture on implementation. Just can you remind us or summarize the timeline that we're looking at from this program until it's fully implemented and operational? I realize, you know, your important years have gone on.

MS. BRIGGS: I'm not going to, because I think that would be a better question for NHTSA than for me. I mean I don't -- they really don't like me speculating about time frames. If one of the OEMs wants to put forward their thoughts on that, I welcome them, but I'm not going to speculate on a time frame.

MR. McCORMICK: I could give the earliest that it would possibly be -- that it would be delivering benefit, and there's some difference of opinions of how long, but let's take the decision in 2013 to decide whether or not they're going to pursue rule-making. In general, historically that takes about two years to get to a decision point. So you're at 2015.

We asked the administrator, RITA,

a year ago whether or not they would make a deployment decision in advance of the 2016 election, and they said, no, it would be middle 2016. We asked, how long do you normally give and what historically have you given major industries to do an implementation, and the answer was two to five years. So, at earliest, that puts you off till 2018.

Well, presuming that no one starts implementing until they're required to, which is not a good assumption, because I think a lot of the OEMs have determined that there's value to V2V just between their own vehicles, but if you start and you want to get to at least 50 percent of the new vehicles being manufactured, okay, that puts you off five more years. So between about 2023, 2025 --

CHAIR DENARO: Excuse me, Scott. Because you're assuming that even with a mandate, --

MR. McCORMICK: Yeah

CHAIR DENARO: -- there would be some kind of roll-out period.

MR. McCORMICK: They're asking me -- they're not going to go out and retrofit the existing cars.

CHAIR DENARO: Right.

MR. McCORMICK: But there might be an after-market thrust.

CHAIR DENARO: But even with new cars, there's a roll-out period.

MR. McCORMICK: There's a roll-out period, and that's the two to five years that they give them to provide the implementation. So you're looking at probably, earliest, around 2025 to get useful benefits, and that's just on the vehicle side. That's why I'm saying that the RSEs can be operated from zero, because there's a number of ways to get the information back to all of those authorities without putting up roadside equipment, which -- I believe it was Kirk a couple years ago told me -- he said unless you mandate that I use part of my budget, you know, the difference between putting up a $25,000, you know, DSRC Wi-Fi tower versus filling five potholes is -- the question is

obvious.

MR. STEUDLE: Well, that would be like 500 potholes.

MR. McCORMICK: Sorry, sorry. Five hundred potholes. Big potholes. I mean that's the whole issue that you have. You have budgeted for structure issues that are being driven by, "I don't want my bridges to fall down, I don't want my roads to be undriveable." It doesn't do me any good to tell you how slow I'm going if I'm sitting in a hole. So the reality is that we probably --

MR. STEUDLE: We'd know where you're at, though.

(Laughter.)

MR. McCORMICK: The reality is that you're probably looking at, earliest, 2025 and likely 2030, but if you look historically at the implementation of any technology in a vehicle, that's not an unreasonable thing to do, and this is probably the first time that there's been a concerted public-private effort to try to figure out how to move forward to

provide those safety benefits of reducing the accidents, the crashes, the deaths, the injuries. And so, you know, we can't be worried about whether we're going to get this tomorrow. We've got to be worried about how we're doing it right so that there is continual and obvious benefit accrued so that we can determine whether we should continue deployment.

MR. BELCHER: I would just -- I mean that's just --

MR. McCORMICK: That's my opinion.

MR. BELCHER: Yeah, I know. And I would say that that -- well, that works in the traditional manner in which technology gets deployed in vehicles. I just don't think that can be an adequate reality. I think there's got to be an after-market solution that's driven by the private sector that gets deployment much, much sooner.

MR. McCORMICK: And I think you will, and I think you're going to see it out of an evolved version of this.

MR. BELCHER: I agree, so yeah.

VICE-CHAIR KLEIN: I mean that might be a crucial issue. You're saying the after-market is actually really strategically important for achieving faster goals.

MR. McCORMICK: There are two things that are strategically important. One of them is what I'll call a nomadic device market. The other one -- and what's one of the reasons I'm looking at the commercial -- in 2014 they're going to be looking at the rule-making for interstate commercial vehicles. Given that they can act like they did with the texting rule, there's an opportunity there that if they decide to go forward, that they could require implementation in all interstate commercial vehicles within a couple years.

In our opinion, that would be a huge incentive for the after-market, the nomadic market, and even the invented market, including the ones that Walt just witnessed a few months ago in the Midwest, to actually roll this out in a much, much quicker fashion, and it doesn't require any RSEs to do that with.

So I think there's a couple of things. I think this is the process that the OEMs have to go through. They incur so much liability from whatever they put in a car, is that they can't do it any differently than this. Okay. But to Scott's point, yes, I think there's a couple of things that could be real game-changers, real disruptive in terms of accelerating this whole program, and given that I run the Connected Vehicle Trade Association, I'm already looking forward to seeing those happen.

CHAIR DENARO: So this is an important discussion, so, sorry. We'll --

MR. CRONIN: I serve at the pleasure of the committee chair today, so --

CHAIR DENARO: I'm just interested whether John or you have any comments, you know, based on both the time sequencing of an OEM solution, what you might choose to do yourselves, and what about this after-market thing? How do you see this?

MR. CAPP: Well, some of Scott's

estimates, the NHTSA piece he's probably optimistic on. I mean they have a lot of constraints. They have to prove a lot of things, and Ray reviewed that yesterday. Totally understandable. It's probably a rule-making process. For something this major, is likely more than a couple of years.

CHAIR DENARO: Good point.

MR. CAPP: We could think of many examples that would show that.

CHAIR DENARO: Is there another example, John?

MR. CAPP: Well, for example, Congress told NHTSA, what, four years ago to mandate rear back-up cameras.

CHAIR DENARO: Okay.

MR. CAPP: And that's still not gotten to a final rule stage --

CHAIR DENARO: Okay.

MR. CAPP: -- for a variety of reasons.

CHAIR DENARO: Okay. Well, that's good.

MR. CAPP: Just one example. That's just a simple piece of technology that we're already putting on most of our cars anyway. So, and as you get to complicated things like this, it does take longer. You know, a lot of the things that involve multiple systems on a vehicle, you know, Ray talked about adding up the cost. They need to show the cost benefit. It's going to get complicated in terms of showing that benefit into the future. I think we're in for a number of years. But most of us kind of think that's a required step so that we can get this common understanding established. None of the OEMs, to my knowledge, are holding back, saying, you know, geez, I want to deploy this now, but I'm going to wait for somebody to tell me to. We can go deploy it and have three General Motors cars talk to each other. But until we solve the things that Mike and Valerie talked about, it won't achieve this dream. So nobody's going to jump into it until you know what the rules are, --

CHAIR DENARO: The standards, yeah.

MR. CAPP: -- how the security thing's going to work, and we tend to think that it's going to have to have some type of central governmental piece to it to make that happen. If it can all be private, that's great, too. But -- and the safety application's driving it, and it seems like NHTSA's got a key role to play there.

CHAIR DENARO: And I don't want to put you on the spot, but I assume not just your company, but talking about all car companies, this is a benefit to make your drivers and your owners safer is a good thing.

MR. CAPP: Yeah. I mean the CAMP research has been showing a better part of that for ten years, and we're believers in the technology. We've demonstrated it. We --

CHAIR DENARO: Right.

MR. CAPP: Absolutely. It has potential to solve, we believe, you know, 80 percent of crashes ultimately, whatever. But a big -- yeah, there's a huge safety potential benefit, so we're all in. But we know that you

can't accrue those benefits --

CHAIR DENARO: Right, right.

MR. CAPP: -- until you know that it's secure and until I know that your company is also going to deploy in the same way.

CHAIR DENARO: Right, right.

MR. CAPP: So you need to get to this all-in point kind of sort of --

CHAIR DENARO: Okay.

MR. CAPP: -- to make it happen. And then the other thing that I mentioned yesterday is that, you know, where some type of a mandate might be required is that because of the relatively low benefits early on, whatever the cost of the technology -- I mean Roger will sell us the box for ten bucks -- it's still competing against something else that a consumer will buy for ten bucks.

CHAIR DENARO: He said that last night at dinner, by the way.

(Laughter.)

MR. CAPP: But I mean consumers make choices on CD players and infotainment things

and other safety devices, too. So there's other safety technologies that we're putting on vehicles today that have comparable costs that we're talking about that accrue benefits now. So from a consumer standpoint, they might choose one or the other. So, again, we kind of need to know where the ultimate roadmap's going and have the confidence to get there, and then we can make these commitments a little more from a longer-term high-level company standpoint.

CHAIR DENARO: Sure. Right. That makes perfect sense. So it seems to me that there's another model here, and so my question to Valerie and John would be, are you considering this? And that model is mandate or no mandate; that the auto industry, at least a good collection of them, really want to do this anyway. And so there's kind of like this private thing. So, back to, you know, Scott's idea. How can this be accelerated? Which I really, really think is a good idea. What about the model of if you assume that the OEMs are

going to move ahead with this, then job one is to get the standards in place and that sort of thing, get that thing nailed down so that private industry, both on the infrastructure side as well as on the OEM side, can get on with it.

MS. BRIGGS: Oh, we're absolutely doing that.

CHAIR DENARO: Okay, okay.

MS. BRIGGS: I mean John is shaking his head, too. Yeah.

CHAIR DENARO: Which could accelerate things a lot more.

MS. BRIGGS: Yeah. And I think that's a good segue to Brian.

(Laughter.)

CHAIR DENARO: Oh, Brian, you're still there.

MR. SHULMAN: Before Brian, Bob, I was going to say that's pretty much the European model. That's how they're going forward there.

CHAIR DENARO: That's a good point. I agree with you.

MR. SHULMAN: The car-to-car

communication consortium is working with an Amsterdam group which is doing infrastructure, and they're trying to get the standards finished this year, --

CHAIR DENARO: Yeah.

MR. SHULMAN: -- and they're talking about a 2016 let's go to product. Maybe it'll just be Mercedes and Audi and BMW to start, --

CHAIR DENARO: Yep, yep.

MR. SHULMAN: -- but let's get started.

CHAIR DENARO: I'm aware of that, Mike, and that's a great point. Thanks for bringing that up, yeah.

VEHICLE-BASED DATA AND AVAILABILITY

MR. CRONIN: So we've been discussing safety for a day-and-a-half, and I have somewhere between 10 minutes and 30 minutes, depending on how much of a break you want, to discuss the rest of the 80 percent of the program.

So, sit back and I'm going into

detail now.

CHAIR DENARO: Brian, take what you need, because other than the need for a break, we're pretty flexible on our break-out time. We've got plenty of time there, and I think this is an important discussion, so --

MR. CRONIN: Okay. So my goal is to keep the multi-taskers over here away from multi-tasking and engaged, because this is a lot -- going to be related to what you guys are most interested in -- not that you weren't interested in everything else for the day-and-a-half -- and to keep everyone else on this side of the room engaged as well. And so I'm not going to talk about the whole program, but I'm going to talk about a few critical things that kind of flow from what we've been discussing. And so a lot of it is about the data and how we get that from vehicles over to the public sector and private sector to make use to manage the system more effectively.

And so a couple things to highlight. Like we said, NHTSA can and has authority to

regulate the safety. They cannot regulate putting equipment on vehicles to send data that would be nice for mobility. If they're the same, great, but adding a whole bunch of data that they don't need for safety is not really something they can mandate. So, it's a big issue.

Secondly, as we indicated, Federal Highway -- this is for you, Mike -- Federal Highway does not implement. So the states implement, and Federal Highway does not have the legal authority to require the states to implement. So we have to figure out what are the applications that are going to have benefit that the states and others will want to implement. Or, our memo to Congress in 2015 has to outline some key changes that may have to happen. Not saying we're going there, but that is on the table.

So, connected vehicle. We've seen this. There's data that's going to be flowing from vehicles. Right now there is data, OnStar, other systems, that there is data out there

flowing, but it's not as much data and data types that we envision that a connected vehicle system could enable.

So we -- in the first committee meeting I briefly went over the whole V2I program in ten minutes or less, and I talked a lot about some of the different applications. So I'm hoping you remember those. Probably don't, but there's just a suite of safety and mobility, and I'm mostly going to talk about mobility and environment today, and we're going to talk a little bit more about the data.

So Mike put up his slide about basic safety message and how all the data elements -- I summarized this a little bit here. But the key point is that the basic safety message is just broadcast. It's not stored on the vehicle. There's no storage. It's just being sent out. So in order to hear it, you have to have something next to that message, next to that vehicle transmitting, whether that's another vehicle or roadside equipment. Well, we're not putting 2 million roadside equipments

out there, especially not right away. Maybe over the future. You never know, but there has to be something right there to hear it an then you can do something with it. It has a short range and the basic safety message is tailored for the low-latency V2V safety applications, like it should. Okay?

So we tried to look at, well, if given that scenario, can we do all these mobility applications if we have the data and the basic safety message, and we only have the basic safety message being sent over DSRC. And so we looked at it for mobility, environment, weather. I'm going to run through some of that.

So a couple key things is we can do some of the mobility applications in a local -- that are localized. So, at an intersection. Cooperative adaptive cruise control, which is cars following cars. That's really a V2V mobility application. Some queue warning. So there's several types of applications that, with the data and basic safety message, we could do, and we need part 1 and part two. Part 2 is not

sent all time; triggered on events and various different things. However, if we take -- and this, I think, gets into the evolving scenario about the channels and the radios and which radios are used for what. But if we are sending part 2 data elements all the time, that will burden the communications system, and we really don't need that for mobility.

So most of the mobility applications do not need data sent ten times a second. It doesn't change that rapidly and we can't use it that often. But we're going to need the different data. We need it over a wider area than just that local where that RSE is. So we can do most of the mobility applications with the data in part 1 and part 2, so we're not talking about a lot of new data elements and new sensors or new equipment that the car companies would have to put on to go and get, but we have to think about different ways to get that data off the vehicle, and so whether that's cellular or something else. And so that is a big thing that we need to start discussing

how that's going to happen if we want all these mobility applications, with the assumption being RSEs are not going to be everywhere. We'll see how that happens and how that evolves.

From the weather, we also looked at a bunch of different sort of weather applications. So this is doing treatment and management of the system in adverse weather conditions, and so predominantly we're okay with the data that's in there and we have some information here about how often and when you need it.

And then on the environment side, we're also generally okay with the applications that are being talked about from the environmental perspective with the data in part 1 and part 2 of the basic safety message.

However, there is some additional environmental-related data that could be useful. It's not critical, but it could be useful, and over time as things evolve, it would be nice to have that information. There is some information related to emissions that we could

get directly or we can infer, so we're trying to look at that. But the summary is that most of the data is fine, but we're going to really need to think about some different messages.

So, I have a few slides here, and just to explain something. This is the big picture that Mike showed, boiled down to one little thing over here. And so it's my articulation of that in sort of the mobility view of the world. It's unclear whether that's fully accurate, but it's probably pretty darn close, and we're trying to talk about architecture and systems and how this weighs in. So I have a few slides, and I'm going to try to walk through some of this to highlight some of the big questions to keep Steve's head spinning that we have to think through and try to figure out, and what's the federal role, or do we just hand it over to the market to make happen. So --

VICE-CHAIR KLEIN: Do we have these slides?

MR. CRONIN: You do have these

slides.

So we talked -- and what we're using is sort of a weather example. There's an icy patch on the road, a vehicle finds that, and we want to get that information back to the maintenance center to take action and do something. So, the vehicle's moving. It determines that, whether it's through a braking or some sort of diagnostic, it determines that there's an icy patch, and there's some of the data in part 1 that we can infer from that.

The other thing I've thrown up here is, under SAE J-2735, there's other messages. So we've talked about signal phase and timing message coming from signals. There's something called a probe data message which was created in the earlier VII days, which would -- which relies on storage and relies on basically taking the data, storing it on a vehicle, and transmitting it when you get to an RSE. And so that message is still out there. We have no way to make that message be a reality, and so there's a lot of discussion about how that

happens and does the auto industry use that, others use that? So -- but there is a message there, and so we're looking at that. So there's multiple different kinds of messages that could be set through DSRC.

Then -- and this is -- let me see. Let me make sure I get the right word. These would be functions. So they could all be the same entity doing some of these things. But we need to aggregate the data. Kirk doesn't necessarily need to know every single data, but wants to know the trend of what's going on, on the highway. George wants to know how long the queue is. So Matt Smith talked about some of these things yesterday. But we need to aggregate the data. There's companies out there that do that now. There's a lot of questions about the business and we don't necessarily need to step into that, but we need to aggregate the data. It needs to get down. There needs to be applications, whether that's the public sector doing some for their good, private sector doing some that they sell back

to drivers and users of the system, and then the information has to come back.

So this just sort of shows a feasible scenario with using DSRC. Yes.

MR. WEBB: Brian, George Webb. First car hits that icy patch. I'm 500 feet behind. I've got a DSRC-equipped vehicle or whatever. Do I get anything to tell me there's an icy patch 500 feet ahead of me? Is that -- in other words, is that car going to broadcast, wait a minute, I've just hit something here, and it's broadcasting. If I had a roadside, I understand that. But without having a roadside, is it sending that same message and the cars are picking it up behind them

MR. CRONIN: You probably don't know that it's an icy patch, but there might be part of the V2V message that sort of there's a sudden deceleration ahead, and so whether the car has the smarts in there to infer something, I don't know. But if there's no RSE there, you're not getting anything.

DR. RAJKUMAR: It could say that

traction control was engaged, for example.

MR. McCORMICK: Why do you say if there's no RSE there, you --

MR. CRONIN: What?

MR. McCORMICK: Why do you need the RSE? You can go car to car. It may not be derived information. I may just know that I've lost traction control. Okay?

MR. CRONIN: Right. And so there might --

MR. McCORMICK: But knowing that the car up ahead of me where you're at lost traction control is information I can process without having somebody tell me there's ice there, so I'm really wondering why I need an RSE. RSE is useful for communicating it back to the DOT so they know to send out the salt truck, but it's not --

MR. CRONIN: And, yeah. So it happens. You know, if the OEM --

MS. BRIGGS: I think this is a single-hop, multi-hop question that Walt would be able to address.

MR. McCORMICK: Well, but that's the purpose of V2V, is --

MS. BRIGGS: But --

MR. CRONIN: Well, it's partly multi-hop, but it's partly just if you're within the range --

MR. McCORMICK: Right.

MR. CRONIN: -- if you get a traction control, and has the auto industry built an application that does that.

MR. McCORMICK: Right. And the only difference between --

MR. CRONIN: And we're not --

MR. McCORMICK: -- in this scenario between single-hop and multi-hop is that if it comes from his car to his to mine, that's not multi-hop. That's just sequential signal hop. It's if I want to get it to you and not pass it to me and I'm just passing it through, that becomes a multi-hop. So just for definitional purposes, this is all a single-hop scenario.

MR. CRONIN: So we aren't going to solve this here, but this is --

MR. McCORMICK: Right.

MR. CRONIN: -- one of the issues. I mean that's why we're bringing this up.

MR. McCORMICK: Well, it's not necessarily to solve it, but I think it's important for the committee to have a broader understanding of what it is we're talking about.

MR. SCHROMSKY: So you're determining hard braking or something that's -- so, just checking my notes. There is a system that says -- for weather that sends a broadcast text message that -- FEMA sends tornado. So you're talking about more real small isolated, this lane is --

MR. CRONIN: In this situation, yeah. I mean there's -- so there's --

MR. SCHROMSKY: Okay. All right. Because you're asking the combination of two different systems.

MR. CRONIN: And this just used a weather example, --

MR. SCHROMSKY: Okay.

MR. CRONIN: -- I mean, so there's

all kinds of traffic examples or freeway examples or --

MR. SCHROMSKY: Okay.

MR. CRONIN: -- different things, but -- so the main point of this slide is there's at least a basic safety message, maybe a probe message. We're not sure how to make that happen. That has to go through V2V RSE where it is, and who knows how often it's going to be placed. And then the system can work. And we need security, likely. It's a little unclear for some of the mobility stuff.

CHAIR DENARO: But, Brian, the definition of probe message, it's not like real-time like the DSM; correct? It's just store and dump contact --

MR. CRONIN: Correct. So the probe message, basically you're driving along the highway. It takes -- you're still doing your ten --

CHAIR DENARO: Right, right.

MR. CRONIN: It stores some of those --

CHAIR DENARO: Yeah.

MR. CRONIN: -- on a regular basis.

CHAIR DENARO: It will just store them down.

