IntelliDrive^{SM} **Mobility**

Data Capture and Management
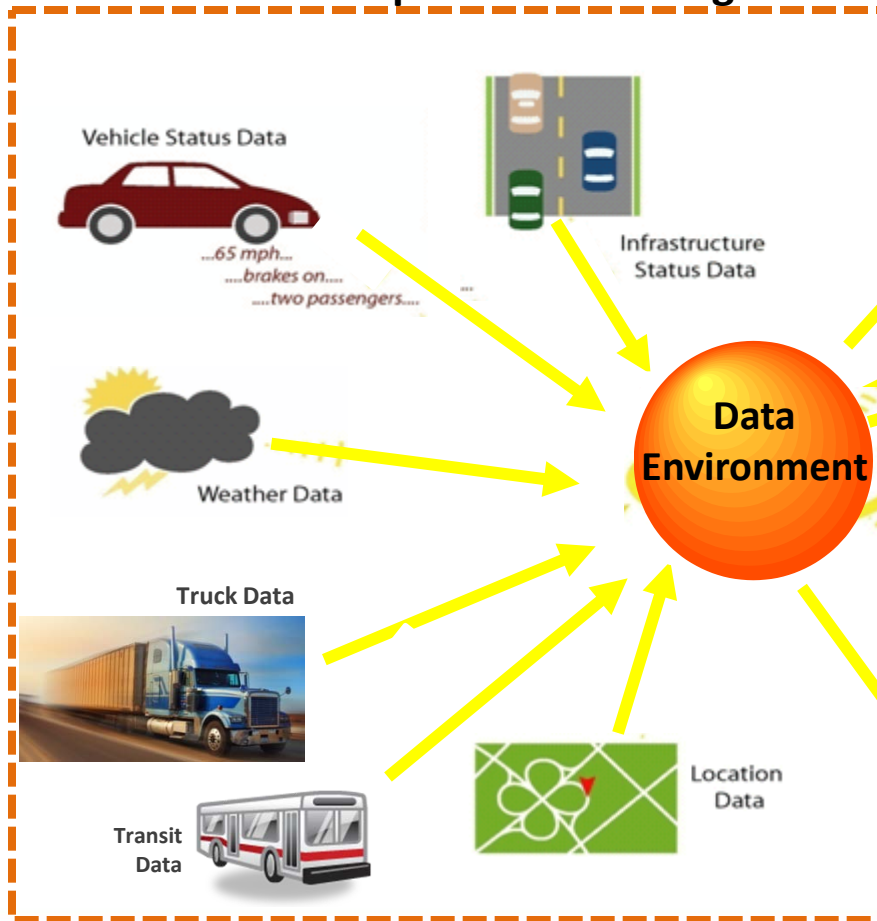
Gene McHale, FHWA Office of Operations R&D

TRB ITS Committee Midyear Meeting

Irvine, California
September 21, 2010

- Vision of Data Environments

- Key Issues

- Prototype Data Environment

- Sample Research Questions

- Future activities

U. S. Department of Transportation
Research and Innovative Technology Administration

IntelliDrive^{SM} Mobility

Real-time Data Capture and Management

Mobility and Environmental Applications

Vehicle Status Data
...65 mph...
....brakes on....
....two passengers....

Infrastructure Status Data

Weather Data

Truck Data

Transit Data

Location Data

Data Environment

Reduce Speed 35 MPH

Weather Application

Transit Signal Priority

Real-Time Travel Info

Fleet Management/ Dynamic Route Guidance

Signal Phase & Timing Adjusts Real-Time Conditions

Safety Alerts and Warnings

U. S. Department of Transportation
Research and Innovative Technology Administration

Data environment:

- well-organized collection of data of specific type and quality
- captured and stored at regular intervals from one or more sources
- systematically shared in support of one or more applications

