

Status of ITS in United States

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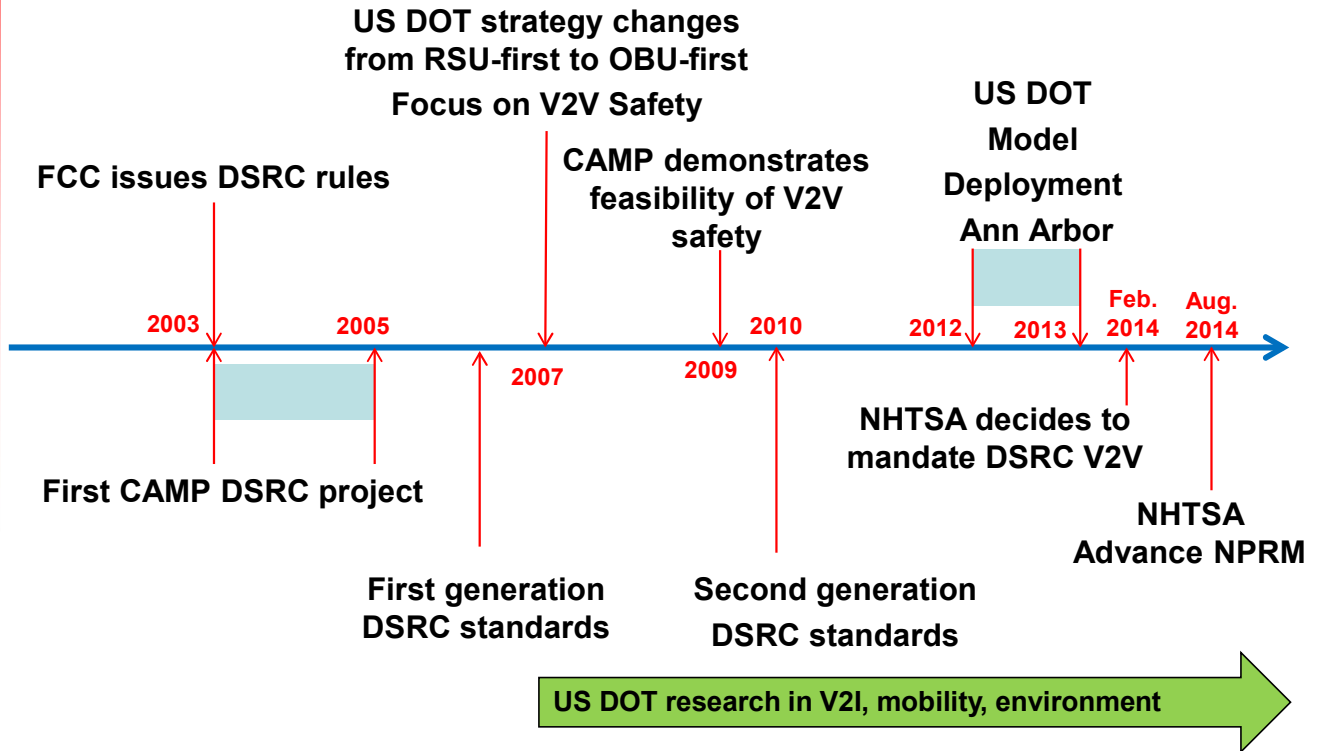
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Outline

- Update on NHTSA plan and US DSRC Standards
- DSRC Spectrum Sharing Issue
- Thoughts on use of DSRC in support of automated driving

