DEDICATED SHORT-RANGE COMMUNICATIONS (DSRC) AND SPECTRUM POLICY

Volker Fessmann
Transportation Research Specialist
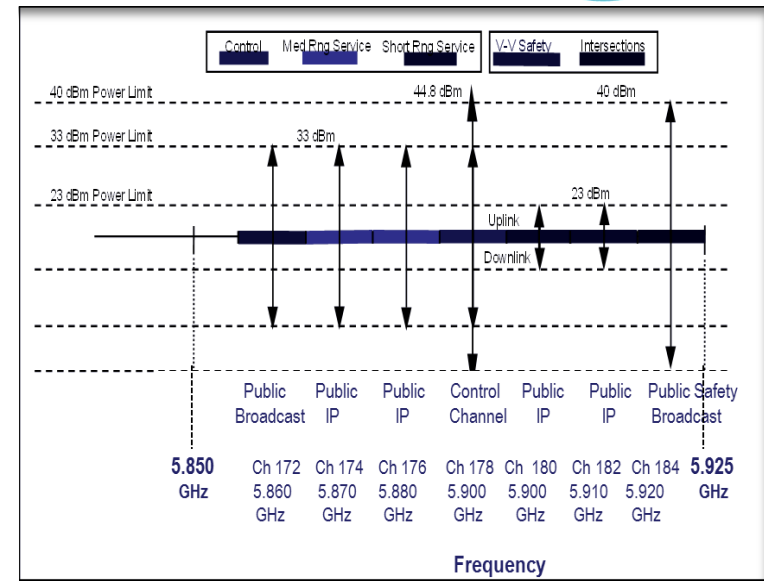**FHWA – Office of Safety R&D**

ITS Joint Program Office

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Dedication of the 5.9GHz DSRC Band

- FCC Report and Order FCC-03-324 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.*"

Dedicated Short Range Communications

- **What it is**
  - Low latency, Wi-Fi-like medium adapted for vehicle environment
  - Original FCC spectrum allocation in 1999
  - FCC revised allocation in 2004 and 2006
  - FCC refreshed the record in 2016
- **How the technology works**
  - Data can be distributed in a broadcast mode (300m range – line of sight)
  - Peer-to-peer data exchanges as well
  - Engineered to work well in a moving vehicle environment

DSRC Spectrum Basics

5.850 GHz								5.925 GHz
			CH175				CH131	
5850-5855 reserve 5 MHz	CH172 service 10 MHz	CH174 service 10 MHz	CH176 service 10 MHz	CH178 control 10 MHz	CH180 service 10 MHz	CH182 service 10 MHz	CH184 service 10 MHz	

Source: FCC Report and Order FCC 03-324

- **Packet-based** medium based on **IEEE 802 family** specifications for lower-layer definition

- Additional **network** layer definitions and a **cryptographic** process for establishing trust and protecting confidentiality given in **IEEE 1609 family**

- **Payload** definitions and performance requirements for common data units established in **SAE standards**

- General **IP transport** available with certain **priority** requirements and packet **size** limitations

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DSRC Channel Usage

5.850 GHz		CH175			CH181		5.925 GHz
5850-5855 reserve 5 MHz	CH172 service 10 MHz	CH174 service 10 MHz	CH176 service 10 MHz	CH178 control 10 MHz	CH180 service 10 MHz	CH182 service 10 MHz	CH184 service 10 MHz

Source: FCC Report and Order FCC 03-324

Virtual guard band from UNII-3 below

Time-critical safety-of-life and property applications; e.g., V2V safety, situational awareness, intersection safety

*e.g., I2V safety, mobility & non-priority applications**

*e.g. vulnerable road user & security communications**

WAVE Short Message Protocol (WSMP) broadcast only; service advertisements, broadcast-based services with minimal bandwidth requirements

*e.g., future V2X safety, security, mobility & non-priority applications**

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Public safety or government applications only; e.g., emergency vehicle signal pre-emption, other public safety, public transit

Flexible assignment to promote spectral efficiency, support application priorities and prevent adjacent channel interference; dynamic assignment by control channel