MR. CRONIN: And then when you get to an RSE, it'll download those. If their storage fills up, it gets rid of old ones or, you know, does some changing of the process.

CHAIR DENARO: I'm sure you're aware -- this is Bob -- but -- and the OEMs are working on a lot of this -- there's a lot of stuff coming along in this area even beyond the list that you had on there.

MR. CRONIN: Yes.

CHAIR DENARO: I'm aware Japanese manufacturers are very sensitive about the ride on their car, and they're going to record suspension events. I hit a pothole, I hit a road thing, whatever, and the next time you go over that, it's going to remember where that is. It's going to reset things and you'll never even feel it, and that sort of thing. So there is going to be a -- and there's a concept called

learning car.

MR. STEUDLE: Wow, am I going to save a lot of money.

(Laughter.)

CHAIR DENARO: There you go. There you go. In fact, they could probably do a little deal with you. They could probably do a little deal with you. Just tell them where they are.

But, and in this concept of learning car which will remember your route and so forth, and then there's a whole host of green kind of things. Okay? If a car remembers your commute, it's going to give you like 30-percent better fuel economy because it remembers what it can do better, you know, on that. All of that can get tied in with kind of probe data also, and be used back at the server for other kind of things.

MR. CRONIN: Right.

CHAIR DENARO: So there's really a complex web here of kind of information. And since we're talking over the next five or ten years, all this stuff's going to come to reality.

So this will evolve.

MR. CRONIN: So there's a lot of things that are going to come in reality without a federal role.

CHAIR DENARO: Right, right.

MR. CRONIN: And so the real question is, where is the federal role and what do we need to have happen and how does all those systems that are improving an individual traveler's experience --

CHAIR DENARO: Right.

MR. CRONIN: -- also make it back over to our operators so they can proactively manage the system more effectively, you know. So what they tried to identify yesterday with Matt Smith's presentation is if they knew how far the queu was backed up, if they knew where the icy patch was, if they knew some of these other things in closer to real time, they could proactively manage the system more effectively.

CHAIR DENARO: And back to Valerie's discussion. Is there laying in -- lurking in here someplace an interesting

business model where private companies perhaps are going to be able to be interested in paying for this kind of stuff?

MR. CRONIN: So let me run through the next of couple slides, and then you've hit question one, I think, or two or three or whatever on my slides.

CHAIR DENARO: Right, right.

MR. CRONIN: So the next one is cellular. So there are some existing, you know, cellular. We just had a whole big discussion about embedded cellular, brought-in cellular. So there is a cellular world, and the question is, is it possible to broadcast a basic safety message through that or -- and really the key part is, right now there's a limited set of data that we get as cell phones as probes or whatever. And so the question is, with NHTSA and with the process of our connected vehicle sort of pushing for a larger data set, it's really that larger data set has tremendous value, and it's more than the current data set that's currently available and what you're going to find

available how you want, you know, through purchase through somebody. And so there's that whole process.

And then there's the merging of the two. And so we talked a little bit about that, about the multi-something radio and how are we going to make all that happen.

And then -- for you, Theresa, and you, Steve -- there are fleet vehicles -- and you. That's snowplows or transit buses or whatever that have other sensors that they are going to put on those vehicles, and we're going to be able to merge that data, plus probe data, plus data from all the other vehicles, and manage that whole system. So there's a complex suite of things of, how do we get really the data off the vehicles and over to the public sector or private sector to do something useful?

So here's the list of questions for you to contemplate. What are different benefit and costs related to the different scenarios? How much DSRC-based roadside infrastructure do we want the public sector to install versus

are there cellular solutions? And then, how does a user pay for that? What are the different deployment scenarios, the market feasibility. Trying to think if there's anything else I want to highlight that you can't just read. And really what are the business models for the OEMs related to this? So that was all I have.

MR. McCORMICK: Could you go over to that third to last bullet?: "What are the fault tolerances for event detection based on vehicular data versus information delivery to vehicles?" So you're asking for the fault tolerance difference between transporting information off versus receiving information?

MR. CRONIN: Yes. So, let's see. I'm going to read this one more time. All right. So --

MR. McCORMICK: It looks like it's a bidirectional question --

MR. CRONIN: Yeah. And so -- you know, one of the aspects is, so if we're determining that there's an incident based on -- or an icy patch or something, how much will

you trust that result based on sort of the information we're getting through the system to then take a proactive action to, say, you know, divert traffic off the highway or do something like that, or treat or do something. And then --

MR. McCORMICK: Oh, okay. So it's from a mobility mindset.

MR. CRONIN: Yeah.

MR. McCORMICK: Okay. Thank you.

DR. RAJKUMAR: Brian, I imagine a vehicle would have DSRC and also cellular communications, and then one could be running a different set of applications based on unique preferences. Have you thought about how these applications go through DSRC, these applications go through cellular, based on the licensing fees or whatever else?

MR. CRONIN: So we understand that is an issue and it's unfortunate Walt is not here, but we don't have an answer for that. I mean, so we envision that sort of scenario, but what I kind of started from the discussion

was -- is from -- we have no, as U.S. DOT, way to make that happen from a regulatory or sort of way. And so it's sort of market based, and so what we're trying to do right now is understand the benefits from the public sector side, so that will either encourage roadside deployment or encourage the industry to step up and create the infrastructure or applications that are necessary.

DR. RAJKUMAR: But NHTSA can mandate that the DSMs go through DSRC. They can mandate that.

MR. CRONIN: They can and they're not deciding whether they will.

DR. RAJKUMAR: Yes. Thank you.

VICE-CHAIR KLEIN: Let me kind of follow up. This is Hans. And, Raj, there's always a question of few, but I mean we can have -- what messages and what applications run over what types, that's an internal matter. It can almost be dynamically decided; right? You don't have to specify one thing running over one -- one thing running over another type?

MR. McCORMICK: It can't be dynamically decided, and the reason is, is that because of things such as latency and security and packet size.

VICE-CHAIR KLEIN: Well, some applications can only run over DSRM because they need those characteristics. But mobility, messages can -- if you've got available capacity on DSRM, send it that way.

MR. McCORMICK: Right.

VICE-CHAIR KLEIN: If it's cheaper, DSRM, --

MR. McCORMICK: Any non-safety thing.

VICE-CHAIR KLEIN: -- because this is a layered model, again. The application is not fixed to one particular underlying medium.

MR. CRONIN: Yes. And most of the mobility applications and environmental applications do not need DSRC. If DSRC roadside infrastructure is out there, they certainly would use it. But, so the real question really is -- well, there's several questions, but one

is, is there something that stimulates roadside infrastructure to be put in from the mobility and environmental perspective? Because there is from a signal -- signalized intersections and so forth. There might be the bundle of mobility and safety applications that there's a lot of added value, and so we should do that. But there's a lot of space between those intersections and there's a lot of space between those highway miles, unless the Motor Carrier puts stuff out there, that we need to figure out how to get information off of vehicles.

MR. BELCHER: Brian, can the OEMs use the connectivity models that they're currently developing, you know, to access the cloud and bring data into their vehicles? Can they use that for these? I mean is there a way to use the infrastructures they're currently building and telematics options that they're currently doing for mobility applications?

MR. CRONIN: I would say there probably is, but I, you know --

MR. GEISLER: Yeah, yeah, yes.

Yeah, and it's probably cheaper and easier than DSRC.

MR. BELCHER: Right, and I assumed that. I just --

MR. CRONIN: And the question is, will they?

MR. BELCHER: Will they.

MR. CRONIN: Or what encourages them to do so? So I could see very easily the OEMs will do this for their owners to do -- there's a whole host of applications that will improve the driving experience. The question is, what stimulates them to make that data available, and "available" doesn't necessarily mean free, to Kirk and George and Joe and to venues to operate the system more effectively. And so I -- I mean that's really probably the key question, is -- and so we're trying to understand what data do we need that will improve their ability to operate and the ultimate from that, and then it's a question of what needs to happen to enable that.

MR. KIRBY: Well, these current,

you know, driver information systems sort of gathering probe data and feeding it back to vehicles, they already are doing that; right? The incentive for the manufacturer is that information needs to go to a place to be integrated so they can feed it back to their vehicles to tell the driver about driving conditions down the road; right? And that's already kind of going on to a lesser degree. And, you know, to some degree that's also getting into the public sector --

MR. CRONIN: So to some extent -- I mean you're describing this model (pointing to screen) in which -- an INRIX, --

MR. KIRBY: Right.

MR. CRONIN: -- as a data aggregator, is getting through cellular and various sources a whole bunch of information. They're aggregating it and then they're selling it.

MR. KIRBY: right.

MR. CRONIN: And then Kirk is using it to then tell you travel time between certain points.

MR. KIRBY: Correct.

MR. CRONIN: And the big issue right now is that's about the only application -- and I might be overstating it -- but that is the one application that they've been able to do. So there's a lot of work about -- with that existing data set, can they do anything else? And so what we're articulating is with the connected vehicle data set, we can do a lot more. And so it might simply be a business model that -- the question, how do we get that bigger data set pushed out.

MR. ALBERT: To me, one of the key areas like what's been talked about over there, was the data aggregator. I know in work that we've done with the western states' DOTs, we've developed an aggregate system, and it is just, you know, for cameras and weather information and stuff like that. But it was a huge challenge institutionally to get all that data, to put it into one machine, to synthesize it all and make it meaningful data. Has anyone developed a prototype to say how this is all going to work

for a data aggregate system with all the probes? Because, I mean, I know we're finding it's -- or maybe it's mostly institutional, but being able to get that data, play that data, to synthesize it and aggregate it, --

MR. CRONIN: Yeah.

MR. ALBERT: -- it's been a huge challenge.

MR. CRONIN: So we have as part of our data capture program something where we're creating a research data exchange, which is essentially attempting to take existing state transit public sector data, cellular-based data that we have access to, and then some of the new connected vehicle data sets, and then being able to aggregate that into a full picture of what it could look like and then how we can do that. So we are doing some of that, but we also think that that, a data aggregator in a system, you know, we're not creating that, you know. So we're just trying to make sure we understand the data and make sure that it can be explained so people can use it. We are in the process

of working with everyone doing the Safety Pilot to get a data set of that that we can make available sooner than nine months after the Safety Pilot's done, but it's a big challenge.

MR. McCORMICK: Analogous to that, there is one area that is doing something, and that's with the power generation utilities out in Southern California. We've been talking to them, because they're looking at the fact that if there's 100,000 electric vehicles and everyone wants to charge it up when they park, they all need to have communications so that they know -- so that they don't have range anxiety. The utilities aren't planning on letting these people plug in and charge up, because that would be sucking more energy out of the grid at their peak hours. They're actually looking at it as, oh, I might have 100,000 batteries that are half full that I can take power out of. So they're looking at how do they manage that whole solution, and there -- some are public and some are private. But they're looking at a mechanism that says, "Well,

okay, let me know what your schedule is going to be Are you going out to lunch? Do you need to have it charged up at an earlier time to get home from work or whatever? I'll charge you first. If you don't want to opt in to giving me that information, you get your energy last." And there's all kinds of problems with that, obviously, but they are actually looking at that kind of a question. It's unfortunate that they're not really involved in this discussion, because as we move more and more towards hybrid vehicles, it's going to become more critical to understand how to manage both the energy and the commute equation.

MR. KIRBY: This issue you mentioned earlier about, you know, data fusion, the cameras, and INRIX data and police scanners and all that, we have a system in the Washington region that we've developed that's doing that now. It took a long time to put together, and part of the key to getting it going was a federal earmark, because only -- this was multi-state, multi-jurisdiction, multi-mode, three state

DOTs, one regional transit agency, a number of local jurisdictions. And from a regional perspective, it's very hard to get all those folks together to put money in a pot to do something -- you know, they have money, but they've got other things to spend on; right? And the only way we got it going -- this is a critical role for the federal government, you folks, is to recognize that, you know, the institutional problems here require someone with a big picture to come in and recognize the metropolitan benefits or statewide benefits and provide the funding to get these folks together. And the apple tree as the earmark, we were able to demonstrate the value of this to the point where the states are now find that, voluntarily on their own, they're pooling money to keep this thing going. But we would have been happy to get it off the ground without the federal funding, you know, to get this started.

But having done it, once you get this platform established, you can add all kinds of bells and whistles as new data comes on board.

You know, the value of the thing just, you know, increases exponentially. Every little new piece of data just adds, you know, to the value, and it provides, you know, a set of information for the incoming agencies to manage incidents, and also to get information out to the public quickly about, you know, not only -- I mean you can get speed and things like that from INRIX, but you don't know, if there's a delay, whether it's a five-minute delay or a 50-minute delay. You can only figure that out by cameras and police information and things like that. So there's a lot of data fusion that requires, you know, people as well as, you know, that data. But I think this is a very powerful, you know, tool and we're, you know, building our own. It was a pressing issue from our elected officials because of our inability to respond to some major incidents that occurred going back to 9-11, snowstorms, other sorts of things where we just didn't have the communication, you know, to get the information fused and back out to the public, and so we've been putting a lot of

resources into that. And to the extent this will add value to it, you know, it's all for the good, but I think unless you have that institutional structure, you know, to fuse the data and process it and get it out, no one's going to be there listening for this and using it.

MR. CRONIN: Yeah. And so, I mean -- Kirk, did you --

MR. STEUDLE: No question.

MR. CRONIN: So, you know, that brings up a good point in that there's sort of, I think, an evolving discussion in the public sector about, does the public sector want to do that or do they want to let the private sector do that data fusion for them and give them information, and so --

MR. KIRBY: Well, I would argue there that there's a critical public sector role. The private sector is not going to be able to do all of this because a lot of it is public-sector information. It's, you know, aggregation from police, public safety, you

know, other -- fire and so forth. It's cameras and things that are run by public agencies, and really only the public sector has access to all of this and the ability to integrate it. Now, once the information's been integrated, the private sector can help get it out and communicate it. It can also provide input to it. But without a major public sector role, it's not going to happen and the fusion is not going to take place, is my experience.

MR. STEUDLE: I'll just add for the committee -- this is Kirk -- Congress just passed a bill that has flat funding. They don't expect the next bill to have any more funding, or the one after that. We're going to be lucky if there's not a one-third cut. So, while I agree that that's how that got going and it was good, I think to assume that that would be a model would be a very bad assumption. I mean there's just no money there to do that. So I think we've got to look and -- you know, my counterparts are looking at, well, how do we find a private business model to do this? Because there's not

going to be $7 billion to just put this in place. I mean whatever the -- I pulled one of those Bill Jones' number up.

MR. KIRBY: I think, you know --

MR. STEUDLE: And I still have the slash marks in my back from when I challenged him with that about several years ago, so --

MR. KIRBY: Well, you know, I'll just add one more comment to that. You know, the incremental public funding to do this fusion is relatively modest relative to lots of other things that we're doing. I mean we funded it out of CMAC, which is not a big program, and it's still there, by the way. So, you know, that's a resource that can be used, and what you'll get into a relatively modest investment to do the integration, institutional coordination, and fusion, you know, is you're adding value to all this information that's pouring in from all over the place, including, you know, new information which, if it's not being put together and put back out, you know, is not generating benefit. And the putting it

together part, you know, it's not that costly to add that leg.

MR. CRONIN: So you bring up a good point in that, and it's something for the committee, is, what's Ron's talking about is actually a need that's now and people are doing now, regardless of whether we have connected vehicles or not. Connected vehicles is actually just another data source. And so it is a big issue. We have a couple integrated corner management sites. We've mentioned that before, which the big hurdle is there's this data fusion and real-time data -- real-time decision-making based on that data. And the big difference and what sort of they're doing with the corner management is they're not just using -- and RITIS has done some of this in the D.C. area -- is they're not just using highway data with other highway data. They're fusing that with arterial data and transit data to sort of give the whole system perspective. But -- I mean so it is a big point, is there is a data fusion role that the industry needs, regardless

of whether we get connected vehicle.

VICE-CHAIR KLEIN: What's the name or the reference for the systems?

MR. KIRBY: Well, we have -- the overarching entity is called the Metropolitan Area Transportation Operations Coordination. MATOC is the acronym. You'll find that on our website. But the data engine, that is RITIS, which is Regional Integrated Transportation Information System, which is run by the University of Maryland. And that's all of the software that, you know, falls together, you know, INRIX data, weather data, arterial data, transit data we're getting, and they're branching out into AVL data off of buses, all kinds of things that are being fused into that. But at the end of the day, you know that produces a map or a set of data, okay, but it doesn't add the judgmental component. You know, there's still a staff that sits over that. And there's a system in New York, TRANSCOM, which is really just the model that we used to build off of that.

So the staff is looking at that. They're looking at police scanners, they're looking at other qualitative information, and then integrating that into messages that they're putting out, you know, to the public and to the operating agencies. But the data fusion part and the RITIS part is a really powerful component of it, so that's -- you know, those are two pieces, but they're adding weather information now. You know, real-time weather information is being added.

MR. ALBERT: Brian, I guess I'd like to offer, you know, the Northwest Passage Project that I'm trying to lead for the multi-state corridor initiatives, Northwest Passage goes, for those that don't know, from Washington State to Wisconsin on I-90 and -94. That seems to me, what I'm seeing in many corridors, multi-state corridors, is everyone's building their own aggregate system. Seems to me some demonstration projects on trying to build one aggregate system -- and I'd offer Northwest Passage as maybe a prototype -- seems

to me would make a lot of sense. Otherwise, our aggregate systems aren't going to be talking to the other aggregate systems. And, you know, being able to lay out not only what data you currently have, but how all the probed altogether data coming in, would be real useful. And we're still scoping the project. I don't know if that would be of an interest to you, but these multi-state initiatives seem to be a great way to role things out and help out with market penetration and roll-out and all that other stuff.

MR. CRONIN: And a key part of connected vehicle is the interoperability of all the equipment engaged in the system, and so we can't have different equipment in vehicles in Montana that are in Virginia and the roadside equipment. I mean so all of that has to be the same, and so that actually is a fundamental difference that will maybe enable us to drive something like that, because right now, while the general practice -- I'll just -- I'll generalize here -- is if Michigan built

something, Ohio's not going to take it. They might, but, you know, they're probably not. If CalTrans does something even open source, you know, they might -- some other state might use it, but there's not a lot of that. And so that's another thing we were actually trying to push with our mobility work, is doing a lot of open-source application development so that as these things work, it's easier to roll them out on a nationwide basis.

VICE-CHAIR KLEIN: And you're working in that area. What kind of activities, actually, do coordination or harmonization? Are there specific --

MR. CRONIN: Well, I mean there's a lot of the standards work, and then as we get into the application development, we're intending to do and use it -- do an open source so we have a lot of input from folks, but --

VICE-CHAIR KLEIN: And are you encountering that? Steve, you're actually right at this point of addressing these issues in a practical sense.

MR. ALBERT: Yep.

VICE-CHAIR KLEIN: And are you seeing a -- are you making a connection --

VICE-CHAIR KLEIN: That's what I'm trying to do.

VICE-CHAIR KLEIN: Yes.

MR. STEUDLE: Okay, okay. This is Kirk. If I can add, we actually take from Wisconsin and continue a Great Lakes connection all the way to Ontario with the Interstate 94.

MR. ALBERT: And we're coordinating with that group.

MR. STEUDLE: Yeah, okay. I was hoping you were --

MR. ALBERT: Yeah, we are.

MR. STEUDLE: -- because they've done a lot of work in coordinating the standards and in pulling data from all four of them already or six of them, all the way to Ontario.

MR. CRONIN: The question might be is what is it within that system that encourages the states to cooperate and use the same technology and system that is not the case in

predominantly most everything else? So --

MR. STEUDLE: Well, I will tell you, just -- there's a couple. I mean the one we all look to is the I-95 corridor for this; right? So that's kind of been the model, and, frankly, that was the model that we looked at and said, well, look, we have a lot of trade that happens in and around the Great Lakes that travels I-94, and so, well, it's probably in our interest to make sure that we're doing things collectively and together and start a conversation. It doesn't happen for all of them, though. You're exactly right. You can take, you know, whatever heading south, maybe, maybe not.

VICE-CHAIR KLEIN: We're at 10:30 and we're a little past and we're running behind in a couple of ways. So, a 15-minute break. Thank you very much.

MR. CRONIN: Yep.

VICE-CHAIR KLEIN: Fifteen-minute break. Back at quarter to eleven.

(Whereupon, the foregoing matter went off the record at 10:30 a.m. and went back

on the record at 10:50 a.m.)

