What Can IPv6 Do for DOT?

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How We See Internet Protocols Today

- Internet Protocol (IP) version 4 is the current language that is used by computers to pass data
- IPv6 is the newest version of IP
- IPv6 is designed to overcome some of the weakness of IPv4
  - More secure
  - Scalable
  - Robust services
  - IPV4 supported by wireless technology is becoming more and more ubiquitous throughout private, public and commercial sectors

Forecasting the Future (and not always getting it right…)

"***The phonograph has no commercial value at all***." -- Thomas Edison, American inventor, 1880s.

"Who the hell wants to hear actors talk?" --
H.M. Warner, co-founder of Warner Brothers, 1927

Or…

"There is no reason anyone would want a computer in their home." -- Ken Olson, president, chairman and founder of Digital Equipment Corp. (DEC), maker of big business mainframe/mini-computers, arguing against the PC in 1977.

IPv4 Wireless in Today's Home

- (In)Security
- Limited Network Access Speed
- Immature Technology
- Accessibility/Portability/Scalability
- Limitations to External Communications

Next Generation Home

- More Secure
- Ubiquitous
- High Speed Communications
- Advanced Technology (Intelligent Systems)
- Scalable

Comparison of Home

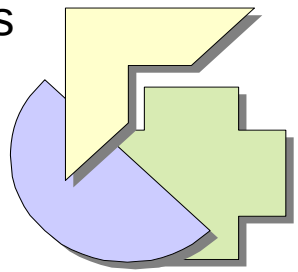
Today's Home

•Paper-based phone books, sticky notes and aged community data.

•Difficult to restructure home with personalized creature comfort.

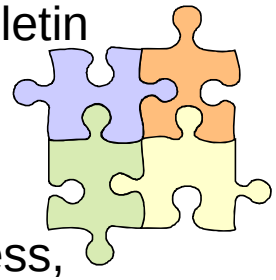
•Dog-eared cookbooks, sour milk, products that are hard to find.

•Limited and unstable wireless systems with relatively slow-speed and expensive internet linkage.



Future Home

•Interactive wireless Bulletin Boards with ubiquitous connectivity.



•Role-based home access, profiling and feature selection.

•Mature RFID and data catalog capabilities and integration to allow a rich set of kitchen or other home-based capabilities.

•Extremely wide-band wireless and internet connectivity.

Current Personal Transportation

- Global Position System/Geo-Spatial
- On Board Second Generation Auto Computers
- Phone/PDA (Personal Digital Assistant)
- “EZ-pass”
- OnStar
- Digital Media/Satellite Radio
- Bluetooth/hands free technology

Examples of Next Generation Private, Commercial and Public Transportation Technologies

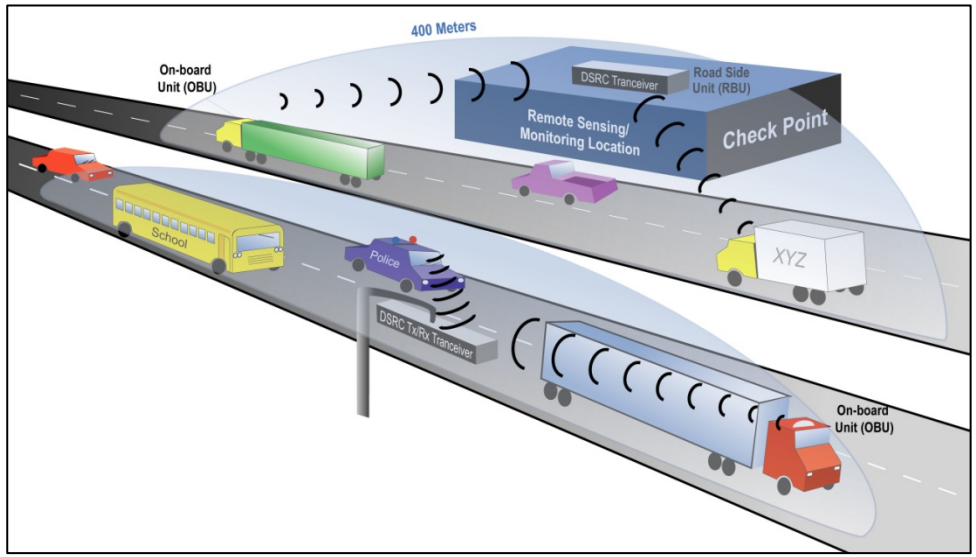
- Intelligent GPS based routing
- Non-interrupted communication — home to work
- Timely notification of onboard vehicle status
- Accident prevention technologies
- Onboard real time entertainment systems
- Multi-media communication systems
- Automatic vehicle location capabilities for commercial and transit fleets
  - ✓ Technology will potentially serve as an *anonymous* traffic flow and weather probe, providing a virtual network of millions of mobile sensors
- US Department of Transportation (US DOT) Joint Program Office Intelligent Transportation System (ITS)

