Connected Vehicle Tracks

- NHTSA’s decision to pursue rulemaking for V2V communications is not coupled to the FHWA V2I activities.
- V2I Deployment will be voluntary but if deployed should to the greatest extent possible be interoperable at the National level.
- The related technologies will be leveraged to further enhance transportation safety, improve mobility, lower costs, and reduce the impact it has on the environment.
Commonalities

- DSRC for safety applications
- Security Certification Management System
- Need for interoperability
- Potentially augments / replace other technology
- Societal issues
  - Privacy
  - Benefit & Costs
- Market penetration impacts
Differences

• Other communication technologies for non-safety applications
• Voluntary deployment
• “One Size” deployment doesn’t fit all
• Early benefits to the transportation system’s owner/operator and vehicle owner.
• Potential to get “others” to pay for deployment
V2V Activities

• Decision to pursue rulemaking
• Research Findings
• Advanced notice of proposed rulemaking (ANPRM)
• Pursuing SCMS development / deployment
V2I Activities

- Progressing of V2I Deployment Guidance
- Developing supporting guides, toolkits, products
- Connected Vehicle Pilots
- Connected Vehicle Reference Implementation Architecture (CVRIA)
- Commercial Vehicle Information Systems and Networks (CVISN) program
- Weather Response Traffic Management
- Smart Roadsides
FHWA’s Plans and Objectives
Guidance on Infrastructure Implementation

• Guidance - not regulation
• Currently in draft stage – seeking input
• What and how to implement infrastructure and supporting systems
  – Guidelines
  – Best Practices
  – Toolkit
• Supporting high-priority applications
  – V2I safety applications (crash warnings at traffic signals, etc.)
  – Dynamic mobility
  – Road-weather
  – Environmental
• Based on DOT research and AASHTO analysis of infrastructure needs and deployment approaches
V2I Deployment Guidance Roadmap

Standup workgroup
- Kickoff meeting
- Develop detailed task/product/outcome descriptions

Define public agency needs
- AASHTO Footprint Analysis/Outcomes
- Identify requirements
- USDOT Modal Outreach
- Draft requirements
- Product needs finalized
- Product development SOWs

Standup Deployment Coalition - Secure technical services
- Define possible scope of services
- Develop SOW for technical services
- Contract for technical services
- Standup Coalition

Specific Policy topics
- Organize process
- Select topic areas
- Develop draft policies
- Present to Sr. Policy Task Force
- Agencies' Review
- Recommendations reviewed/approved

Develop non-policy V2I products
- Draft products
- Vet
- Finalize

Finalize products/policies
- Stakeholder input of draft products/policies
- Modify/update
- B/C Analysis, marketing plan, etc.

USDOT review/approval/finalize
- Distribution/marketing guidance
- Distribute products
- Begin updates
Overview of Guidance

• Efforts and Rationale for Guidance: Implementers’
  1. Needs
     • Deployment is coming
     • How do you prepare?
     • Existing guidance on ITS is insufficient for CV
  2. FHWA Analysis: USDOT has results to share
  3. Note: This guidance is not coupled with the NHTSA proposed rulemaking on V2V Communications
Deployment is Coming

• V2V auto industry deployments moving forward
• NHTSA announcement about regulatory proposal that would require V2V in new vehicles
• V2I prototype deployment testing nearing completion
• Ongoing supporting research such as AASHTO Footprint Analysis and Pooled Fund Studies
How Do You Prepare?

• Infrastructure will be deployed and operated by State and local DOT’s
  – Not a “shall” – Use of V2I is not mandated
  – But, you need to know about planning, funding, deployment, etc.

• What investments could be made to leverage a nationwide fleet of equipped vehicles in support of state and local policy and operational objectives?
Existing guidance on ITS is insufficient for Connected Vehicles

• CV Resembles ITS Deployments But Is Different In Many Ways
• Guidance Defines the V2I Components of a CV Environment
• Other V2I Deployment Considerations are described
CV Resembles ITS Deployments But Is Different In Many Ways

• Technologies go beyond connected to be cooperative, allowing data and information to be fused in real-time

• CV technology requires a level of national interoperability and functionality not found in today’s ITS deployments

• Security and Privacy needs for CV are greater than for today’s ITS

• Basic CV technologies are evolving at a dynamic pace
V2I Components of a CV Environment

- Applications: Safety, Mobility, Environment
- Roadside Units (RSUs)
- Signal Phasing and Timing (SPaT) enabled traffic signal controllers
- Data links between V2I components and a traffic management center (TMC) or other back office
- Any sensors or relays that link to or serve those components
Other V2I Deployment Considerations

• V2I deployment sites can serve more than one application, strategy, or impact area.

• V2I deployments and CV technology should consider pedestrians, bicycles, and other possible non-motorized users that may be within highways rights-of-way.