Data Capture

Data Environment

Information

Raw Data

Application
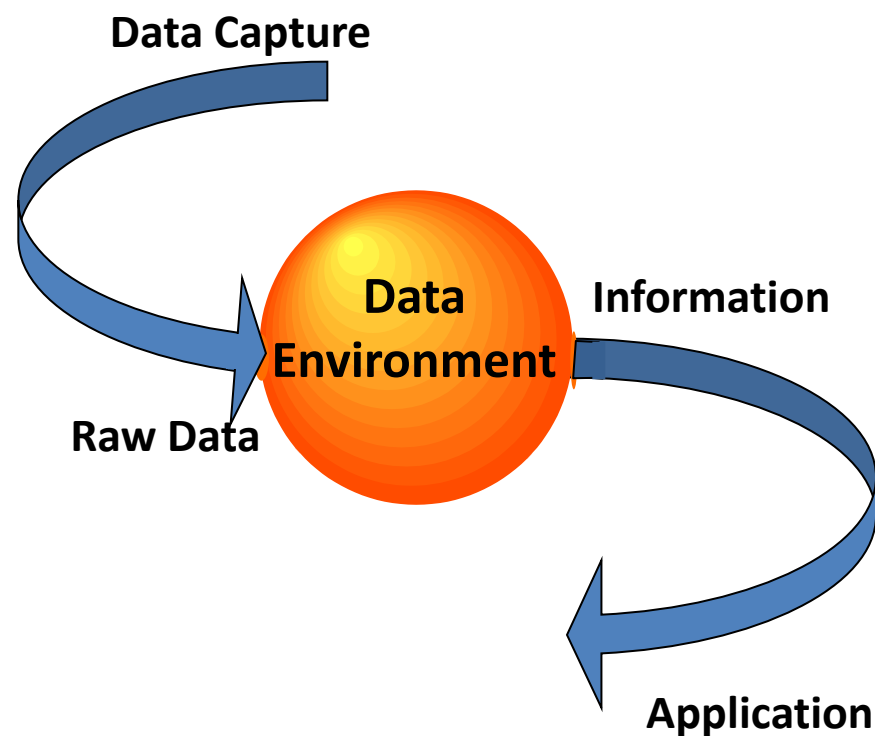
Elements of Data Capture and Management

- **Meta data**:
  - Provision of well-documented data environment

- **Virtual warehousing**:
  - Supports access to data environment and forum for collaboration

- **History/context**:
  - Objectives of data assembly

- **Governance**:
  - Rules under which data environment can be accessed and procedures for resolving disputes
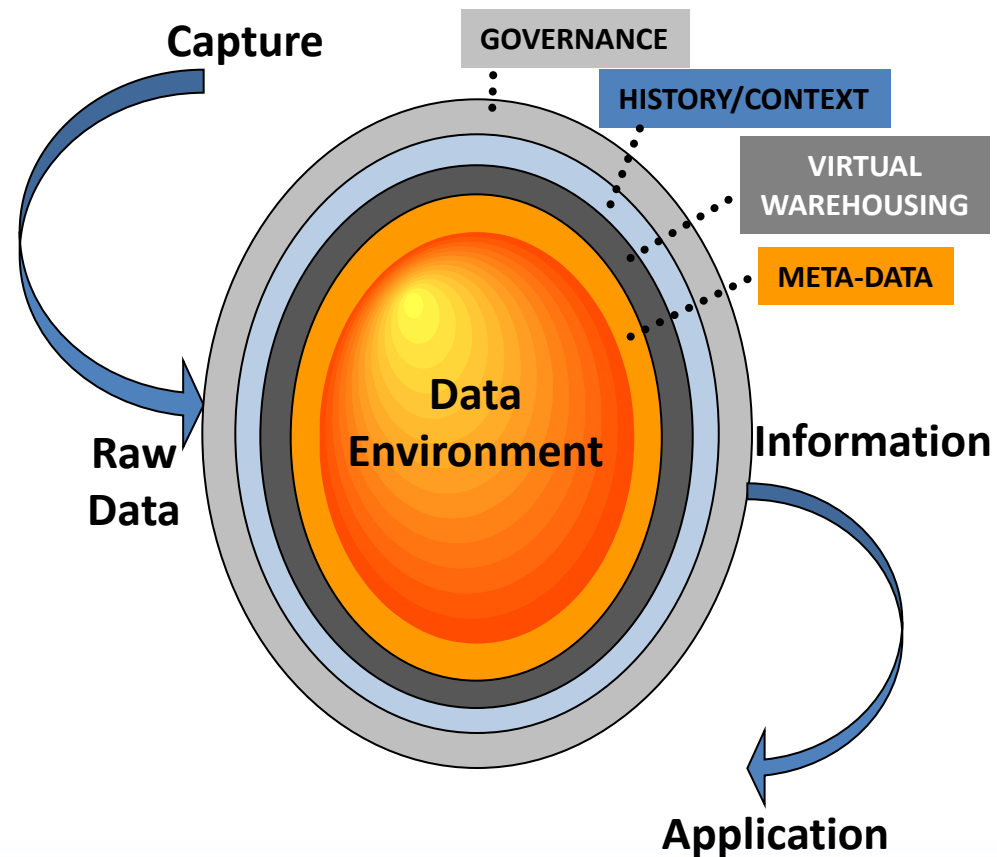
- *Intellectual property rights*

