

THE FUTURE OF CONNECTIVITY IN TRANSPORTATION: FROM 5.9 GHz to 5G

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Dedication of 5.9GHz DSRC



- FCC Report and Order FCC 99-305 allocated 75 MHz of spectrum in the 5.9 GHz DSRC band
- The FCC noted the benefits of DSRC "...to improve traveler safety, decrease traffic congestion, facilitate the reduction of air pollution, and help to conserve vital fossil fuels."



- Original FCC spectrum allocation in 1999; FCC amended allocation in 2004 and 2006
- FCC refreshing the record in 2016
 - Updates to sharing proposals
 - Solicits equipment for testing



What Do We Think We Can Achieve?

DSRC-ONLY Applications:

Applications that cannot be replicated by any current, known vehicle-resident sensor- or camera-based systems:

- Dependent on communications interoperability
 - V2V:
 - Intersection Movement Assist (IMA)
 - □ Left Turn Assist (LTA)
 - Emergency Electronic Brake Light

• V2I:

- Red Light Violation Warning
- Curve Speed Warning
- Reduced Speed/Work Zone Warning

Automation

High-speed Platooning



A: Broadcasts hard-braking 'event' when decelerating over the defined threshold B: Vehicle potentially obstructing the view of Driver C and D C and D: Receives hard-braking event from A and displays a warning if the vehicle is in the forward path





Architecture & Standards for ITS



- US DOT maintains a National reference architectures for ITS
 - Connected Vehicle Reference Implementation Architecture (CVRIA)
 - Integrated into Nation ITS Architecture during 2017
 - Multi-view, communications view identifies standards at high level
 - Detailed standards/profile specifications being developed
 - International cooperation
- Architecture evolves with technology, ITS needs
- Supports multiple appropriate communications technologies
- Specifies specific technology when required
 - 5.9 GHz DSRC for universal interoperability of V2V safety
 - Universal, no-cost public access for safety, mobility, sustainability services
 - Does not preclude complementary approaches



DSRC Eco-System



Technical Maturity	 ✓ Physical Medium (802.11p-wirless local wide area network (LAN) Standards ✓ IEEE Standards for Wireless Access in Vehicular Environments (WAVE)—Architecture, Security and Management Standards for V2V and V2I ✓ SAE Data Standards—Dictionary, Message Sets ✓ SAE Performance Standards
	 Band Plan supports a highly mobile environment (low latency, multi-path resilience, no association times)
	 Appropriate research into noise/interference allow applications to account for noise above and below the band
Technical Efficiency	 ✓ Band Plan allows for: → High density per second per square kilometer → Innovative use of spectrum: broadcast + peer-to-peer modes
Policy and Institutional	 ✓ User requirements are met: → Trust and Authentication → No subscription fee
	 ✓ Institutional requirements are met: → Aligns with regulatory constraints → Achieves co-existence with other primary users

 \rightarrow Achieves appropriate level of international harmonization

DSRC Channel Usage



* Flexible channel assignment examples per SAE J2945/0 (draft in ballot)

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- USDOT and industry has made considerable investment in life-saving technologies—emerging in our CV Pilots and Smart Cities now
- Spectrum sharing has introduced a new challenge
- USDOT is not opposed to spectrum sharing *if primacy respected*:
 - With the condition that unlicensed devices allow interference-free operations of crash-avoidance and other ITS uses in real-world conditions
- FCC's Rule (Part 15):
 - The Nation's deployment preparations are dependent upon FCC and NTIA enforcing Part 15—unlicensed devices must not interfere with licensed services
- NHTSA has submitted an NPRM on V2V communications to OMB



Coordinated Research

- USDOT Research Plan v3.5.3: (Update to be released December 2016)
 - Establishing baselines for device operations
 - Measuring interference under varied environmental scenarios
 - Identifying thresholds at which interference occurs
 - (http://www.its.dot.gov/research_archives/connected_vehicle/pdf/DSRC_TestPlanv3.5.3.pdf)
- FCC Test Plan Published (October 2016)
 - Phase I Laboratory Testing (in progress)
 - RF Characterization Measurements
 - Benchtop Interference Susceptibility Tests
 - Interference Mitigation Tests
 - Phase II: Basic Field Research with Devices (being planned with USDOT
 - Phase III: "Real-world" Scenario Testing (being planned)
 - (https://transition.fcc.gov/oet/fcclab/DSRC-Test-Plan-10-05-2016.pdf)



Evolving into the Future

• 5.9 GHz DSRC:



Opportunities on the Horizon:

- □ 5G, 60 GHz
- Software defined radios
- New forms of Wi-Fi

USDOT Research:

- USDOT researching and comparing requirements to DSRC to determine their capability to support cooperative safety/mobility/sustainability transportation applications.
- Tracking/participating in standards fora ITU, ISO, IEEE 802.11/1609
 - Monitoring 3GPP & oneM2M evaluating greater engagement





• 5G Requirements Timeline:





Timeline & phasing

There will be **two phases** for the normative work

- The first release of the 5G specification will be completed by Sep. 2018/Release-15, addressing the more urgent subset of the commercial needs
- The second release of the 5G specification to be completed by Mar. 2020/Release-16, for the IMT 2020 submission and to address all identified use cases & requirements

With the following, tentative, release timing



Advancing Into the Future





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