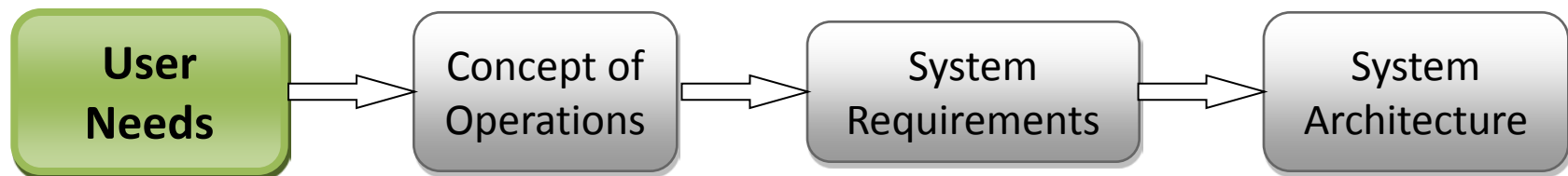


# IntelliDrive<sup>SM</sup> System Engineering User Needs Workshop



# Agenda

- Introductions & Logistics
- IntelliDrive System Engineering
- System Engineering
- Vehicle Infrastructure Integration (VII)
- IntelliDrive Program
- User Needs Overview / Examples
- User Needs Break-Out #1 / Discussion
- User Needs Break-Out #2 / Discussion
- Wrap Up

# Introductions

- IntelliDrive SE Team
- Participating Organizations:
  - State/Local Transportation Agency
  - Public Safety/ Emergency Services
  - Automotive/Vehicle equipment developer
  - Traveler Information Service Provider
  - Academic / Research organization
  - Networking / Telecommunications Provider
  - Transportation Device Manufacturer
  - System Integrators
  - Transit communities
  - Rail communities
  - Automotive OEM
  - Traffic system operators
  - Commercial vehicle operations
  - Tolling agencies
  - Aftermarket broadcast device vendors
  - Aftermarket auto-maker/retrofit device vendors
  - Aftermarket & Carry-in Device Vendors
  - Data Aggregators
  - Others

# Logistics

- Main Room
- Breakout Rooms
- Restrooms
- Safety Issues

# INTELLIDRIVE SYSTEM ENGINEERING (SE)

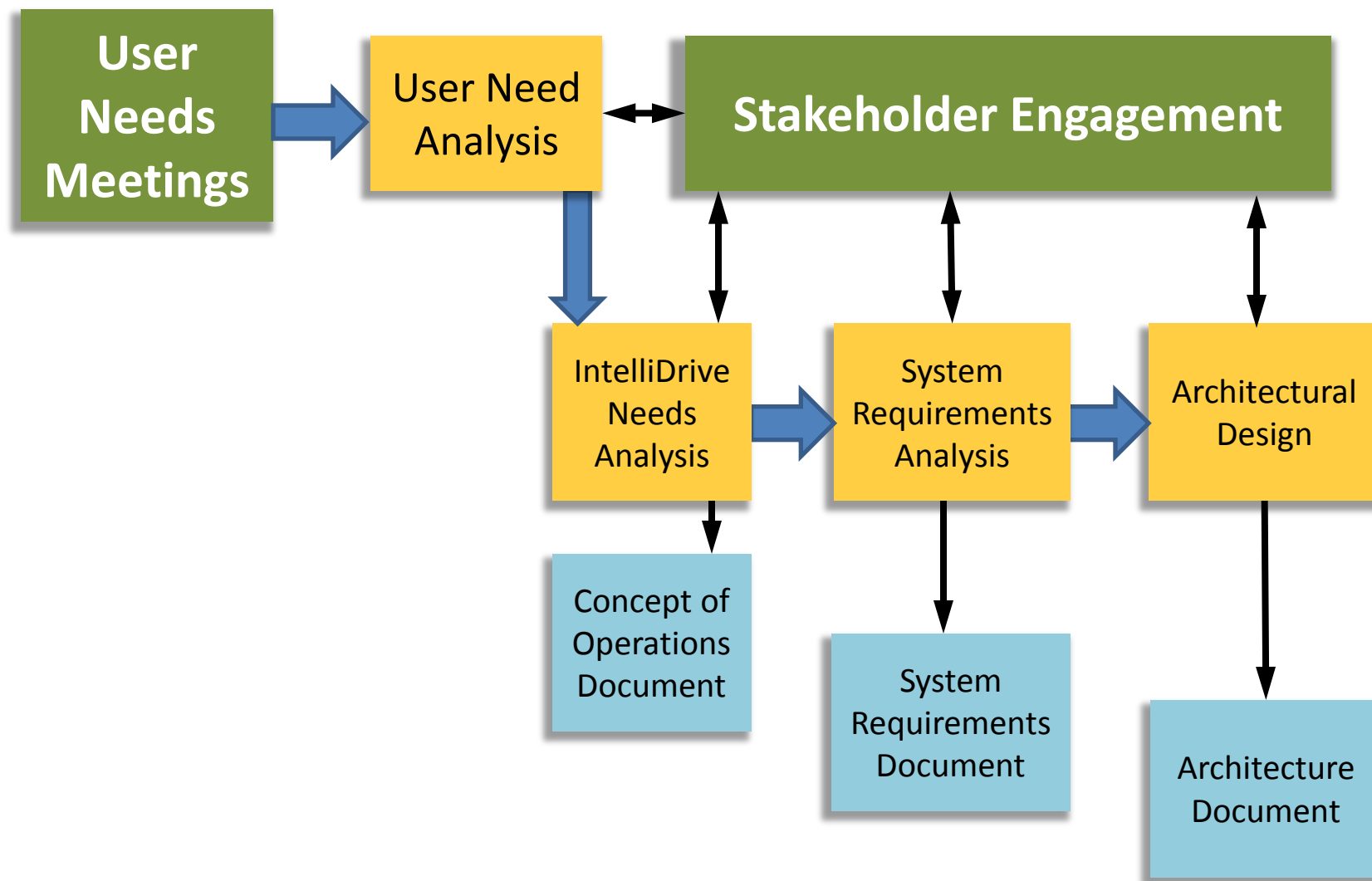
# IntelliDrive SE Program

- Revisit and update the IntelliDrive concept of operations, requirements, and architecture
- Existing documentation and lessons learned will be used as a resource
- Focus on the Core, Enabling System necessary to form the basis for the safety, mobility, environmental applications
- The first step in this process is to elicit User Needs from you.

# IntelliDrive SE Program (cont.)

- Provide the technical foundation for future activities
  - next generation of field tests
  - initial and ongoing deployments
  - continued research as the core technologies and program evolve

# IntelliDrive SE Process





# SYSTEMS ENGINEERING

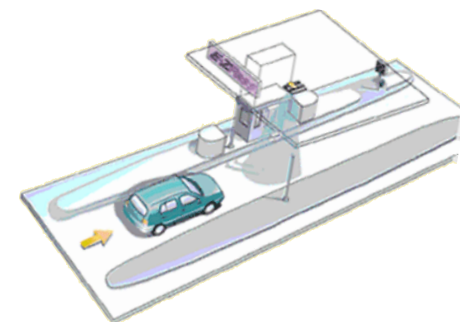
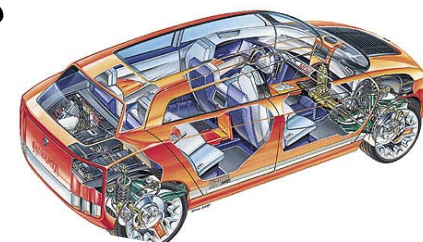
# What is a System?

“A combination of interacting elements organized to achieve one or more stated purposes.”