- *Privacy*

- *Governance*

- *Standards and Regulation*

- *Meta-Data*

- *Quality Assurance*

- *Storage*

- *Access and Security*

- *Operations and Maintenance*

Data Capture Prototype Data Environment

- https://datacapture.noblis.org/

- Data (and meta-data) from the Michigan IntelliDrive Test Bed
    - Documented probe data samples from recent tests (POC/NCAR)

- Trajectory Conversion Analysis (TCA) program

- Simulated 100% market penetration data for the test bed contributed by the University of Michigan Transportation Research Institute (UMTRI)

- Forums for researchers to register projects, flag erroneous data, contribute analyses and data views

Log Files from Onboard Equipment (OBE)

← Raw (Detailed) Log File

Trajectory Extract

```
1219244661807    Wed, 20 Aug 2008 15:04:21 GMT    B420    CommManagerOBE#1.14.2#34        34
1219244661807    Wed, 20 Aug 2008 15:04:21 GMT    B420    CommManagerOBE#1.14.2#34        34
1219244661820    Wed, 20 Aug 2008 15:04:21 GMT    B420    CommManagerOBE#1.14.2#34        34
1219244661820    Wed, 20 Aug 2008 15:04:21 GMT    B420    CommManagerOBE#1.14.2#34        34
1219244661826    Wed, 20 Aug 2008 15:04:21 GMT    B420    com.vii.delphi.probedata#4.6.2  45
1219244661827    Wed, 20 Aug 2008 15:04:21 GMT    B420    CommManagerOBE#1.14.2#34        34
1219244661835    Wed, 20 Aug 2008 15:04:21 GMT    B420    com.vii.delphi.probedata#4.6.2  45
1219244661842    Wed, 20 Aug 2008 15:04:21 GMT    B420    com.vii.delphi.probedata#4.6.2  45
1219244661898    Wed, 20 Aug 2008 15:04:21 GMT    B420    CommManagerOBE#1.14.2#34        34
1219244661944    Wed, 20 Aug 2008 15:04:21 GMT    B420    com.vii.delphi.probedata#4.6.2  45
1219244661965    Wed, 20 Aug 2008 15:04:21 GMT    B420    com.vii.delphi.probedata#4.6.2  45
,27,"Periodic",1219244648265,1219244661697,0,1219244661847,"2001:1890:110e:ba27:0000:0000:00
   thePosition {
     utcTime {
       year 2008,
       month 8,
       day 20,
       hour 15,
       minute 4,
       second 8
     },
     longitude -667487552,
     lat 339555236,
     elevation 3605,
     heading 55897,
     speed 1800,
     timeConfidence notEquipped
```

1	OBE ID	logfile	line	date	time	secs	speed (	long	lat	x-ft	y-ft
112427	B450	1	29190	8/25/2008	19:05:51	11883	63.3	-83.4321	42.48429	-22529649	15482951
112428	B450	1	29221	8/25/2008	19:05:52	11884	63.1	-83.4322	42.48404	-22529668	15482859
112429	B450	1	29256	8/25/2008	19:05:53	11885	62.9	-83.4322	42.48378	-22529684	15482766
112430	B450	1	29257	8/25/2008	19:05:54	11886	62.9	-83.4322	42.48353	-22529696	15482674
112431	B450	1	29262	8/25/2008	19:05:55	11887	62.6	-83.4322	42.48328	-22529704	15482582
112432	B450	1	29266	8/25/2008	19:05:56	11888	62.6	-83.4322	42.48302	-22529710	15482489
112433	B450	1	29267	8/25/2008	19:05:57	11889	62.6	-83.4322	42.48277	-22529716	15482397
112434	B450	1	29293	8/25/2008	19:05:58	11890	62.6	-83.4322	42.48252	-22529721	15482306
112435	B450	1	29294	8/25/2008	19:05:59	11891	62.4	-83.4321	42.48227	-22529728	15482214
112436	B450	1	29295	8/25/2008	19:06:00	11892	61.1	-83.4321	42.48202	-22529734	15482124
112437	B450	1	29296	8/25/2008	19:06:01	11893	58.4	-83.4321	42.48178	-22529742	15482036
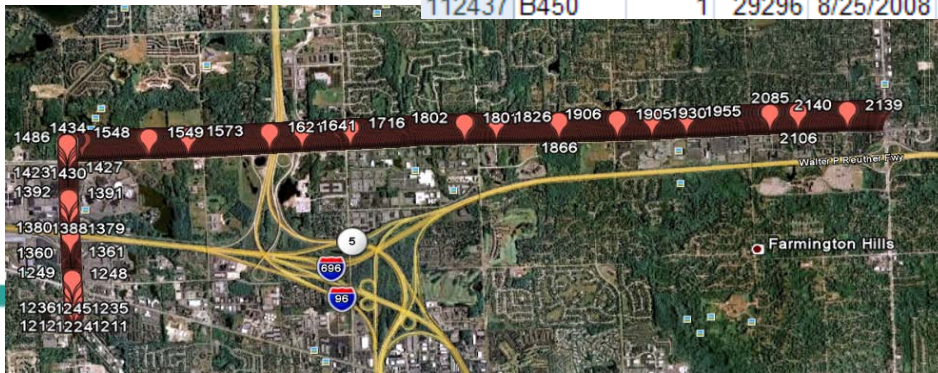
← Trajectory Plot with Google Earth using