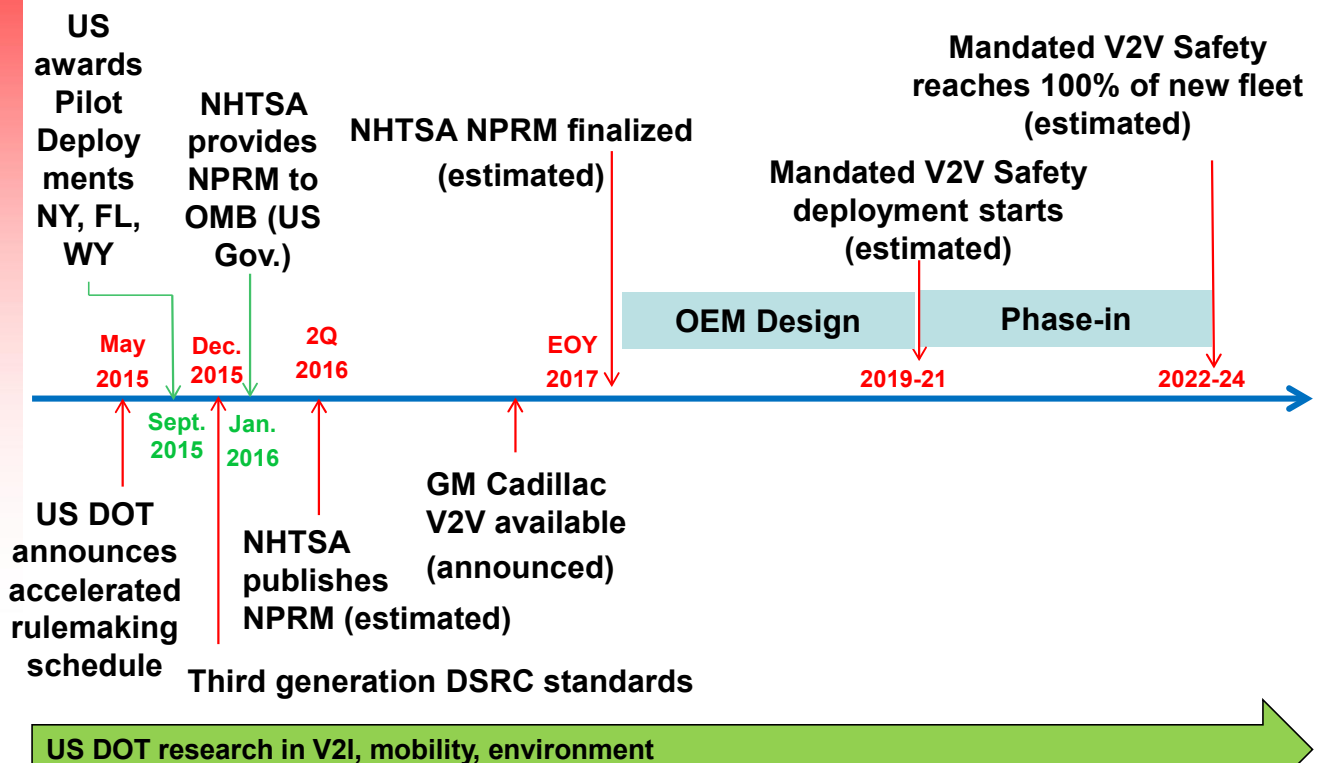
NHTSA DSRC Rulemaking

Events prior to 2015 ...