• Autonomous and automated vehicles are not addressed in this guidance at this time.
Walking Through The Sections of the FHWA Draft Guidance

- Workshop – 9/12
- Comment period mid-October
  - Online
  - Email (robert.arnold@dot.gov)
  - Written (to me)
Topics Covered in the Draft Guidance

- Planning
- Federal-aid Eligibility
- V2I Deployments and NEPA
- Interoperability
- Evaluation
- ITS Equipment Capability and Compatibility
- Hardware/Software Certification
- Reliability
- Use of Right of Way
- Allowance of Private Sector Use
- Design consideration for facilities
- Use of existing infrastructure

- Use on public sector fleets
- Procurement processes
- Legacy systems/devices
- Communication technology
- DSRC Service Licensing
- Data Connection and Latency
- Connected Vehicle Privacy Principles
- Connected Vehicle Security
- Data Access
- Manual on Uniform Traffic Control Devices
- Using Public-Private Partnerships
Planning

• V2I site deployments, operations, data access and exchanges will require closer collaboration between modes, jurisdictions, and the private sector
• Planners need to consider V2I strategies in their Long Range Plans
• National ITS Architecture and CVRIA should be used as guides for planning, defining and integrating V2I deployments
  – Application requirement are emerging and can be found on CVRIA site: www.its.dot.gov/arch/index.htm.
• FHWA is developing a planners guide and a companion deployment guide
Federal-Aid Eligibility of V2I Equipment and Operations

• No source of new funds identified
• V2I activities are eligible for Federal-aid Funding
  – Specific program requirements must be met
  – Eligibility may need to be determined on case-by-case basis
• Federal-Aid Funding
  – General Eligibility
  – Safety
  – CMAQ
V2I Deployments and NEPA

• V2I deployment improves efficiency or safety and are covered under 23 CFR 771.117 (c)(21) as a Categorical Exclusion (CE) for certain intelligent transportation systems (ITS)

• Deployments will typically be within existing operational right of way and are not likely to trigger unusual circumstances provisions discussed in 23 CFR 771.117 (b)
Interoperability

• V2I deployments need to be
  – compatible with CV security policies
  – Support the distribution and/or receipt and use of security certificates to the maximum extent possible
  – Protect privacy at the highest level appropriate to the performance of a CV environment

• Information is exchanged through Basic Safety Messages (BSM) using SAE J2735 and “signed” with a valid certificate

• BSM Message Handlers (not an exhaustive list)
Evaluation

• Due to the newness of CV and V2I technology, it is important to determine effectiveness

• General ITS project resources will be useful for this purpose

ITS Equipment Capability and Compatibility

• Early V2I deployments will likely be installed with existing ITS

• Start considering V2I communications and standards when new ITS equipment and traffic signal controllers are purchased and installed

• FHWA recommends for any equipment purchased after January 1, 2017, agency follows system engineering process and deploy equipment in and environment that is CV ready.
• Connected Vehicle Ready is currently defined as a roadside installation that has the following characteristics:
  – Reliable Power Supply
  – Two secure backhaul communication links
  – ITS equipment or controllers that are NTCIP standards compliant
  – Electronic map or geometric description of the surrounding area available in SAE J2735 compliant format
  – Roadside cabinet space sufficient to house an external process that may be installed in the future
  – Considerations/plans for future mounting locations for a DSRC RSU that will enable future V2I communications
Hardware/Software Device Certification

- USDOT intends to enter a Cooperative Agreement with one or more facilities that will conduct qualification and certification testing for various connected devices.
- Cooperative agreement will identify an approach for a Connected Vehicle Certification Testing Program.
Hardware/Software Device Certification (continued)

- USDOT has proposed a four (4) layer approach to connected vehicle devices and applications certification that includes Security Credential Management Systems (SCMS)
  1. Environmental Abilities
  2. Communication Protocol Abilities
  3. Interface Abilities
  4. Overall Application Abilities
Reliability

- Reliability of equipment should be incorporated into the system engineering process – see FHWA Rule 940
- V2I safety equipment – Reliability is paramount and should be incorporated into design, procurement and deployment
- V2I mobility applications will not necessarily backup existing schemes and have standalone functionality.
Use of Right of Way

- Use of ROW for V2I Roadside unites follows current regulations and funding eligibility
- Installation in ROW will be allowed as long as its use has a public benefit and does not impair the safety of the roadway
- Private Sector secondary use is allowed, if
  - Does not interfere with mobility/safety
  - Opt-in, easily disabled, and no cost to drivers
  - Fair market value of private application use established
Allowance of Private Sector Use

• FHWA supports the ability to maximize the possibility of private investment to leverage costs for deployment and operations
• Conditions listed for off-public right-of-way private sector use
• Cost associated with installation and operation of private sector use or components would not be eligible for Federal-aid beyond the operation of the communication backhaul
Design Consideration for Facilities

• V2I applications may be used to mitigate safety and operational impacts that arise due to substandard geometric features of highways

• Deployed equipment needs to be interoperable and coordinated with other modes of transportation

• Avoid stand alone deployments to the maximum extent possible
Use of Existing Structures and Infrastructure

- Installation of CV equipment is allowed on existing structures/infrastructure as long as its use has a public benefit and does not create potential safety issues.
- Private sector secondary use is permissible as long as it complies with Right-Of-Way section.
- Designers should consider how CV technologies will affect pedestrians, bicyclists and other non-motorized users; access to transit services; and livability enhancements.
Use on Public Service Fleets (Including Incident Responder Vehicles)