Also: extracts of snapshots in log file and RSE interaction events

IntelliDrive

```xml
<probeVehicleData>
 <msgID><probeVehicleData/></msgID>
 <startVector>
  <utcTime>
   <year>2008</year>
   <month>8</month>
   <day>28</day>
   <hour>14</hour>
   <minute>54</minute>
   <second>50</second>
  </utcTime>
  <longitude>-667453355</longitude>
  <lat>339646020</lat>
```

← XML Format (J2735 standard)

Parsed, spreadsheet format ↓

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
1	RSE#	date	file_name	date	time	SS#	serial#	lat	long	elevation	heading	speed	cntVSDTs	psn	lights	brake_st	brake_boost	abs
172	34	8/21/2008	14.28.28.00	8/21/2008	14:20:51	2	B422	339555826	-667488866	3649	5646	0	15	27337	NULL	NULL	notEquipped	notEquipp
173	34	8/21/2008	14.28.28.00	8/21/2008	14:21:06	1	B422	339555826	-667488866	3649	5646	0	15	27337	NULL	NULL	notEquipped	notEquipp
174	34	8/21/2008	14.28.28.00	8/21/2008	14:28:27	0	B422	339528960	-667484052	102491	38306	0	NULL	NULL	NULL	NULL	NULL	NULL
175	34	8/21/2008	14.28.40.00	8/21/2008	14:28:36	1	B422	339518706	-667489306	3482	34189	0	15	27337	NULL	NULL	notEquipped	notEquipp
176	34	8/21/2008	14.28.40.00	8/21/2008	14:28:37	0	B422	339517732	-667489452	102485	34098	0	NULL	NULL	NULL	NULL	NULL	NULL
177	34	8/21/2008	14.28.56.00	8/21/2008	14:27:35	4	B450	339555898	-667492440	3675	489	0	13	26754	NULL	NULL	notEquipped	on
178	34	8/21/2008	14.28.56.00	8/21/2008	14:27:50	3	B450	339555490	-667492340	3611	63120	82	13	26754	NULL	1111	notEquipped	on
179	34	8/21/2008	14.28.56.00	8/21/2008	14:28:05	2	B450	339557281	-667492733	3617	8160	429	13	26754	NULL	NULL	notEquipped	on
180	34	8/21/2008	14.28.56.00	8/21/2008	14:28:06	1	B450	339557446	-667492360	3614	11550	550	13	26754	NULL	NULL	notEquipped	on
181	34	8/21/2008	14.28.56.00	8/21/2008	14:28:53	0	B450	339534751	-667479633	102457	38455	0	NULL	NULL	NULL	NULL	NULL	NULL
182	34	8/21/2008	14.28.56.00	8/21/2008	14:26:35	4	B450	339555787	-667492510	3593	489	0	13	26754	NULL	NULL	notEquipped	on
183	34	8/21/2008	14.28.56.00	8/21/2008	14:26:50	3	B450	339555992	-667492568	3641	489	0	13	26754	NULL	NULL	notEquipped	on