Project Snapshot -- US DOT VII Effort

- VII envisions a nationwide system in which intelligent vehicles routinely communicate with each other and the transportation infrastructure in real time
- The purpose is to enable a number of new services that provide significant safety, mobility, and commercial benefits
- In 2008, a joint decision by the U.S. DOT and the auto industry will determine if the investment necessary to equip new vehicles and the roadway infrastructure with VII communications is warranted and can be synchronized

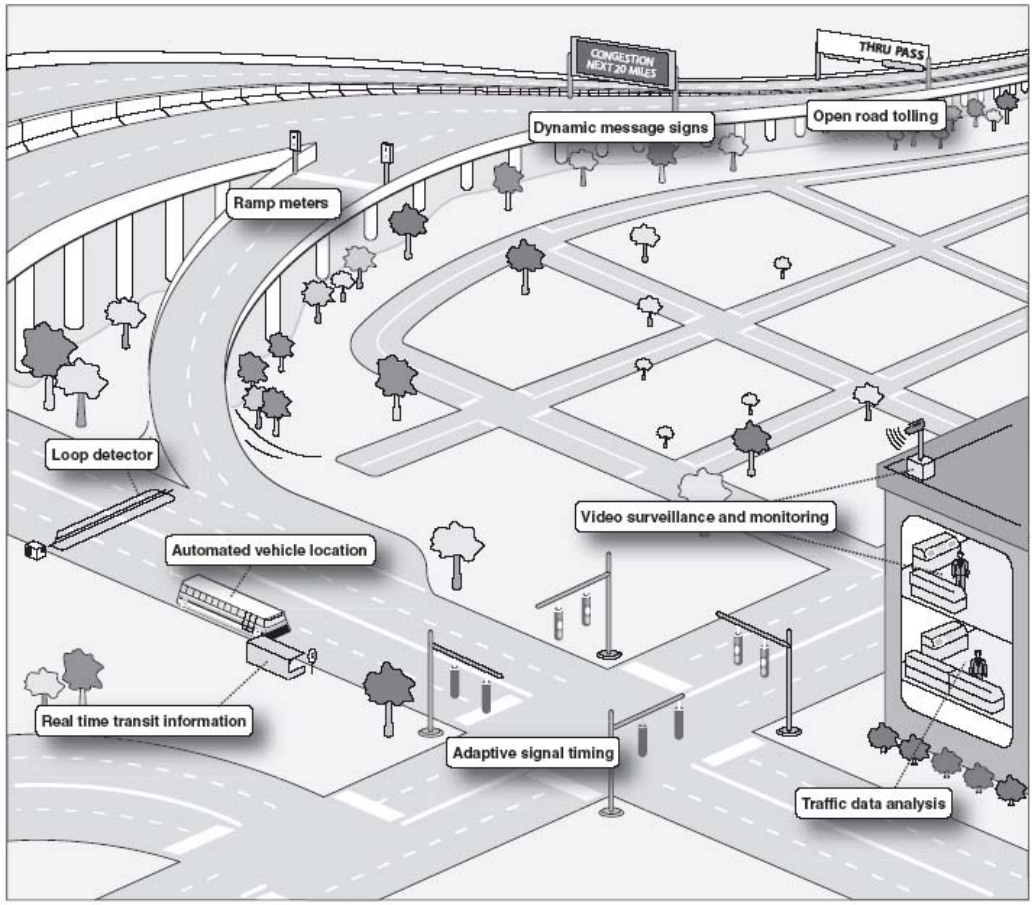
Supporting the Development of the VII Communication System