International Council of Systems Engineering

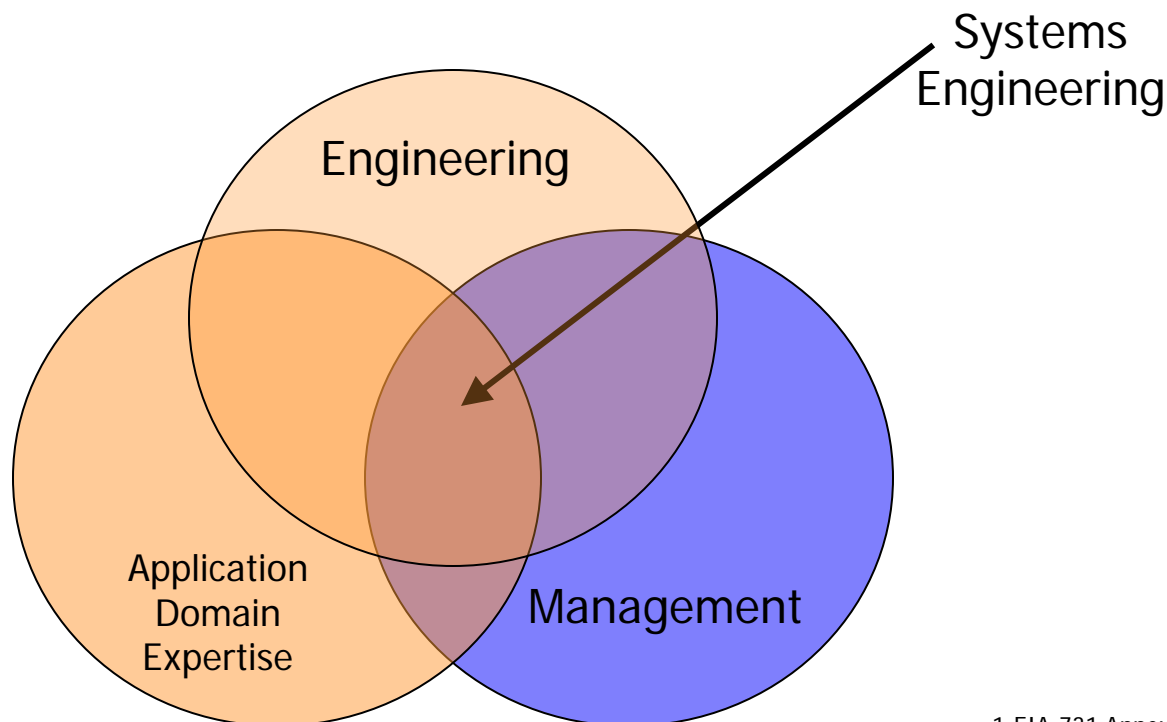
“An aggregation of end products and enabling products to achieve a given purpose”

Electronics Industry Association EIA-632



# What is Systems Engineering?

An **inter-disciplinary approach** and means to enable the realization of successful systems.<sup>1</sup>



# Systems Engineering (cont.)

- Focuses on:
  - Defining customer needs and required functionality early in the development cycle
  - Documenting requirements
  - Then proceeding with design, implementation, and system validation while considering the complete problem

# Systems Engineering Principles

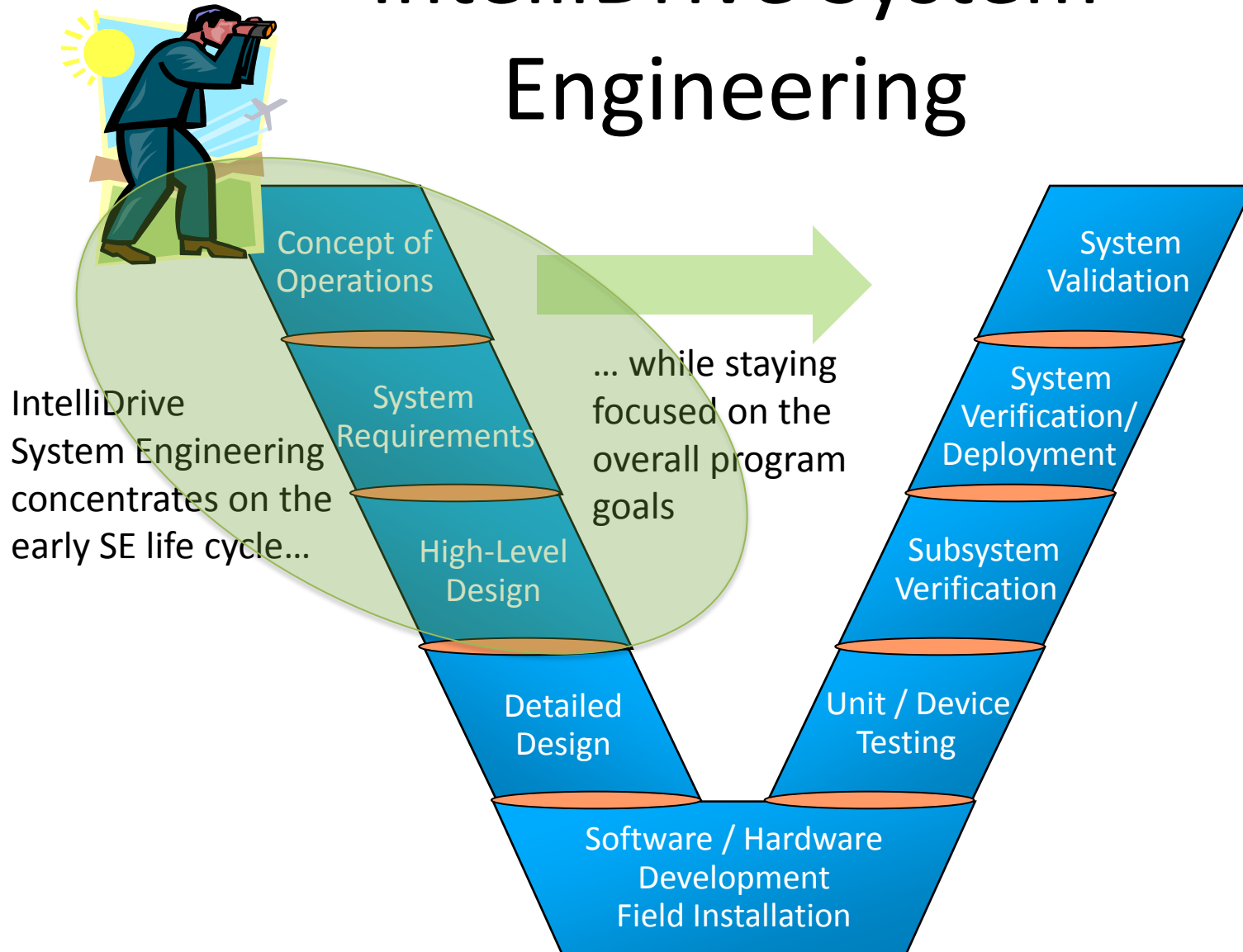
- Start with Your Eye on the Finish Line
- Stakeholder Involvement is Key
- Define the Problem before Implementing the Solution
- Delay Technology Choices



# Benefits of Using SE

- Reduced risk of schedule and cost overruns
- Increased likelihood that implementation will meet users' needs
- Improved stakeholder participation
- Verified functionality and fewer defects
- Better documentation
- More adaptable and resilient systems
  - Extensibility, scalability, robustness

