Cooperative Systems Research in the US
The IntelliDrive℠* Program

Steve Sill, P.E.
Program Manager; Vehicle Safety Technology,
ITS Architecture and Standards
ITS Joint Program Office

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* IntelliDrive is a service mark of the U.S. Department of Transportation.
Original Vision

- Dramatic safety improvements
- Promise of revolutionary mobility improvements
- Reduced Environmental impact
- Achieved through wireless communication
Vehicle Infrastructure Integration (VII)
Products and Results

- Acquired spectrum for DSRC
  - Rules and operational guidelines
- Hardware and standards for the 5.9 GHz DSRC radio link
- Concept of Operations
- Sample applications
  - Safety, Mobility, Commercial
- 5.9 GHz DSRC - centered system architecture
- Comprehensive Lessons Learned
  - Technical, Operations, Policy
# VII Proof of Concept (POC) Test 2007

- **POC Goals and Objectives**
  - Validate Standards
  - Demonstrate core services capability
  - Demonstrate applications support capability
  - Demonstrate security, privacy, anonymity

- **V2I-focused**
  - DSRC 5.9GHz message exchanges
    - Draft/trial use standards
    - “Stub” (partially developed) applications

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<th>Key Criterion</th>
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Michigan POC Testbed

- 55 RSE Sites (45 sq-miles)
  - 12 Freeway Interchanges
  - 43 Signalized Intersections
- Backhaul
  - WiMax: 17 sites
  - Wireline (T1): 20 sites
  - 3G: 18 sites
- 75 Center-Line Miles
  - 32 Interstate and Divided Highway
  - 43 Arterial
- Test Fleet
  - 25 vehicles
  - 10 OEMs
VII POC – Lessons Learned

DSRC radio link – sufficient range and interoperability
  ▪ Challenges with overlap

Services – Maps, Communication, Probe Data, etc. are viable

Security/Privacy – Effective controls are viable
  ▪ Challenges regarding certificate revocation list (CRL) and scalability

Standards – Viable standards (IEEE 1609, IEEE 802.11p, SAE J2735)
  ▪ Additional development needs identified

POC proved that the basic technical concept would work. But could it be practically implemented?
Rethinking the Challenges

The “Chicken and Egg” Issue
- Investment in vehicles without infrastructure?
- Sufficient benefits without infrastructure?
- How to deploy infrastructure – (~300,000 units)?

Three Major Challenges
- What comes first – vehicles or infrastructure?
- How to get adequate fleet penetration to realize benefits?
- How to deploy (and pay for) the infrastructure?

A new approach: IntelliDrive
What’s Changed from VII to IntelliDrive

- DSRC only: Technology options
- OEM production units only: Aftermarket & retrofit opportunities
- Light vehicle focus: All vehicle types
- Prototyping/proof of concept: Focus toward deployment
- Limited stakeholders: Broader stakeholder engagement
- Limited visibility by "outsiders": Greater program transparency
- US focus: International harmonization
- Loosely coupled programs: Strong, collective USDOT support, coordination, and leadership
Unchanged from VII to IntelliDrive

- Connectivity → V2V and V2I
- National level interoperability
  - Open standards for communications and data
- DSRC for safety
- Safety, mobility, and convenience applications
- No compromise on safety or security
- Protect privacy
- Close collaboration among USDOT, state and local transportation agencies, and vehicle manufacturers
IntelliDrive Overview

What Is IntelliDrive?
- Multimodal initiative that aims to enable safe, interoperable networked wireless communications among vehicles, the infrastructure, and passengers' personal communications devices

How Does IntelliDrive deliver networked connectivity?
- Applications provide connectivity
  - Among vehicles: enable crash prevention and hazard warning
  - Between vehicles and the infrastructure: enable safety, mobility and environmental benefits
  - Among vehicles, infrastructure, and wireless devices: provide continuous real-time connectivity to all system users
- A starting point for transformational transportation connectivity
- Ultimately to encompass safety, mobility and environmental applications
Major IntelliDrive Objectives

Rapidly advance vehicle to vehicle communications technology
- Potential NHTSA regulatory Decision on In-Vehicle Equipment by 2013

Accelerate in-vehicle technology
- “Here I Am” messages
- Enables safety and active traffic management

Accelerate infrastructure communications capability
- Signal Phase and Timing (SPaT) as initial focus
- Enables safety, mobility, and environmental applications

