Vehicle Infrastructure Integration

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October 24, 2005

Topics Covered

• What is VII
• Applications and Opportunities of VII
• Basic Operating Concept
• DOT Initiative
• What are the Issues Effecting Deployment
• Impact on Traveler Information
Vehicle Infrastructure Integration

Connecting Vehicles and Infrastructure

Creating an “enabling communication infrastructure”

Definition: The establishment of vehicle to vehicle and vehicle to roadside communication capability nationwide

Purpose: To enable a number of new services that provide significant mobility, safety and commercial benefits
Driving Forces: Safety

We have the opportunity to change the trend.

Driving Forces: Mobility

We have the opportunity to create a turning point.
How We Got Here

- The confluence of three activities have presented an opportunity
  - Growing emphasis on crash avoidance (Safety) and system management and operations (mobility)
  - Advancements under the ITS vehicle safety program (Intelligent Vehicle Initiative)
  - Evolution of communications technology

VII Can Enable a Wide Range of Applications

- Work Zone Management
- Traveler Information
- Weather Sensing
- Commercial Applications

...for example
Types of Potential Applications

• Cooperative Safety Systems
• Active Probe Vehicles
• Commercial Applications
• Mobility Management

Cooperative Safety Systems

• Primary Examples
  – Intersection Collision Avoidance
  – Road Departure Warning
• Other Opportunities
  – Work Zone Management
  – In-Vehicle Signing
  – Wireless Truck Inspections
Probe Vehicles

- Vehicle to Roadside Communication Would Enable Vehicles to Act as Active Probes
- Data from Existing Vehicle Based Sensors Could be Communicated to Roadside
- Example Information
  - Average Speed and Travel Time
  - Incident Detection
  - Origin/Destination
  - Onset of Precipitation
  - Road Condition
- Potential Coverage of Every Road and Street

Commercial Applications

- A Wide Range of Commercial Services Will Likely be Enabled
  - Personalized Traveler Information
  - Dynamic Route Guidance
  - Info-tainment
  - Innovative Road Pricing Strategies
  - Electronic Payment for Services
  - Fleet Management
    - Asset Tracking
    - Cargo Monitoring and Security
Mobility Management

- V2I Could be an Enabling Technology for a New Generation of Direct Traffic Assistance or Control
- Possibilities Include:
  - Queue Management
  - Dynamic Intersection Control
  - Merge Assistance

Technology

- A number of technologies could be used to provide this basic communication capability
  - WiFi
  - Cellular
  - DSRC
- DSRC at 5.9 Ghz is a primary technology being considered
- DSRC was specifically designed to support a number of use cases being considered
- DSRC is not required for all use cases
- Other possible communication modes do not require public sector involvement
Simple Block Diagram

Driver

Driver HMI

Vehicle Data

On Board Unit

Message Switch

Subscriber Applications

Road Side Unit

5.9 DSRC

End User

Questions
US DOT VII Initiative

Motivation

• Potential of VII is Clear
• No One Use May Justify Deployment
• No One Entity May Cause Deployment
• Some Sort of Cooperative Venture May be Needed
• Determining that Arrangement is a Major Focus of this Effort

Objective: To determine if the investment necessary to equip new vehicles and the roadway infrastructure with communications are warranted and can be synchronized.

Milestone

• A Decision to Proceed With Deployment Accompanied by a Plan for Deployment

Can We?

Several key issues will have to be resolved:

• Technical implementation
• Privacy and data ownership policy
• Business models public and private
VII Coalition

- USDOT
  - FHWA
  - NHTSA
- AASHTO
  - 10 State DOTs
- IBTTA
- Local Government
- Vehicle Manufacturers
  - BMW
  - Daimler Chrysler
  - Ford
  - GM
  - Nissan
  - Toyota
  - VW

Working Together!