# IntelliDrive System Engineering



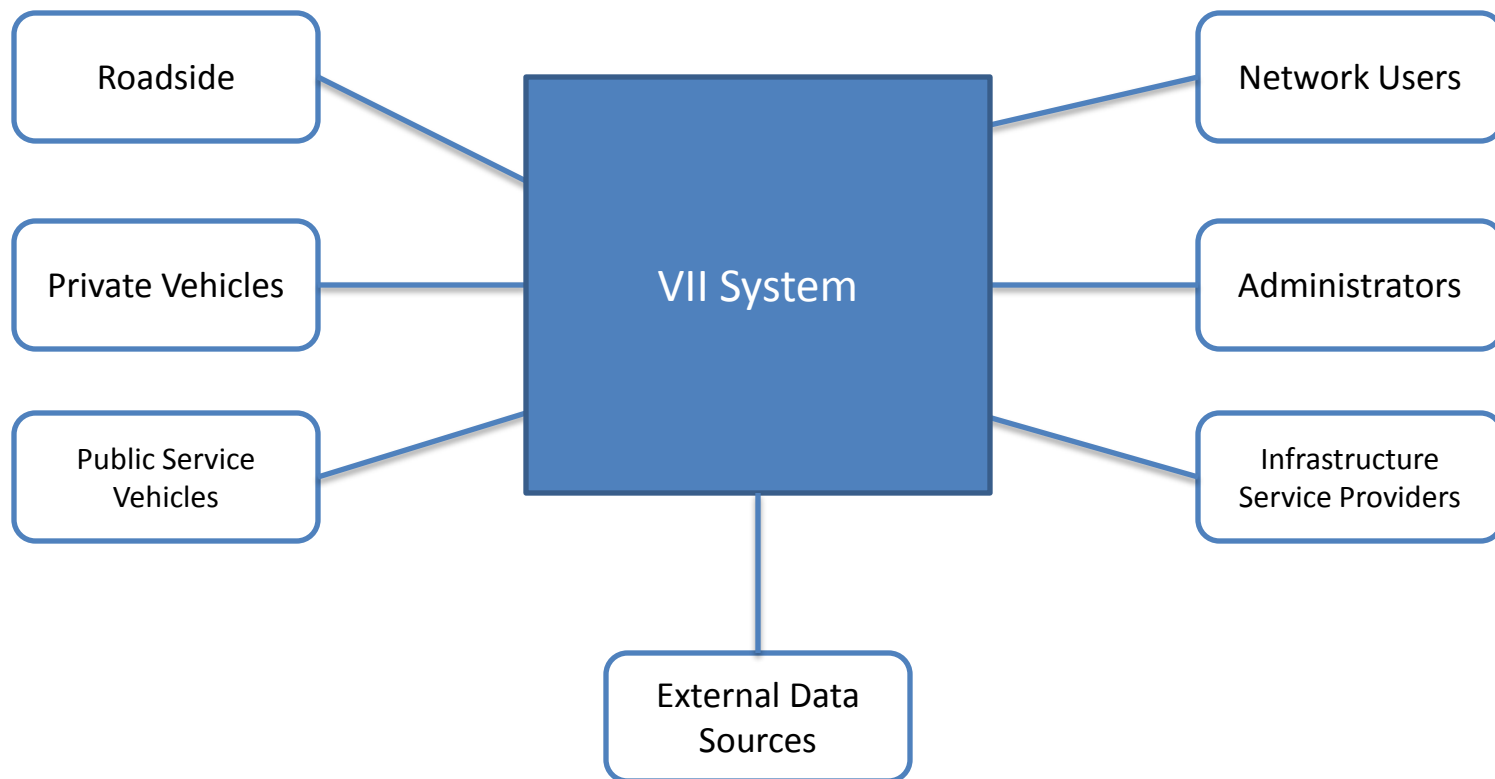
# VEHICLE INFRASTRUCTURE INTEGRATION (VII)



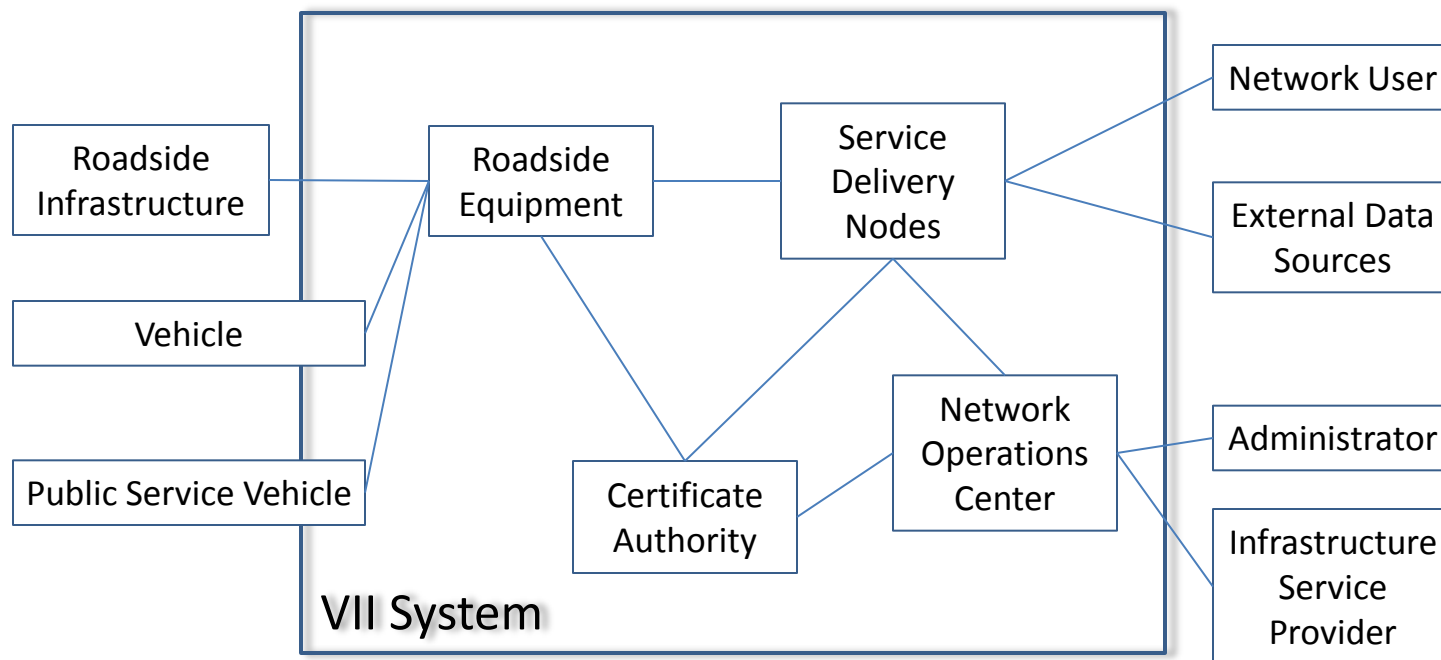
# VII Key Constraints

- Communications – air gap bridged by 5.9 GHz DSRC and only 5.9 GHz DSRC
- Vehicles equipped as new production only
- VII Network not to be used to replace existing infrastructure (e.g. to provide communications between centers and signal controllers)
- Probe data required
- Privacy principles

# VII-era Context



# VII-era Resulting Architecture



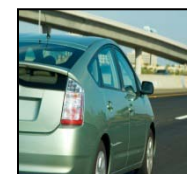
# INTELLIDRIVE<sup>SM</sup> PROGRAM

# What is IntelliDrive?

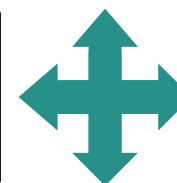
- Suite of technologies and applications that use wireless communications to provide connectivity:
  - Between vehicles (of all types)
  - Between vehicles and roadway infrastructure
  - Between vehicles and wireless communication devices
  - Between wireless communication devices and roadway infrastructure