Develop on-road multi-modal pilot deployments for high-value applications

Monitor and evaluate driver distraction issues

Understand benefits and communications needs (DSRC/other) of transformative mobility and environmental applications
Program Structure

Applications
- Safety
  - V2V
  - V2I
  - Safety Pilot
- Mobility
  - Real Time Data Capture & Management
  - Dynamic Mobility Applications
- Environment
  - AERIS
  - Road Weather Applications

Technology
- Harmonization of International Standards & Architecture
- Human Factors
- Systems Engineering
- Certification
- Test Environments

Policy
- Deployment Scenarios
- Financing & Investment Models
- Operations & Governance
- Institutional Issues
Safety

V2V Communications for Safety Vision
- Vehicles (all types) communicating with other vehicles
  - Data and communications supporting a new generation of active safety
- National interoperability

V2I Communications for Safety Vision
- Enabling safety applications designed to avoid or mitigate vehicle crashes
  - Crash scenarios not addressed by V2V
- National interoperability
Mobility & Environment

Real-Time Data Capture and Management Vision
- Active acquisition and systematic provision of integrated, multi-source data
- Enhanced operational practices
- Transformed future surface transportation system management

Dynamic Mobility Applications Vision
- Expedited development, testing, commercialization, and deployment of innovative mobility applications to:
  - maximize system productivity
  - enhance mobility of individuals

Environment (AERIS) Program Vision
- Real-time, environmental data/information available to:
  - Multimodal transportation management
  - Drivers and network operators
- Enables improved environmental practices
Cross-Cutting Research

Human Factors Research
- Optimal way to provide safety advisories, alerts, and warnings
  - Avoid introducing hazards via distraction
  - Addresses integrated vehicle equipment and nomadic devices

Policy Research
- Address policy and institutional issues that limit or challenge successful IntelliDrive deployment
- Formulate options for deployment scenarios, financing/investment, and governance including alternatives analyses

Certification Research
- Define needs, develop supporting test methods and tools
- Self-sustaining, fee-based program
- Assure Nationwide interoperability
- Oversight structure
Cross-Cutting Research (cont)

Systems Engineering (SE) – Redefining the IntelliDrive Architecture

- Rigorous application of SE
- Fully described user requirements
- Complete system architecture
  - Define IntelliDrive as a comprehensive and interoperable system
  - Define interfaces requiring standards
- Reflect evolution from VII to IntelliDrive
- System Requirements Specification (SRS), provides inputs to standards updates
Cross-Cutting Research: IntelliDrive Test Environments

IntelliDrive Test Environment
- Real-world, operational test beds
- Precursor for future IntelliDrive deployments

Research Plan
- Stabilization test environment
  - Into good state of repair/working order
  - Open access for researchers

Test environment is open to all research organizations
No cost to participate, minimal constraints and equitable access
Cross-Cutting Research: Multi-Application Pilot ("Safety Pilot")

Goal
- Support 2013 NHTSA regulatory decision with field data
  - Whether or not to require/regulate V2V capabilities
- Public awareness and acceptance

Primary Objectives
- Demonstrate V2V and V2I for safety real world implementation and obtain empirical data using multiple vehicle types
- Assess driver acceptance
- Aftermarket devices and retrofit systems, assess possible deployment acceleration

Scope and Schedule
- Approximately 3000 vehicles with broadcast-only capability
- 60 fully equipped vehicles with two-way V2V capabilities
- CY2010-2013
IntelliDrive Research Questions

- Penetration vs. Effectiveness
- Driver Acceptance
- Security and Scalability
- Positioning – Absolute and Relative

Multi-Application Pilot to provide real-world deployment for proving solutions

Test bed for technology development in a real-world environment
IntelliDrive Policy

How will tradeoffs between security, privacy and functionality be managed?

Operations
  - Who will monitor for misbehavior?
  - Who will operate the security/certificate authority?

Compliance & Enforcement
  - Who will enforce standards?
  - How will the rules of operation be developed and enforced?
  - How will DSRC and other IntelliDrive devices/software/applications be certified?

How do we assure appropriate stakeholder input and appropriate sharing of results?
For More Information…

Please visit the following websites:

www.its.dot.gov
http://www.its.dot.gov/strat_plan/index.htm

For more information on USDOT ITS Standards:

http://www.standards.its.dot.gov/

Or follow us on:

http://www.its.dot.gov/rss_feed.htm
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