NPRM = Notice of Proposed Rulemaking

Events moving to deployment



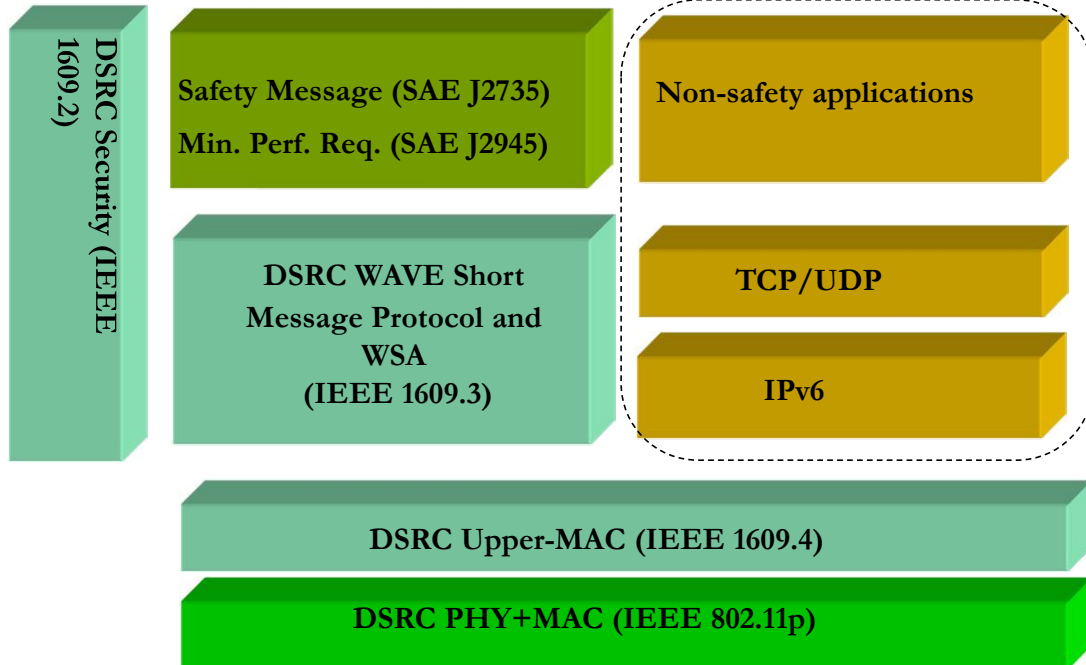
OMB = Office of Management and Budget

RSU Deployment: Road authorities

Implication for US Standards

- All IEEE 1609 and SAE standards revised in 2015
- SAE J2945/1 V2V Safety Communication Requirements was published for the first time:

On-Board System Requirements for V2V Safety Communications



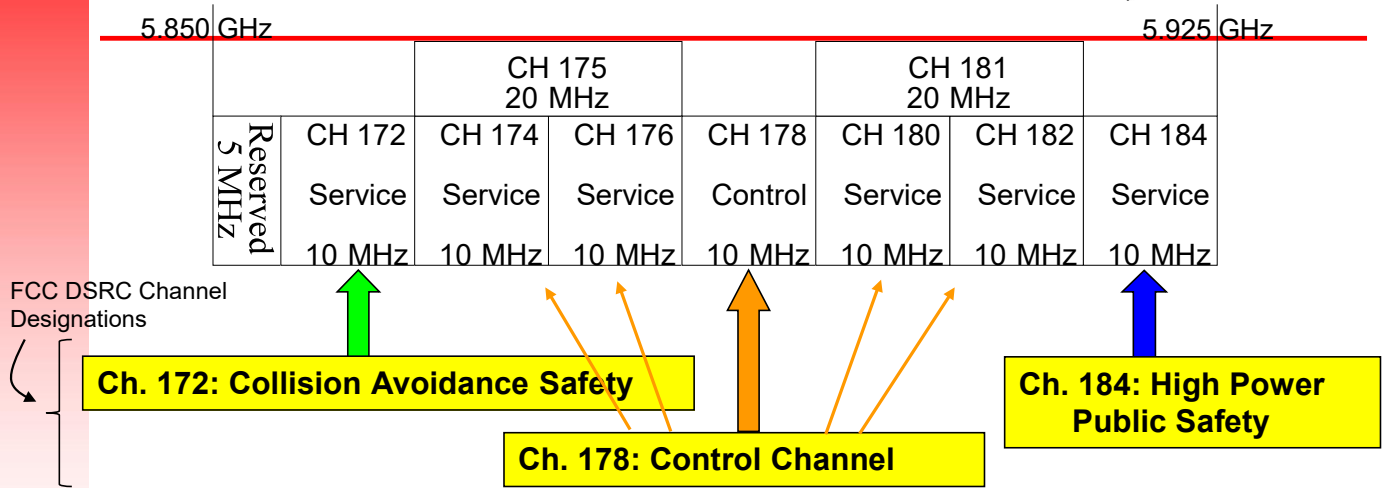
Additional US Standards

SAE is working on additional standards, beyond those critical for USDOT rulemaking:

- Revised Map and SPaT messages (Signal Phase & Timing)
- Revisions of Signal Preemption messages
- Personal Safety Message – for pedestrians, bicyclists, road workers ...
- Cooperative Adaptive Cruise Control
- Platooning
- New attention to Traveler Information Message (I2V)