Drivers



Vehicles



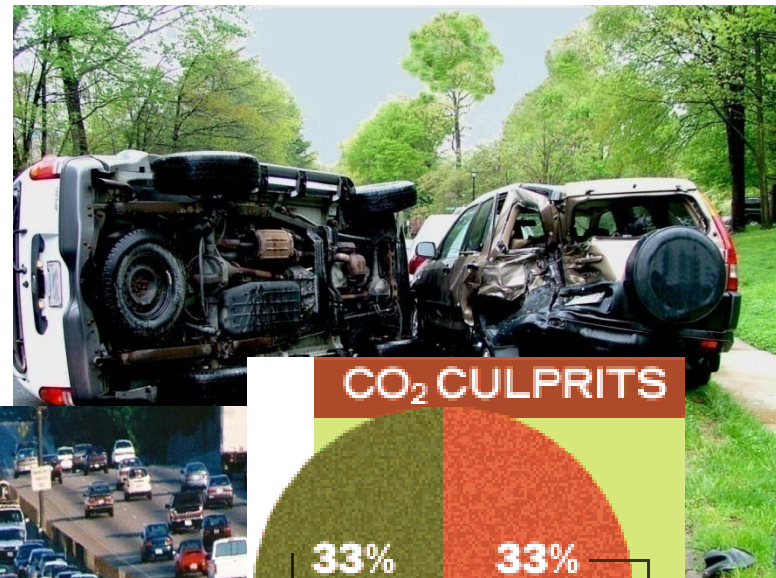
Infrastructure

Wireless  
Devices

# The Problem!!!

## Safety

- 33,963 deaths/year (2009)
- 5,800,000 crashes/year
- **Leading cause of death for ages 4 to 34**



