U.S. Department of Transportation

Dedicated Short Range Communications (DSRC) and the Future of Surface Transportation

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Background and Purpose

- **Background:**
  - The Dedicated Short Range Communications (DSRC) radio service is important for advancing transportation safety, mobility and sustainability.
  - It is a critical component of the Department of Transportation's vision for wireless applications for transportation.
  - The Department has invested more than $120 million in Intelligent Transportation Systems research funds into DSRC based applications through the IntelliDrive[1] research initiative and its predecessors, with plans to continue significant research investments in the future.
- **Purpose of Meeting:**
  - Discuss the transportation community's continued interest in DSRC
  - Discuss remaining open issues regarding the DSRC radio service

[1] IntelliDrive Is a registered service mark of the US Department of Transportation.

The Problems

Safety

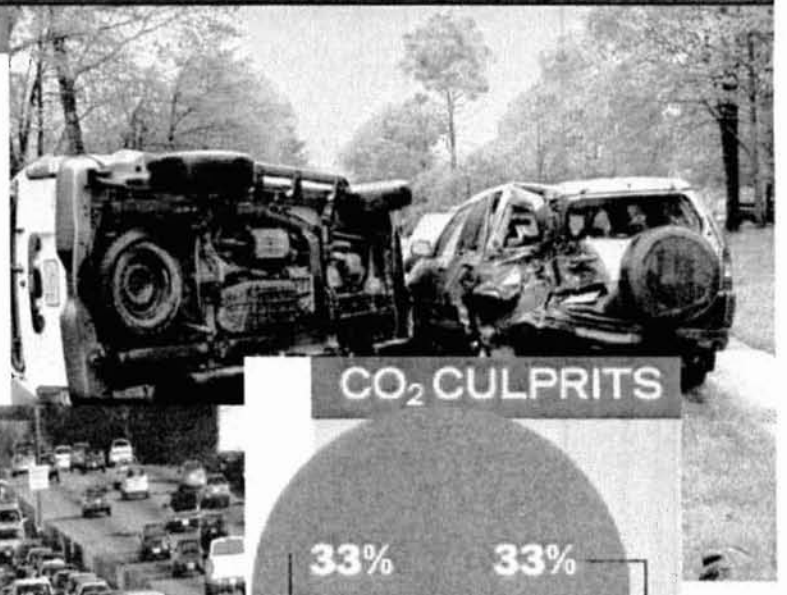
- 33,808 deaths/year[1]
- 5,800,000 crashes/year [1]
- **Leading cause of death for ages 4 to 34[1]**

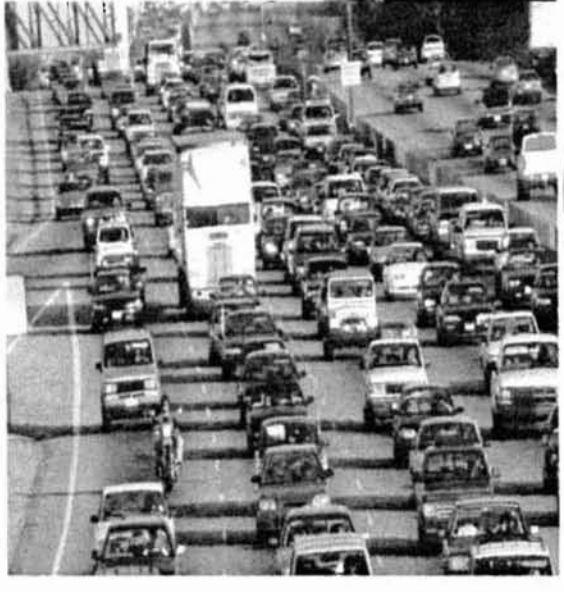
Mobility

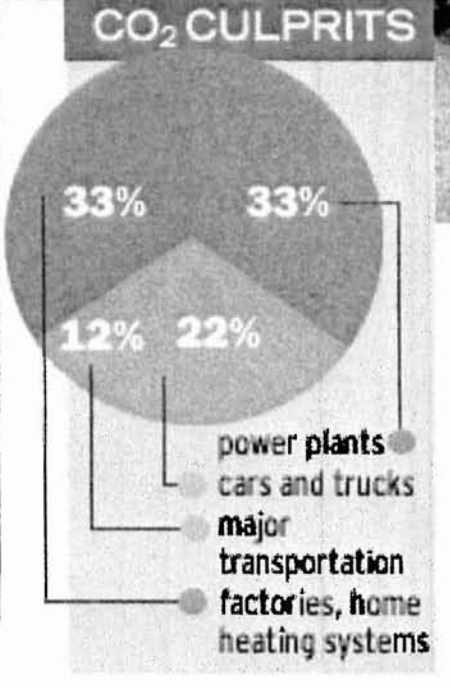
- 4.2 billion hours of travel delay[2]
- $87.2 billion cost of urban congestion[2]