- U.S. DOT has FCC approval for (co-primary) use of 5.9 GHz spectrum supporting communications between vehicles and roadside access points
- Dedicated Short Range Communications (DSRC) equipment and supporting infrastructure is being developed as part of U.S DOT's VII initiative to provide safety, mobility, and commercial services to the driver
- Imagine the potential number of end-points across the Nation



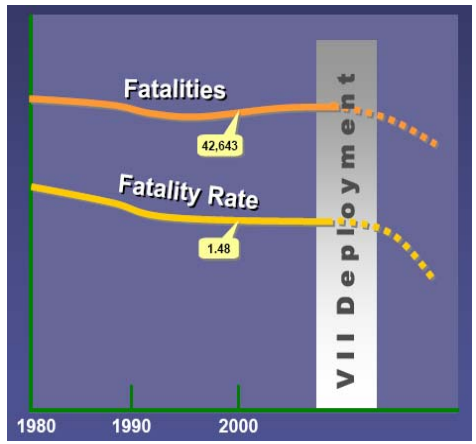
What are Intelligent Transportation Systems?

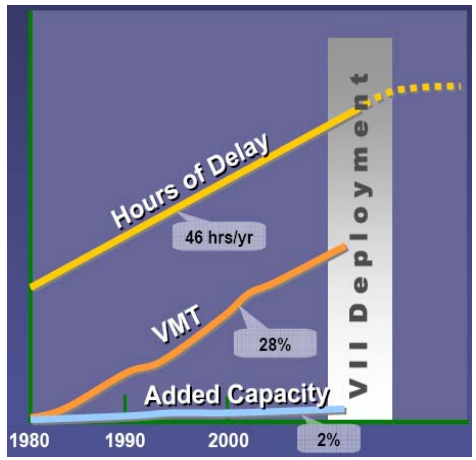
- Intelligent transportation system(s) (ITS) improve transportation safety and mobility and enhance productivity through the use of advanced communications technologies
- ITS encompasses a broad range of wireless and wire line communications-based information and electronics technologies
- When integrated into the transportation system's infrastructure, and in vehicles themselves, these technologies relieve congestion and improve safety
- ITS technology is divided into intelligent infrastructure systems and intelligent vehicle systems



VII Falls Within The ITS Suite of Programs and is the Result of a Confluence of Advances in Several Areas

- Growing emphasis on crash avoidance (Safety) and system management and operation (Mobility) within federal and state transportation agencies
- Growing interest by car manufacturers (OEMs) to extend services to their clients on the road (e.g., telematics)
- Advances in wireless and wireline communications allow cheaper (lower cost of deployment), better (higher throughput), and faster (lower latency) solutions
- FCC allocation of spectrum for vehicle communications—5.9 GHz (DSRC)





This Construct is Intended to Provide a Win-Win Scenario for Public and Private Industry

Automotive companies get safer cars and transmission of vehicle data at low cost

Offer vehicle data for public applications

- Prevent crashes
- Mitigate crash severity
- Transmit real-time safety messages to drivers
- Notify control center of traffic incidents
- Optimize transportation operations and maintenance
- Support transportation planning and roadway asset management
- Enable consumer and business transactions
- Provide a pipeline for remote diagnostics
- Improve auto recall, warranty, and service efficiency

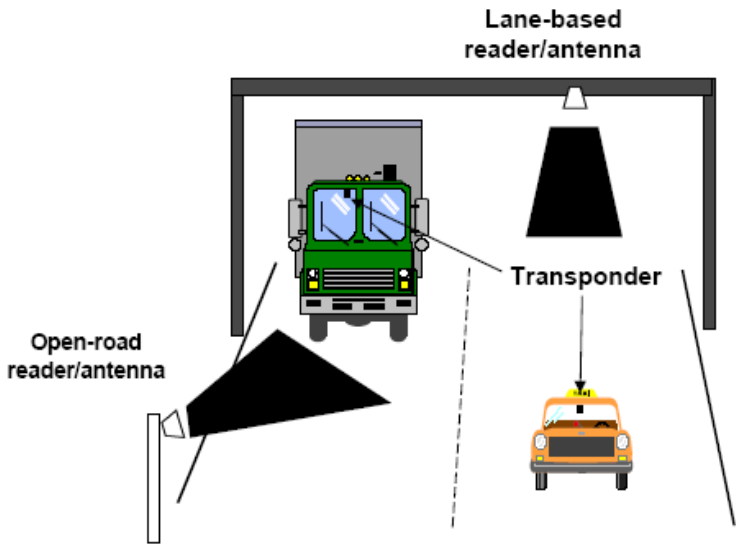
Public agencies get safer roads, improved traffic management, and a new source of planning data