Possible joint work with ETSI

DSRC Band Plan

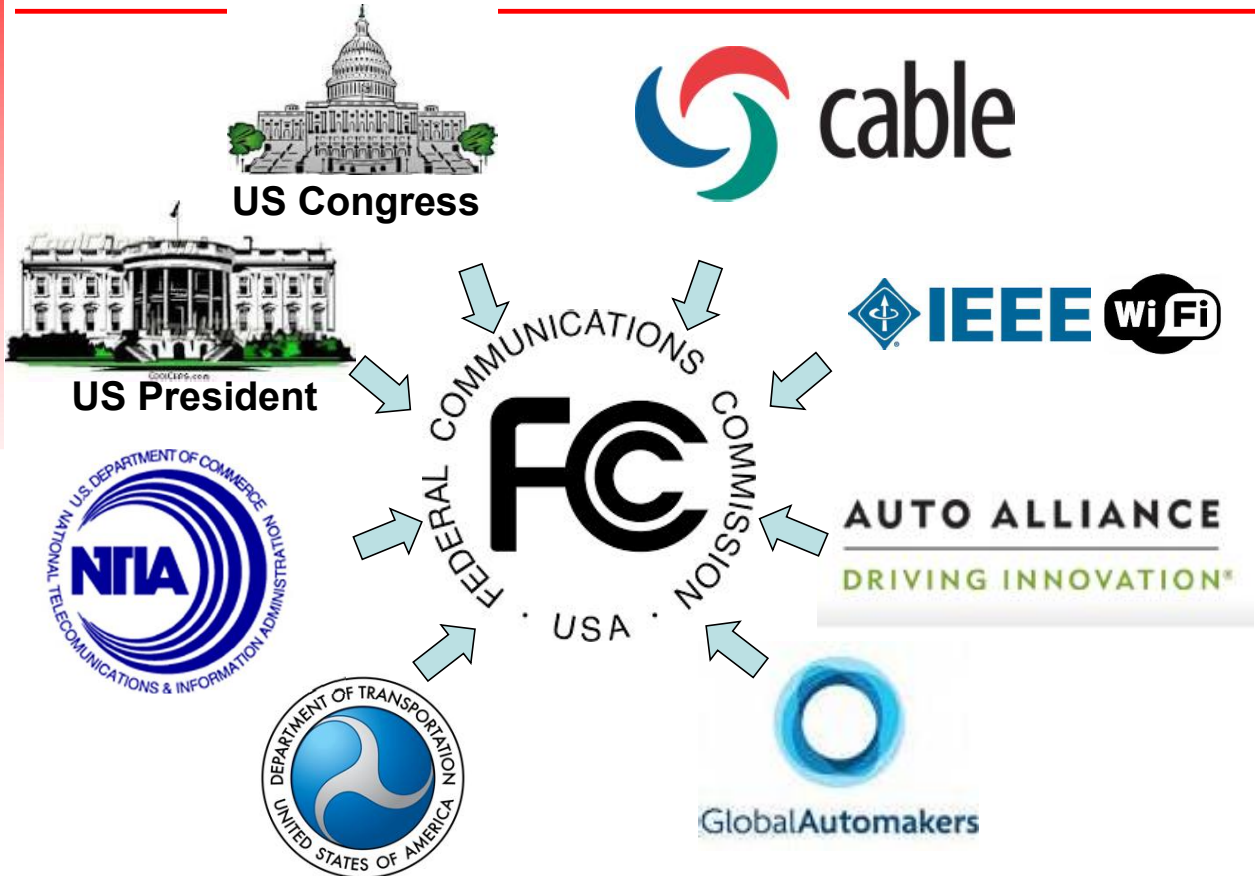


- Ch. 172 likely to be limited to BSM, MAP, SPaT (and possibly a few others)
- Most DSRC applications will use other channels.
- Many of those applications have safety implications and critical communication performance requirements
- Automated Driving-related applications are prominent among these