Environment

- 2.8 billion gallons of wasted fuel[2]







[1] National Highway Traffic Safety Administration, 2009

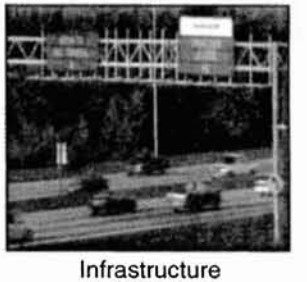
[2] Texas Transportation Institute: Urban Mobility Report, 2007

The IntelliDrive℠ Solution

- IntelliDrive℠ is a suite of technologies and applications that use wireless data communications to provide connectivity:
  - Among vehicles of all types
  - Between vehicles and roadway infrastructure
  - Among vehicles, infrastructure and passenger wireless devices

Drivers

Vehicles

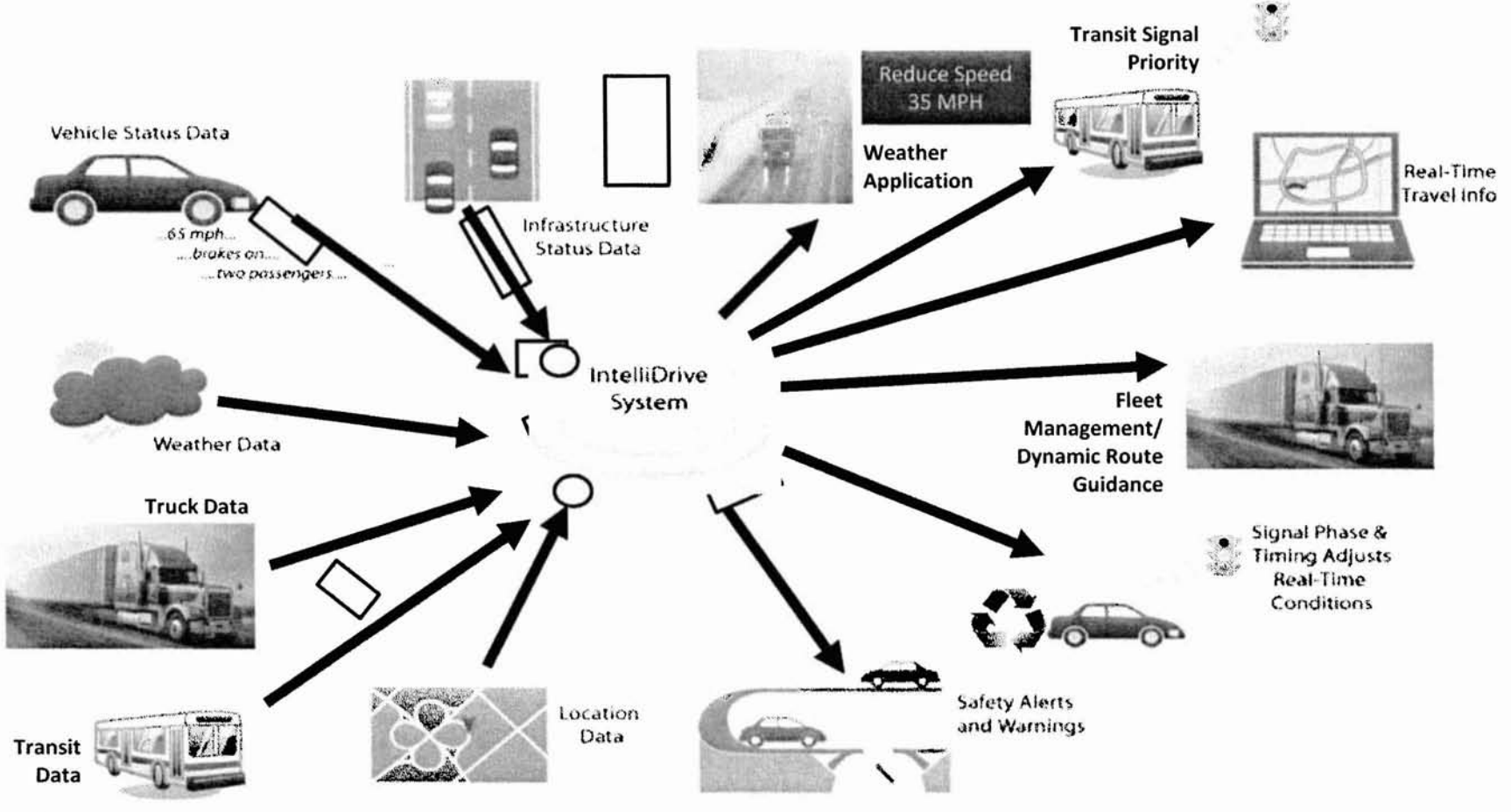


Infrastructure

Wireless Devices

Networked Environment

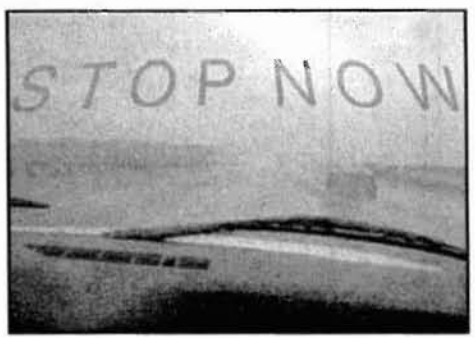
IntelliDrive℠ Networked Environment
DATA IN, ACTIONABLE INFORMATION OUT



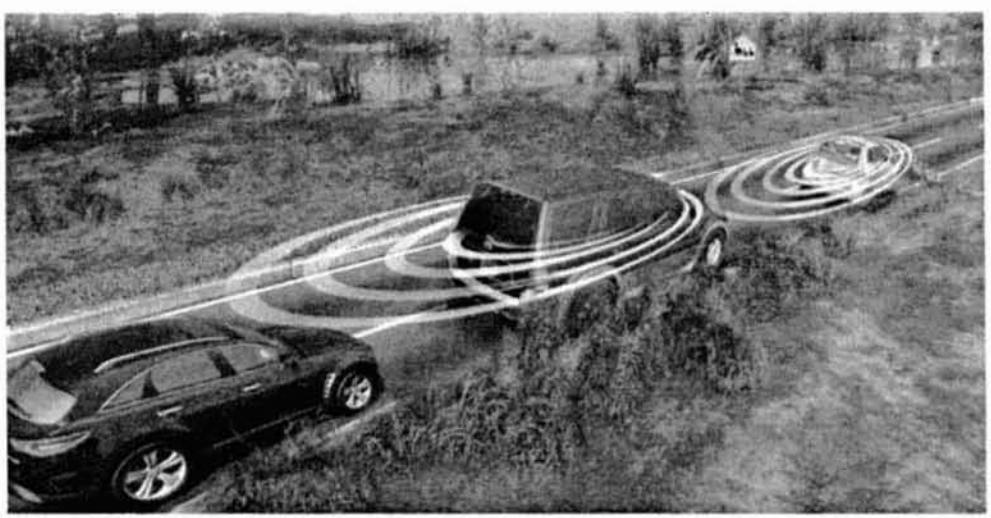
Opportunity for Safer Transportation

- Greater situational awareness
  - Your vehicle can "see" nearby vehicles and knows roadway conditions that you cannot see
- Reduce or even eliminate crashes through:
  - Operator Advisories
  - Operator Warnings
  - Vehicle Control