Offer right-of-way for roadside equipment

Dedicated Short Range Communications (DSRC) is a General RF Communications Link Between the Vehicle and the Roadside

- Dedicated Short Range Communications (DSRC) technology has been chosen to support both Public Safety and Private operations
- DSRC fact sheet:
  - Based on IEEE 802.11p
  - Range up to 1000m
  - Data rates from 6-27 Mbps
  - 7 licensed channels in 5.9GHz
  - Low latency ~50ms
  - Security using public key infrastructure (PKI)
  - Long term stability (technology evolution is controlled by FCC and standards)
  - Postured for IPv6 at roll-out

DSRC Components



VII Deployment will Enable a Wide Range of Applications

Work Zone Notification

Intersection Collision Avoidance

Traffic/Congestion Notification

Travel Information

Vehicle Infrastructure Integration

Cooperative Intersections

Cooperative Driving

In-Vehicle Signage

Vehicle-to-Home Applications

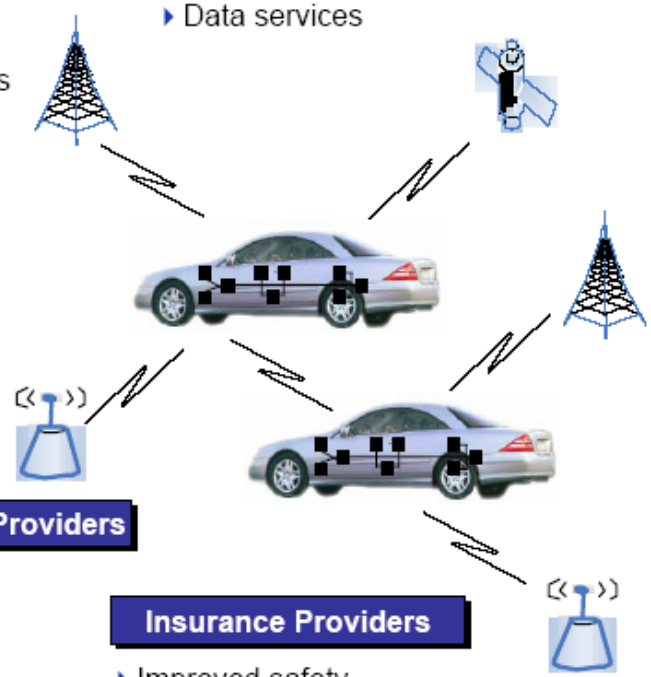
VII will fuel services reaching the entire auto industry value chain that integrates unprecedented government involvement and partnership

Customers
- Improved safety
- Improved mobility
- Commercial and consumer applications

Carriers
- Air time
- New subscribers
- Data services

Vehicle Manufacturers
- Potential increased vehicle sales
- Additional service and device revenues
- Real-time vehicle data for improved service and reduced warranty costs
- Direct access to customer; improved CRM