- Federal-aid highway funds can be used for V2I applications installed on public sector vehicles.
- To achieve interoperability, all components need to comply and be consistent with the CV architecture and standards.
- Applications on public fleets must comply with all guidance and recommendations for driver attention.
- Guidance and negative impacts of misuse should be conveyed to operators with signal preemption capabilities.
Procurement Processes

• Overarching goal is consistent, secure, and interoperable implementations

• A generation of ITS deployment has provided many agencies with mature procurement practices that can guide CV environment procurements
  – Proactive Stakeholder Involvement
  – Stakeholder engagement through the entire procurement process
Procurement Processes (Continued)

Key actions for Quality Deployments

• Identify existing assets that can be modified for delivery of power and communications to the deployment location
• Consult ITS Costs Database
• Consult with staff who manage statewide IT
• Apply specification produced by USDOT / establish state or local Qualified Products List
• Modify existing guides for project deployment to include CV assets as part of the project cost estimation. Reference Systems Engineering for ITS and new FHWA reference materials under development.
• Apply AASHTO’s Connected Vehicle Footprint Analysis
• Establish test procedures and systems acceptance methodologies
• Coordinate with the agency’s asset management unit
• Establish and operations and maintenance plan for the deployed system
Legacy Systems/Devices

• Guidance covers legacy systems owned and operated by public agencies
• Legacy systems or devices critical to the function of active safety applications must be retrofitted or replaced in order for the safety application to continue to do its job.
• Other legacy systems and devices may be augmented by V2I safety applications to improve safety or mitigate a design exception.
• Legacy systems may support or be supplemented by other V2I applications
  – Retrofitting or replacement may not be required
  – However, support for V2I and other CV applications and functions must be considered as these legacy systems and devices are upgraded and replaced.
• System engineering process should be used in establishing equipment maintenance and replacement plans for legacy systems.
Communication Technology

- Selection of communication
  - will be based on a system engineering analysis
  - Consistent with application interoperability across the Nation
  - Use must comply with established requirements for non-interference
- DSRC is accepted technology for V2V safety
- Other communication technology may be better suited for V2I mobility applications.
- FHWA developing reference guides/tools that deployers should reference once published
<table>
<thead>
<tr>
<th>Dedicated Short Range Communications (DSRC) Service Licensing</th>
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<tr>
<td>• December 17, 2003 FCC Report and Order established licensing and service rules for DSRC Service, under 47 CFR 95, in the ITS Radio Service in the 5.9 GHz band</td>
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<td>• Safety applications always have primary status over non-safety applications in this band.</td>
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Dedicated Short Range Communications (DSRC) Service Licensing (Continued)

• Government entities will be authorizing a geographic-area license based on that entity’s jurisdictional area of operations

• Non-Government entities will be licensed based on each applicant’s area of operations

• Likelihood of cross border and overlapping geographic-area issues – high level of jurisdictional cooperation and coordination across boundaries will be necessary
Data Connection and Latency

• DSRC is line of sight only / It is expected other communication technology will be used
• Reliable data connection and low latency must be maintained to ensure safe and reliable CV system
• Low latency should be measured from end-to-end or between the originating and responding application
Connected Vehicle Security

• Security Certificate Management System (SCMS) is designed to protect the security and privacy of BSM data exchange between vehicles and between vehicles and infrastructure

• CV SCMS is a complex, advanced solution to provide trust and authentication within a highly mobile environment

• USDOT has determined that the CV PKI should be organized so that no single organization within the PKI holds enough information to link BSM from a vehicle to a specific driver or identified vehicle
Data Access

• Federal law does not assign ownership, access, and use limitations to broadcast data.

• As a result, USDOT and FHWA do not currently have a specific policy assigning data ownership or limiting access to BSM data.

• Transparency and consent will therefore be critical elements in V2I deployment.

• FHWA will issue further documentation on this topic
Manual On Uniform Traffic Control Devices

• V2I applications providing traffic control information to drivers must be consistent with the MUTCD
• In vehicle displays will be implemented by OEMs
  – Data received must be sufficient to generate the appropriate information consistent with the MUTCD
  – Information cannot conflict with road signs, signals and markings
  – In-vehicle systems must convey priority captured by road signs, signals, and marking
Using Public Private Partnerships (P3)

- To the extent possible, P3 should be considered for deployment
  - “Commercial” applications cannot compromise safety and mobility objectives
  - Provide safe maintenance practices
  - Hold the jurisdiction harmless due to lack of both public and private services.

- P3 agreements needed
Products/Tools Under Development

- System Engineering Process for Vehicle to Infrastructure
- V2I Benefit Cost Analysis Tool
- V2I Planning Guide
- Guide to V2I Cyber-Security
- Guide to Licensing DSRC Roadside Units
- Guide to V2I Communication Technology Selection
- V2I Message Lexicon
- Guide to Initial Deployments
- Warrants for Deployment
How do you stay engaged?
Questions
V2I Deployment Coalition