Work Zone Notification



Intersection Collision Avoidance

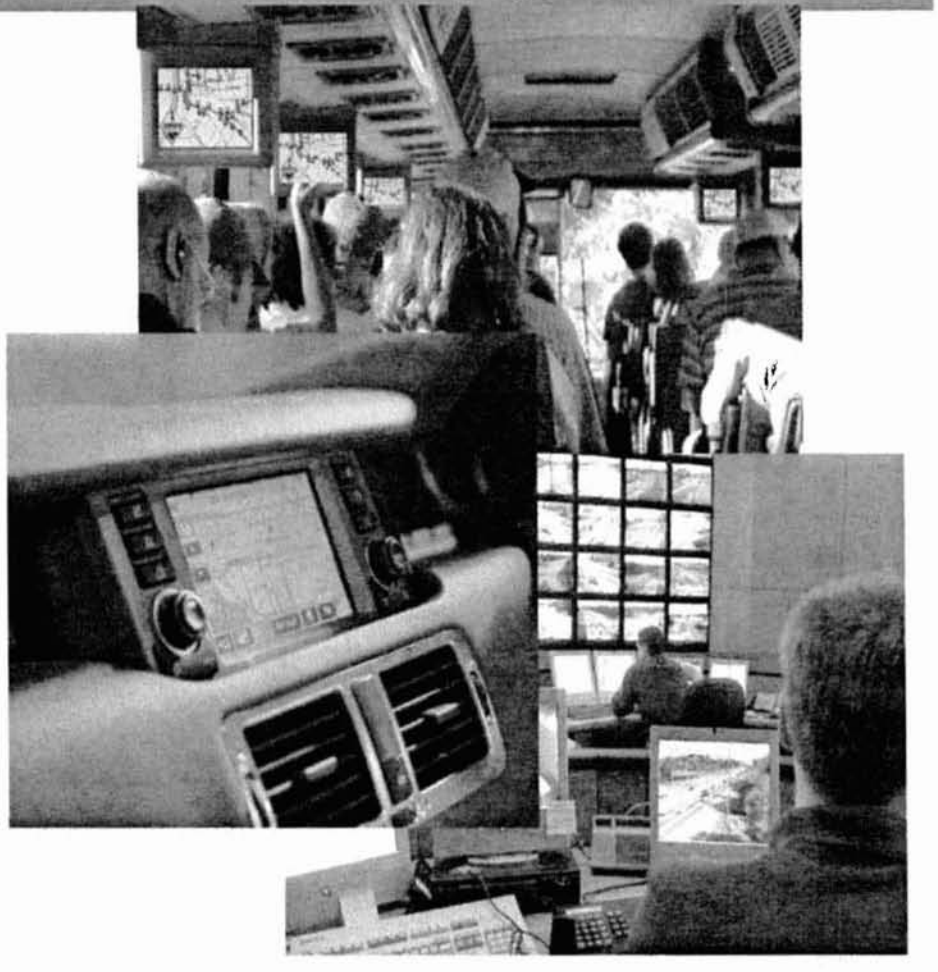


IntelliDrive has the potential to address 82% of the vehicle crash scenarios involving unimpaired drivers (NHTSA internal analysis).

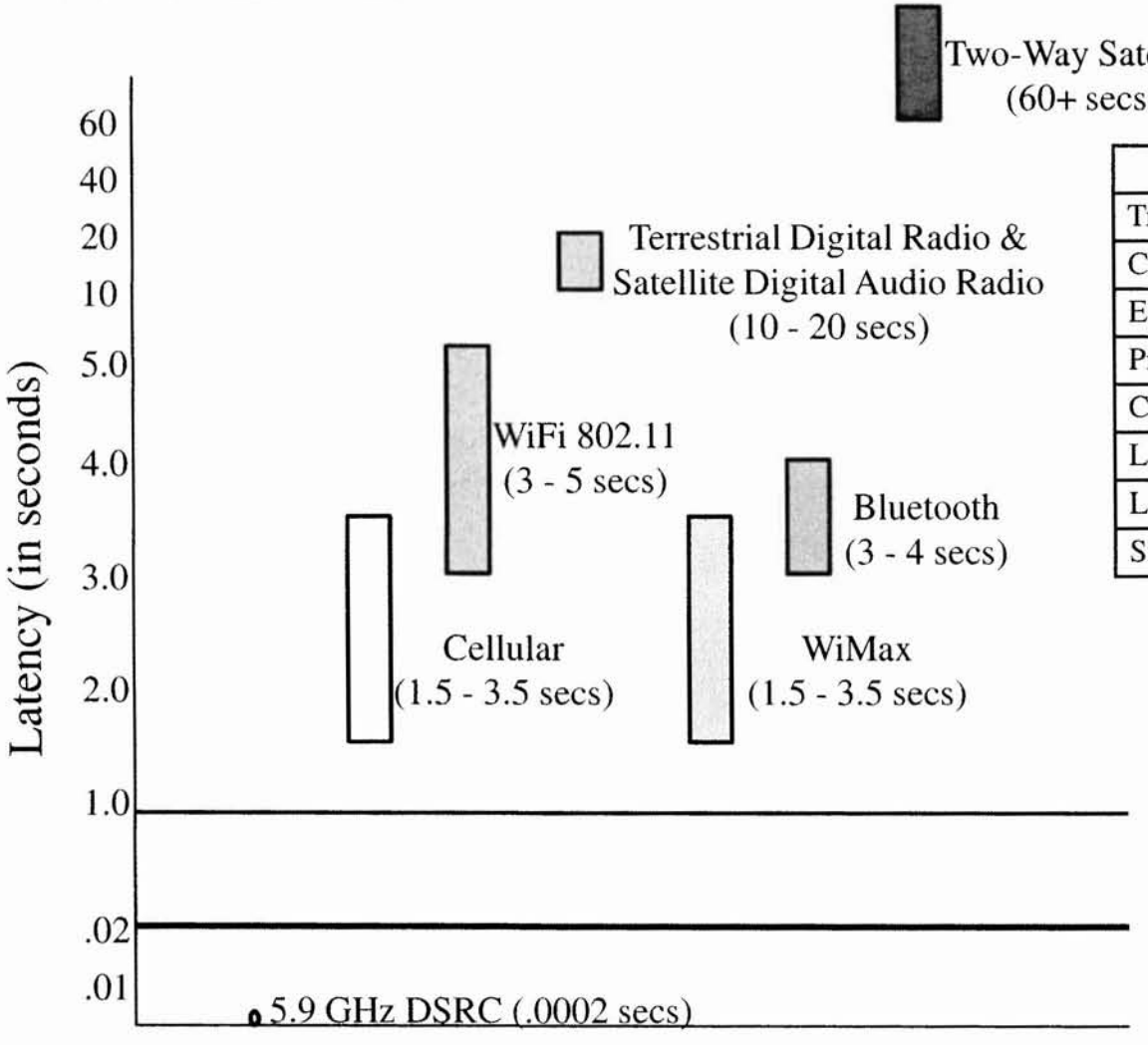
Opportunity for Greater Mobility & Efficiency