VICE-CHAIR KLEIN: So why don't we quickly, folks who weren't here yesterday, say a word, introduce yourself, at least say what your firm is and what your background is.

MR. HARDIGAN: Sure. So I'm Pete Hardigan. I was actually here yesterday listening, and I work at Ford and I'm sitting in for Steve Kenner. We're part of the automotive safety office at Ford Motor Company. So we work on events, rule-making, strategy, policy issues for the board.

MR. GEISLER: I'm Scott Geisler. I work for John Capp in the safety electronics innovation area, doing driver distraction, active safety systems, and VX.

VICE-CHAIR KLEIN: Other folks who are --

MR. LAMAGNA: Sam.

VICE-CHAIR KLEIN: Sam, --

MR. LAMAGNA: Yes.

VICE-CHAIR KLEIN: -- why don't you quickly just introduce yourself. You were here

yesterday, but I don't think you introduced yourself, so --

MR. LAMAGNA: Sure. My name is Sam LaMagna. I'm at Intel Corporation. I'm part of the business group that's called the intelligent systems groups. It's easier to think of it as anything that is not a PC, a laptop, tablet or phone. And my role with that is I'm chief of staff for that group. We're about 1,500 people driving about a $2 billion business. This is automotive -- automotive is one of our primary focuses.

VICE-CHAIR KLEIN: Good. Thank you.

Anybody else?

(No response.)

SUBCOMMITTEE BREAKOUT MEETINGS

VICE-CHAIR KLEIN: Okay. We are going to start with a quick review of some of the past products of the previous ITS PAC. So Bob, who's been here a while, is getting ready. Oh, you're over there. He's getting ready.

Are you ready to --

CHAIR DENARO: I'm ready.

VICE-CHAIR KLEIN: Okay. To show us a little bit about what's been done in the past and the kind of things that the ITS PACs produce. A little overview of some of the prior outputs of this committee.

Then the different subcommittee heads will give a quick summary of their charge and mission as they see it, and there'll be a little opportunity for people either to -- if you want to change committee. There's a few people who are unassigned and who are welcome to make a commitment to a different -- one committee or another. And then we'll go into breakout rooms as our committees and work on the substantive issues of that -- of our particular subcommittee, recognizing that some subcommittees are, I think, a little more ahead of the game than others.

Then we'll come back. Then we're going to have a lunch break at noon. I assume we're here in this classroom, in this room here? Okay, good. And then we'll do subcommittee

reports out after lunch. Maybe not -- try to end closer to 2:30 than to three, and I think over sandwiches if the subcommittee folks keep chatting and doing some work over -- while they're eating, they can do that, too.

Without further ado, Bob, a little background information.

CHAIR DENARO: Okay. And I'm going to start with a commercial announcement, but it's not my book. It's some colleagues, actually, from GM. If you haven't read this book, I highly recommend it. It is a fun read if you're in this industry. If you have read it, you'll probably show that opinion. It's called "Reinventing the Automobile", and by Bill Mitchell and Chris Borroni-Bird and Larry Burns. And what's cool about it is they talk about what the future -- or what should the future be of the automobile. Very high on electrification there, tying into the electric grid. Some of the comments that came out earlier about vehicles maybe being the storage of power for the electric grid, you know, is

something that's in this book. And then a whole lot of information about connected cars too, why that's essential. So it's really a fun read and I guess that I recommend it.

So, the other thing, then, that Hans said was to just acquaint you with this. Now, I know you've all spent hours on the site, so this is really redundant for you. But in the case that there might be one or two of you who haven't been, this is the RITA site and our particular page, called the ITS Program Advisory Committee. So you'll see on here --

VICE-CHAIR KLEIN: If you Google on "ITS PAC", it comes right up, by the way.

CHAIR DENARO: So all the past meetings are here. So here's all past meetings. There's read-aheads. And, in fact, there will be both -- you see I'm highlighting here both the minutes of our previous meeting, which was a summary, obviously, of that, and the actual transcript, which I'm being recorded right now to be the transcript of this meeting, and then, of course, all the read-heads for any particular

meeting will be there. If you go up here, for example, this was the final memorandum that the previous committee submitted. And just to show what the format of that thing looks like, not that we have to do it exactly like that, we talked about the activities and so forth. There's a little introductory stuff that we put together on what's the context for all this? Why are we making these comments? Well, you know, there's an evolving transportation communications market, a little bit about our process, and then a little pontificating here. We've come up with this hard safety, soft safety discussion, which is something we felt -- it's a little controversial that we call it that. Some people still might disagree with that, but that's too bad. That's their decision. And then we get into recommendations, and I think there were like 24, 27 or something like that, and you can see the recommendations. Again, this is a format we chose. This committee does not have to do it exactly this way. I'm not going to go over all this, but you can read that.

What we did in some of these recommendations is sometimes give a little narrative, say, hey, here's a discussion about this thing that we delivered. Here's some of the things, and based on that, boom, boom, boom, here are some of the recommendations that came of discussion.

Yeah, Raj.

DR. RAJKUMAR: So, Bob, this is a public website?

CHAIR DENARO: Absolutely.

DR. RAJKUMAR: Anybody out there can access it?

CHAIR DENARO: Absolutely, absolutely. It has all of our activities. They're public. This is completely accessible by anybody. Right, right.

So that's the example of the advice memorandum.

DR. RAJKUMAR: So watch what you say.

CHAIR DENARO: Yes. I didn't say that. Then if you really want to get -- have

some fun, this is the report to Congress. So remember, the process here, we write this memo, it goes to the JPO, it gets vetted around in there and everything else, and eventually up to the Secretary, and the Secretary is submitting the report to Congress. In that process, the JPO is responding -- must respond by law -- to every one of our recommendations and they can even concur, disagree, or something in between. And so if you read through this, you'll see a repeat of our recommendations.

So, for example, here's Recommendation 1, verbatim as we have it in there, and here is, quote, the Department's response to Recommendation 1. "We concur," yada, yada. Really good information in here, both -- I mean for all of us here, both on what the previous committee looked into, but then also it was good information about what the JPO is doing. And in many cases, by the way, it was good work already going on. So we, as a committee, chose to focus on some things, and that became a recommendation, full knowing that

maybe they were doing some work on this. And, you know, through our meetings like this, we knew that, but we still wanted to maintain that focus as a committee, and they responded, "Here's what we're doing." In some cases, they only partially -- and I think -- I went through this -- there were no complete disagreements, but there were some partial agreements in some cases, and in agreements with part and not other parts, because sometimes what we were recommending that either the Department or the nation should do in this area was not within their purview or something, you know. And so there were reasons why, you know, they were not agreeing with parts of that.

But anyway, this -- if you read through this, it'll give you a good feel for this process and what our mission is in terms of generating our next note. So, does that help?

MR. VELEZ: Following up on a comment, --

CHAIR DENARO: Yes.

MR. VELEZ: -- that all products produced for or by the committee must be made available to the public. So this website is not only for your use, but also for the public to access --

CHAIR DENARO: Right.

MR. VELEZ: -- and print those documents.

CHAIR DENARO: Yeah. That's correct. Okay. So anyway, yeah.

MR. LAMAGNA: I just want to thank you for this. The last time we all met, John had, you know, our entire strategic team just basically come to this website, and it is well put together. And you are right. Information in here is just golden nuggets everywhere. So as we do our own research to learn and spin off and try to catch up with the rest of you guys, thank you for putting it together.

CHAIR DENARO: You're very welcome. Don't thank me. I mean it's Stephen and Charlie and the JPO team --

MR. LAMAGNA: Thank you, all you

guys.

CHAIR DENARO: -- really put this together, so, yeah, they do a good job. I agree. It's really very useful. Very well organized and everything else.

All right. So the last thing I want to do, then, is switch over back to my PowerPoint here, and this is where we stand currently. There was some discussion yesterday, does anybody remember what the committees are. These are the subcommittees we decided on at the previous meeting. This is summarized in the minutes of the previous meeting, but I'm showing you. I actually intended to send this around a couple weeks ago. I forgot to do that, so I'm showing it to you now. In the dark green, I've got who volunteered to be the lead. In the lighter green is who signed up to be there. I will admit, confess, in the technology review that some of you signed up. Other ones of you are drafted. So, like Raj here. And so I know you're on multiple committees. I know that can be a challenge and all, but, you know, in the

case of technology review, I felt it was important to have the inputs of some other people. But that's where we stand right now.

And unfortunately, in this format, you know, there are -- a couple of people become obvious that they haven't signed up, and I really don't want to highlight that.

MR. McCORMICK: But you did.

(Laughter.)

CHAIR DENARO: No, I really don't want to highlight that and embarrass anybody, so --

(Laughter.)

VICE-CHAIR KLEIN: Some committees are still welcoming new -- let me just say, there's a few that don't have too many people on.

MR. GLASSCOCK: And I guess I just received an e-mail that Gary Toth is resigning from the committee, so --

CHAIR DENARO: Okay. All right. I was wondering. Okay.

VICE-CHAIR KLEIN: Will there be a

replacement for him?

MR. GLASSCOCK: Yes, you can replace him.

VICE-CHAIR KLEIN: Because he seems -- his -- the committee charter identifies certain roles, and he seemed to be -- what was his organizational affiliation?

MR. GLASSCOCK: I can't pull it off the top of my head, --

VICE-CHAIR KLEIN: It is here.

MR. GLASSCOCK: -- but we can certainly replace him.

VICE-CHAIR KLEIN: Very top, Project for Public Spaces.

UNIDENTIIED SPEAKER: I think -- isn't that discretionary?

VICE-CHAIR KLEIN: I don't know.

MR. AUGUSTINE: Yeah. I think he's a designated category.

MR. GLASSCOCK: Yeah. So we will need to replace him.

VICE-CHAIR KLEIN: And what's the procedure for doing that? Is that the committee

--

MR. AUGUSTINE: It's the same procedure for the full committee. So, whether it's the slate of 20 or one individual, it has to go up for secretarial --

MR. GLASSCOCK: And to the White House for -- Or you could choose not to; right.

VICE-CHAIR KLEIN: But the committee originate -- the nomination originates within the ITS PAC or --

MR. AUGUSTINE: Yes. I mean by the legislative authority, the Secretary shall appoint, but we provide the recommendations to the Secretary. They sometimes take our recommendations totally and sometimes, well, we have a different individual in mind, and --

VICE-CHAIR KLEIN: I see.

MR. AUGUSTINE: So it's per the discretion of the Secretary.

CHAIR DENARO: And to be honest, I had very little input into that. I made a couple of recommendations, but I really let them do that.

VICE-CHAIR KLEIN: Okay.

MR. AUGUSTINE: And some of the considerations go into the willingness to serve, the time and ability to attend the meetings, and there has to be a balance between is the individual able to serve and does that actual recommendation get appointed.

CHAIR DENARO: Well, legislation also specifies certain representation by certain sectors.

MR. AUGUSTINE: Right; correct. And this is one of the required sectors.

VICE-CHAIR KLEIN: Okay. Our next step. What's our term? The head of each of the subcommittees is invited to give a few words about their mission statement, if you will, after which we will then -- we might have a little cross-discussion with some overlap, but I think we're going to head off into the classrooms as our -- into different -- they are classrooms, I guess, nearby.

MR. GLASSCOCK: They're rooms. Yes.

VICE-CHAIR KLEIN: And Stephen Glasscock has identified those rooms, and if you want to go ahead and say Security -- we sort of went from left to right. Security Framework will stay in this room?

MR. GLASSCOCK: Right. Security stays here. The Market Driven Group is going to go to Room 1121, which is right outside this door. The Outreach is going to Room 1120, which is right next door to 1121. And the Technology Review is going to Room 2223, which is at the top of these stairs, and I'll help direct everyone.

VICE-CHAIR KLEIN: Thank you.

MR. McCORMICK: I have a question on that. We have a couple of us who are on multiple committees.

VICE-CHAIR KLEIN: Right.

MR. McCORMICK: How do you want us -- and most of them, you know, are duplicated between Technology and Security. Is there a way to combine them? Because that -- I think we can probably get through the Security

framework issues quickly and then move -- most of them are in Technology Review.

VICE-CHAIR KLEIN: I mean the committees are still somewhat in flux. That's Bob --

MR. McCORMICK: I'm asking Bob, yes, I guess.

VICE-CHAIR KLEIN: I mean it becomes one awfully large committee, I think.

CHAIR DENARO: Well, I don't -- I think Scott's suggestion is something else. For the purpose of today, we can combine the discussion.

MR. McCORMICK: Just for today.

CHAIR DENARO: And they can still go off and do their separate thing. But I think this is all open to discussion. You know, we decided on this list rather quickly in the last meeting. Based on two days of a lot of knowledge gathering here, we may decide to change this a little bit. I have some questions about the charter of some of these that maybe need to be changed a little bit, so I think that's all open

for us to discuss whether we want to change that. But I like Scott's suggestion that -- I don't have a problem, for example, maybe combining Security and Technology, because they are kind of related.

MR. McCORMICK: Well, I just meant for today, just for the purpose of --

CHAIR DENARO: That's what I mean, yeah.

MR. McCORMICK: I mean I think our work is done outside of here for the most part.

CHAIR DENARO: Yeah, yeah. Yep.

MR. McCORMICK: We have a new body of work under Security to address, --

CHAIR DENARO: Right.

MR. McCORMICK: -- but I don't think that's -- since it hasn't been disseminated to the committee, we can't really address it here other than just to give an overview of it, so -- and I think that we need to get started, based on our last telecon with the Technology group. So I'm just thinking that there's kind of a short meeting for the Security framework before

we do the read-out, and then we can go onto our other meeting.

CHAIR DENARO: Yeah, sure.

MR. McCORMICK: Unless anybody on that committee objects.

CHAIR DENARO: Okay. So let's say we will combine those two for today, meeting, and so --

MR. GLASSCOCK: We can stay here.

CHAIR DENARO: We stay here? Yeah, okay. So we'll stay here. How about the other three? Is there any reason to combine any of those for today?

VICE-CHAIR KLEIN: Standards and Market-Driven are -- we're going to have a lot of overlap, so --

MR. GLASSCOCK: Standards are doing their own thing right now, so they're already -- Scott Belcher's on the phone with others, so --

VICE-CHAIR KLEIN: And now, Scott. He's a one-person committee? Is that --

MR. McCORMICK: Steve Kenner's on

there.

MR. GLASSCOCK: Well, Steve's not here, so --

VICE-CHAIR KLEIN: I see. Steve is on that, yeah.

CHAIR DENARO: But there's no people overlap between the remaining two of them, so we might as well keep it separate.

VICE-CHAIR KLEIN: How's it been in the past? I mean one of the things, if we divide in subcommittees in previous years and people going on their own, does it come together at the end or --

CHAIR DENARO: Yeah, absolutely. I mean -- Because, again, subcommittees -- I'll put it in strong words -- have no authority to make recommendations. So they bring their findings -- we're asking them to do the heavy lifting, figure out what they want to focus on and everything else, come back to the general committee, then we will all discuss each of the work of the subcommittees and decide as a total committee what we want to move forward with

recommendations. Either we'll go completely with what was recommended or discard some things or whatever. You know, it'll be kind of a consensus of what we want to go forward with. For example, we may find with five subcommittees that we have 35 recommendations. I'm going to suggest that's probably too many. So, you know, we probably need to consolidate down and combine and so forth. Yeah.

MR. ALBERT: In light of the numbers on your Market-Driven, which I'm on, and I'm wondering if it makes sense to try to combine Market-Driven with Outreach, given that there is a relationship between those two.

CHAIR DENARO: That's kind of what I was thinking, too.

VICE-CHAIR KLEIN: Well, that would drop us down to three committees -- subcommittees. In the past, is that comparable to --

CHAIR DENARO: Well, there's two things to remember. We're talking about today's meeting versus --

VICE-CHAIR KLEIN: Yeah.

CHAIR DENARO: -- actually combining, so I think those are two different things. So if we do literally combine those two subcommittees, which might make sense, that brings us maybe to four at this point, because even though Security and Technology will meet together today, we're going to keep them as separate subcommittees.

MR. McCORMICK: And this doesn't mean we can't at some point add another subcommittee.

CHAIR DENARO: Correct, and I think fewer is better, frankly. More participation, you know, a little less work for us when we pull it back together.

VICE-CHAIR KLEIN: Fine. Then let's -- I would say let's keep the subcommittee structure, but two pairs will meet together and then all review the subcommittee stuff.

CHAIR DENARO: And why don't those two subcommittees, when they meet together, decide whether they really want to merge, you

know, to change it to be one. That's fine. Just come back and tell us.

VICE-CHAIR KLEIN: So, Steve, you said if Security and Technology meet in this room and there's a bigger room --

MR. GLASSCOCK: It will handle the combined committee. It will maybe be a little bit tight, but, yeah. The next largest room is right out here, so --

VICE-CHAIR KLEIN: And do you know the number on that one?

MR. GLASSCOCK: It's 1120.

VICE-CHAIR KLEIN: 1120. Okay. So a pair meet here, a pair meet in 1120, and Standards is already having its meeting right now.

MR. GLASSCOCK: Right.

VICE-CHAIR KLEIN: That's pretty easy stuff. Okay. Can we get a reminder of the security -- the charter for the Security subcommittee?

CHAIR DENARO: Well, why don't we do this. Since my computer's already up here,

why don't I show you the Technology Review one.

VICE-CHAIR KLEIN: Okay, great.

CHAIR DENARO: This is the format, at least. There may be others.

MR. BERG: I have a quick clarification question. Is policy or the policy associated with any of these groups implicit, or --

CHAIR DENARO: Policy?

MR. BERG: -- is there to be a separate thing?

CHAIR DENARO: Yeah.

MR. BERG: Because I think if we had a -- you know, like a cross-cutting policy, because we've had a lot of technical representations and learned a lot in the last day-and-a-half and, quite frankly, a lot of the technologies, I think, is being adequately addressed. However, the policy underneath that, like some of Valerie's research questions that really don't have an answer, might really be what this committee is best at doing, and not, you know, studying the 70 feet down

technology question.

MR. McCORMICK: Yeah. I wholeheartedly agree that a policy committee -- subcommittee ought to be formed.

VICE-CHAIR KLEIN: I think we all -- we might all -- are there any that won't be getting into policy? Certainly Market-Driven adoption strategy is -- a policy for markets --

CHAIR DENARO: So maybe the two choices -- I agree that policy, in my opinion, cuts across all of these. We can handle it -- each one can handle policy or we could define a new subcommittee called Policy. Those seem like the two options to me.

MR. McCORMICK: Well, I'd like to make a -- give some recommendation.

CHAIR DENARO: Okay.

MR. McCORMICK: Since we have a number of people that are overlapping, maybe when we have our next face-to-face meeting, that our break-out time essentially ought to be working on aggregating those policy issues,

rather than trying to hold a working session for a subcommittee; that the subcommittee could report out the work they've done offline.

CHAIR DENARO: So let me make sure I understand what you're saying. Are you suggesting that we should have a session in our next meeting on policy? Is that what you mean?

MR. McCORMICK: Instead of the break-out sessions --

CHAIR DENARO: Yeah.

MR. McCORMICK: -- for the separate subcommittees, that we could collect all of the different policy issues --

CHAIR DENARO: Right.

MR. McCORMICK: -- and come together and collectively work on them, rather than --

CHAIR DENARO: Okay.

MR. McCORMICK: -- rather than -- because we've got duplicity, and it's going to be difficult to --

CHAIR DENARO: Actually, that's a great suggestion, I think, because policy --

everyone in here is thinking about policy.

MR. McCORMICK: Right.

VICE-CHAIR KLEIN: I think we're going to have policy -- I think these are five policy committees almost. I'll be interested to the extent to which they're not policy committees almost.

CHAIR DENARO: Yeah, but Scott has a good suggestion here and so I think you're saying the same thing. Each of these subcommittees will have certain policy issues they identify. Bring that back and as a committee we'll have a good solid session on policy. Yes. Good. I like that.

VICE-CHAIR KLEIN: Okay.

CHAIR DENARO: Okay?

VICE-CHAIR KLEIN: You're going to talk a little bit about your charter, then.

CHAIR DENARO: So this was the charter we came up with. And this was -- in our break-out we'll look at this, whether we want to change this. But I'll let you read it.

(Pause.)

CHAIR DENARO: So, pretty simple, encompassing -- like I said --

DR. RAJKUMAR: Bob, given the discussion, maybe there should be a word, "policy," in there somewhere.

CHAIR DENARO: Sure.

DR. RAJKUMAR: Policy implications.