DSRC Spectrum Sharing Issue

- DSRC/C-ITS operates in licensed 5.9 GHz spectrum in the US
- Unlicensed devices (Wi-Fi, LAA) want access to more spectrum
 - Government regulators see economic growth advantages
- Sharing between licensed & unlicensed devices is new emphasis
 - Unlicensed must not cause “**Harmful Interference**” to licensed
 - Sharing with radar systems works, based on “detect & vacate”
 - But, sharing with short range V2V and V2I is quite different
- US FCC initiated formal question about 5.9 GHz sharing in 2013
- IEEE 802 “Tiger Team” completed work March 2015 without consensus
- Biggest risk to successful DSRC deployment

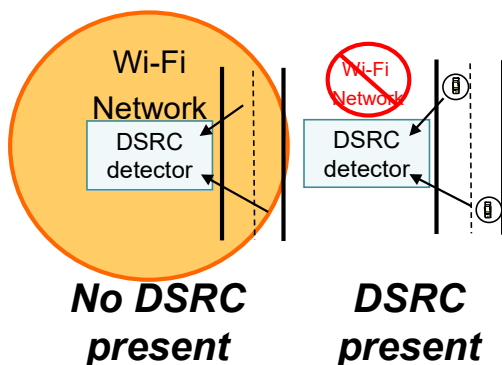
Major US Stakeholders



Two sharing proposals

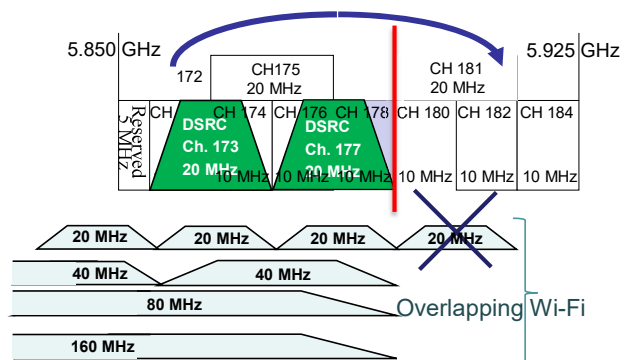
DETECT & VACATE:

- Proposed by Cisco
- Currently being tested
- No changes needed to DSRC
- Each Wi-Fi device has a DSRC detector
- When DSRC detected, no WLAN
- When no DSRC present, WLAN ok



RECHANNELIZATION:

- Proposed by Qualcomm
- Auto industry opposes this
- Not completely defined – cannot yet be tested
- Requires significant changes to DSRC operation
 - Shift key safety messages
 - Use 20 MHz channels



Current Status

Focus is turning to testing:

Cisco Detect & Vacate:

- Cisco developed prototype DAV hardware
- Cisco and auto groups told FCC in May about plans for joint testing
- Cisco provided preliminary test results in August, -95 dBm detection

Testing Principles

- US Senators prompted DSRC, Wi-Fi, and Satellite stakeholders to agree on a set of “Testing Principles” in September
- Two FCC Commissioners called for FCC to sponsor public testing

FCC/US DOT:

- US DOT published a DSRC-Unlicensed Device test plan in August
- **FCC will announce public test plan soon: 3 Phases**

1. **Lab testing**
2. **Outdoor, small number of devices**
3. **Outdoor, large number of devices**

