

Sharing the 5.9 GHz Band Between Unlicensed Devices and DSRC

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- 🕒 **Internet connectivity (via in-car modem or tethering)**
Streaming or Fast content downloading at hotspots (Redbox “filling station”)
- 🕒 **Displays (mirroring, A/V content to other screens)**

Connecting to Internet



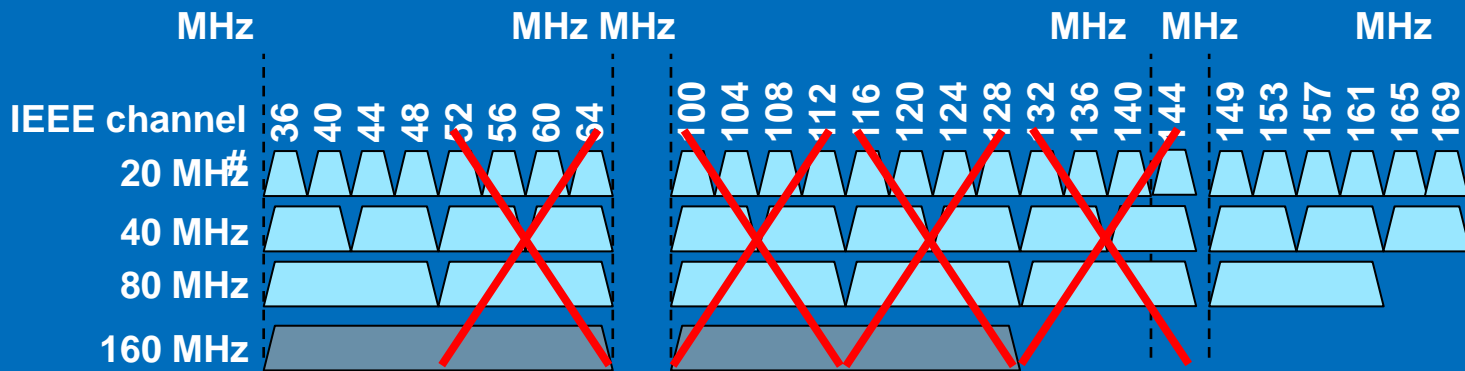
Mirroring



Why 5.9GHz Spectrum Sharing?

- **The demand for Wi-Fi in vehicles is increasing rapidly – almost 30% CAGR**
- **Use cases will require simultaneous internet tethering and video streaming**
- **Use cases will also require multiple simultaneous video streams**
- **160MHz bandwidth modes in 802.11ac can't be used today without DFS**
 - **DFS is problematic in mobile environments**
 - **Poor availability, especially in urban environments**
 - **False alarms**
 - **Detection algorithms interrupt video streaming**
- **ITS band is not being used significantly today**
 - **Extending unlicensed use into 5.9GHz band makes 160MHz channels available**

Current view/existing spectrum Channelization for 20/40/80 MHz



- The U-NII-1 band (5150-5250MHz) was approved for outdoor use in 2014
 - An automobile is considered outdoor use
 - U-NII-1 can only be used indoors in Europe and Japan
- U-NII-2A (5250-5350MHz), U-NII-2B, and U-NII-2C (5470-5725MHz) are problematic for vehicles
 - Requires Dynamic Frequency Selection (DFS) – poor channel availability
- Thus, only TWO 80MHz channels can be used in the US without DFS for 11ac in cars
 - U-NII-3 was expanded to 125MHz in May 2014
 - Five channels of 40MHz are available
- 160 MHz is not currently available for automotive applications without DFS
- Europe allows 25mW in U-NII-3
- Japan doesn't allow U-NII-3 for WLAN