CHAIR DENARO: We're going to break out, so we'll go ahead and modify this and then break out. I'm just giving this as an example.

MR. McCORMICK: I would like to offer up a one-word amendment, --

CHAIR DENARO: Yep.

MR. McCORMICK: -- is that that last sentence is, "... to impede or accelerate deployment." I think you ought to look at both options, --

CHAIR DENARO: Yeah.

MR. McCORMICK: -- because, to Belcher's comment earlier, you know, we ought to be looking at ways that we can make it happen

sooner than --

CHAIR DENARO: Yep. I like that, yep. Okay. So the other thing we did -- and these really were the intent -- what I'm showing you, this is what the Technology Review subcommittee did. We had one call, by the way, when we did this. But the other thing I'm showing you is our intent for the break-outs here. So let's come back. We're going to look at charters now or people are going to state where they are now. Let's finalize that so we know what we're looking at.

And I think my goal would be, as we look at the charters of the -- whether it's four or five subcommittees that we have, make sure that we're comfortable. First of all, let's eliminate any overlaps and then, secondly, let's make sure there's not gaps that there might be that we're missing.

The second thing we want to do -- or two things, is, you know, what is the focus -- what are some of the focus items you're going to look at, what's your process, and not on this

chart -- well, actually, it'll come up here. It is on the chart. But anyway, so this is the initial list that we came up with technologies that the Technology Review subcommittee was going to look at -- a couple of those were added very recently -- and then the process that the subcommittee was going to use.

So this first bullet, "Agree on technology and issues," we want to do today. We want to potentially identify either additional interaction we need with JPO experts and, with the experience of people on the subcommittee, some outside experts if we think there's somebody we want to talk to for input on some of our issues. Then, request reviews, we deliberate on those concerns, and document recommendations, which I guess there should be another bullet. We then bring back to the overall committee for the overall committee to pursue.

And so the other piece that I'd like to accomplish today, I recommend, is first was the charter description, get that nailed down.

And the second one was agree on your -- or this says, "Technologies and issues." But what are the issues you -- specific issues you might be dealing with in your subcommittee, the process by which you're going to go about that, and then identifying additional experts, be it internal to JPO or outside. If we can bring that back today and discuss that.

Any other suggestions? Any comments? Does that make sense? Yeah, George.

MR. WEBB: George Webb. Bob, from the standpoint, given we're sitting here mid-October, --

CHAIR DENARO: Yep.

MR. WEBB: -- there's the end-of-the-year, --

CHAIR DENARO: Right.

MR. WEBB: -- interim. I know it's not on our calendar, but as far as our break-out session, should we not be taking a running thought process about how to coalesce something in near term as far as identifying--

CHAIR DENARO: Great question,

great question. Yeah, and it does follow tomorrow's discussion chronologically, but I have some concerns about that interim memo, what we want to do. Just surface it now, so to you point, that we might want to discuss it in the break-outs.

And I've had a couple of discussions with a few of you. That interim memo can be almost anything we want. It can be as simple as -- and I'll be a little facetious here, but, "We're having a lot of fun and we're really thinking hard and we'll get to you in a year on our final recommendations." Okay? At the other end of the spectrum, we really could make official recommendations, you know, in this thing, "This is only our first part, but so far these are some recommendations we have." So we have that choice of anywhere along that continuum of what we want to do.

Past committees for the -- well, we actually, I guess -- the first one, we did make some recommendations in the first year. Last committee, we did not make any hard

recommendations, I don't recall, but we really left that for the end one.

What occurs to me is that we have the super-important NHTSA decision happening next year October-ish or whatever. Our memo -- official memo that we do at that point is really too late to impact any of that. I mean it might come a little bit before, but anything's going to be nailed down by then in terms of what they are saying about their rule-making.

So my point is that if we feel there are some issues -- we haven't done all of our work yet, but if we can come up with a few issues that we think are really significant that we want to make to input to that NHTSA decision, you know, we don't -- you know, we're not serving NHTSA, but we're making comments from our purview. But if we want to have our recommendations be part of what's viewed in that whole process, then we really need to do that in this memo that's coming up this year.

MR. McCORMICK: Let me ask a question. Let me back off from that NHTSA

rule-making decision. How far in advance of that in months would be a reasonable amount of time for them to get this information? Rather than picking the end of this year to try to congeal out an answer, could we do it in March? Could we do it in June? When would be sort of the drop-dead date that we'd want to shoot for -- that they would want? And maybe that's a question for the DOT people.

CHAIR DENARO: I'm not sure if even JPO would know that, but --

MR. AUGUSTINE: I guess what I would say is whatever recommendation we get from the committee, it takes several months for us to prepare those responses, get it approved by the Secretary and transmit it to Congress. So we can formulate our responses quickly, but actually seeing that in a formal memo that gets posted and transmitted to Congress is a several-month process.

CHAIR DENARO: But does this interim memo get posted to Congress?

MR. AUGUSTINE: Yes.

CHAIR DENARO: It does.

MR. AUGUSTINE: Yeah, yeah.

MR. McCORMICK: I'm more concerned about the actual NHTSA -- for the recommendation for NHTSA, that regardless, even if it's in an informal report --

MR. AUGUSTINE: Right. Now, you can provide us as the committee informal recommendations that do not have to go through Congress. Okay? But if you put it in a memo and submit it, then we by legislation have to respond.

MR. McCORMICK: Let me re-characterize that question.

CHAIR DENARO: Okay.

MR. McCORMICK: If we wanted to give NHTSA recommendations that might be -- or thoughts -- I mischaracterized that -- that might be useful in their decision-making process, when would be a reasonable time to get that?

MR. CRONIN: So, I mean based on what we know today, it would absolutely have

to be in by August. Now, I'm not certain if that answers your --

MR. McCORMICK: Yeah.

MR. CRONIN: -- reasonable to fully act, but what I -- from what I know today from all the analysis that's going on, it has to be in by August. Earlier is better.

MR. McCORMICK: Well, I'm going to throw out a --

MR. CRONIN: But I mean we can take -- I think we should take that back to NHTSA and double-check that, but from what I know of what's going on now, that's what I could offer.

MR. McCORMICK: Well, I'm going to throw out a suggestion here, is that we have done quite a bit of work. We have had -- and that work has been assimilating all of the information provided by the JPO, NHTSA, others, in terms of understanding the scope of work that's been done and the direction that they're going in. We've identified committees and areas of tasks that we're going to work on. We have at least a couple of areas of suggested

-- I wouldn't call them recommendations yet, because we haven't even consented on them, but we have at least in the security framework and probably a couple others before the end of the year. We'll have a couple of areas that we've identified that are suggestions we want to work on.

And I would submit that I think that's a reasonable end-of-the-year report in terms of what's been accomplished, where you're going, identifying our direction, identifying where we can provide value with the recommendation that we worked to provide by a, let's say, end-of-June time frame. You know, a document, a referential thought document to NHTSA in our areas of where we think they might want to consider in their rule-making decision. To me, those are critical things that have to be done.

Whether we get something to Congress, whether it's approved by the Secretary, all is an over-arching, more formal process that requires us to all pretty much and

close to unanimously agree on where it's going, as opposed to providing the JPO with -- and NHTSA with some valuable -- or whatever we think is valuable input that might help them support their process.

CHAIR DENARO: Yeah. So, to summarize, you're suggesting two documents. We do our formal thing at the end of the year, but we allow ourselves additional time and do this informal thing June-ish for those purposes; right?

MR. McCORMICK: Well, that's what I'm -- what I'm hearing might be of value.

CHAIR DENARO: Yeah, yeah, yeah.

MR. McCORMICK: And I guess I'd like to hear John's reaction to that.

CHAIR DENARO: Any more thoughts about that?

MR. AUGUSTINE: Yeah. You know, the difficulty is in a subcommittee -- and, Bob, you talked about this -- a subcommittee can do a lot of deep dive on a certain issue and have certain thoughts, and we listen to those

thoughts and we try and take what's applicable and apply it. Then it has to come actual to the formal full committee to be adopted. So anything that is, you know, pre-decisional, deliberative, we take that input and we apply it. It may not actually end up in a formal memo. So I guess the dividing line is anything that comes across as a formal recommendation, we have to formally respond, and that takes time. But I think what you're asking is, can we provide informal or some technical advice now and early and not have it go through the full process? Yes, but you have to be careful, if it gets voted on and adopted, that could become a formal recommendation that we have to formally respond to.

VICE-CHAIR KLEIN: Or we could do both.

MR. AUGUSTINE: You could take some informal technical feedback to us now, put it also in a memo that we can formally respond to. You have the option of doing both. But you just have to be careful. The committee and the

subcommittee, you know, those meetings do fall under the FACA guidelines. We have to follow FACA guidelines. So if you say, "This is a subcommittee meeting that we're going to give you, you know, data from directly as an output," you know, the committee's going to have to weigh in on that and that would have to be a public meeting, and then we'd have to formally respond. So there are limits to that. The FACA rule does -- we can go and give you the formal details of FACA, you know, later on, but just be aware of that.

VICE-CHAIR KLEIN: Can the end of -- this year's end-of-year memo, can it be late? Or is it -- you know, because it's going to -- we're going to get it in in December. It's going to become official in March or April. That's getting awfully close to June.

MR. GLASSCOCK: No, it's due February 1 to Congress.

VICE-CHAIR KLEIN: It's due --

MR. GLASSCOCK: February 1st to Congress.

VICE-CHAIR KLEIN: -- February 1st to Congress.

MR. GLASSCOCK: Right. Congress.

VICE-CHAIR KLEIN: And then it's due to you by when?

MR. GLASSCOCK: If you get it to us December 1st, we are lucky to get it out February 1st.

MR. AUGUSTINE: Yeah. But we will do it as fast as we can.

MR. GLASSCOCK: And depending on your number of recommendations, you know. Yeah.

VICE-CHAIR KLEIN: So there's not much wiggle room there. By December 1st is really it.

MR. AUGUSTINE: And you can provide a second advice memo later in the year, in June as well, and we have until February of next year to respond to. So your options are open, but if you want to get us something this year, we technically have a February 1 deadline to respond to it.

VICE-CHAIR KLEIN: When we submit it to you, at that point it goes on the website, and then later your response comes up on the website?

MR. AUGUSTINE: I believe that is the process.

MR. GLASSCOCK: Yes, yes. We will post your advice memo --

VICE-CHAIR KLEIN: So it does go public straight out of this committee.

MR. AUGUSTINE: -- before we provide -- yes. So the public will know what your recommendations are, and then we have some time to comment.

MR. GLASSCOCK: We work on the responses and recommendations, and then that goes to the Secretary, who then will then pass it on to Congress. So, you know, it's --

MR. AUGUSTINE: And then once we complete that process, that's what gets posted to the public on the website so everyone has full transparency, and so what was --

MR. AUGUSTINE: In that second

posting.

MR. GLASSCOCK: And all of our responses are vetted through the multi-modal process, so that's what takes some time. It's not just our office, but --

MR. AUGUSTINE: And it becomes a departmental response, so we have to coordinate it with the lawyers and counsel and the modes and OST.

MR. GLASSCOCK: It's the government.

VICE-CHAIR KLEIN: Because actually we're technically -- we're not advising NHTSA. So having NHTSA as an audience isn't quite what -- isn't our -- you're our primary audience.

MR. AUGUSTINE: Yeah, but I mean you can put -- as Bob mentioned, you can put anything in your advice recommendation. When it applies to us, to the JPO, we say thank you and where it is. You can tell NHTSA to go do something, and we have to say, well, we're the JPO, we don't have regulatory authority -- but we will, you

know, coordinate with NHTSA appropriately. I mean, you know, it will get to the right people. We just won't have the authority. The JPO doesn't have the authority to direct NHTSA or -- there's limits to what we can do.

CHAIR DENARO: So my recommendation is that -- and I'll open it to counter-arguments, but my recommendation is that we proceed with our formal process of this year putting together some level of recommendation memo that will be vetted through the whole process, yada, yada, and then we find -- and then we continue to do our work, enrich some of our information and knowledge, and someplace next summer -- Scott addressed it or suggested that we generate some summary of our discussions, and we'll find an appropriate thing to call that and maybe some rules, like we don't specifically have recommendations. You know, we don't call them recommendations. But anyway, something we could call that, so that's an input to this whole process, but it doesn't go through that formal thing, and then we do our real formal thing at

the end of the next year. Does everyone agree with that? Does sound right -

MR. AUGUSTINE: That sounds reasonable and I think Brian's point is correct. There is a -- there will be a time limit that, whether it's informal findings or summary or a formal recommendation, --

CHAIR DENARO: Yeah.

MR. AUGUSTINE: -- that gets beyond our ability to factor it in to whatever is decided.

CHAIR DENARO: Right, right, right.

MR. AUGUSTINE: So, just be cognizant of that.

CHAIR DENARO: Yeah, yeah. No. And so we'll work to that time limit, but I think what we're saying is that buying a little more time so we can get a little further in our knowledge and everything is going to benefit everybody. So we're just -- you know, we're finding a way to fit our calendar process to the realities of what's happening with the whole program, and I think that makes sense. That's

to everyone's advantage.

Any other opposing views? Okay. So that's the plan. We'll do that. So, thanks, George. I think you started this.

MR. WEBB: No problem.

CHAIR DENARO: I think one thing you implied in your comment there was in a break-out we want you to be thinking about, now, those two documents, both the formal one for here -- what do we feel comfortable with that your subcommittee's going to bring back to this whole committee in terms of a submittal for this formal -- this year's formal memorandum, and then what are other areas we're going to continue to investigate? We'll have an interim summary of that activity in June or whatever, and then eventually that becomes our final recommendation there. So the subcommittees ought to be thinking about that.

And just to clarify, personally I would prefer -- I don't mind if obviously we engage with JPO, they're participating in subcommittee work and so forth. But in terms

of some summary of our activities, I would rather that come from the entire committee as opposed to individually from subcommittees for this June thing, just so we -- I want to have consensus here. Okay? Okay.

VICE-CHAIR KLEIN: We have to approve the interim report due in December. We can do that without an actual meeting of the committee?

MR. GLASSCOCK: Yeah.

MR. AUGUSTINE: You know, Stephen raises a good point. The only thing to consider is whatever subcommittee recommendations, ideas, thoughts that you have, that you give to the full committee for consideration. There has to be a full quorum -- so that's ten members, or ten or eleven -- to adopt that. So you can't say, well, we only have eight or nine people. Let's go ahead and formalize it. You have to have a quorum.

MR. GLASSCOCK: You can do that by conference call, though. It doesn't have to be --

VICE-CHAIR KLEIN: You can do it by conference call.

CHAIR DENARO: Yeah, but our plan is we will have a meeting. It'll be by phone.

VICE-CHAIR KLEIN: Yeah, right.

CHAIR DENARO: So we'll do a little Google thing and we'll figure out where we can have enough people to have a quorum, but we'll go ahead and produce this memo together for a phone meeting. Because most of that work anyway is really the writing and the editing and that sort of thing, and then we can talk about it together on the phone.

VICE-CHAIR KLEIN: Okay. By the way, I'm just want to point out before this slide goes away, the process part applies to all subcommittees, and I find this -- I find that actually a really useful thing when thinking about my committee. "Agree on technologies and issues, identify JPO experts and outside experts, request reviews of the outputs with written questions, deliberate on concerns, document recommendations." Those are

cross-cutting procedures.

Okay. Scott, do you want to talk about --

MR. McCORMICK: Yes.

VICE-CHAIR KLEIN: Can we go back to the yellow -- to the yellow slide with the subcommittees?

MR. McCORMICK: Actually, if you don't mind leaving that up there, I think -- just because I want to talk to the process briefly.

VICE-CHAIR KLEIN: Okay.

MR. McCORMICK: Our subcommittee, Technology, the Security Framework subcommittee task was to review the current security construct for the V2X connected vehicle program, and provide assessment of the direction and any suggested areas of continued research or consideration. And we basically are down to about, for at least the first look at it, down to the third bullet where we didn't end up with a recommendation. We ended up with a series of questions, and those questions defined

whether or not -- you know, if those questions are answered, then, by JPO or somebody else, they can say, yes, we already did consider this, it wasn't -- we weren't aware of it.

So that's where we are, and before we get to that step of delivering on concerns, we had some other knowledge that was brought in by one of the committee members that wasn't ready for our previous meeting that we're going to look at next. We won't do it during this working session, because it hasn't -- we haven't had time to disseminate it to the committee, but we'll have another committee meeting to do that. And when we do the report-outs, we'll go over what the report is from the work we did already.

CHAIR DENARO: And just an overlap question, then. Your subcommittee is called Security Framework, but are you going to deal with the technology of security as well? Is there a need for some there?

MR. McCORMICK: We actually took a -- the purpose of the committee was to -- what

we first did was we said, well, let's disseminate the information on what the current security framework is and let's disseminate some information on what the history of how it got to be where it was. And then we brought in two outside experts, people that -- one that was the architect for the VII consortium and -- Scott Andrews and William White, who did both of the cryptology recommendations on this program, to explain why they did what they did and the path that they took. Out of that, we generated some questions. You know, was this considered? How was this going to be dealt with? Because it wasn't evident in the body of knowledge we had, and it wasn't -- or it wasn't developed enough to answer some of the concerns. So before we would get to a recommendation of what anybody wants to do, we wanted to make sure that we understood exactly why they were going where they were going that way, to fill a few gaps in for us, and then to capture some more -- some other ways of looking at the solution and seeing if those had a fitness to it, and that's some

of the work that we've just received. So, you know, we're not to the point of making a recommendation. We're to the point of saying, we have a few questions that we have to ask --

CHAIR DENARO: Yeah.

MR. McCORMICK: -- to make sure it was --

CHAIR DENARO: So looking at this list for technology, and if we meet together, we can talk about that, --

MR. McCORMICK: Yes. We did look at the background.

CHAIR DENARO: -- but should you guys be dealing with DSRC communication, capacity, 5.9 GHz sharing --

MR. McCORMICK: We did.

CHAIR DENARO: -- and LTE?

MR. McCORMICK: We did address --

CHAIR DENARO: And we don't need to do that here?

MR. McCORMICK: We did address all of those in our specs.

CHAIR DENARO: Then we don't need

to do that here; right?

MR. McCORMICK: Well, we were addressing it in terms of security. The question is, is whether or not you're addressing it --

CHAIR DENARO: Correct.

MR. McCORMICK: -- in terms of mobility or other services.

CHAIR DENARO: Well, that's my question.

MR. McCORMICK: We're still going to have that open question.

CHAIR DENARO: That's my question. So is there something, you know -- all right. Well, maybe when we meet together today we'll --

MR. McCORMICK: Right.

CHAIR DENARO: -- sort that out. Okay.

VICE-CHAIR KLEIN: Okay. We're on the market-driven deployment. The market-driven deployment is right now pretty nebulous, pretty wide open, because I think it's

-- what we've seen in the discussion over the last two days is market questions arise all over the place and they're potentially quite creative and novel institutional approaches and -- but they may also be kind of familiar approaches as well. So, a couple examples, some of them familiar, some of them possibly kind of new paradigm about how to do information services that contribute to transportation.

We've talked about the issue -- obviously, OEM implementation is a huge market dimension, market-driven implementation dimension, or the idea of a privatizing of a certificate authority. But we've also seen the whole question of like app development coming up as a major area, where that's kind of a new approach to transportation where you develop a general platform, maybe DSRC serves as a platform, and independent third-party or private developers are coming in with new systems that contribute to mobility or contribute to safety.

Certainly on the infotainment side

or the general information systems side, there's clearly a vision seen for private entrepreneurship coming in, doing any number of services, but many of which may contribute to the public sector mission. So there seems to be market opportunities for completely new benefits coming in which in some respects will be free to the public sector or at very low marginal cost, because the actors developing those services or functions have their own model, are making their own -- have their own business model and are self-supporting and sustainable on their own.

An example that happened at lunch was the idea of people driving around and detecting potholes on the basis of their smart phone. Turns out that that data is enormously valuable to the public sector, and if you can get it for free, you can save a lot of money doing road surveys and quality inspections. So there seems -- that's kind of what I would call more generally the network model or the internet model in which one entity's generation

of data or their business model can generate information that has significant externalities, positive externalities that has significant values to other members in the transportation community, and they can be made available to them at little or no cost. So it's the dream come true of getting free stuff, free data, free services potentially from someone who's making money doing it one way, and they're generating those externalities.