- Creating an information-rich environment for multi-modal transportation solutions.
  - Traveler information for rerouting or "modal shift" options
  - Better system management & performance of the road network
  - Urban planning

- Environmental benefits
  - Reduced stopping/starting at traffic signals ,which consumes 3-5 times more fuel than constant driving
  - Navigation systems with real time information can reduce fuel consumption by 10.5% over systems without real time traffic data



Communications Technologies



Active Safety Latency Requirements (secs)	
Traffic Signal Violation Warning	0.1
Curve Speed Warning	1.0
Emergency Electronic Brake Lights	0.1
Pre-Crash Sensing	0.02
Cooperative Forward Collision Warning	0.1
Left Turn Assistant	0.1
Lane Change Warning	0.1
Stop Sign Movement Assistance	0.1

Least stringent latency requirement for Active Safety (1 sec)

Most Stringent latency requirement for Active Safety (.02 sec)

Note: Y-axis not to scale for illustration purposes

Data source: Vehicle Safety Communications Project – Final Report

Major Stakeholders

- **Automobile manufacturers**
  - Two multi-company partnerships (Crash Avoidance Metrics Partnership and Vehicle Infrastructure Integration Consortium)
  - R&D by individual automakers including BMW, Chrysler, Ford, General Motors, Honda, Hyundai-Kia, Mercedes, Nissan, Toyota, and Volkswagen
- **State Departments of Transportation**
  - Pooled fund study involving Virginia, California, Florida, Michigan, New York, Texas, Washington, and U.S. Federal Highway Administration
  - California IntelliDrive testbed
  - Michigan IntelliDrive testbed
  - Arizona testing of signal and ramp meter priority applications
- **U.S. Department of Transportation**
  - Multimodal program led by the Research and Innovative Technology Administration
  - Includes Federal Highway Administration, Federal Motor Carrier Safety Administration, Federal Transit Administration, and the National Highway Traffic Safety Administration

Evolution of IntelliDrive

- **Original model**
  - DSRC based mobile data communications (only)
  - Start with Vehicle to Infrastructure (all application types) and evolve into Vehicle to Vehicle safety applications – major infrastructure deployment required
- **Current perspective**
  - Safety → DSRC based
    - Aggressively pursue Vehicle to Vehicle systems; leverage vehicle capability for Vehicle to Infrastructure spot safety
    - Commercial mobile wireless services (e.g., 3G, LTE, WiMax) do not provide the required location specific, high availability, low-latency communications
  - Non-safety (mobility, environment)
    - Leverage existing data sources & communication types; include DSRC as it becomes available