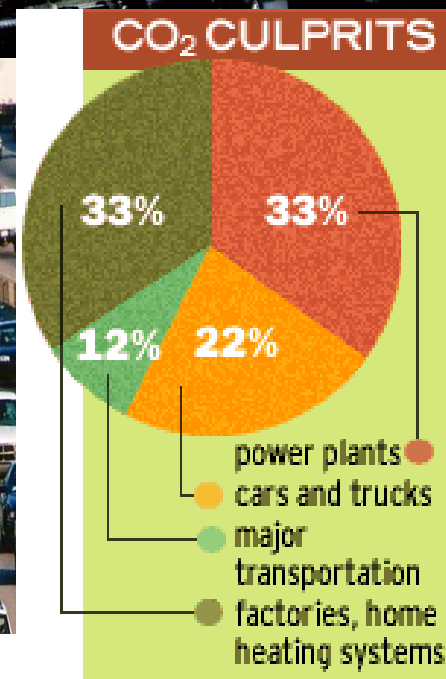
## Mobility

- 4.2 billion hours of travel delay
- \$78 billion cost of urban congestion

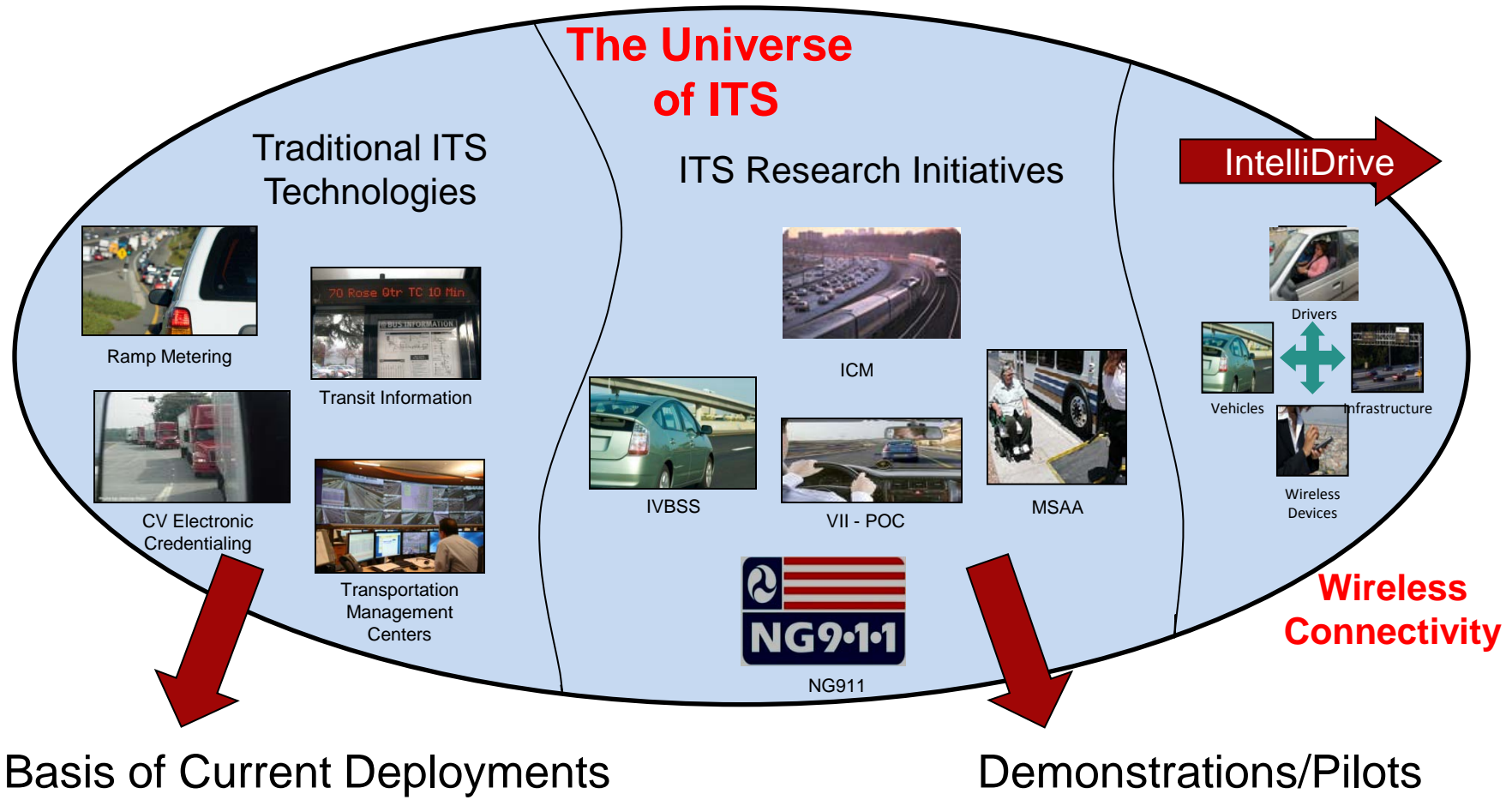


## Environment

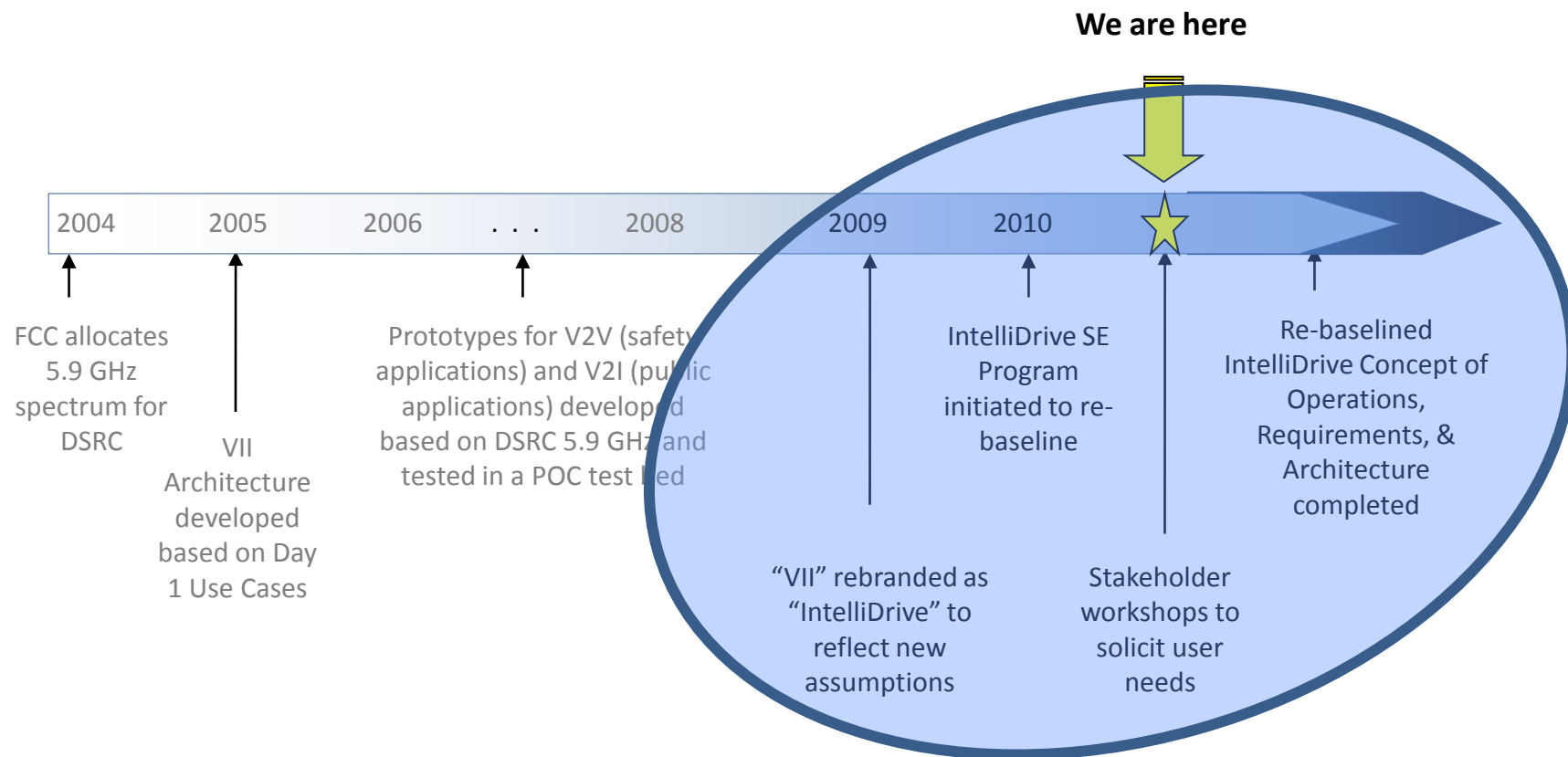
- 2.9 billion gallons of wasted fuel
- Emissions