I think the market-driven model is connected with the layered network model, information technology layered architecture, in which different players provide pipes in which data's running over, others provide platforms which are generic environments that can hold applications, and yet other players can provide applications and services running on the system. So if you can put it out as a service in the public sector, make sure there's a platform out there, you're empowering others to enter the system and provide goods and services, and possibly deliver lots of goods

and services essentially -- or quite possibly for free to the public sector.

So one of the questions in this is, obviously, what's the role of federal government, what's the role in JPO, in creating a system that empowers private-sector actors to invest their money to make money on their own, and yet to yield these externalities, these benefits for the public sector? What are the kinds of things that our committee could advise JPO to empower the private sector, and it might be -- some of these we've already seen. I think they are in place. We've seen standards that create large markets that are attractive to entrepreneurs. We've seen questions of open data. I think a lot of state and local agencies are grappling with how much data they should give away, under what terms they should give it away. The feds could help set common standards that make the state and local operators comfortable in sharing data. That can be a real empowering mechanism for entrepreneurship to deliver services back into

the sector.

So, market-driven deployment combined with the layered network model of information technology. I think we've been around long enough. Most of us are aware of it. I think JPO is already doing work in that area, but I'm hopeful that our subcommittee can see additional opportunities and can make some constructive recommendations to JPO to do even more in this area, the payoff being you get good stuff for free. People start giving you valuable data and you get more services contributing to the mission of DOT.

Okay. That's our charter. Anyone else? Any comments, questions? We have so far really two members on the committee. We're merging with Outreach and Communications, but others are certainly welcome.

Let me just say, Ron, I'd be very interested to have you, because your comments about what's going on in the metropolitan region, I think, is a great example of an opportunity for this.

Okay. Then let's move to --

MR. KISSINGER: John.

VICE-CHAIR KLEIN: Yes.

MR. KISSINGER: This is Peter. I guess I have a question through a bigger picture question. I mean Scott's subcommittee talks about potential recommendations are for additional JPO research, which certainly is in our charter. That's their primary mission. He just talked about recommendations might be for JPO to do other things, which, again, I think we all kind of understand that. But what I'm having some difficulty, is putting that in some sort of context of timing, because we have this enormous decision coming up next October. There's a hell of a lot of stuff going on, and I sense that we as a committee have a limited opportunity to influence what's going to happen between now and next September, October, with the possible exception if somehow this committee could come together and make some consensus recommendations, that it would be, again, more appropriate to probably go to NHTSA as we talk,

as opposed to going to JPO, which might suggest what they -- you know, what they might do with that rule-making or things that they should include in the rule-making process.

VICE-CHAIR KLEIN: Um-hmm.

MR. KISSINGER: So I'm just, you know -- and I think, you know, the flip side of that is I think we need to be sensitive, especially at this crucial time, that we don't overburden the JPO and their large staff to deal with a lot of things which could be more appropriately dealt with like after next August or after next September or after that big decision is made.

VICE-CHAIR KLEIN: A couple things. First of all, even with the NHTSA and the DSRC and the Safety Pilot focus in the near and medium term, there's clearly market-based issues that come up very strongly here. The institutional design of the certificate management authority, could that be a fully private entity or not? The implementation of that system, there's been some question, are there any -- if it's a phased

private-sector implementation that's driving DSRC, again, there's a lot of market issues there. If DSRC is itself a platform, it becomes one of the pipes available in the car. Is it -- could some of the dynamics of this layered model and, some thought, even external investments contribute to the implementation of DSRC and Safety Pilot?

So I think that there's a lot of these market issues that will really be directly relevant and actually quite important to DSRC, particularly the certificate registration authority. I think that is going to be key to this whole thing.

In terms of over-burdening JPO, gee, after June or July JPO -- somebody's workload might drop off at the end of 2013. I don't know. So you might be looking around for some new things to -- additional things to look at. I don't know. But I think even Brian said at the beginning there's an 80-20 split. He said at the beginning, here's the other 80 percent of what we're doing. Is that about right?

Brian, you're here?

So, I mean there's a lot of JPO activity going on in addition to the DSRC. So I think speaking to some of those activities, I think, is appropriate. The only thing I'm more concerned with, is that we would recommend things that you're already doing, because I think you're doing very important things in this area already. So we would -- our committee would want to be really sure that we're adding value to what you're already doing.

MR. McCORMICK: I'd kind of like to do a point of order here, because I think there is some clarity that's needed. Our charter objective, even though we provide our recommendations through the JPO -- if you read it, it's in section 8 -- our charter is to provide -- to make recommendations to the Secretary regarding ITS program needs. We've been first asked to help evaluate and look at the Joint Program Office and this particular initiative. But to your point, there's nothing that fits under the umbrella of what the ITS program needs

are that are outside of our ability to contribute. They just become -- the JPO becomes the vehicle by which we communicate that to the Secretary.

So -- and I'm not saying this isn't a very important thing that we ought to be doing, but if that recommendation is something that we think we ought to be talking -- providing to NHTSA, that's the JPO's job to communicate that through, whether that's through the Secretary or directly to them.

So I don't think we ought to get bogged down on whether or not it's something the JPO is working on. JPO works on a lot of things and they've specifically asked us to look at certain areas when Shelly did that back in May.

But our charter is to look at the program needs, objectives, plans, approaches, contents and progress for the ITS needs. That covers an awful lot of stuff. So I think if we decide collectively that there's an area that we need to be providing our thoughts on, that's

not out of bounds. Granted, there's a lot of important stuff that we are being asked to review and get our heads around with regards to this program, but nothing's off the table that fits under that umbrella. I don't know if you want to --

MR. AUGUSTINE: I mean I think the committee -- that's fair. You have a pretty wide flexibility on giving us advice and it will go to the Secretary, so if it's technically not in our bailiwick, it will get to the right people. We will say that's not our -- we don't have authority, but I understand your issue and we either agree or don't agree and here's why. It will get to the right people, yeah.

CHAIR DENARO: Yeah. I mean part of our charter says to review the JPO programs with, you know, state of the art and likely to be deployed and so forth, at a minimum. There are words in there, "at a minimum."

MR. McCORMICK: Right.

CHAIR DENARO: So, you know, the instructions for us say, please, spend some time

on their program and give us that, but if you feel you need to go beyond that, have it. And so I completely agree with what you're saying. So -- but I think both of those are important. I think we have -- my opinion -- I think we have a duty to review what JPO specifically is doing and count on that, but we have a broader responsibility to say, what are the -- as I said, you know, at the last meeting, what are the barriers, potential barriers to deployment of this whole ITS thing? How does it get done? And I think we need to address that.

MR. CALABRESE: Bob, this is Joe. And there's enough on our plate to that respect. Other than this, I have no idea what else they're working on.

CHAIR DENARO: Okay.

MR. CALABRESE: This has been everything we've talked about --

CHAIR DENARO: Right.

MR. CALABRESE: -- for the last three years.

CHAIR DENARO: Yeah, yeah, yeah.

MR. CALABRESE: If anything else.

CHAIR DENARO: Yeah.

MR. CALABRESE: And maybe that's the issue.

CHAIR DENARO: I think Sam has a question.

MR. LAMAGNA: Yeah. It's encouraging that the team is --

CHAIR DENARO: If you can speak over here so --

MR. LAMAGNA: Oh. It's encouraging that your team is looking at how to leverage standards and drive openness to fuel innovation. You know, let cats rain, and raining cats. Right. So are you also looking at the other side of it that says perhaps if left to openness, there will be too much fragmentation. There won't be enough critical mass to drive any particular advancements. Are you going to be making a recommendation that certain aspects of this, at least in the initial phase, should be more closed in order to get everybody oriented to kind of get everybody

focused? So you almost have a balance of this stuff on the right really should be taking advantage of openness. The stuff on the left should be kind of closed to drive innovation quickly.

VICE-CHAIR KLEIN: No, it's not a foregone conclusion that open standards are the be all catch all. Yeah, so a discussion of standards and their role and markets and their role and market-driven implementation is --

Outreach Communications. Where are we with that?

MR. STEUDLE: Well, we are going to use this afternoon's break-out to formalize -- to develop and formalize a charge, but our basic charge is to provide recommendations on critical multi-level communications needed -- needing to be considered for successful deployment. That's what we're going to -- that's what we view as our charge, and I'd take any input.

We appreciate the list at the bottom of your five steps that you had in there. We will need to consider internal things, internal

communication, internal communication spectrums, communications -- in the last day-and-a-half, we didn't talk at all about communications, other than Bob pointing out the website. That's there for us. So there's a lot of communications that need to happen that I suspect some of it's happening. I've seen some of it. Some of it immediate with the Safety Pilot, some of it long-term for the results and the roll-out later.

So I can see us coming up with some short-term to long-term recommendations or things that need to be considered. I will tell you that I don't think the committee will come back and say buy this kind of advertising on these days of the week and on this page in the newspaper. But larger global pieces that said these need to be communicated. Our plan needs to be developed for this group, this group, an internal tech group, a general public group, whatever. Those things we'll kick around in our break-out session.

CHAIR DENARO: And, Kirk, I would

encourage you to also document the why, why this should be done. I think that's important. That sounds good. And standards, I think, we'll defer on because Scott's out doing his meeting right now, so we'll hear from him when we come back.

VICE-CHAIR KLEIN: Very good. Can we think --

CHAIR DENARO: We need to figure out a schedule, revised schedule here, because we have lunch ready over there.

VICE-CHAIR KLEIN: There isn't a -- this would seem to be a natural point to eat.

MR. McCORMICK: Joe has a question.

MR. CALABRESE: Well, not a question, since I've been embarrassed twice. I just wanted to say --

(Laughter.)

MR. CALABRESE: -- that my recall was both at the last meeting and at the end of our conference call last month, I volunteered or placed myself on this committee, unless I was vetoed for some reason. I'd like to take

my yellow stripe off my name.

CHAIR DENARO: Oh, you'll get accepted, yeah.

VICE-CHAIR KLEIN: Outreach and Communication.

MR. CALABRESE: Thank you.

(Simultaneous speaking.)

CHAIR DENARO: Why don't you do it right up to like an hour. Let's see. We've got 12:30 to three, --

VICE-CHAIR KLEIN: Yeah. We'll try to make it close to 2:30.

CHAIR DENARO: -- which is 2 1/2 hours. I would say an hour-and-a-half lunch/break-out, and then an hour back here. What do you think?

VICE-CHAIR KLEIN: Yeah. We could bring food into other rooms, or is that going to leave pasta salad all over the carpet?

Let's eat in half an hour. I think that's better. Eat in half an hour. So, by 12:30. Lunch is until 12:30, and at 12:30 we go into break-out rooms. Security and

Technology here, Market and Outreach in 1120. Standards is doing its own thing. Half-hour break or 35-minute break for lunch.

CHAIR DENARO: And then what's the program after that?

VICE-CHAIR KLEIN: I think we're going to need 35 minutes just to go through the line and --

CHAIR DENARO: Okay. And one hour each and then break out, and then an hour back here?

VICE-CHAIR KLEIN: An hour break-out and an hour back here. That's a good deal. So we'll -- 12:30 to 1:30 we'll be having a break-out.

(Whereupon, the foregoing matter went off the record at 11:54 a.m. and went back on the record at 1:46 p.m.)

SUBCOMMITTEE REPORT-OUTS

VICE-CHAIR KLEIN: Is there anyone who would like to commence, or shall we go through the same order? Bob, do you want to be the first guy or --

CHAIR DENARO: Yeah, we can -- we can, because of the unconventional discussion from us, but --

VICE-CHAIR KLEIN: Okay. Great. And I guess we were four groups. I don't know if we'll hear from Scott Belcher.

CHAIR DENARO: Scott Belcher? I don't know.

VICE-CHAIR KLEIN: Okay. We'll save him for last.

CHAIR DENARO: Is Scott still here?

VICE-CHAIR KLEIN: So a quick summary might be, you know, seven to ten minutes or something like that.

CHAIR DENARO: Yeah. Let's wait a minute and see if we can find Scott.

(Pause.)

MR. STEUDLE: All right.

VICE-CHAIR KLEIN: You have seven to ten minutes.

OUTREACH COMMUNICATION/PROMOTION PLAN

MR. McCORMICK: So I'm going to go by Bob's little note there so we can keep on

task here, but our charge, we're going to wordsmith it a little bit more by e-mail later. We didn't spend a lot of time now. We felt it was kind of close, and it really is just, "Provide recommendations to U.S. DOT on critical targeted audience. Multi-prong communications that need to be considered for successful deployment." That's the broad scope of where we're operating under.

The preliminary issues that we identified kind of fell in two buckets. They were short-term needs between now and when NHTSA makes their decision, and then the long-term needs, because the communications are different between them.

So the first task under the short-term is to primarily start with the media coverage that happened -- and our recommendation is to look into this -- that happened from the Safety Pilot launch. Everybody was there, saw all the stuff, loved it. Did anybody look at it from a communications standpoint and said, how effective was it? Yeah, there was some

stuff that was done, but how -- what else could have been done? What worked well? And then, how do we carry that stuff forward?

The second one on the short-term, we said we needed to develop -- DOT needs to develop an outreach strategy for multiple targeted audiences, other federal agencies, states, counties, cities, insurance companies, truckers, trucking associations, advocates, and private industry vendors that are in this realm that mainly would work -- that would be members of Scott's -- members. And part of that strategy would be to engage them and ask them -- and again, we're talking about communications -- barriers, success, what things really work.

Along with that is to do some research on the best way to communicate to the various groups, including the general public, and that also includes using and developing test words, how best to communicate. This isn't -- you're not communicating your research findings. You're communicating a vision of what's coming. So we said that's a second

piece.

The third piece -- and this is in the short term -- is to accumulate a repository and track the media that's going on, because right now we don't know. You can -- George was in the meeting and Googled "connected vehicles," and he got, you know, a couple of stories. But is there a place where they're all together and are we looking at who's saying what and how, and how do we actively manage that whole discussion? That's short-term.

Longer term, we suggested that we need to do and we need to identify the benefits and discuss the benefits more to enhance the acceptance. So, and that's maybe to the elderly population, to the population of mothers with kids, to the population of just kids in general, just kind of targeting. But where -- how does all that happen and what works best?

This next piece kind of rolls in with the experts and we really feel that our recommendation would be that U.S. DOT needs some communications/public relations experts public

relations experts involved in the conversation, because this is not just about talking about the research that was done. This is about communicating the benefits to the future to get people to buy into the vision as to where they're trying to go. So, again, there's a little bit of that in the short term. Most of that communication is focused towards the NHTSA decision and it's probably internally within, you know, the closed circle. And then after that, it becomes much broader and we really recommend that they have some additional professional assistance to go along with that.

Policy issues are cost and privacy. Who's paying for it, how, and then privacy. And I figured -- we all said that's probably going to pop up in a lot of people, so we didn't spend a lot of extra time talking about that.

And then to round this out, the last thing is, what would we recommend being the interim 2012 memo? Three things. U.S. DOT develop an overarching strategy. Where are you going with this? A communications strategy.

How are you going to talk? Second, focus on the short-term before the NHTSA decision about what has to be communicated and to who and how do you get there. And the third one is engage the professional assistance from those communications professionals.

So, that's it in about eight minutes.

VICE-CHAIR KLEIN: Yeah, great. Any comments or --

MR. STEUDLE: Should ask the rest of my committee members. Did I capture all of that?

VICE-CHAIR KLEIN: Yeah, other committee members.

MR. KISSINGER: I think the one thing was we did talk about giving more consideration to what the role of this committee might be and at a minimum taking advantage of the connections that many of us have around the room that would be happy to, you know, volunteer our services to DOT at some point, and whether it was, you know, Scott getting a hold of his

constituency or Mike basically getting articles in AAA Magazine and those kinds of things.

MR. STEUDLE: Yeah, that was an important -- that's a short-term and long-term. How do we help, short-term, help get that message, and then long-term, how do we really help talk about it in a broader sense, because we all have constituencies that -- and are very broad with the people sitting in this room.

Thanks, Peter. I skipped over that bullet.

TECHNOLOGY REVIEW

VICE-CHAIR KLEIN: Okay. Bob, we'll now come back to you.

CHAIR DENARO: Sure, and I will invite Scott and Roger and anyone else who was in the room with us to weigh in. So I would say with some amount of embarrassment that we didn't do what we were supposed to do, but what we did may have been more important.

MR. McCORMICK: Yeah. That's our story and we're sticking to it.

(Laughter.)

CHAIR DENARO: So that's our report.

(Laughter.)

CHAIR DENARO: The discussion we had really is central to the role of our committee in general and what we ought to be doing, and we had a good debate about, at one end of the spectrum, we can be on a witch hunt and ferret out all kinds of little clever or problems here and there and so on and so forth. On the other hand, we can say, you know, a good amount of these are going to be solved by various participants in the system. One example would be we don't necessarily want to criticize the government for not getting into some area that's actually going to be solved by a system integrator or the OEM implementing or whatever else.

And, in fact, that itself might be one of the issues that we deal with: What is the proper role in this -- in implementation of this system leading up to it of the private sector versus the government? An example of

that that we did get into in some detail -- and it's kind of a fun discussion -- was about the driver-vehicle interface, and it is -- it does appear as number 5 on my list up there.

And we talked about the fact that on one hand we certainly know that standardization's going to be important and, you know, you don't want to distract drivers, and it's a whole bunch of things that are going to be very important to successful deployment. The question is, who should be doing that and to what extent? So, should NHTSA be coming up with a design of the driver interface and specifying that to the OEMs? Or, again, the other extreme might be, should they say, "We're totally out of this. We're not going to even comment on that. It's really up to the industry to decide"? Or, is there something in between there?

For us as a committee, my opinion is that we have a responsibility there to make sure whatever the right solution is or whatever is done there does not cause this system not

-- you know, not to be implemented and deployed. So, a wrong move on either side of that -- either too much government involvement or too little government involvement -- could be a problem.

And the middle ground in there might be that if we decide that standardization is important and that may happen by the industry by voluntary standards, then maybe the role of the government is just to monitor and influence that, provide leadership and make sure that happens. So, not be totally outside of it, but also not in there.

And then one comment we had from one member of the committee is, in general what the implementers would like is for the government to specify performance, not design. So that kind of folds right into this whole discussion here.

So, that was a little complicated what I just said, and it maybe not be real, but I think it was an important discussion of what is the nature of the issues that we should be dealing with as a committee and, you know,

leaning back and recommending to the government? And I guess at this point I think it was a good discussion. I think we need to think about that some more, and then as we develop our recommendations, take that into consideration.

Some of the other comments we had were with respect to the timing. Should we be focusing on elements of this system that are going to be important eight years from now, or should we be putting more focus on things that are important to, say, the NHTSA decision? And I think we had a reasonable consensus that we probably want to do both, but we certainly need to focus very heavily on the short-term of this NHTSA decision, but not totally ignore some of the longer term, especially if there are decisions made now that could have long-term impact that would negatively impact the program.

Any other participants want to weigh in on anything else there? Scott, did that do that -- summarize it well there?

MR. McCORMICK: Yeah, yeah. I think that's -- we all consent that the first

four items were ones that were worthy of further investigation.

CHAIR DENARO: So we have more work to do in fleshing out what the real -- the issues we're going to deal with and need for outside experts, all of the stuff that we want to get done, but I think it was an important philosophical discussion on where can this committee have valuable input and impact on the success of the program.

STANDARDS HARMONIZATION

VICE-CHAIR KLEIN: Okay. Great. Scott, do you want to talk about the standards?

MR. CALABRESE: I'm not really a committee of one. There were other people on the phone. Since you all decided that standards is about as sexy as -- well, it's not very sexy.

So what we've done in the Standards committee is -- Steve Kenner has agreed to be on it from this group, and then we've gotten some outside experts. We've asked Steve Sill, who handles the international standards activities for the Joint Program Office; Dick

Schnacke, who is the head of the what's called ISO/TC 204, which is the primary ITS standard-setting body, and then -- I'm just -- I'm blank. I'm sorry. Gummada Murthy, who's at AASHTO now, on -- but was at Virginia -- or was with Virginia DOT and runs a number of their things.

So in some respects we view our mission as being the chief cheerleader and antagonist for the U.S. government around standards. It is a very -- it's very important and it's very important that we take this seriously, especially as we move into an era of standards harmonization. So we're going about this in two ways.