- Working Group in Place
  - USDOT, AASHTO, Auto Companies
- Public Sector Use Cases Identified
- Preliminary Architecture Developed
- Designing Prototype System
- Evaluating Deployment Options
  - Business Models
  - Institutional Issues
- Conducting DSRC Test Program
**Deployment Options**

- Three Basic Modes of Communication
  - Vehicle to Vehicle
  - Local Vehicle to Roadside
  - Network Vehicle to Roadside
- Any of the Communication Modes Could Be Deployed Singly or in Combination
- Each Could be Deployed Using Various Communication Technologies
- Some May Require Public Sector Involvement
- Challenge – Need for Coordinated Deployment of Roadside and Vehicle Units

**Basic VII Deployment Concept**

- Time from “Deployment Decision” to “Basic Nationwide Capability” would be 2 to 3 years
  - Nationwide footprint of roadside units
  - New vehicles equipped with on-board units
- Streamlined infrastructure deployment process
What Is Nationwide Footprint

- Metropolitan Areas Areas
  - Top 50 Urban Areas
  - 50% of all signalized intersections
  - All urban freeway interchanges
  - 60,000 to 100,000 roadside units

- Rural Areas
  - Some coverage in all 50 States
  - All Interstate intersections
  - All intersection of NHS routes
  - 18,000-23,000 units

- Special Locations
  - Defined by each State = 2500

- Total Initial Deployment
  - 80,000-125,000 Units

- Full Long Term Deployment – 200,000 – 250,000 units

Technical Attributes:

Security / Privacy

- VII safety applications and privacy concerns demand a secure system
  - In vehicle and roadside

- Technical recommendation:
  - Digital signatures (encryption) using Public Key Infrastructure (PKI)
  - Requires a national certificate authority

- General operating strategy
  - Common applications would not require private information
  - Services requiring personalized data would be opt in services
Technical Attributes: Network Operations

- Network operations 24 / 7
- Subscriber authorization
  - Who has access
- Certification of applications for vehicles
- Software updates for current / new applications
- Configuration control

Technical Attributes: Standards

- National standards for
  - DSRC
  - Message sets
  - Data dictionaries
- DSRC standards mandated by FCC
- Technology evolution must be in a regulated / controlled environment

“Long-Term Stability”
Business Model Implications of Technical Attributes

• Requires a capability to:
  – Manage security: certificate authority
  – Ensure quality of service
  – Manage the network
  – Manage standards evolution
  – Manage access to data
• Mechanism needed to perform functions or contract for them
• Public / private oversight essential

Sustainability Requirements

• Recognized that state and local governments do not currently have resources to sustain a telecommunications network
• Capability must be created to be responsible for long-term sustainability
Business Model Implications

- Deployment must be nationally uniform
- Timeliness, security, quality of service, essential
- Installation and O & M addressed up front
- Stable, sustainable arrangement needed
- Public / private oversight required

Need for an Operational Entity

- Oversee VII operations over the long term
- O & M entity with public and private control
  - Contract with a non-profit: FFRDC
  - Private non-profit: AAMVAnet
  - Federal chartered corp: TVA, COMSAT
  - Government agency: FAA
- Via legislation, regulation, and / or incentives
Business Model Options
Current Thinking

• Range of funding approaches
  – Full Federal financing
    • Not through "Conventional Federal Aid"
  – Public/private partnership
    • Telecommunications industry
    • Information services industry
    • Other?
• State/local DOT cooperation in streamlined approach

We have work yet to do

– Application Development
– Privacy
– Data ownership
– Liability
– Deployment approach
– Business approach
Traveler Information Implications

- **Opportunities**
  - New data source
  - Access to the vehicle
  - New business opportunities

- **Issues**
  - Impact on existing business models
  - Data ownership and availability
  - Public vs. private sector

- **Timeframe**
  - Probe data expected to be an early application

Summary

- A work in progress
- Requirements becoming clear
- Many options to consider
- A dynamic environment
  - Technologies, business entities, customer services
Imagine the Possibilities

- A High Risk / High Reward Venture
- Team Consensus: “It is worth pursuing”

Over 42,000 reasons why!