Highway Departments
- Improved traffic management
- Improved safety



Hardware Suppliers
- Sales

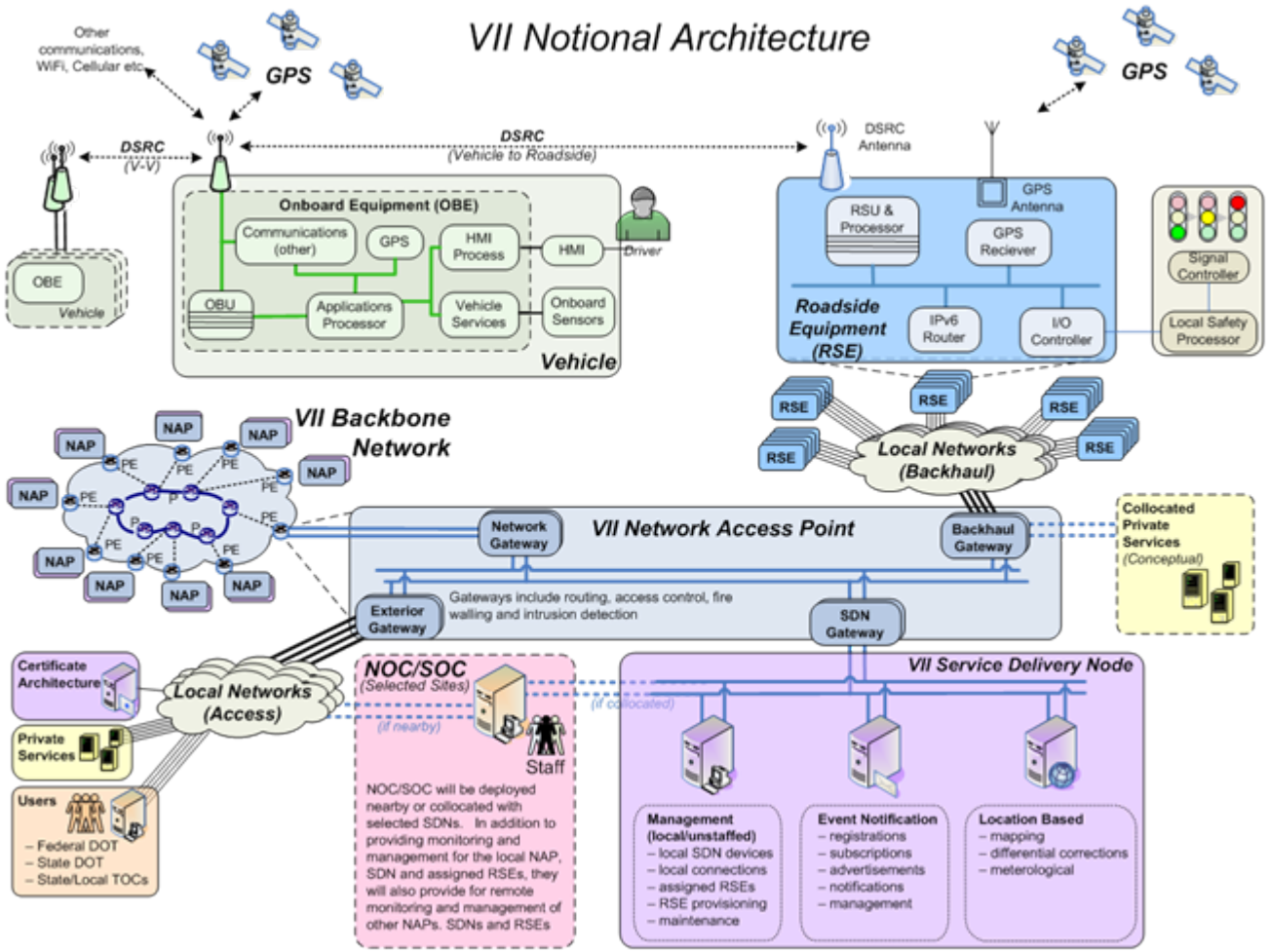
Automobile Dealers
- Sales of services and vehicles
- Marketing

Service/Content/Application Providers
- Subscribers
- Service and hardware revenue
- Access to customer base

Insurance Providers
- Improved safety
- Lowered regulation costs
- Better customer data

Government
- Improved safety
- Improved mobility

VII Notional Architecture --
Potential of Hundreds of Millions of IPv6 End-Points



Managing our Expectations

- System planning, integration and deployment of large State/Federal Government infrastructure systems typically lag leading edge commercial systems development and deployment
- Consequently, some components of the Intelligent Transportation System (leveraging IPv6) may take many years to appear (e.g., Smart roads)
- Funding
- Immediate Acceptance
- Standards, process and format agreements

Challenges & Opportunities

- **VII is a very complex initiative that faces many challenges**

Short-Term Challenges

- Improve coordination and integration among current stakeholder groups
- Address user privacy
- Address end-to-end security
- Drive use cases to completion
- Address mapping requirements/architecture
- Address location accuracy
- Resolve data ownership and access issues

Long-Term Challenges

- Obtain industry wide buy-in
- Engage commercial vehicle entities
- Determine public safety requirements
- Address liability issues
- Stand-up business/operating entity
- Plan for operations and maintenance of VII system
- Ensure system sustainability

How Industry/Government Synergies Help "Get There"

- Enable future development of new net-centric devices, applications and services
- International competition
- Lead by example
- Serve as market catalyst

Questions and Comments