First, a lot of work went in, in the last Program Advisory Committee on standards, and we made a series of recommendations to the Department of Transportation and to Congress about what we thought should be happening in the standards-setting arena, and we've gone through those recommendations and, for the most part, they're still all important

recommendations and they still are all meaningful. At the high level, one recommendation is that the Joint Program Office, but also the Secretary of Transportation, the Secretary of Commerce, and the White House, engage in the standard-setting process at a -- and it be engaged at a higher level and make public statements about the necessity for equality and harmonization of standards. One of the things that we see in the international standard-setting arena is that the Europeans and the Japanese, to some extent, have a much higher level of political engagement in this, because they see this as a market differentiator and as a competitiveness issue in which they're going to support their industries.

And so the folks who are involved in the standards-setting process recognize we're a different country and with a different value set, but it is important that if we're going to maintain our competitive position, that we engage higher levels of folks in the dialogue. And the second part of that is that we need

to be putting that level of pressure and that level of support, especially as it relates to the EU, because they are doing that.

And so we felt that those comments are still valid and we'll restate some level of those. We made a finding -- the second finding is that, you know, there needs to be greater engagement in the standards process of some of the significant stakeholders, particularly the OEMs who kind of come and go when it's important for them. But continuity would be important. We see that on the European side, a greater level of continuity, and that's just one example.

We asked or we suggested that an analysis be done, the costs of not having standardized -- or not having harmonized standards. That hasn't been done. I think it's a difficult thing to do, but I think there is some value in that.

There is a working group of the EU and the United States on harmonization, and there's also one with the United States and

Japan. Our recommendation is that those meetings engage a broader cross-section of stakeholders and a higher level of stakeholders, and that the meetings be on a regular -- more regular basis and they be longer. Again, part of it is political, but what you see from the other regions is they will have senior political officials and a very strong cohort of private-sector companies and a very intentional plan of attack for these meetings. I mean they really are viewing this as a -- you know, as a meaningful and -- and what we've done in the past is had a couple of DOT folks made the meetings open to the public, and so we might get one or two private-sector folks there. But we haven't gone about it as strategically as we could or as other folks have, or as we have, quite frankly, in the United States in other areas, other standard-setting areas outside of ITS.

So anyway, so there were a number of things that we want to continue to support the JPO on to try to elevate this. It needs

to be elevated within the department. Very difficult to do at this time with an election coming up. Very difficult to do at this time with all the GSA stuff going on and there being a clamp-down on international travel and clamp-down on all that kind of stuff. But if we don't say it, nobody else will. We need to elevate it at the White House level, and so we'll continue to do that. And then, so our interim memo will be kind of, here are the issues that we've already stated that we think need to be addressed, and then to provide the JPO an alternative to -- an opportunity to give the committee kind of an update, kind of here's where we are after six months. And on many of these, the things I've mentioned, they have made great progress on and are doing good stuff.

The second part of what we'll do is to look at where there are other important initiatives that are ongoing in the standards-setting area that we want to provide support for and encouragement for adequate engagement on. One of the most important and

most politically difficult issues is what are meetings between the International Standard Setting Organization, ISSO, and ITU, which is another international organization, and I think it's a sense of the committee that DOT needs to be actively engaged in that, and that's challenging politically and we recognize that. But somebody's got to make that statement that it's important that we be there as a nation, not just as a collection of individuals.

So that's kind of where we're going with this. My recommendation is that -- for the next committee meeting is that we bring in a couple of these experts to make sure that everybody on the committee is at a common level of understanding about what's going in the standards world, how we're playing, and what the ITS JPO's already doing in that space so that people aren't just going to take -- aren't just going to read the recommendations and say, "Oh, that makes sense," but they'll actually understand them and either agree or not agree and provide that kind of input.

Any questions?

VICE-CHAIR KLEIN: IT participation. Does that go through the State Department? This is in the DOT, but --

MR. McCORMICK: The ITU-T is a part of the United Nations committees. It's the International Telecommunication Unit. It's largely -- you have to be a country to participate, and I was the vice-chair of one of the committees during -- for standardizing communications between 2001 and 2004. It's largely governed by the European telecoms. They for a number of years -- we started things like the 4-E network car expos that they now hold every couple of years at the Geneva auto show.

They struggled for a number of years to find relevancy, partly because ISO was doing some work. They're not really a standards-setting body, but they are trying to figure out what their role is in this space. They have a lot of resources that they can deploy to it, because they have members from all the

different countries send people to Geneva to have them work on this activity.

They have been trying to, over the last, I'd say, eight years now, we've been trying to get them to incorporate input from private entities, which they normally don't bring in. So that you guys know historically, there's been a very difficult position with the United States within the ITU, because largely -- and, quite frankly, because largely the FCC and other bodies were going over there to be obstructionists in terms of how the ITU wanted to recommend using certain bandwidths worldwide, and they didn't want them because it disrupted our DOD use of those same bandwidths.

So the ITU-T is, I think, worthwhile in terms of the fact that they're now working on a couple of working groups addressing stuff in this area, and my suggestion is that it's going to be important because they largely involved telecoms, who historically have not been participating in this space that they're

--

MR. BELCHER: Um-hmm. That's very fair.

VICE-CHAIR KLEIN: Okay. Any other questions?

(No response.)

MARKET-DRIVEN ADOPTION STRATEGY

VICE-CHAIR KLEIN: Then I will report back from Market-Driven Adoption Committee, which was Steve Albert, Ron Kirby and myself, and the three of us and JPO participation -- or, I guess, presence.

Our charter. This is a bit of a committee output. Our charter generally: "To identify practical and realistic strategies to accelerate market-driven adoption and service provision. Strategies would include focused institutional models, scalable approaches, building markets." A specific charter focus would be the promotion of markets and market-driven approaches, identifying untapped valuable data, cases of what would be called positive externalities where there's data that

exists that isn't being used and could be shared. Data originating in the public sector shared with the private, and private shared with the public. Look at making those kinds of connections where owners of data potentially and users of data come together, which it seems there might be situations where there's a win-win situation out there and it doesn't -- it isn't really happening. Identifying standards to achieve economies of scale and to achieve interconnection and interoperability so people can makes those kinds of connections.

We also specifically focused on some issues, market-related issues that relate to the NHTSA decision and to DSRC. That would include examining institutional models for certificate management, particularly private models, private-sector models provided by institutionalized certificate management. And the market -- the role for markets in phased deployment of connected vehicles, including the role played by private sector OEMs and the private sector after-market which may end up

playing a significant role in that phased deployment.

Some specific issues we came up with. What's the status of data on the vehicle? Who owns it? is one important question. And perhaps a more important question is, who can access it? It may be owned by the driver, its ownership may be ambiguous, but it may also be inaccessible to all but a small number of actual players. It was felt that some of that data was potentially very valuable, well, to lots of players, including public sector agencies.

Another specific issue: The willingness and potential unwillingness of different actors to share their data. The public's, as they were mostly public-sector guys, we characterized the public sector as, "Sure, happy to share, no problem. Lots of stuff can be given away for free," and some concern that maybe the data firms, they make you pay or in some cases they -- some firms with data might not even be accustomed to selling at all. That might just not -- might not even

be part of their business plan to really sell the data, other than to use it to give added value to their customer base.

Specific issue: Identifying opportunities for mutual benefit for win-win. Where is some data that's already been paid? Well, where's somebody who could benefit from that data? Find some cases, build markets, build connections, define standards, and suddenly you have win-win situations.

Specific issue related to DSRC: What is the market value of that unique type, that 5.9 GHz? Are there certain -- is that just waiting to host some applications we haven't thought of yet that would really generate market interest and market development for using the system that's currently being developed for public sector safety applications? Maybe there are other applications that would benefit from the unique characteristics of that particular connection.

Specific issue: Identifying benefits of private data to the public sector.

Again, looking at those externalities. How does private-sector-generated data going to help improve safety to address congestion, to help us do asset management, and so on?

Some key policy issues that we identified were strategies to achieve economies of scale, interconnection and so on. Standardized -- standards play a big role here. Standardizing APIs. So it's easy if all agencies -- if all agencies with their data, public-sector data collection, offer a similar plug-in point where others can tap into it. Standardizing DSAs, data sharing agreements, so that no matter which agency you're going to, you get a relatively predictable, consistent agreement that allows private sector actors to know what they're getting and overcome the diversity that typifies public agencies. Standardization of data formats, again, so you can plug in. So if you can plug in to a standard plug, access standard data under standard terms and conditions across the United States, you've there created a huge standard wealth of data

that the private sector might really want to invest in and generate value from. And possibly some reversal where the private sector -- investigating how the private sector might have a similar attitude or opportunity or opening towards the public sector.

We talked about the importance of mapping out information ecosystems. We've got a couple of cases on our committee. The Washington, D.C. metro area, the multi-state Northwest Passage, where committee members have been dealing with this, where there's all these databases out there, and understanding even a method or way of conceptualizing or mapping out what data's out there, what's the standards, how does it interconnect, who owns it, what are the terms under which these things are made available. We talked about the incredible value of the VIN database which is owned or operated by the Department of Motor Vehicles, and it's incredibly useful for environmental -- it has a lot of environmental data because it has model number and so on. That's just an

example of the kind of data that's out there in the metropolitan region. How do you map it so you can build a strategy for aggregating it, fusing it, and extracting value.

In terms of experts, we identified -- we did not identify too many outside individuals, but we would like to talk to someone from some of these data firms, an INRIX person, a Google person, an OEM data person, would all be of interest, these private-sector players who are sitting on data, and get their perspective. What's their perspective on their own data? What's their perspective on the data that exists in the public sector, the willingness to share, the modalities of sharing. We'd like to speak some of these markets or a marketing expert to understand better how these things come together.

And we're interested in some internal talking to some of our colleagues here. George, your name came up an AASHTO person, getting a larger perspective on the states currently, and, Kirk, yeah, talk to both you

guys. And Walt, you came up as well. We were talking about what are the proprietary standards that exist in a vehicle. There's a lot of interest in the public sector in that data on the vehicle. Can we somehow get the data, what's the status of that data, including what are the kind of proprietary standards that keep it inside the data and not sharing as much?

For our 2012 memo, I think the things that would come up are some of these general topics, and if we get into issues around DSRC, we're looking institutionalization, certificate management, the market value of the unique pipe, and so on. We didn't spend too much time on that topic.

Any comments from other members of the committee? I know this is a different setting.

MR. ALBERT: We're the first ones to use "practicable."

VICE-CHAIR KLEIN: And we used, yes, the "practicable," the widely-used term.

MR. BELCHER: Hans, just from a

non-committee standpoint just for this larger committee, there is interest in sharing the DSRC spectrum. There's a study going on by NTIA right now on whether data, whoever that spectrum, can be shared. There are private entities that would like to utilize some part of the spectrum and they would make the argument that doing so would create a better market for our needs, and so that's currently underway, I think, and the position of most of the folks who are actively engaged in connected vehicles are that they -- well, position of everybody engaged in connected vehicles is they don't want to do anything that puts the connected vehicle program at risk or puts individuals' safety at risk. The position of DOT is that's their position, but if you can share, we're interested in seeing how. The position of other folks are, no way, no how. So you've got -- that's kind of where we might need some discussion, and the study is supposed to be out at the end of 2013, around the same time as the decision about whether -- how to go forward with connected

vehicle program.

VICE-CHAIR KLEIN: Is that considered plausible that there would actually be a positive benefit? I don't know if there's been a discussion on this with JPO, that others staking a claim on 5.9 GHz is not so much a rival risk situation as a possibility of promoting the use of it in a way that also dovetails with the objectives of the JPO? It hasn't been my perception that that's the case, but it's one or the other. But I haven't seen it facilitated.

MR. AUGUSTINE: Well, I guess we don't exactly know until we see the NTIA report about how problematic or -- I think they seem to understand our concerns about protecting the vehicle safety and connected vehicle safety applications, and that was our major point, said that is our number one priority. Obviously, all along there's been envisioned the concept of having other non-safety applications cooperating in the DSRC space. Now, Walt talked about it probably made sense to look at some

more sophisticated channel management schemes and what do we need to do, any kind of refinements to the standard or updated protocols that would further protect the safety critical applications, but allow those other mobility and convenience and -- you know, there's a lot of other benefits that would go along that are not safety.

So, I would agree with you, Hans. I think this is an opportunity to say we and then the Standards committee are coming to the realization that a more sophisticated channel management approach would not only make the spectrum more efficient, but it may actually provide an opportunity to say here's where other users could be located that would be far enough away from the safety channel that would allow coexistence. So I definitely think we should look at a win-win approach.

If I was NTIA or FCC, I don't think I would accept there's no way to improve efficiency, it's a hundred percent perfect, we're not going to make any changes. I think

that's unrealistic. I don't think that's helpful, but I think we've already acknowledged I think we can come up with some schemes that would help both our internal applications, but allow those other non-safety applications to operate in a peaceful harmonious coexisting fashion and not provide interference.

MR. LAMAGNA: I'm kind of on the same page as John. I've read --

MR. McCORMICK: I'm sorry. I can't hear.

MR. LAMAGNA: I'm sorry. There's some reports published from -- actually, it was a service provider that said service sharing that band with their -- with other adjacent usage models, we'd be able to get some economy of scale and solve security, real-time concerns, manageability through loss and usage models. So, while they may not be identical schemes, there are ways to kind of leverage off of each other's work, gain economies of scale and drive down some costs. It does muddy things up. There's always that risk in it, but I think it

does, again, drive some creative thought about how to solve cross-industry problems.

VICE-CHAIR KLEIN: Good. Any comments on these? Well, let me ask you. I really would love to have a listserv where we could easily communicate with each other and possibly put something out and have a share among this committee. Let me just have a show of hands. If that was to be set up, would anybody not want to be on it?

SECURITY FRAMEWORK

MR. McCORMICK: Excuse me, Hans. Did you want me to give my Security Framework report?

VICE-CHAIR KLEIN: Oh, I thought that you guys were in the same group.

(Simultaneous speaking.)

VICE-CHAIR KLEIN: Okay. Then I'll ask this listserv question after, so I wanted the possibility of posting what we've heard here, so --

MR. McCORMICK: Okay. I've mailed out to everybody everything that was on here

as well. I don't know if I sent you all the attachments. If you wanted any of the attachments that were there, let me know. I'll send it out. I'm not going to go over those questions, just in the interest of time, because I've already sent them out.

Basically, where the committee is at is that we've gone through and we have a number of questions that we have for the JPO to determine how far they went into research on these topics. Since those were also inputted by outside experts who are involved with the JPO and dealt with the program, we're fairly comfortable that they haven't been addressed, but we want to answer those first before we move further with that.

We also have another body of work that's been recently presented that we're going to be going over shortly and trying to then craft two documents. One are whatever policy-level recommendations or questions or statements we may want to put into the December report, and the other one is either those questions or

thoughts or comments that we want to -- that we feel are collectively appropriate to submit back to this committee to look at for inclusion in that December report as well; that we're going to shoot to have all of that done before mid-November so that we can do the telecon and get back.

Did you have an idea, Bob, when we thought we might reconvene on that telecom if we have a December 1st drop-dead date for -- with JPO?

CHAIR DENARO: Yes. December 1st?

MR. McCORMICK: Wasn't that --

MR. GLASSCOCK: We said that because the committee -- we call it the memo.

MR. McCORMICK: Yeah.

MR. GLASSCOCK: Kind of circulate it to over it and try to get it to Congress by February 1.

CHAIR DENARO: Oh, right. Right, right. So the answer is no, but obviously, in terms of talking about it and getting it written, that has to be in a couple of weeks. So we'll

have to float a meeting request around to --

MR. McCORMICK: Okay.

CHAIR DENARO: -- talk about that. The first or second -- I mean, yeah, first or second week in November, right, I think at the latest.

MR. McCORMICK: Okay. Then that's all I have.

CHAIR DENARO: First week, something like that.

VICE-CHAIR KLEIN: Yes. Okay. Well, it may be that if we -- if the subcommittees want to potentially refine a little bit their statements and post them to the group, maybe with one more iteration or possibly two, we could have our memo. I don't think more than two iterations that we have time for.

CHAIR DENARO: Yeah. True, but we've got to bring that together as a committee and decide, with all the piece-wise submittals, what is -- first of all, what is our consensus on those issues and what subset of them might we pick and how we construct it.

VICE-CHAIR KLEIN: Right. Absolutely. Which is not that easy to do online, but we are --

CHAIR DENARO: No, no, but we'll have to do it. Yeah, yeah.

VICE-CHAIR KLEIN: So in order to share that information, if we were able to set up a listserv -- and I know that JPO has shared information on some modalities for doing that, there may be others -- does anybody not want to be on an e-mail address that would get -- reliably reach everyone on the committee? There's a risk it will generate traffic and you might not like it, but there is also the guarantee that when you send out an e-mail, you know you're reaching the committee or others will know that it's going to get to you. So if you're -- if everyone's okay with that, I'll try to make it happen in the background. And if you're concerned about sending an e-mail and -- and otherwise, I'll try to make that happen.

CHAIR DENARO: Did we figure out whether that fits with the rules and --

MR. GLASSCOCK: Oh, yeah, you can do that.

CHAIR DENARO: Yeah.

MR. GLASSCOCK: Yeah, Bob.

CHAIR DENARO: Okay.

MR. GLASSCOCK: As long as everything's brought back to the table.

CHAIR DENARO: Okay. Right.

MR. GLASSCOCK: Always remember that part.

VICE-CHAIR KLEIN: As long as everything's what?

MR. GLASSCOCK: Brought back to the group. I mean, you know, nothing -- you can have side discussions, but then everything has to be brought back to the group for their consideration.

VICE-CHAIR KLEIN: The final outcome of that discussion.

MR. GLASSCOCK: Yeah, yeah.

VICE-CHAIR KLEIN: Right. And a --

MR. GLASSCOCK: You can certainly have side conversations and --

VICE-CHAIR KLEIN: And an e-mail list, that would be for the entire group, we've got that capacity?

MR. GLASSCOCK: Yeah.

VICE-CHAIR KLEIN: Okay. Great. Okay. Then I would say let's have the committee chairs go ahead and do another editorial pass and post it to the group. Let's do that as our next step, and then we're going to work towards distilling that down to our memo. So keep that in mind, that this is your initial input into our memo.

MR. BELCHER: Hans, could I --

VICE-CHAIR KLEIN: Yeah.

MR. BELCHER: -- just ask for clarification? I apologize if I was out of the room when you did it. The memo -- the intention of the memo is to do what?

VICE-CHAIR KLEIN: Fulfill our duty to generate a memo in December. It's our first -- so, a) we have a responsibility to produce the memo. It's, you know, what are we trying to do? Well, that's the discussion here. What

is our -- what's the message we want to get in to the Secretary of Transportation?

MR. BELCHER: And what is that?

VICE-CHAIR KLEIN: And we have five different perspectives coming here from the five different subcommittees, and I think initially we're going to have five submissions for that memo coming from the five subcommittees, and then we're going to have some kind of a distillation process as --

MR. BELCHER: So it's the sense, then, that we would produce a pretty high-level memo which may be five to ten paragraphs, one or two paragraphs per committee, that says in the big picture this is the direction that we as a committee -- these are the primary areas that we're going to focus, and these are areas that we think that the Department of Transportation ought to be focusing, and we'll give you more detail when we send our final memo? Is that kind of the -- so if we've got to go back and write something, --

VICE-CHAIR KLEIN: Um-hmm.

MR. BELCHER: -- how specific, how detailed? Or is it just pretty much big picture, this is the directional in nature?

VICE-CHAIR KLEIN: Before I, you know, turn to Bob, who's done these before, and I guess you've done them before as well, I mean I think that's going to be somewhat open. I mean we can have some big picture. We can push for some -- some committees might have some rather specific things coming in. I think it would be useful to review some of the earlier memos that are out there for those -- particularly for those of us who are new to this committee, to get a sense of the kind of product that has come out in the past, which we don't have to reproduce a particular format.

I don't know, Bob, if you have any comments on that.

CHAIR DENARO: Yeah. I think you might have been out of the room. We discussed both that memo and the informal report that we're going to write in June. Were you here when we discussed that? Okay. So --

MR. BELCHER: I can get it off --

CHAIR DENARO: No, let me just bring you up to speed, because I think it's good for all of us to hear just to, you know, make sure we understand where we're going. We decided to do two documents. Well, three documents. One is our formal memo this year. Second one would be our formal memo at the end of next year and being October-ish or whatever. But we also focused on the NHTSA decision, saying, you know, if we feel passionate about some particular issues that we think ought to be considered by the Department in general and perhaps as input information for the NHTSA decision, then it would be good to get information there.