Flexible assignment to promote spectral efficiency, support application priorities and prevent adjacent channel interference; dynamic assignment by control channel

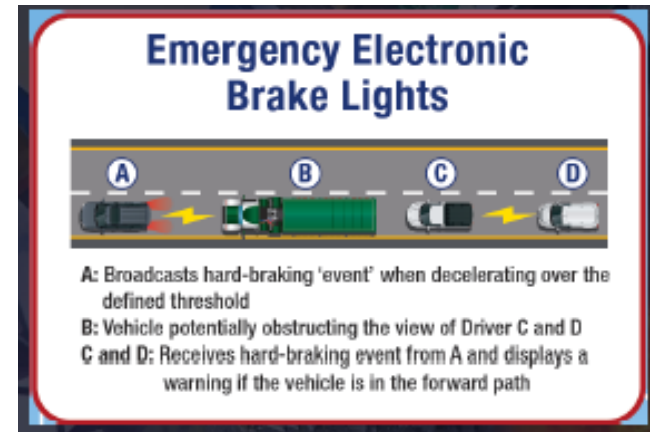* Flexible channel assignment examples per SAE J2945/0

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:

- **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

Emergency Electronic Brake Lights

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

DSRC Environment

DSRC

Technical Maturity
- ✓ Physical Medium (802.11p-wide area LAN) Standards
- ✓ Band plan supports a highly mobile environment *(low latency, multi-path resilience, no association times)*
- ✓ Appropriate measurements of noise/interference allow applications to accounts 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 fees
  - → Privacy, Security
- ✓ Institutional requirements are met:
  - → Aligns with regulatory constraints
  - → Achieves co-existence with other primary users

DSRC Related Research Reports

- Vehicle-to-Vehicle Communications: Readiness of V2V Technology for Application

  - http://www.nhtsa.gov/staticfiles/rulemaking/pdf/V2V/Readiness-of-V2V-Technology-for-Application-812014.pdf

- DSRC Technology and Application – Report to Congress

  - https://www.its.dot.gov/research_archives/connected_vehicle/pdf/DSRCReportCongress_FINAL_23NOV2015.pdf

- DSRC Test Plan

  - https://www.its.dot.gov/research_archives/connected_vehicle/pdf/DSRC_TestPlanv3.5.3.pdf

- DSRC Licensing and Spectrum Management Guide

  - https://rosap.ntl.bts.gov/view/dot/3577

FCC Record Refresh for 5.9 GHz

- Federal Register Notice
  - https://federalregister.gov/a/2016-13510
  - Published on June 7, 2016
  - Comments provided by July 7, 2016
 - Reply comments provided by July 22, 2016

- *The Commission solicits the submittal of prototype unlicensed interference-avoiding devices for testing, and seeks comment on a proposed FCC test plan to evaluate electromagnetic compatibility of unlicensed devices and DSRC.*

Background on Ideas for Sharing

- Two primary mechanisms for sharing the spectrum are being explored:

  □ "detect & vacate": an approach whereby unlicensed (Wi-Fi) devices operate in same channel as DSRC but must vacate the channel if DSRC signals are detected.