- Open Source Python program
- Inputs
  - Vehicle Trajectory Files (Actual or Simulated)
  - RSE locations and range
  - Parameters for snapshot generation & transmission
- Outputs
  - Snapshots generated and transmitted to RSEs
  - Snapshots discarded for buffer overflow or RSE gap
  - Probe segment number changes

IntelliDrive

- 189 Origin/Destinations
- Models 6 AM – 11 AM
- 10,000 concurrent vehicles
- RSE interactions modeled
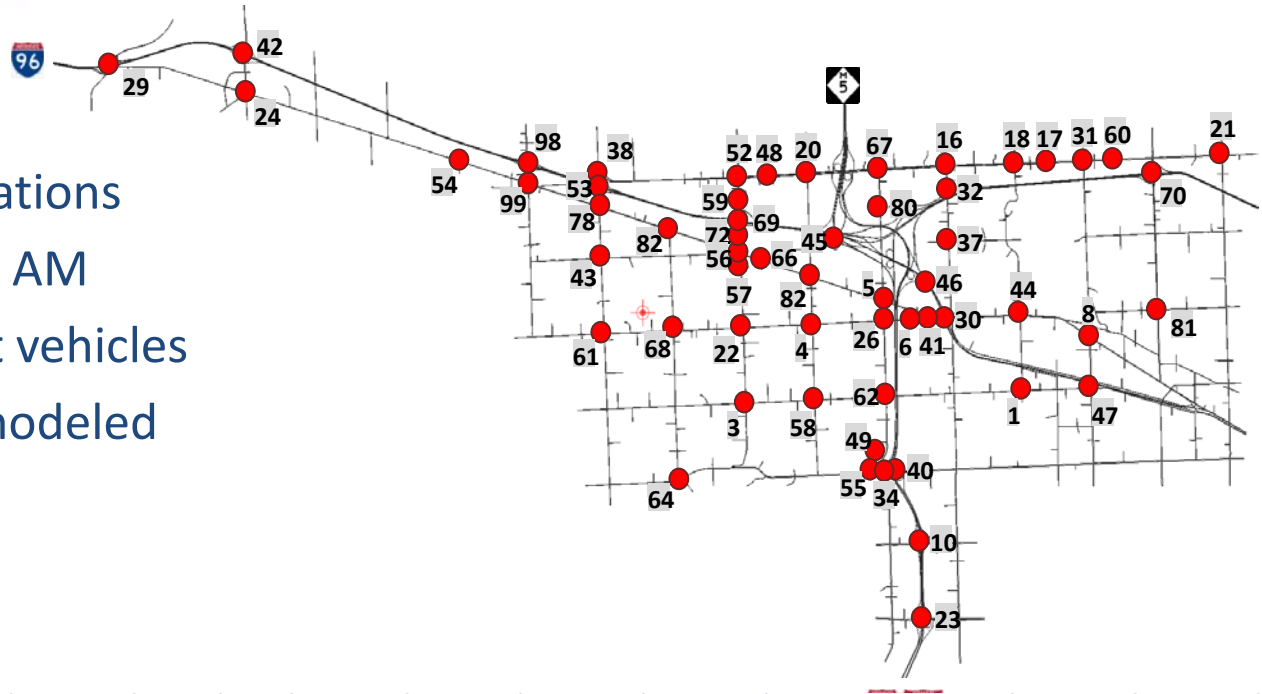
UMTRI Paramics IntelliDrive Simulator
RSE-specific snapshots output
Simulation executed with Paramics version 6.60

Year	Month	Day	Hour	Min	Sec	Time	RSE_Nam	VehID	Type	PSN	SnapYear	Snaptime	Long	Lat	XPos	YPos	ZPos
-	-	-	h	min	s	s	-	-	-	-	-	s	-	-	m	m	m
2010	6	17	6	0	0.6	21600.6	RSE 26	32518	1	3932749	2010	21511.5	-83.4308	42.45356	-22304.1	6921.34	260.06
2010	6	17	6	0	0.6	21600.6	RSE 26	32518	1	3932749	2010	21521.5	-83.4309	42.45504	-22302.2	7084.76	260.23
2010	6	17	6	0	0.6	21600.6	RSE 26	32518	1	6775253	2010	21543.5	-83.4309	42.45799	-22298.5	7412.9	260.57
2010	6	17	6	0	0.6	21600.6	RSE 26	32518	1	6775253	2010	21547.5	-83.4309	42.45824	-22298.2	7440.58	260.59
2010	6	17	6	0	0.6	21600.6	RSE 26	32518	1	6775253	2010	21551.5	-83.4309	42.45851	-22297.9	7469.95	260.62
2010	6	17	6	0	0.6	21600.6	RSE 26	32518	1	6775253	2010	21555.5	-83.4309	42.45885	-22297.5	7507.71	260.66