The problem we ran into is our ability to have a meaty discussion or recommendations, if you will, or activities in the next few weeks. You know, we've got pretty much everything we have right now. So we didn't feel capable of getting too far for this formal memo, so what we decided was -- and we checked with the formalities of whether this is possible

-- we can do kind of an interim report, if you will, that will not go through the formal vetting process next June, roughly, we said, which would be a good timing for impact on the NHTSA decision potentially, maybe a little earlier than that. And that would not be official recommendations, which requires a vetting process and everything else. It would be, say, a description of our activities, some of our thoughts, and so forth, that we think should be considered. So we've got these two documents that we're talking about.

So, backing up, then, this document -- I agree with Hans that we really haven't decided yet whether this document will be kind of what you just said, Scott, of here's where we are and we'll get back to you later on with recommendations at a little more high level, or whether we're ready with some specific recommendation. There might be some level, high level, but there -- maybe there's a few recommendations that we feel good about documenting right now. We have the latitude

to go in either extreme, and we really haven't decided that yet. So that's the current process.

MR. BELCHER: John, what would be the most helpful for the Department?

MR. AUGUSTINE: We talked a little bit about this before the break. I don't want to overly constrain the committee, so I appreciate the -- you know, asking for what's helpful to us, but you really have the flexibility to provide input in many different ways at many different times. We'll take informal, we'll take one on one, and we'll take formal committee recommendations. I think that the biggest help is to know that the internal DOT staff, for anything related to the 2013 decision, has to be done, as Brian indicated -- prior would be helpful to August, but by this time next year the internal teams will be going up through the DOT political leadership, all sort of our thoughts, recommendations, for senior approval, and we're going to recommend to the global leadership.

So things that are introduced in September, even, October, we won't have the chance to then coordinate it, bounce it off, and then continue on the process. It'll be too late. So things with the 2013 recommendation should be given to us in the summer, and then anything for longer term, gaps in our program, readjustments, new issues, things that we should stop doing, all of those future issues that are not associated with 2013, you can give those to us whenever. We can build that into the, you know, sort of future direction. Is that helpful?

CHAIR DENARO: And that was the basis on which we formed that sequence of three documents I was talking about. Does that make sense to you, Scott?

VICE-CHAIR KLEIN: All right. We've got two more items on the agenda. One is the, well, discussion of the interim advice memorandum. So that, we kind of --

CHAIR DENARO: Right.

VICE-CHAIR KLEIN: -- already

talked on that.

CHAIR DENARO: Right.

VICE-CHAIR KLEIN: And then the summary and wrap-up. Do you want to talk more about the interim advice memo?

CHAIR DENARO: Yes, I do.

VICE-CHAIR KLEIN: Okay, good. One question. Do we want to take a quick break, pit stop break for five minutes? Or people can do that as the discussion goes on.

(No response.)

VICE-CHAIR KLEIN: Continue, continue? Okay. We'll continue. Go ahead.

2012 INTERIM ADVICE MEMORANDUM DISCUSSION

CHAIR DENARO: Okay. Yeah, and I realize energy level's getting low. Okay. It's that time of the day, but as much as we can, I would like to really frame this interim memo for December that we've got to put out there, and so I threw out my opinions and what I heard in terms of the range. We can be everywhere from high level to we can have a few

recommendations. Subcommittees have now gone off and had a little bit of discussion. Now you've come back.

So I'm open to suggestions at this point on what we should have in the interim memo, the December memo. Your suggestions should be, in general, about whether it's high level or more detailed, and then, as much as possible, I'd like to get to specifics. I'd like to have people offer up specific issues that we should have in there, and let's start getting a list and see where it is, because, frankly, practically speaking we're going to walk out of here in two hours, and you know as well as I do that your attention on this program is going to be greatly diminished. So this is the most productive time we have right now, other than a phone call meeting, which we'll have, and some extra work. But it really would behoove us to use this time right now as much as possible.

So, I'm open. Kirk.

MR. STEUDLE: Bob, this is Kirk. From the communications group, we've got -- we

gave kind of three immediate things that we think need to be in there.

CHAIR DENARO: Okay.

MR. STEUDLE: I would suggest that this memo should stay high level enough. I would suggest we don't get way in the weeds; --

CHAIR DENARO: Yep.

MR. STEUDLE: -- that, frankly, we may be telling them to do something that maybe we don't have enough information to know what they're already doing.

CHAIR DENARO: Right.

MR. STEUDLE: So we've suggested that we suggest that between now and the NHTSA decision, that they engage some professional communications assistance to develop an over-arching strategy, and specifically targeted towards the short term between now and the NHTSA decision on what communications need to happen right now for it and right after.

MR. BELCHER: I would agree. I would agree with you, Kirk. I think the other

part of it is, you're right, we're not going to get back together, and especially when you get into the technical side, the security side, I don't know what the hell you're talking about and I'm not going to understand it on a conference call.

MR. STEUDLE: We don't need --

MR. BELCHER: So I think this has got to be pretty high level. I mean from the Standards committee we've got two or three things like at the level that Kirk would do. A little bit of motherhood and apple pie, but does add value. That I think -- you know, I think the rest of the committee could read and say -- I mean, as you said, Kirk, engage a communications specialist. Yeah, that sounds good to me. You know, I don't have to go back and think about that a lot, and I think if I've got to go back and think about it and understand it in the next month without some detail, I'm not going to be able to do that.

CHAIR DENARO: Yeah, yeah. That's practical -- practicable.

(Laughter.)

CHAIR DENARO: Any other comments, suggestions?

(No response.)

CHAIR DENARO: Everyone's agreeing with that, I think.

MR. McCORMICK: I really think we might be able to get to a position where we could talk about maybe one or two things that we don't think they should be pursuing.

CHAIR DENARO: Okay.

MR. McCORMICK: I think the ones that we addressed earlier were high enough up and fundamental enough in terms of how they work, to come back and say, I don't think this should be a problem in a driver interface, you know, or at least characterize what we think they should be doing. Because to all of us, that's just distraction. That's not really providing any value, it's not really going to change the world, and it does cost them, you know, resource dollars and time to spend on it that might be able to be applied to something else. So, I

don't know that the report necessarily needs to be devoid of one of those, "It's obvious you ought to stop this right now," if we could come to that conclusion.

CHAIR DENARO: My only concern about that would be, you know, cherry picking --

MR. McCORMICK: Yeah.

CHAIR DENARO: -- cherry picking a couple of things that randomly happen to have surfaced as opposed to a more top-down approach to everything, and I would still say, following what Kirk and Scott said, that the way we express that probably is more high level --

MR. McCORMICK: Right.

CHAIR DENARO: -- these are our discussion and decisions, as opposed to recommendation number one.

MR. McCORMICK: Agree.

CHAIR DENARO: Yeah.

MR. McCORMICK: Yeah, that's probably the better approach to just say we don't think you should be doing things that shouldn't

have any effect on it.

CHAIR DENARO: Yeah. I mean I'm not ready to outline it now and I'm willing to get back with my subcommittee, but I think there are two or three issues in Technology that we feel comfortable about that we wouldn't want to say some words about. Again, not getting into too much specifics, but these are areas of general concern that need to be handled.

What about what we've been thinking about at an even higher level? We've just gone through a day-and-a-half, and, you know, maybe I get a negative response from this, but does -- are any of you -- were any of you struck by something that I said, wow, this is an area -- or I'm surprised about this, this is an area that really needs better treatment, or this is a risk for the program? Did anything come out in the last couple of days that at a much higher level ought to be there?

I'll throw out one. I've heard a reasonable amount of debate in the last couple days about the role of public and private. I've

heard it both from JPO presenting, saying, wow, we're really thinking about this back end thing. You know, it could be -- you know, we've really got to figure out whether this is public or private, or public -- private-public, you know, partnership. And so there's some uncertainty there, which is okay at this point there. I've heard, then, from the private sector saying, we're concerned about maybe the government getting into things that they shouldn't get into in some cases.

So there's a theme that I'm kind of grabbing onto and I'm wondering -- it's hard for me to do it right now at quarter to three in the afternoon on the second day, but maybe with a few more days of thought that might gel into something that's a little higher level that we want to lob out there and say, hey, you know, we're seeing this conflict here, and this is an area that really needs to get resolved.

MR. McCORMICK: And another one is the area of policy development. I don't know that I'd heard anywhere that, you know -- I mean

you know where Valerie's touched on some of it, but the reality is that there's data, there's privacy policies, there's all sorts of policy-level activities that -- and it may not be that it's the JPO's, you know, area of purview to be in, but they certainly are going to govern this whole program and its implementation, and maybe it's that they're just not aware that this policy investigation is going on, or maybe, as I'm actually aware of in certain areas, it's being deferred, and I think that's something that, at least evidence of a concern, that we need to have some understanding of what they're looking in terms of the policy aspects, who's going to be addressing them, and whether or not they're going to go forward.

Go ahead.

MS. BRIGGS: In terms of policy, I think you hit the nail on the head earlier when you said policy goes across everything. So I think for us to provide you effective info on that, we need to know if there are some specific areas of policy in particular that you're

talking about, because there are mobility policy issues and there are policy issues with the security network and there are policy issues with, you know, NHTSA rule-making. And so I think policy as a term is very broad in general.

MR. McCORMICK: Well, I think we can narrow that down. I mean we did that in January. We had that workshop on the data and privacy policy. You can't deal with privacy without dealing with the data aspect of it. There's a number of different areas that, if you don't start down that path engaging all of the stakeholders, you know, it's going to be less than robust. Yes, sir.

MR. AUGUSTINE: And I agree with Valerie. That's helpful to be precise when you say "policy," so we know if it's privacy or security or data ownership or liability, anything, we can address those. But I think the policy discussion does bring out an interesting point for you as a committee to think about. When you're providing us with advice and recommendation, I think there's some

guidance and recommendation that's really targeted to the DOT or to NHTSA or to ITS JPO, RITA, and that's helpful. And usually when we get those recommendations, we respond or advise Congress. And Congress, you know, not to speak for them, but a lot of times they say, well, this sounds like it's handled at the departmental level, and they recommended the department do such and such, the department concurred. Great. Sounds like we've got an agreement. There's no role here.

Then there's other types of recommendation that really are designed for Congress's ears, and that's where the policy issues come in. So when we have to grapple with something that says, well, we agree with you; however, we don't have the authority to do that, that requires involvement with another department or agency, those --

MR. McCORMICK: Right. But that's still a recommendation we can make.

MR. AUGUSTINE: Sure. And so my point is to make sure the committee does sort

of wrestle with what is the recommendation that's really geared to the Department and we can take that immediately and do something with, versus the guidance that really the ultimate audience is going to be the Secretary and the two chambers of Congress --

MR. McCORMICK: Okay.

MR. AUGUSTINE: -- that are going to deal with maybe some policy issues that say, Very interesting recommendation. And actually, this committee and that committee can actually get together and do something there. We may not have much of a response other than we agree it's an issue, we agree that that's out of our purview or involves another committee, so make sure that you get --

MR. McCORMICK: Understand, but I just don't want to wait years to hear that.

MR. AUGUSTINE: You probably should gear the policy things more towards the Congressional message; what would they do with that and is it for us or for them?

MR. McCORMICK: Understand. I

just didn't want to wait 12 more months before they heard it.

MR. AUGUSTINE: Yes.

VICE-CHAIR KLEIN: Does the interim memo go as far as --

MR. McCORMICK: Yes.

VICE-CHAIR KLEIN: Who's the audience for the interim memo? It goes all the way up?

MR. AUGUSTINE: Yes, it does.

VICE-CHAIR KLEIN: Okay. So no one else is waiting for it.

MR. AUGUSTINE: Yes.

VICE-CHAIR KLEIN: By the way, Bob, I think what you said was a little bit different. I think policy is important, but we went quickly -- you were talking about roles and responsibility around this certificate registration authority. I think the term there is institutional design, and it's -- to me it came out loud and clear that that's a big, big job waiting to be addressed and, in fact, I would say it's not even the challenge of designing

this organization and the roles and responsibilities on a certain set of tasks. You're going to have to design a process to get those designers together.

It's one thing to design technology, but when you start designing roles and responsibilities, you're designing people and organizations, what they're going to do. And to do that, you have to get them in the same room quite often and hammer things out. So you might start thinking about designing a process by which the key players who might have roles and responsibilities would come together and start thinking and brainstorming and talking about how you're going to ever implement certificate registration. Certificate registration is going to be a very tough nut to crack.

MS. BRIGGS: So I would note that we are a research organization, --

VICE-CHAIR KLEIN: Yes.

MS. BRIGGS: -- not an implementing organization, and that's an important

distinction. So we work with the stakeholders on a research level and we try to answer the research questions.

VICE-CHAIR KLEIN: It might be a -- I'm a social scientist -- it's a kind of social science research question: How do you design a process to create something like that? I mean, you could look at other examples and come up with some other templates for how others have done it, or facilitate -- well, this maybe gets into implementation -- facilitate a process by which stakeholders come together and begin to design it themselves. But who would have ownership of that design challenge? Who does that?

MR. AUGUSTINE: I think that gets - this is becoming circular. I mean, this becomes a major policy question. Who is the operator and maintainer of the system and the implementation and, you know, Valerie's correct. It will not be the ITS JPO. Our small staff is not going to be involved there. You know, we can certainly help tee up, we can do

some research, we can do some thinking, we can do some pros and cons, but ultimately I think this does come under the purview of the committee to say, we believe that the federal government should have no role, have some role, or have the entire role. I mean that's your purview to make that guidance choice. That's something that will actually get to the decision-makers and they will say, interesting point. You're raising a policy issue that the committee's having trouble grappling with, and at least the committee, which has brought leadership and expertise, is recommending this approach. So that will help break the logjam or at least cause the internal discussion to go up our political chain and say, they're recommending something that, you know, we currently aren't designed to do, we may not have the authority to do, or maybe there's a good reason why we can't, and we need to come back to the committee and decision-makers and lay that argument out. But I think that is the role really where the committee could also be the tie-breaking vote

for where this ultimately goes. You will be influential in saying, we've seen what the research and the Department's looking at. We believe you should go this way or that way because of our broad perspective.

VICE-CHAIR KLEIN: I'm saying in that case we could propose a particular institutional design.

MR. AUGUSTINE: You could.

VICE-CHAIR KLEIN: But an alternative is to say, listen, we're not going to claim that we have an institutional design in mind.

MR. AUGUSTINE: You could stop short of saying --

VICE-CHAIR KLEIN: We propose that there should be a process. There should be some kind of process by which to consider alternatives, a process to consider alternatives without saying this should be the alternative or advocating one alternative or another.

MS. BRIGGS: And that is what we are

doing. I mean, that's what we see in the research that we've been doing on alternative security models. I mean, we're trying to weigh all of the options and understand their implications. So I think that's what we've been trying to do through the research, is understand, is understand the implications of alternative scenarios.

VICE-CHAIR KLEIN: To the point where the -- I mean, it's one thing to look at the different technical architectures and the approaches to the technology, and implicitly that might have an institutional effect, but to really focus in on roles, responsibilities, institutional design, I didn't quite hear that in the presentations over the last couple days. I didn't focus on institutional design. And maybe that's a policy-level process, so maybe you say to Congress they should begin to think about how to have a process.

MR. AUGUSTINE: Yes. I think there's more details that we have in our research document, and it's ongoing. You've seen a

summary of --

MS. BRIGGS: Yes.

MR. AUGUSTINE: You know, it's hard to boil down these, you know, 200-page reports into ten PowerPoint charts, but I think there's still more work to be done on that point. We're doing some of that thinking, but I guess our problem is we don't have the wherewithal, the outside role to bring all the technical details to bear. We bring our best thinking on it, coming from a transportation perspective, but these policy issues get beyond our --

VICE-CHAIR KLEIN: Well, it may be at a political level that that kind of --

MR. AUGUSTINE: Yes. Someone has to --

VICE-CHAIR KLEIN: And it's a process that occurs almost at the political level. Let me just -- maybe I'm being not disinterested. It sometimes occurs in academia, kind of a very -- the least political place you can think of. I've seen this in other places. Certainly the history with the

institutional design for the internet, it was kind of like radioactive and they kind of put it off and tried to diffuse it by making it as neutral as possible.

MR. SCHROMSKY: One thing I'm -- Bob, going back to your original question and what we've learned over these last two days, and one of the things I brought up earlier is, I'm a technology guy, a data guy. So it's all about data mining and getting information.

And thank Stephen for driving in the car. When the light bulb went off for me is: if we're really concerned about traffic safety, let's focus on traffic safety. What I found in the last two days, we lump applications, mobility, all these other things that we can do. Somebody else will do that. It might be done by this committee in judging that, but what needs to be done to all those wonderful things I saw the display, the vibrating seats, enabling that technology should really be the core focus, because we kind of glance over infrastructure. It's mentioned. We lump in

traffic, weather and all that kind of stuff. That's great. There's other mechanisms that'll be faster to market that can do that.

But what needs to happen to make what we saw in that demonstration happen in the near term; right? And I think the core things are, you know, is that frequency DSRC, the security, the certificates, and how that works? Because all you're trying to do is get data that I can get -- what I can get today from a vehicle or another device; right?

So that's the one thing I took away, is if I just focus on traffic safety and the communication from vehicle-to-vehicle, nobody's really doing that, and it's hard because it's dependent on other people participating, whereas today it's kind of independent; right?

So that was like the big take-away that I -- you know, we lump a lot of different things and how we can do it different ways, but when I really break it down, to do what I did in that drive-around for the last 30 minutes,

what needs to be done, and that should be the focus. Because I think sometimes when you're talking about application, mobility, we're kind of lumping a bunch of things in there. Because I look at traffic cams and MDTs in snowplows. We've been doing that for 15 years; right? It's been done. It goes into a CAD.

You know, I think Ron said it well. Well, the problem was nobody was sharing it; right? All the different departments, DOT, wasn't sharing with fire, EMS, police, and then, God forbid you share with the constituents; right? So -- or the citizens. So that's already there.

Just, how do you do that vehicle-to-vehicle communications? Then we've got a couple of tangents on there. All the wonderful things we could do, but then you've got to get the basic framework of how that works and how it functions. I think that would be easier for us rather than boil the ocean and try to do all these other things, if that makes sense.

CHAIR DENARO: Okay. Well, what I want to do -- and that's one of them -- is I want to write down some of these. I'm going to put to pen paper here and I want you guys to weigh in on whether this is -- I want to get down to a manageable number of issues that we want to address at this high level and say these are areas that we're going to be weighing in and are concerning us, you know, that -- and maybe the work's being done in there, but this is where we're going to go.

So, from the discussion we just had, I wrote a few things and, like I said, I'm just writing this down so you can weigh in whether you agree or not.

One that I'm hearing is the whole public-private responsibility mix, whatever, and I heard a couple of pieces of this. One is the whole back end, this question about is it wholly government, is it wholly private, is it public-private partnership, and so forth. Okay? I think we said that's a really important decision. We see JPO is struggling with that.

Probably opinions out there. You know, I don't know if we have anybody here who's really representing, say, a big system integrator who might say, "Yes, let me have that. Get out of my way." So, I don't know. But anyway, this is one area. We'll come back here in a minute and talk about these.

Second one that we certainly have been hearing is policy -- I'll call it policy development and, to Valerie's point, we need to get more specific about that, not generic. But, you know, I heard privacy, and you can help me with -- some others are there. We'll come back and flesh that out.

Another one that I don't think we discussed here just now, but I did hear this earlier and I really liked the discussion, so this is kind of one of my favorites, and that's speed of deployment, and that discussion would be, do we go strictly with the government program of deployment, if Scott's numbers are great, by 2025? Or are we really going to push for incentivizing the private sector to get going?

We had this short discussion about, hey, if we just create the right playing field -- in fact, who was it? John, when he was here, said, just give me some ground rules here of some standards or whatever so I know that this playing field is going to be stable and we're going to go, you know. Wow. That's exciting to me. If we can figure out a way that, in fact, we make JPO and NHTSA's job easier, if we can find a way to just incentivize the private sector to take off with this. So, speed of implementation, speed of deployment.

Another one I heard, which again, this is me pulling it out of the discussions, but certainly when Valerie was talking I heard a lot of concerns about cost. Okay? That is costs of the OBE, it is cost of the data traffic, it's cost of operating the whole back end, how much of that finds its way into the vehicle and how much gets done to the consumer. You know, what does all that look like? Again, in this interim memo I don't think we have to have answers necessarily, but I might suggest that

that's one we want to pony up, saying, we're going to really give this some thought and you may see some recommendations from us next year on that.