# Program Evolution

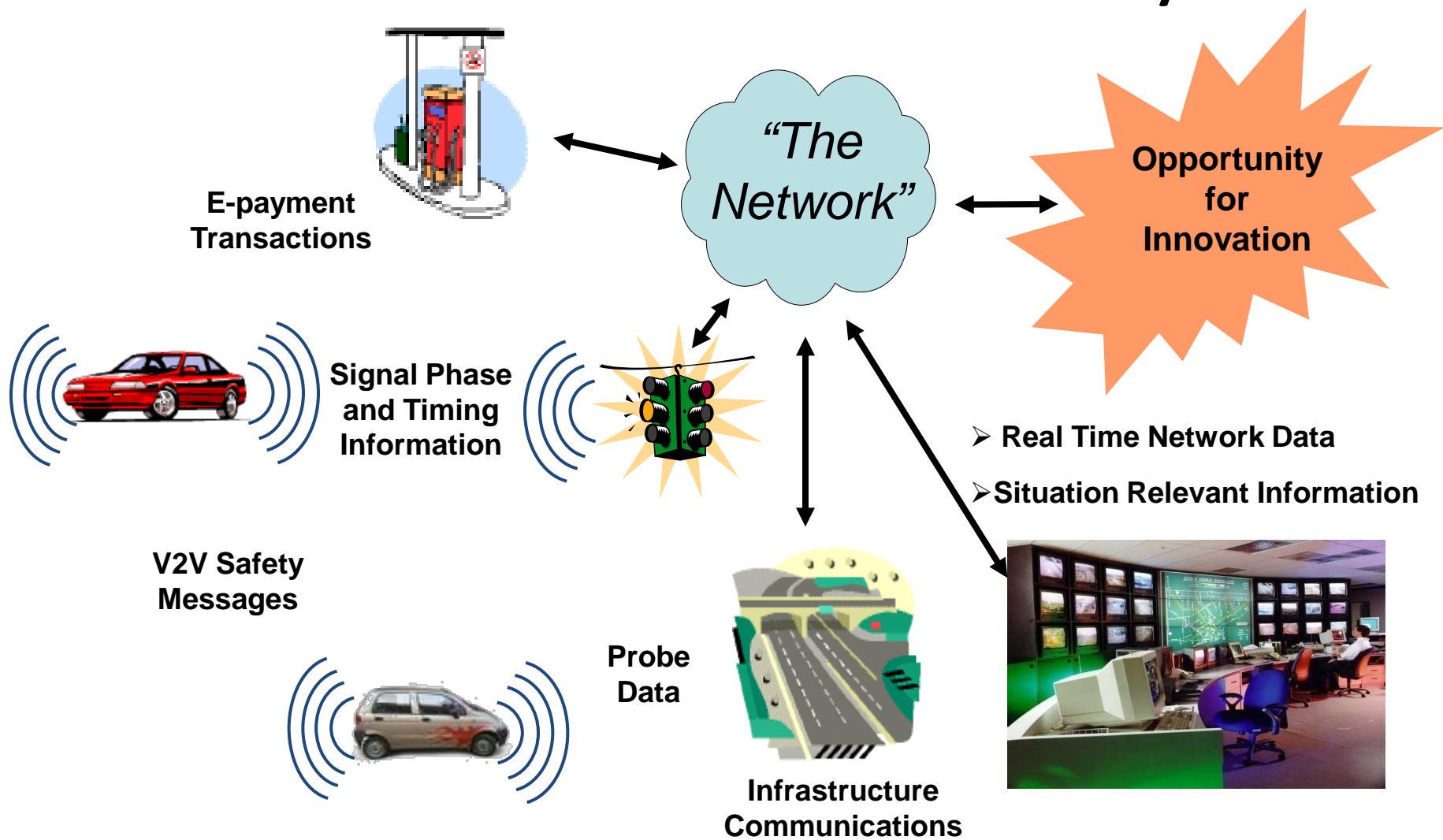


# When is IntelliDrive Taking Place

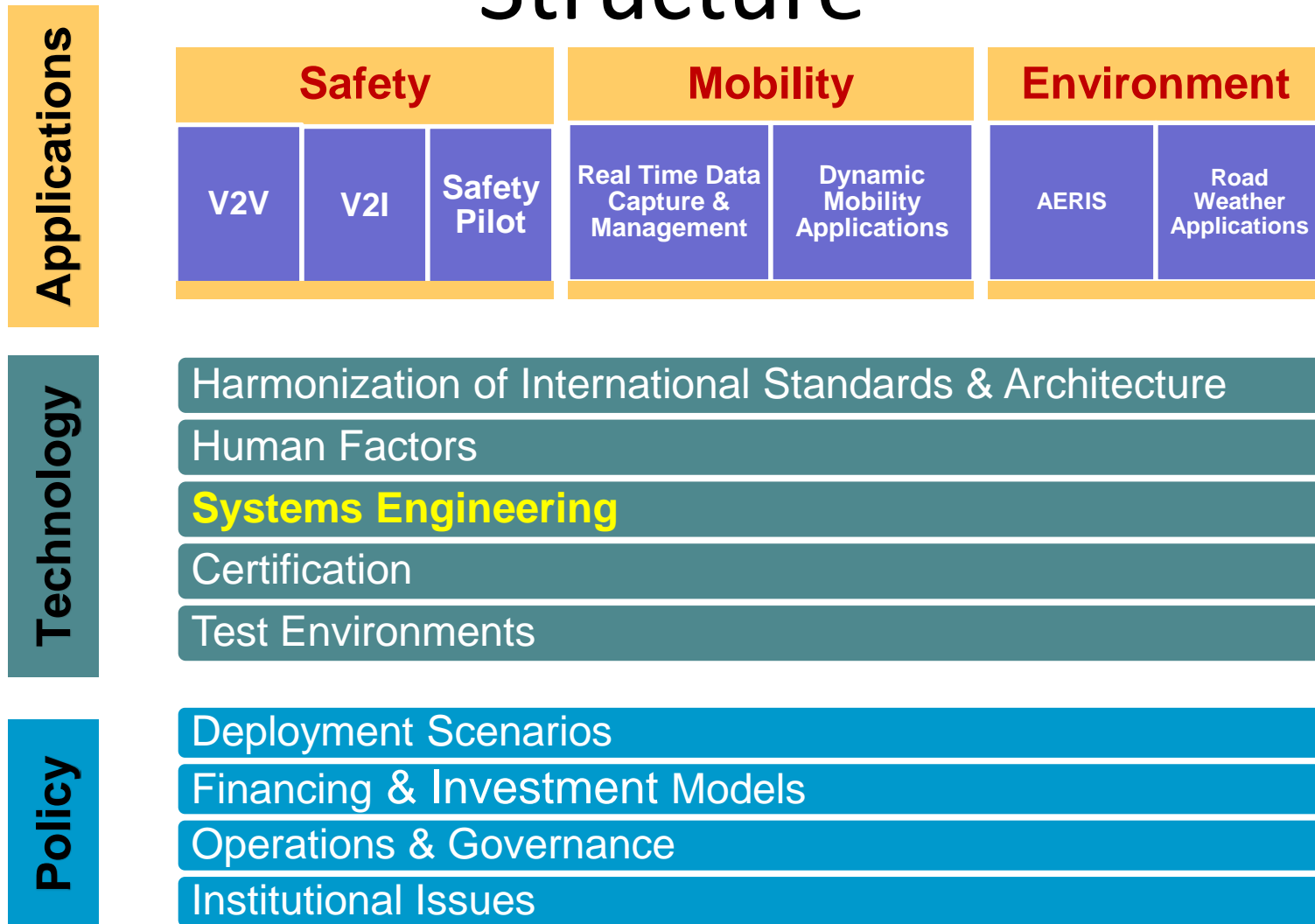




# It's All About Connectivity



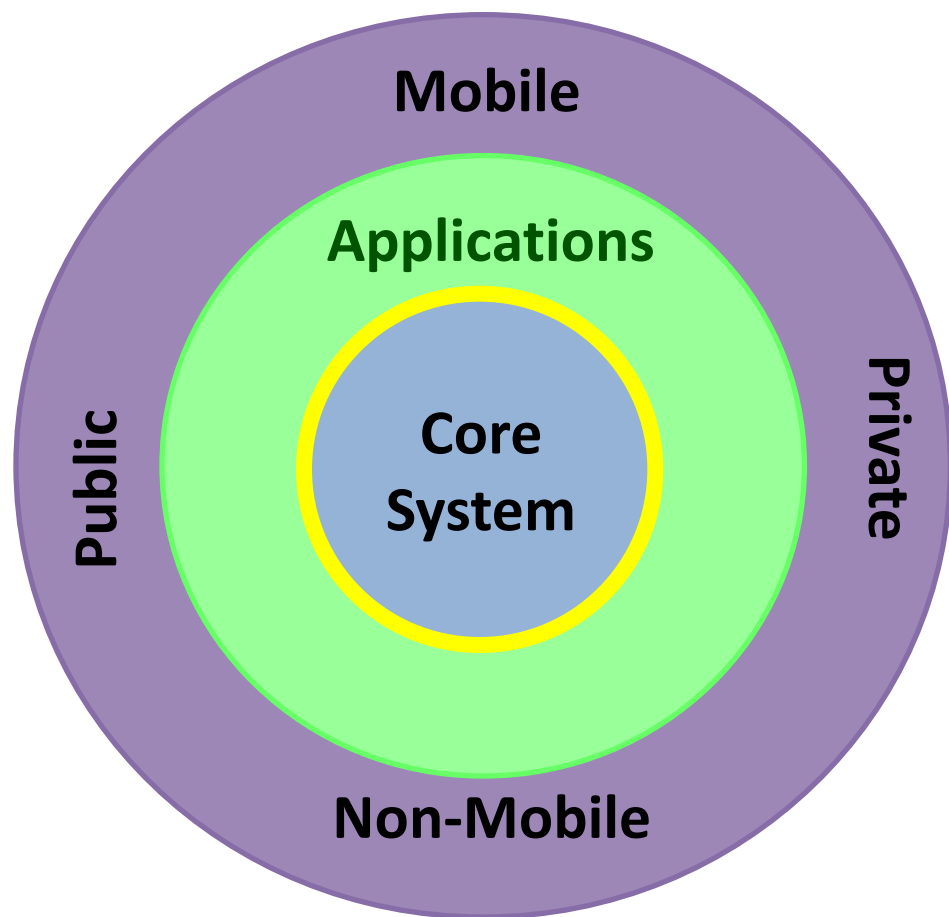
# ITS JPO IntelliDrive Program Structure



# USDOT Activities

- Broad program of research to address all aspects of IntelliDrive
  - Safety – V2V, V2I
  - Mobility – Data Capture Management, Dynamic Mobility Applications
  - Environment – AERIS along with road weather management (*Clarus*)
- As well as looking at higher level issues
  - Regulatory needs
  - Policy framework
  - Standards evolution

# Scope of IntelliDrive



- IntelliDrive is composed of 3 layers:
  - (1) Users, Mobile, Non-Mobile, Public and Private
  - (2) Applications, which bring about safer, smarter, and greener transportation, and
  - (3) a Core System, which enables applications by providing cooperative data exchange capabilities.
- Our Focus today is on the Core System

# Potential IntelliDrive Users

## Mobile users may include:

- Private individuals traveling in motor vehicles
- Public safety personnel traveling in public safety vehicles
- Commercial vehicle operators in commercial vehicles
- Pedestrians and bicyclists
- Transit vehicle riders in transit vehicles
- Transit vehicle operators in transit vehicles
- Traffic management personnel traveling in maintenance and construction vehicles
- Local Utility Personnel
- Private Fleet Users

## Non-mobile users may include:

- Traffic operations personnel
- Transit system operators
- Toll management authorities
- Value added service providers
- Rail system operators
- Fleet dispatchers
- Emergency management personnel

# Safety & Mobility & Environment

- Safety and mobility capabilities, while a continual focus of the program over the last several years, are not intended to be its limit.
- Capabilities that provide environmental benefit are a new focus for IntelliDrive support.
- While strictly commercial capabilities are no longer a point of focus for the IntelliDrive program, commercial capabilities that enhance safety, provide mobility and/or are environmentally-focused may also be supported.

# Potential Capabilities of IntelliDrive

- Vehicle to Vehicle  
(from the basics to more advanced capabilities)
  - Location/speed: “Here-I-Am”
  - Emergency electronic brake lights: “Look out, I’m braking”
  - Accident notification: “I just had an accident”
  - Cooperative platooning

# Potential Capabilities of IntelliDrive

- Vehicle to Infrastructure  
(covers safety and mobility)
  - Intersection based collision avoidance
  - Signal optimization, prioritization, pre-emption
  - Curve speed/rollover warning
  - Credentialing
  - Payment



# Potential Capabilities of IntelliDrive

- Vehicles, Infrastructure and Wireless Devices (mobile to fixed – either broadcast or transaction specific communications)
  - Where is my car?
  - Pedestrian alert to vehicle
  - eCommerce

# How does DSRC fit in?

- Dedicated Short Range Communications (DSRC)
  - Remains *one of* the important technologies used within the IntelliDrive System
- 75MHz of spectrum in 5.9 GHz range allocated by FCC to:
  - “[provide] vehicle-to-vehicle and vehicle-to-infrastructure communications, helping to protect the safety of the traveling public. It can save lives by warning drivers of an impending dangerous condition or event in time to take corrective or evasive actions.”
  - “The band is also eligible for use by non-public safety entities for commercial or private DSRC operations.”