  □ "rechannelization": splits the band to giving the lower portion to Wi-Fi and upper portion to DSRC.
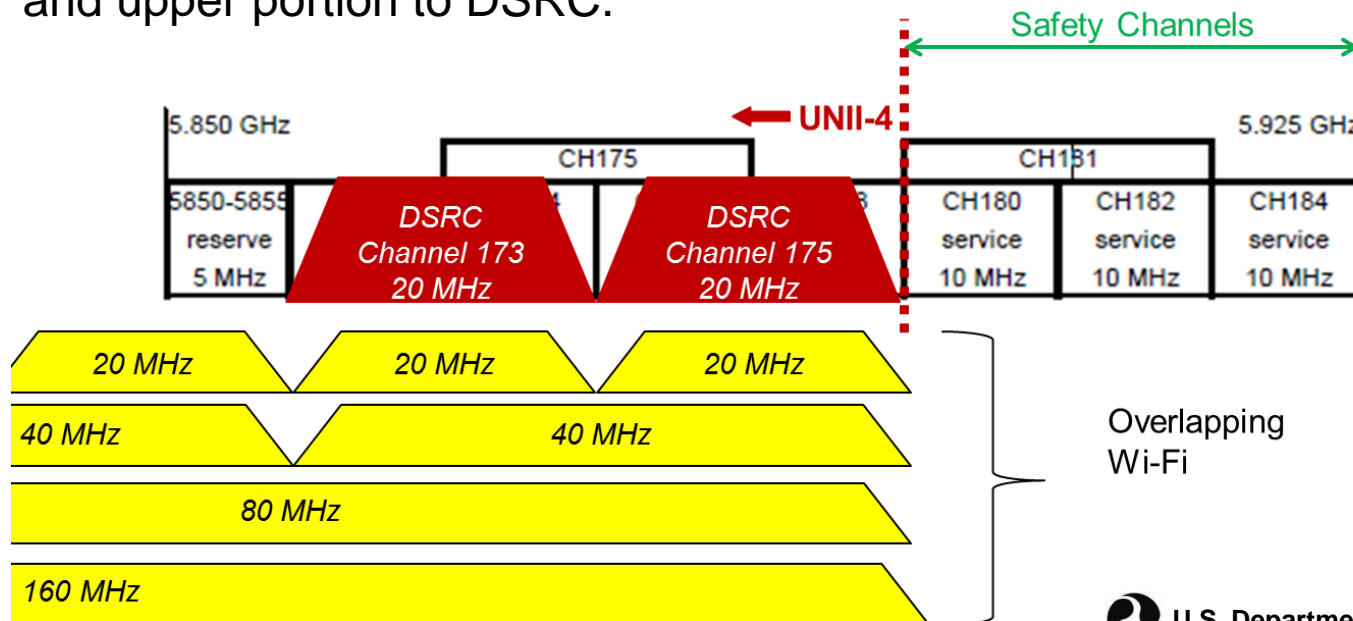
FCC 5.9 GHz Testing Status

- FCC Test Plan Published (October 7, 2016)
  - https://transition.fcc.gov/oet/fcclab/DSRC-Test-Plan-10-05-2016.pdf
- FCC Open House (October 21, 2016) – Review Phase I Testing
  - https://ecfsapi.fcc.gov/file/110254808472/13-49.pdf

- FCC Outlined a Three Phased Testing Strategy
  - Phase 1: Laboratory Bench Testing
  - Phase 2: Basic Field Research with Devices
  - Phase 3: "Real-world" Scenario Testing

Phase 1 – Update

- **Test Units Submitted to FCC in Response**
  - Nine UNII-4 devices provided by five parties in September 2016
  - Six DSRC devices provided by industry in September 2016
  - DOT provide same 10 MHz DSRC devices in October 2016
  - Two 20 MHz DSRC devices provided by industry March 2017

- **Current Status**
  - FCC has completed the evaluation of operation and performance of the devices submitted for testing
  - FCC is developing the final report which will be public

Phase 2 and 3 – Update

- Phase 2 and 3 Testing are dependent on successful completion of Phase 1
- Planning for Phases 2 and 3 has not started yet
- DOT previously offered to provide resources to support FCC in Phase 2 and 3 testing, such as:
  - Test facilities
  - DSRC devices
  - Technical expertise

USDOT Research Activities

I. 5.9 GHz Spectrum Sharing Research:

- Provided technical support for FCC DSRC Phase 1 Laboratory Testing
- Completed initial DSRC & Wi-Fi assessment with automotive industry
- Conducting additional DSRC interference testing with NTIA and US Army
- Potentially supporting FCC Phase 2 and 3 Testing

II. LTE & 5G Technical Developments:

- Analyzing LTE-V2X requirements and related technical developments:
  - AT&T, Ford, Nokia and Qualcomm Launch Cellular-V2X Connected Car Technology Trials
- Monitoring the development of 5G standards that related to V2X technologies

III. International Radio Regulations:

- Actively participating in the International Telecommunication Union – Radiocommunication Sector (ITU-R) to share V2X technical information on relevant ITS agenda items

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Volker Fessmann

Transportation Research Specialist

Volker.Fessmann@dot.gov

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