This whole idea -- and we have a whole subcommittee on it -- of the market launch. You know, there's more to this than "if you build it, they will come." This is going to take a lot both on mitigating concerns out there about privacy and things like that, and articulating benefits, and, you know, maybe we can talk to that as well.

And I'm doing a poor job of lumping together what you said, Kirk, but I'm going to -- in general, we'll call it communications strategy, which was one of your three things, but I'm going to, you know, lump it all under there and we can maybe refine that.

And then the last one, I think, you know, the comment you were making about focus. You know, little buttons we all need to wear to say, "It's safety, stupid." Okay. It's safety, stupid. Let's get the job one done

first and focus on that and not get too distracted. The other things were important and there are some reasons why they're very necessary, but we've got precious little time to get the first thing done, and there's nothing, certainly, in this one --

What do you think? Is this the right way to go?

VICE-CHAIR KLEIN: I just want to add -- I like that list.

CHAIR DENARO: Yes.

VICE-CHAIR KLEIN: It may be here or it may not be here. Just the idea of some of the market topics coming out of our committee were about sort of local data exchanges and data markets.

CHAIR DENARO: Yes.

VICE-CHAIR KLEIN: And they aren't necessarily -- they might be outside of that focus, and yet I -- I think there was good work going on in that area.

CHAIR DENARO: Are they here? Is that --

VICE-CHAIR KLEIN: The launch doesn't refer to DSRC. It refers to the more broad --

MR. McCORMICK: Yes, but I have a problem with that. We haven't defined what the data is yet. I mean, like I said, there's proprietary data for running the vehicle, there's data about the --

VICE-CHAIR KLEIN: Well, at least the examples of what's going on in the Washington metro region and the example of the Northwest Passage, where they're both doing these kinds of things and they're both experiencing, gee, we've got data, it's valuable, we could give it away, but how? Others have data, it's valuable, how can we get it? So it's a facilitating event, so --

MR. McCORMICK: It is, but that's not coming out of this program --

VICE-CHAIR KLEIN: No, and there is work going on at the federal level.

MR. McCORMICK: -- and then this program is dealing with passenger vehicles.

So I'm just saying that I think that's premature at this point until we have a definition of what the data is and what the privacy policies at least are looking like. Talking about capturing data off of a bus that belongs to the city, or a transit vehicle or, you know, a utility vehicle that Kirk has running around the state, that's interesting, but we already do that and it's nothing that we're -- I mean, you know, it doesn't -- there's not a direct correlation to what they're talking about here.

VICE-CHAIR KLEIN: Well, we don't -- there's some of it going on. It's encountering barriers, as we spent a lot of time discussing that in our committee, and there's a role for DOT or JPO to facilitate overcoming those barriers. They're doing it. They're doing interesting work, but it seemed there were opportunities where we could offer some input there, so that seemed pretty straightforward.

MR. McCORMICK: My point is not that you understand who owns the data, as who has rights to it. If you haven't addressed that

fundamental question, that's premature to talk about how you'd use it.

VICE-CHAIR KLEIN: No, we even have some models that are operational that could be diffused.

MR. SCHROMSKY: If you look at public safety, traditionally stages, which is a function of the Department of Justice, that manages the NCIC database, that also has state and local jurisdictions and they all share collectively for the common good. So there is models. But what you're talking about -- I agree with you -- that's already been done today because that data's there; right? It just -- somebody said, oh, it makes sense that DOT talks to police because there's an accident on I-95. I might need DOT there; right? Oh, by the way, I got this data; I might want to share it with the citizens so they can --

MR. McCORMICK: That data's --

MR. SCHROMSKY: Yes, that data's owned by the state, township, whatever it may be. But Scott's point is, who owns that data

that you're getting from the vehicle is not a state --

VICE-CHAIR KLEIN: Well, this isn't totally vehicle focused, but a lot of it is that there's 50 state DOTs or however many in there. Some of them are doing it, realizing benefits. Others are trying to realize benefits. Others are unaware that there's benefits to be realized. It could be -- some of the questions are, how do you diffuse best practice? And to get 50 states to realize these benefits, there's a role for an over-arching coordinator and diffuse it.

CHAIR DENARO: So, Hans, does this -- I mean maybe "launch" is the wrong word in here.

VICE-CHAIR KLEIN: Market facilitation perhaps, or market development?

CHAIR DENARO: Okay. So could it fit under here maybe? I mean --

VICE-CHAIR KLEIN: Well, I think the point maybe they just made is that some of them are already launched and you might want

to -- I would say facilitation.

CHAIR DENARO: Yeah, Theresa.

DR. ADAMS: Yeah. Bob, I would suggest that one of the over-arching things, maybe even top of all this list, is really that whole idea about the NHTSA rule-making. I mean I think all of these things are discussions that feed into that, and that --

CHAIR DENARO: True.

DR. ADAMS: -- that is really, you know, what's one of the -- I mean that was an over-arching discussion we had here, and -- but I think the other part about it -- and all these issues feed into, you know, the realities or considerations in that rule-making. But I think the other message is that for many of us, I know Sonny an I know in our group in some of the break-outs, we all thought, particularly after those of us who got to in the demo -- and I think everybody has -- this is a good thing, and that we really think this is something that should happen, and so I'm sort of suggesting that's a layer on top of all of this --

CHAIR DENARO: Yes, I agree.

DR. ADAMS: -- many of these discussions feed into all of that.

CHAIR DENARO: I agree. We need --

DR. ADAMS: Yes.

CHAIR DENARO: -- to have some introductory material of -- that we're here to help, we're supportive, we're --

DR. ADAMS: Yes.

CHAIR DENARO: -- cheerleaders, we're really in favor, and these are some of the details of how, you know, we're working on it and so on. My proposal here -- and we're not going to flesh this whole thing out right now, but as I was sitting here thinking through this, I'm just -- I'm really strongly -- again, we're focusing on the December memo and we're going to do this other thing that's really addressing, as best we can, the NHTSA decision or we're trying to influence that decision and so forth in a later memo. We've got enough time to work on that. But I'm really trying to focus now on something we've got to do in the next

few weeks, and so I'm thinking out some things that I heard.

Now, when I go back home and read over my eight pages of notes, I might find a few more that pop out for me, but my memory was these are some of the areas. And in terms of talking at a high level about these -- and I'm about to suggest that we volunteer to write up each of these sections and share it on the listserv and get this stuff moving -- is that, you know, we can talk at a high level about the whole public-private dilemma and maybe weigh in with some considerations there or whatever. Even though we're not making recommendations at this point, we can weigh in on the policy and some specifics there, and we can weigh in on deployment. These, you know, as Scott put in, I guess, our December memo says we don't have recommendations at this point, but here's some areas that we're honing in and here are some of our thoughts about this that need to be considered. These guys don't have to respond to those thoughts, yet, you know. And since

they're not recommendations, they'll say, yes, glad you're thinking about that. But it sets up where we're going and it kind of sends -- you know, we're kind of lobbing a message over the wall to NHTSA and others that, you know, these are some areas that are going to be important to the success of this program.

So, is this the right approach? Okay, okay.

MR. LAMAGNA: I'm leaving. First of all, I want to thank you guys for letting me participate and throw peanuts from the peanut gallery. As I head back, there's one statement that struck me the most over the last two days, is when -- I don't know if this helps you or not, but it's when Scott McCormick said the system doesn't tell you whether you're safe; it only tells you whether or not you're in danger from another car. So I think we need to think about focus there. Yes, it's about safety, but this is about getting safer. There's a lot more --

CHAIR DENARO: Yes. Yes, yes.

MR. LAMAGNA: -- to reach a state of safe.

CHAIR DENARO: Good point. Sure, absolutely.

MR. ALBERT: Where do you see the impending issues that always surround institutions in that list? Much of it is focused on technology and technology deployment, but not necessarily the thing that really tends to slow that down, which is institutional arrangements.

CHAIR DENARO: Part of that's maybe in here; right?

MR. ALBERT: Right.

CHAIR DENARO: But not all of it.

MR. ALBERT: But not all of it, and I would encourage you or whoever is writing it -- and I'm not volunteering -- for that piece --

CHAIR DENARO: I think you are.

(Laughter.)

MR. ALBERT: -- is, again, the recognition that institutional issues many

times are the biggest barrier, and here we're dealing with many, many players.

MR. CRONIN: Can I offer up a --

CHAIR DENARO: And thanks for that, Steve, because -- and I do come at things from a technical standpoint. That's, you know, my curse. So, please help me with other things that I'm, you know, not as good at.

MR. CRONIN: So, one comment. On number 3, the speed of deployment --

CHAIR DENARO: Yes.

MR. CRONIN: -- it's a little unclear to me which subcommittee would sort of address that.

CHAIR DENARO: Right.

MR. CRONIN: And then -- and kind of related to that is I think that's an area that we could get a lot of valuable input from the committee on. It's one that I think that U.S. DOT would have a hard time articulating things that are out of our legislative authority. U.S. could say, we really wish we could do that. But the committee could

certainly do that.

CHAIR DENARO: Yes. Oh, absolutely, yes.

MR. McCORMICK: And it doesn't have to come from a subcommittee. It could be just like policy that comes from the collective pot.

MR. CRONIN: But I think that's an area where looking at, you know, our authorities, but then also looking at, well, if these other people can do this kind of thing or this has happened in this kind of market or these are -- is a role that, if the committee had the time to look at, I personally think would be helpful.

MR. ALBERT: I think that tends to fall under the kind of marketing group, I would think, in that you would tend to -- there's kind of the, how do you accelerate deployment and incentivize the marketing and other case studies that have happened in other industries.

DR. ADAMS: We had some of it in the Communications. We talked about some of those messages that would help to have that adoption.

CHAIR DENARO: And, frankly, this can almost be interpreted as a little bit polly-ish -- policy-ish, and therefore cross-cutting across a lot. Because I can remember -- I mean even in the Technology subcommittee we got into a little bit of this. We actually had quite a lengthy discussion about that. So, again, bringing that back to the committee. So, yes, I don't care whether this matches up and we can map these to subcommittees right now. We are the committee. We can deal with this. If some of it can be done with a subcommittee, that's fine. If we deal with it at this level, that's fine, too. But, you know, I'm just trying to get the job done here.

If people can stand up now and say, hey, I'd like to -- what I'm after here is to spread the work around a little bit. Okay? Because I have a day job also. What I'm looking for is maybe a volunteer to do a straw man. I mean to the -- we're talking a paragraph or two. Okay? If we did two paragraphs on eight

things, we'd have 16 paragraphs. You know, that's quite an interim memo. So I'm looking for volunteers. If no one wants to step up now, we can do this again through the e-mails and all of that, and I can -- I will go ahead and publish this list, which is also available for you to edit and comment on, and we can change and modify it.

MR. STEUDLE: I'll do the communications one. It'll be two or three sentences, and that's it.

CHAIR DENARO: All right.

MR. BERG: I'll do the number 3, the speed of deployment.

VICE-CHAIR KLEIN: No, market launch and facilitation.

(Simultaneous speaking.)

DR. ADAMS: Those notes are good. Yes, spread those out.

CHAIR DENARO: You know, Hans, let me just use that as an example. You had some comments. I wasn't really tracking what you were saying, so it would really be helpful for

me if you went ahead and wrote that, and then everyone could get it.

VICE-CHAIR KLEIN: Yes, yes.

CHAIR DENARO: Yes. Any others?

(No response.)

CHAIR DENARO: All right. I'm good with that for now. I don't know which ones I'll take on right yet, but it'll take another couple weeks. I'll publish an outline of this and we'll look to get straw man items in there. All right?

We said we were going to try to quit at 3:30, and we're at 12 minutes to 3:30. So I think we've got enough to talk about the last agenda item, the next meeting, and we're about done.

SUMMARY AND WRAP-UP

VICE-CHAIR KLEIN: That's right. Well, committee products from this meeting -- I think we're there. Next meeting date, location and topics. I think we have certainly enough time to address date and location. We'll just grapple with it.

DR. ADAMS: Roughly what time of the --

VICE-CHAIR KLEIN: The May and October. What are we talking? Sort of a February/March date?

CHAIR DENARO: For our face meeting? Well, we probably first should talk about a teleconference.

VICE-CHAIR KLEIN: Oh, okay. Well --

DR. ADAMS: So our next meeting is a teleconference?

CHAIR DENARO: Yes. I'm just bringing my calendar up here.

DR. ADAMS: Do we need to have something for that -- the end-of-the-year report?

VICE-CHAIR KLEIN: Yes. So we said December 1 is when the deliverable is due. That keeps things on schedule.

DR. ADAMS: And December 1?

VICE-CHAIR KLEIN: That's what -- that was what was said.

CHAIR DENARO: Yes; yes.

VICE-CHAIR KLEIN: And Thanksgiving is November 22nd. A week between --

CHAIR DENARO: Well, we've got to -- I mean the call has to be --

DR. ADAMS: We can't do anything that week in the Midwest.

CHAIR DENARO: We've got to have some time after the call, you know, to do some writing and everything. So, let's see.

MR. SCHROMSKY: The week of the 5th or week of the 12th of November?

CHAIR DENARO: Yes, yes. I'm thinking the week of the 5th. Personally, I --

DR. ADAMS: Tuesday, the 6th?

MR. BERG: Please don't pick at 9 a.m. Eastern Time.

CHAIR DENARO: That's election day.

DR. ADAMS: Oh, yeah. I'd better mark that. Okay.

VICE-CHAIR KLEIN: I mean this is

going to go out with a Google poll that we can block things out. That's not the best week, perhaps.

DR. ADAMS: So, the 13th?

VICE-CHAIR KLEIN: We could try those two weeks.

CHAIR DENARO: Why don't we just tell Stephen to look for some daytimes at the week -- both the week of the 5th and the 12th, or -- yeah, the 12th, and we'll send that out to everybody and get --

MR. GLASSCOCK: Narrow it to Tuesday, Wednesday, Thursday or those weeks? If I give you too many choices, then it's hard to get --

CHAIR DENARO: I know.

VICE-CHAIR KLEIN: I know.

MS. BRIGGS: Well, but why? I mean what's wrong with Monday or Friday?

MR. GLASSCOCK: That's not -- I'm just trying to give two weeks. If I do ten days, it may be hard to come with a --

MR. McCORMICK: The 12th is a

holiday.

MS. BRIGGS: Yes, yes. We won't do a holiday, but the other days, yes. Okay.

CHAIR DENARO: I mean --

MS. BRIGGS: It just seems to me that oftentimes people are free on Fridays. I mean that often ends up being the best day to have meetings. I'm not advocating for that. I just don't know why we're throwing it out.

CHAIR DENARO: Let's go with ten days.

MR. GLASSCOCK: Okay.

CHAIR DENARO: Yeah, let's go with all ten and try it and -- okay.

DR. ADAMS: A ten-day window?

CHAIR DENARO: Those two, yes, and he'll send out a poll for that. Yes. So that'll be a phone call and we'll get an agenda around and all of that. But we'll talk about it, but the purpose of that really will be to focus -- well, continue work on the subcommittees, but really to focus on this December memo. That's really the focus of that

meeting.

MR. WEBB: From the standpoint, okay, so we have the first teleconference. Will that just sort of like, okay, we've got it 90 percent there?

CHAIR DENARO: Yes.

MR. WEBB: Or are we then going to have to have another one to vote on it to transmit?

CHAIR DENARO: No, I don't think we need another call, but you're right. We do need to get consensus, so we'll have to do it through e-mails. But your point is exactly right. By that time -- I want to do some work via e-mails ahead of that time so we've got it 90-percent done and we're really talking about it and then refining it down.

MR. WEBB: I mean if it is that week of the 12th, the very next week is Thanksgiving.

CHAIR DENARO: Yes.

MR. WEBB: It starts --

CHAIR DENARO: Yes.

MR. WEBB: -- affecting lots of

schedules by the next weekend, too.

CHAIR DENARO: Yes, it is. Yes, yes, yes. No, good point. Yes. No, I agree. That was my intent to have it mostly written by then.

Okay. And then in terms of a face meeting, I guess it's really open about having like two or -- we really only had two this year, face meetings, but we could easily have three next year. There's nothing wrong with that. And we're going to have -- I mean we've got work to do, but certainly we're going to have a focus on this report we're writing to feed the NHTSA decision. So I'm thinking February-ish for that next face meeting. February.

MS. BRIGGS: February time frame. Back in Washington?

(Simultaneous speaking.)

MR. GLASSCOCK: -- October. So you're going to have to have how many meetings between then?

MR. AUGUSTINE: Well, I think the input would come to us before October, following

your input to us on the 2013 decision.

CHAIR DENARO: He's talking about the official memo in October, yes. So if we did February. You know, mindful of vacations and all, but in May or June, and that would be the bulk of both of those pieces of deliverables, and then if we choose to, we could have one later, but -- toward the fall to finalize. I'm not going to worry too much about those next two. Let's do the next face meeting February-ish. And, I mean, we don't have much alternative from D.C., right? I mean --

(Simultaneous speaking.)

MS. BRIGGS: Well, I mean our folks are in D.C. So if you want JPO staff to be able to review, that's where we need to do it.

CHAIR DENARO: Yes, yes.

MR. AUGUSTINE: This is somewhat of an anomaly because we have this big research pilot and you asked for all the research --

CHAIR DENARO: True.

MR. AUGUSTINE: -- information for the people that were already here, so it's easy,

but to Valerie's point, if we have to truck 20 people somewhere else -- and you don't necessarily need to have 20 people's input, but if you want the input, that's a consideration.

CHAIR DENARO: Yeah. So I would assume we'd meet in D.C. Okay.

Stephen, what else do we need? Or Valerie or John or Brian, anything else we need to -- business we need to get done here? We good?

MR. VELEZ: There'll be an amount that you will need to deduct from your travel expenses for the government-provided lunches, so that information will be coming to you.

DR. ADAMS: We don't know that number, yet?

VICE-CHAIR KLEIN: Do you know that number yet?

MR. VELEZ: Yes. I can give you that number now.

DR. ADAMS: Okay.

MR. VELEZ: Yesterday's lunch, $14.21.

DR. ADAMS: Okay. For the Wednesday lunch. Okay. And the Thursday lunch?

MR. VELEZ: And today's, $16.24.

DR. ADAMS: Okay.

MR. ALBERT: Say that again. How much?

MR. VELEZ: $16.24.

DR. ADAMS: It was good.

MR. AUGUSTINE: Before -- I don't think we have any other business -- I would just like to personally say thank you to the committee. This has been a very productive and constructive discussion. There was a lot of engagement. We feel that and we do appreciate your time. We know you're taking valuable time out of your day to be here and work with us, and so we do appreciate it. I don't know if anybody else has anything to say, but I'd like to -- before you scatter us to the winds --

CHAIR DENARO: Okay. Well, I'll just summarize a couple of the comments, and we've lost many of our members, so I'm going

to send an e-mail around here. You know, I'll say the normal meeting leader kind of thing, you know. The forming, storming, norming, performing. We're a little bit storming stage right now. Okay. We got a lot of discussion and it's going off in random directions. Don't worry about that. It'll come together, you know, over the next meeting or two. I think this process here of the first memo will help us get focused and all. So I think we're in a very normal track here and I feel perfectly good.

I agree with your statement, John -- thank you for that -- that the level of interaction has been great. I'm really pleased with that. I like the diversity of people. There's been some pretty sharp comments here in maybe some of the subcommittee areas, a few rebukes here and there. You know what? That's part of the story. That's okay. And I do not want to discourage people from speaking their mind. You know, almost everyone spoke their mind here. Maybe, you know, sit back and say,

wow, he had a good point, you know. And so it's extremely valuable to me to hear that and, I think, for all of us.

So, also, you have my thanks for your time. And the last thing I will say is you have a homework assignment and you will get that in capital letters, and that homework assignment, no excuses, is to go read the previous memos and understand what's in there. I don't want to repeat history. So, we've dealt with it before. Maybe there's a new -- a follow-on piece of that, but let's go back and read those past memos, me included. Hans.

VICE-CHAIR KLEIN: My comments? I thought the presentations over the last two days were uniformly extremely high quality. I mean every single presentation here I've benefited from very significantly. So I would like to really give my thanks to everyone here from JPO and everyone from the pilot study, and the committee members, too, for a really interesting discussion. I found this a really good use of two days and I've been grateful for that.

CHAIR DENARO: Yes. Good. Thank you.

(Applause.)

DR. ADAMS: A very nice job.

CHAIR DENARO: Thanks for saying that. Yes. All right. We are adjourned, folks. Thank you.

DAY 2 ADJOURNMENT

(Whereupon, the foregoing matter was concluded at 3:29 p.m.)