# Changing Assumptions & Constraints

- Wireless Technologies such as Wi-Fi and Cellular Communications may supplement DSRC at 5.9 GHz
- Aftermarket and Retrofit Devices – both on-board and handheld
- Deployments could be more organic
- Various Vehicle Types will be supported
- Alternative Approaches to Privacy and Anonymity may be considered
- Different Services may be provided

# VII vs. IntelliDrive

## VII

---

5.9 GHz DSRC only

OEM only

Light vehicles

National interoperability

Must not compromise safety, security

Must protect privacy

Probe data, publish-subscribe

## IntelliDrive

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5.9 GHz DSRC and others

OEM, aftermarket and retrofit

All vehicles

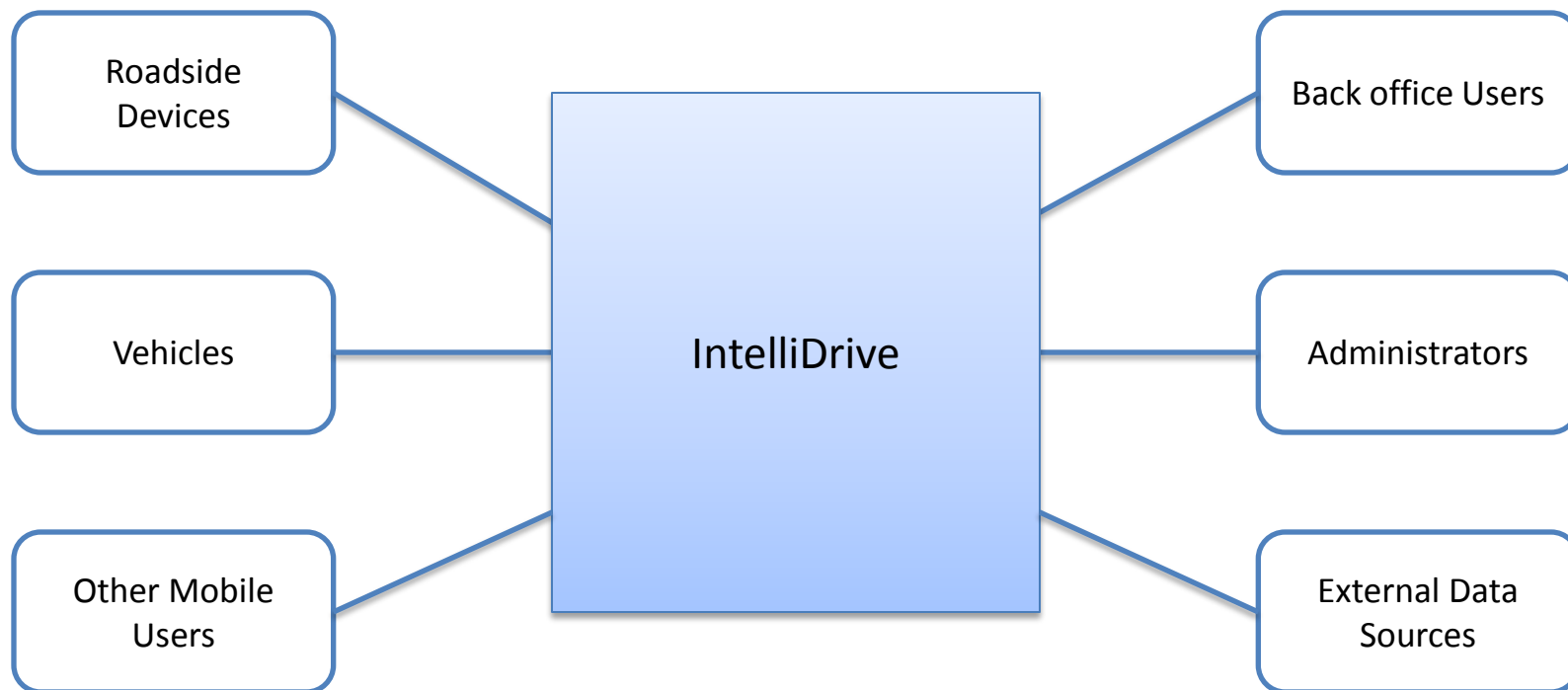
National interoperability

Must not compromise safety, security

Must protect privacy

Probe data?

# IntelliDrive Context



# **INTELLIDRIVE USER NEEDS OVERVIEW/EXAMPLES**

# What is a User Need?

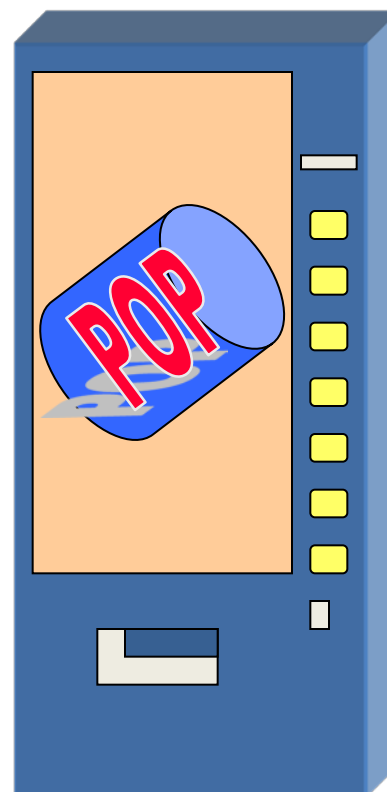
- A “User Need” is defined as a capability that is identified to accomplish a specific goal or solve a problem that is to be supported by the IntelliDrive System.
- “A user requirement for a system that a user believes would solve a problem experienced by the user.”
  - IEEE Std 1362-1998, Section 3.26 - User Need
- Describes “what” is needed and not “how” it is to be implemented

# Characteristics of User Needs

- Scoped to the appropriate level
  - Too general -- needs to be further defined
  - Too specific -- may imply design
- Not Application specific
- May include notional latency, security, size or bandwidth (if applicable) needs
  - Not the solution of any specific interface or protocol



# Vending Machine Example



# Vending Machine User Need 1

- **Who:** Thurston
- **What:** I need the soda pop vending machine to provide a way to quench my thirst.
- **Why:** To increase my chance of survival.

# Vending Machine User Need 2

- **Who:** Allen Wright
- **What:** I need the soda pop vending machine to accept some means of payment for the product.
- **Why:** To finance more product, my salary, and the gas for my delivery truck.

# Vending Machine User Need 3

- **Who:** Tony
- **What:** I need for the soda pop vending machine to increase the amount of customers to my gas station convenience mart.
- **Why:** So that I can sell more snacks and other high margin items in my convenience mart.

# User Needs – The User's Role

- Identify User Needs (capabilities, problems to be solved, processes to be improved)
- Attribute each need to an individual/group/organization
- What is your Rationale?
- Tell us your perspective

# A User Need Example

- **Who?** Traffic Manager
- **What is the problem?** I don't have a complete picture of traffic conditions on my roadway network.
- **Why is this a problem?** I need to manage the roadways to reduce congestion while improving safety and mobility.
- **What do you need to solve this problem?** I need current and historical information that describes traffic conditions on the entire scope of the roadways I manage.
- **Why should IntelliDrive solve this problem?** If I could get vehicle locations with IntelliDrive I could perform better adaptive signal control. Getting this information with fixed sensors is cost prohibitive.

# Another User Need Example

- **Who?** Emergency Operations Center Manager
- **What is the problem?** I currently only broadcast advisory information. I want to selectively send advisory information to travelers in specific geographical areas.
- **Why is this a problem?** The advisories can be received by travelers not impacted by the advisory.
- **What do you need to solve the problem?** I want to increase the relevancy of the advisory information to the travelers for more effective communication.
- **Why should IntelliDrive solve this problem?** I want IntelliDrive to provide me a means to communicate emergency advisory information directly to travelers in certain geographic areas. Providing this capability with existing dissemination methods is cost prohibitive.