Proposals companies
(Cisco, Qualcomm)
should provide prototypes

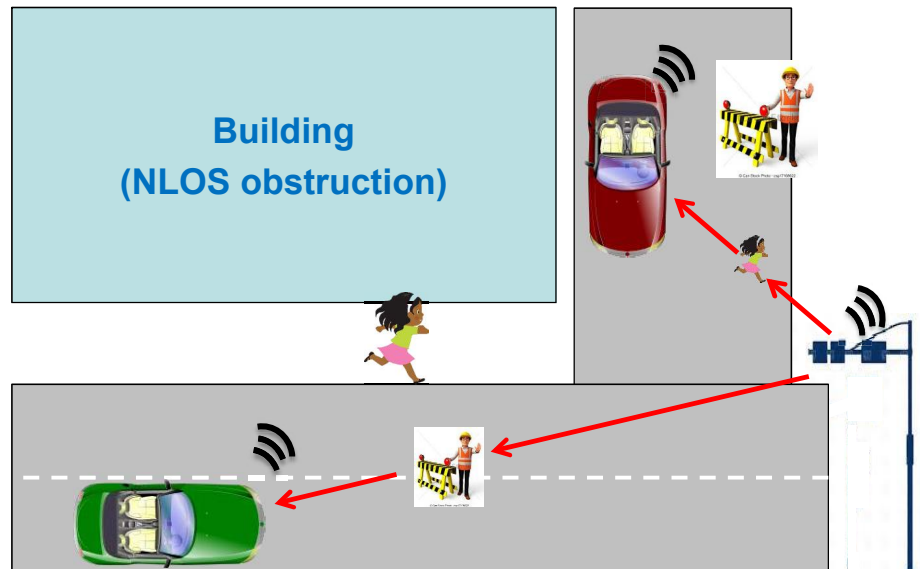
Communication to support Automated Driving

Categories of support

- **Remote sensing**
- **Planned movement and negotiation**
- **Other?**

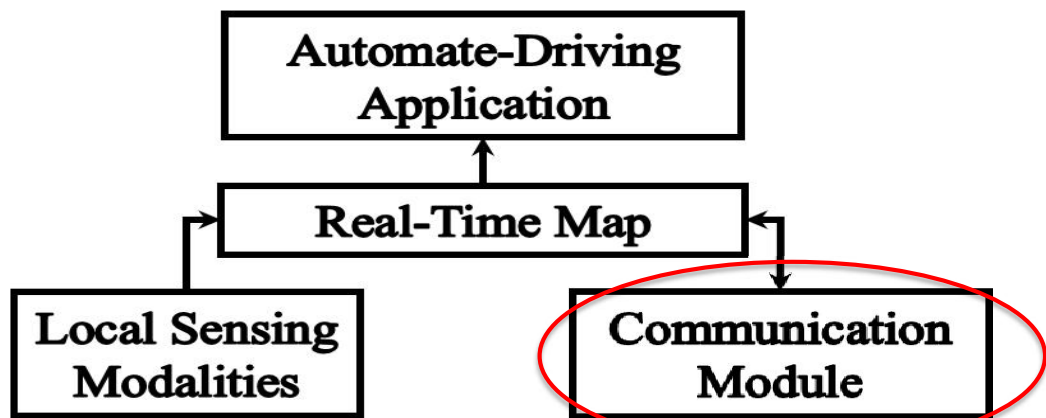
Remote Sensing

- Automated Driving relies on sensing
- **Communication augments sensing**
- Non-line-of-sight
- **Extended Range**
- Additional Precision



Sharing sensor information can improve an automated vehicle's awareness of potential hazards, including pedestrians, bicyclists, other vehicles, road works ...

Augmenting & Sharing Real-Time Map



- Scalability is a concern – May use significant DSRC spectrum
- Need adaptive content management
- ***“Connected, automated vehicles that can sense the environment around them and communicate with other vehicles and with infrastructure have the potential to revolutionize road safety and save thousands of lives.” – US DOT Sec. Foxx 5/13/15***

Planned Movement and Negotiation

- **Machine-to-machine Communication**
- **Negotiate and share planned movement**
- **Cooperative ACC**
- **Join/Leave/Manage platoon**
- **Negotiate lane merge and lane change**
- **Note: humans also communicate in subtle ways**

- **See also “Why Automated Vehicles need to be Connected Vehicles,” Dr. Steven Shladover, IEEE VNC Keynote 2013**
 - http://www.ieee-vnc.org/2013/media/IEEE_VNC_BostonKeynote_Shladover.pdf

Summary

- **US DOT V2V Mandate is proceeding**
 - **Expect NPRM publication 2Q 2016**
 - **US DSRC standards revisions completed in 2015**
- **DSRC Spectrum Sharing is biggest risk for deployment**
 - **Focus is now on testing**
- **DSRC support for automated driving**
 - **Requires preservation of DSRC spectrum**
 - **Sensing and Negotiation**
 - **Active research area**
 - **New standards are in development**