U.S. DOT Actions

- Accelerating research investments
  - Approx. $120 Million in research and testing from 2004 – 2009
  - Approx. $50 million in 2010, and committed to future investments
- Conducting vehicle to vehicle communications safety research and testing focused on a regulatory decision on in-vehicle equipment by 2013
- Researching the ability of aftermarket and carry-in devices to accelerate market penetration
- Continuing research on infrastructure communications capabilities
- Establishing a real world multi-modal test bed for high value applications

DSRC Rulemaking

- In 1999, FCC allocated spectrum (R&O) in response to a petition filed by ITS America
- In 2002, FCC released NPRM on licensing and service rules
- In 2003, FCC issued licensing and service rules (R&O)
- In July 2006, FCC issued Memorandum, Opinion, and Order amending service rules
- DSRC has several outstanding issues
  - Update of the ASTM standard
  - Consideration of industry recommendations for dealing with spectrum sharing between the Fixed Satellite Service and the ITS Radio Service

Allocation and Band Plan

- DSRC allocation is 75 MHz in the 5.9 GHz band
- Band is for low power, short-range vehicle to vehicle and vehicle to roadside applications; shared by the public and private sector
- Six Service Channels and one control channel
- One service channel reserved for safety of life and public safety use
  - Not restricted to vehicle-to-vehicle or low latency applications
- One service channel reserved for high power (2x low power) public safety, safety of life and property applications
  - Not restricted to long range applications

Open DSRC Issues

Standards Evolution

- FCC rules require all DSRC operations in the 5.9 GHz band to comply with ASTM E2213-03 (the current DSRC standard at the time the rule was approved in 2003)
- Rule recognized that the standard was still evolving and that updates would be brought back to the FCC for incorporation
- DSRC standards work moved from ASTM to IEEE
  - Better alignment with scope of IEEE: at it's core, DSRC standard is a variant of 802.11 to address low latency and mobile communications
  - IEEE 802.11p – Approved amendment to 802.11
    - 802.11 chip sets will include DSRC, reducing costs
- Rule needs to be revised to reference IEEE 802.11 and 802.11p rather than ASTM E2213-03

Open DSRC Issues

- **Formalization of Frequency Coordination with Fixed Satellite Stations**
  - Agreement reached between ITS and satellite industry communities and provided to FCC in February, 2008 (See Written *Ex Parte* in WT Docket No. 01-90 and ET Docket No. 98-95: DSRC/FSS Earth Station Spectrum Sharing Protocol)
  - Signatories to the petition were the Intelligent Transportation Society of America, the American Association of State Highway and Transportation Officials, and the Satellite Industry Association.
  - Rule changes to parts 25 and 90 to incorporate the agreed to protocol were proposed in that communication
  - USDOT supports the proposed resolution of this issue, including the proposed rule changes

Open DSRC Issues

- **Potential Rules Clarification for New Type of Sensor-Type Device**
  - FCC rules define two types of units:
    - Roadside Units (RSUs) (i.e., communication units that are fixed along the roadside) that are licensed under Part 90 Subpart M of the Commission's rules ("Intelligent Transportation Systems Radio Service")
    - On-Board Units (OBUs) (i.e., in-vehicle communications units) that are licensed by rule under new Subpart L of Part 95 of the Commission's Rules
  - IEEE standards now recognize potential for a third type of device: a permanent or temporary infrastructure sensor device that is closer to a mobile device than an RSU in terms of capabilities and limitations
  - Need to determine if any action is required to clarify the rules for such devices

Background Slides

Communications Requirements

Communications Requirements	Safety (V2V and intersection crash avoidance)	Mobility and Environment
Range	• Short range is a requirement • Very high update rate (e.g., 10x per second)	• Short range for intersection messages and toll tags, otherwise no requirement
Latency	• Very low latency (≤0.1 seconds) for V2V crash warning	• Low (tolling) to high (traveler information)
Message Size	• Small (100-few thousand bytes)	• Small (tolling, probe) to large (navigation updates)
Update Rate	• High (10x per second or higher)	• Low
Reliability	Very high (safety of life)	• High for tolling (accurate billing), moderate otherwise

Communications Options

Technology	Safety	Mobility and Environment
Current Electronic Toll Tag Technology	• Does not meet requirements	• Adequate for tolling and travel time measurement only • Does not meet other requirements
DSRC	• Meets requirements for low latency, high reliability secure communications	• Meets requirements for all applications • May not be best match for all applications
3rd and 4th Generation Cellular	• Does not meet requirements	• Meets requirements for many, but not all, applications • May be best match for some applications