# Another User Need Example

- **Who?** Vehicle OEM
- **What is the problem?** I would like to provide a way of notifying the vehicle's systems of upcoming bad road weather conditions.
- **Why is this a problem?** Road weather surface conditions can change rapidly and pose a safety risk to vehicles.
- **What do you need to solve the problem?** I need better road surface condition data.
- **Why should IntelliDrive solve this problem?** IntelliDrive can provide actual vehicle's reactions to weather conditions (ABS, traction control etc.) that I cannot get another way. IntelliDrive can also provide information for areas where I cannot install fixed sensors.



# Another User Need Example

- **Who?** Transit Manager
- **What is the problem?** I can't ensure that my transit vehicles stay on schedule.
- **Why is this a problem?** Late transit vehicles has resulted in a drop in ridership.
- **What do you need to solve the problem?** I have a need for the signals to be modified in order to accommodate a bus that is behind schedule.
- **Why should IntelliDrive solve this problem?** IntelliDrive could provide a way for my transit fleet to communicate with the signals and reduce my reliance on proprietary signal priority equipment.

# Next Steps

- Who are you?
- What is the problem?
- Why is this a problem?
- What do you need to solve the problem?
- Why should IntelliDrive solve this problem?

# For More Information...

<http://www.intellidriveusa.org/>



**IntelliDrive**<sup>SM</sup>  
Safer.  
Smarter.  
Greener.

Site sponsored by the US Department of Transportation  
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## News & Updates

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**Proof of Concept Test Results Released**  
March 11th, 2009 at 4:04pm

**IntelliDrive<sup>SM</sup> Brand Replaces VII**  
February 23rd, 2009 at 10:12am

**SAFETRIP-21 News**  
December 4th, 2008 at 3:12pm

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**About IntelliDrive**

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Overview  
FAQs



**Who We Are**

---

DOT's IntelliDrive Program  
Coalition



**Benefits**

---

Future Vision  
Consumers



**Research**

---

DOT-Sponsored Research  
Activities  
State and International Research



**Library**

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Research Reports  
Presentations

# **INTELLIDRIVE USER NEEDS BREAKOUT #1 / DISCUSSION**

# Break-Out Groups

- Identify Breakout Session
- You are encouraged to attend that topic that you are familiar with and that you are interested in
- Once you get there start by introducing yourselves – who you are and what your background with IntelliDrive is.
- Each group will discuss topics particular to that domain along with general findings across all domains

# Break-Out Group Room Assignments – 1:00pm

<b>Breakout Group</b>	<b>Room</b>
Vehicles, Carry-in devices, CVO, Transit, Fleet Management	<b>Donner Pass</b>
Traffic management, Maintenance & construction, Road weather, Critical infrastructure, Environment	<b>Santa Clara</b>
Telecommunications, Data management and aggregation, Network providers, Information Service Providers, Planning	<b>Carmel</b>

# Breakout Group Introduction

- Introduce ourselves
  - Name
  - Company/Agency/ Organization
  - Involvement, Background with IntelliDrive (and its predecessors)
  - Expectations
- Objectives
  - Capture User Needs—  
problems/solutions/rationale

# Breakout Group – Key Questions

- Who are you?
- What is the problem?
- Why is this a problem?
- What do you need to solve the problem?
- Why should IntelliDrive solve this problem?



# Day 2 Agenda

- 9:00 – 9:05 Welcome Back
- 9:05 – 9:45 Breakout #1 Reports
- 9:45 – 10:00 Intro of Breakout #2 Topics
- 10:15 – 10:45 Breakout Sessions #2
- 10:45 – 11:00 Break
- 11:00 – 12:00 Breakout Sessions (cont'd)
- 12:00 – 1:00 Lunch
- 1:00 – 2:30 Breakout Sessions (cont'd)
- 2:30 – 2:45 Break
- 2:45 – 3:30 Breakout #2 Reports
- 3:30 – 4:30 Wrap-Up

# Breakout #1 – Reports

## What did we learn?

- Someone from each group summarize key points
  - Problems
  - Needs
  - Rationale

# **INTELLIDRIVE USER NEEDS**

## **INTRO OF BREAKOUT #2 TOPICS**

# “What If” ...

- What if the following scenarios took place...
  - What could you do with that data or information?
  - What capabilities would you be able to support?
  - What other data would be helpful?
  - What else would be needed to support other capabilities...
- Think of today, and think of the future.....evolutionary and revolutionary

# “What If” Scenarios

1. Broadcast from Mobile
2. Broadcast from Fixed
3. Transactions Based

# Scenario #1

## Broadcast from Mobile

- Scenario 1A: Commercial vehicles are instrumented to broadcast basic safety messages (time, speed, direction) and data necessary to support vehicle-in-motion inspection
- Scenario 1B: Vehicles are instrumented to broadcast basic safety messages every 100 msec
- Scenario 1C: PDAs (smartphone, smart pad) are instrumented to broadcast basic safety messages every 100 msec
- Scenario 1D: Pedestrians/cyclists are instrumented to broadcast basic safety messages every 100 msec
- Scenario 1E: Equipment is installed to collect broadcast safety messages and makes those available to other users out of range of original transmission

# Scenario #2

## Broadcast from Fixed

- Scenario 2A: What if roadside equipment were provided to broadcast data or information that can be delivered to a vehicle in another location that triggers message activation
- Scenario 2B: What if roadside equipment were provided to broadcast data or information that can be delivered to a PDAs (smartphone, smart pad) in another location that triggers message activation
- Scenario 2C: What if roadside equipment were provided to broadcast data or information that can be delivered to a pedestrian/cyclist in another location that triggers message activation
- Scenario 2D: What if roadside equipment provided the capability for application provision (a “qualified user” is given permission to install an application)

## Scenario #3

### Mobile/Fixed Transactions

(Mobile ↔ Mobile; Mobile ↔ Fixed)

- Scenario 3A: Transit fleet management; other fleet management
- Scenario 3B: Heavy vehicles are instrumented to perform transactions (in addition to e-payment)
- Scenario 3C: PDAs (smartphone, smart pad) are instrumented to perform transactions (in addition to e-payment)
- Scenario 3D: Pedestrians/cyclists are instrumented to perform transactions (in addition to e-payment)



# **INTELLIDRIVE USER NEEDS BREAKOUT #2 / DISCUSSION**

# Breakout #2 – Reports

## What did we learn?

- Someone from each group summarize key points

# WRAP UP

# Next Steps

- The inputs from this workshop will be collected and organized
- Findings Report provided to USDOT
  - DOT will disseminate to the participants
- Workshops to be held in San Jose, Washington D.C.
- Next Step for the program will be to update the IntelliDrive System Concept of Operations
- Stay tuned!

**PLEASE FILL OUT YOUR EVALUATION  
FORM**

# Thank you for your participation!

## <http://www.intellidriveusa.org/>

The screenshot shows the IntelliDrive website homepage. At the top left is the IntelliDrive logo with the tagline "Safer. Smarter. Greener." Below the logo is a large video player showing an aerial view of a highway interchange with yellow circular overlays and the IntelliDrive logo. A "Download This Video" button is positioned above the video. To the right of the video player is a search bar and a "Search" button. Below the video player is a "News & Updates" section with three news items: "Proof of Concept Test Results Released" (March 11th, 2009), "IntelliDriveSM Brand Replaces VII" (February 23rd, 2009), and "SAFETRIP-21 News" (December 4th, 2008). Below the news section are five navigation boxes: "About IntelliDrive" (Overview, FAQs), "Who We Are" (DOT's IntelliDrive Program Coalition), "Benefits" (Future Vision, Consumers), "Research" (DOT-Sponsored Research Activities, State and International Research), and "Library" (Research Reports, Presentations). At the top right of the website, it says "Site sponsored by the US Department of Transportation Research and Innovative Technology Administration".