Data Capture & Management Portal

- Prototype Data Environment: IntelliDrive Michigan Test Bed
  - Sample
  - POC
  - NCAR 2009
  - NCAR 2010
  - All Data
- Submit Project
- Projects
- Forums
- Members
- Website Links
- Create content
- Recent posts
- My account
- Log out

Administrator

- Projects Pending Approval

Search

Home › POC Data Files

POC Data Files

The first major set of trials conducted at the DTE was the Proof of Concept (POC)[i] trials during 2008. The POC trials featured fifty-two RSEs within 45 square miles, 27 vehicles configured with OBEs, and a Dedicated Short-Range Communications (DSRC) network. The testing program had three major phases: subsystem test, system integration and test, and public and private applications test. The public application testing portion of the POC trials were conducted during August 2008. RSE data for the public application tests were available for eight days in August 2008. The data in this prototype data environment consists of RSE and OBE data for the middle six of these days. These six days were chosen for inclusion in the data environment because the first and last days had much higher number of duplicate records and questionable data values.

Please select a file type or IntelliDrive type to filter the list.

File Type
Processed ▾

IntelliDrive Type
OBE ▾

[Apply]

Data File Group	Type	Download Files
Nodes and Links in Trajectory File	Meta	📄 Description of Nodes and Link used in OBE Trajectory Files 📄 Nodes and Link Map
OBE File Documentation	Documentation	📄 Documentation of OBE log files and Three Files Derived from them 📄 Documentation of fields in the derived OBE Event files 📄 Documentation of fields in the derived OBE Snapshot files 📄 Documentation of fields in the derived OBE Trajectory files
OBE ID Information	Meta	📄 OBE IDs used for the POC and NCAR 2009 Trials 📄 OBE IDs used for the POC, NCAR 2009 and 2010Trials
		📄 Paramics IntelliDrive Simulator Description

- At what distance are the messages being transmitted to RSEs? Is the distribution of distances normal or uniform or constant or something else?

- What percentage of the snapshots appearing in the OBE log files also appear in the RSE files (i.e. were transmitted successfully)? Does the percentage vary substantially by vehicle?

- When transmission is unsuccessful, does the OBE attempt to send the same set of snapshots later? Does it keep trying until the transmission is successful?

- How often did buffer overflow occur in the OBEs and under what conditions?

- Use of the trajectory data to validate the speed from the snapshots

- Can the snapshots be used to estimate travel time on arterials and queuing statistics at signalized intersections?

- Are reported speeds consistent with link/locations?

- Are reported speeds consistent between different vehicles on the same link?

- Can an algorithm be developed to calculate the speed or travel time of a road section?

- What sort of "filters" would it make sense to have for access to selected subsets of RSE data?

- If all this data collected by RSEs is added to the data environment, how much space will be needed per probe vehicle on a daily basis?

- How would POC or NCAR trial snapshots have looked running the default snapshot generation process?

- The periodic snapshots are generated based on the speed of the vehicle. If we generated the periodic snapshot more or less frequently what would be the resulting change in snapshot content?

- What would be the effect in terms of snapshots received of changing the policy for PSID changes, and PSID "gaps" that prohibited the vehicles from sending to the same RSE more than once with the same PSID?

Paramics Simulation Data Sample Research Questions

- Look closely at stop/ start snapshots for single intersections; can they tell us about queue lengths and intersection overload?

- Are the ratios of messages received at various RSEs similar to the ratios for the actual Michigan location?

- Are the modeled speeds for a link close to the actual reported speeds?

- What is the effect of various market penetrations on the ability to extract useful traffic information from the snapshot data?

- At what market penetration (if any) does it become impossible to identify two sets of data labeled with different PSNs as coming from the same vehicle?

Future Activities

- Investigations into state-of-the-practice for technologies, institutional and policy, and standards
- Broad Agency Announcement (BAA) for Test Data Sets
- Acquisition and hosting of IntelliDrive funded data, such as
  - Near term performance measures demo
  - Safety Pilot
  - Mobility Application Demos
  - IntelliDrive Test Bed
- Development of data environments to support Mobility applications