NPRM 13-22 (13-49) Background

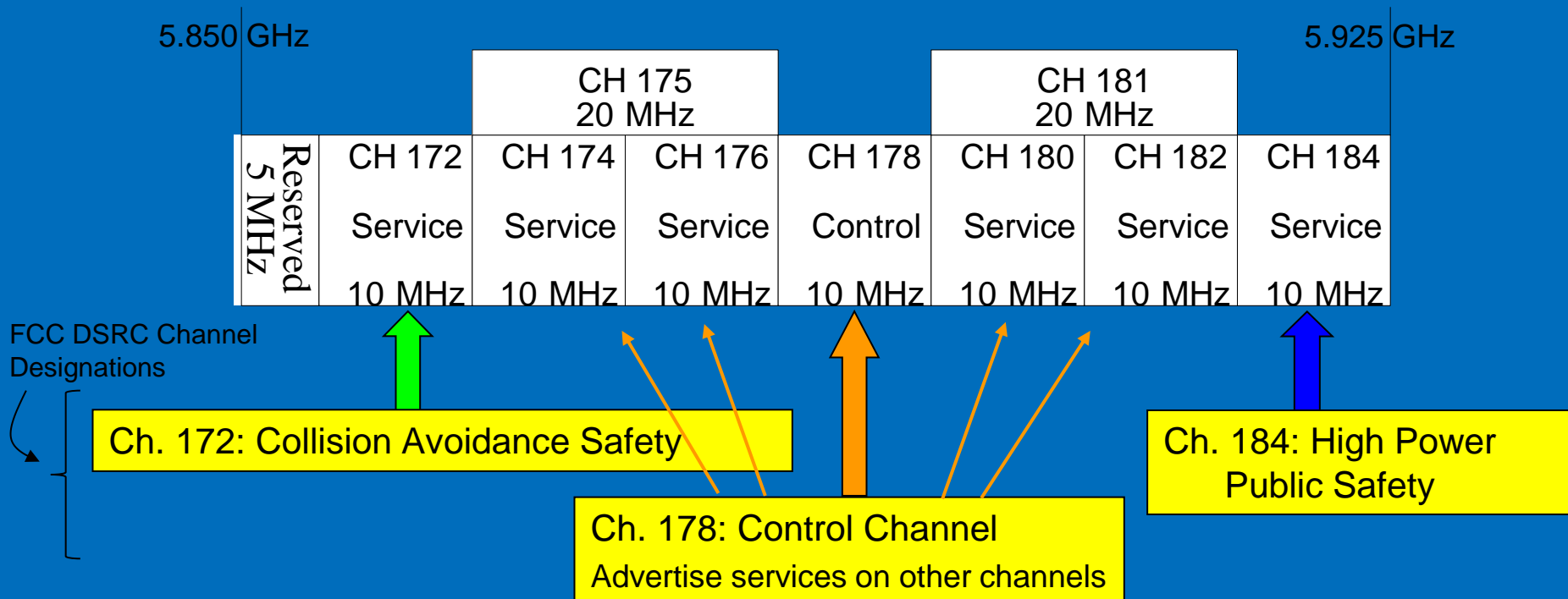
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- **FCC allocated 75MHz of spectrum in the 5.9GHz band (5850-5925MHz) for Dedicated Short Range Communications (DSRC) in October 1999**
- **In FCC NPRM 13-22 (13-49), the FCC invited comments about sharing the DSRC band, which would be U-NII-4**
 - **DSRC would remain as a primary user of the band**
- **802.11ac could be modified to operate in this new U-NII-4 band if approved by the FCC**
- **FCC did not specify the framework or etiquette by which band sharing would occur, other than unlicensed devices cannot cause “harmful interference”**

DSRC Overview

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- Ad hoc V2X communication
- Several hundred meter range
- Applications include Safety, Mobility, Commercial, ...
- 75 MHz of dedicated spectrum in 5.9 GHz



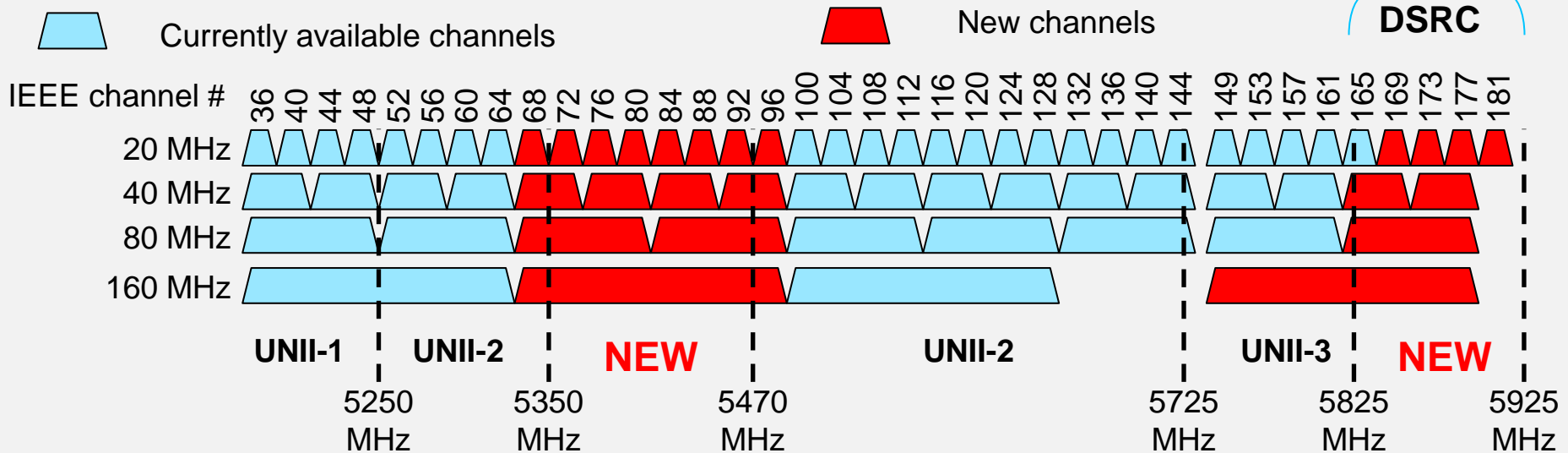
- **IEEE 802.11 convened a “Tiger Team” in August 2013 to address the spectrum sharing issue**
 - DSRC lower layers are 802.11p – a 10MHz variant of 802.11a
 - Open to participation by anyone
- **Two proposals presented**
 - “Detect and Avoid”
 - Spectrum repacking
- **IEEE Tiger Team completed its work in March**
 - No consensus position
 - Filed a final report with a summary of activities and straw poll results
- **No official position from IEEE 802**

Band Plan with Proposed New Spectrum in 5GHz (11ac) - NPRM 13-22/49

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- Wide bandwidth channels desired to support high throughput requirements
- At the same time, large number non-overlapping channels desired to support high QoS requirements
 - To avoid co-channel interference
- Current U-NII spectrum allows only
 - Six 80 MHz channels
 - Two 160 MHz channels
- Additional unlicensed use of 5.35-5.47 GHz and 5.85-5.925 GHz would potentially allow a total of
 - Nine 80 MHz channels (Three new)
 - Four 160 MHz channels (Two new)

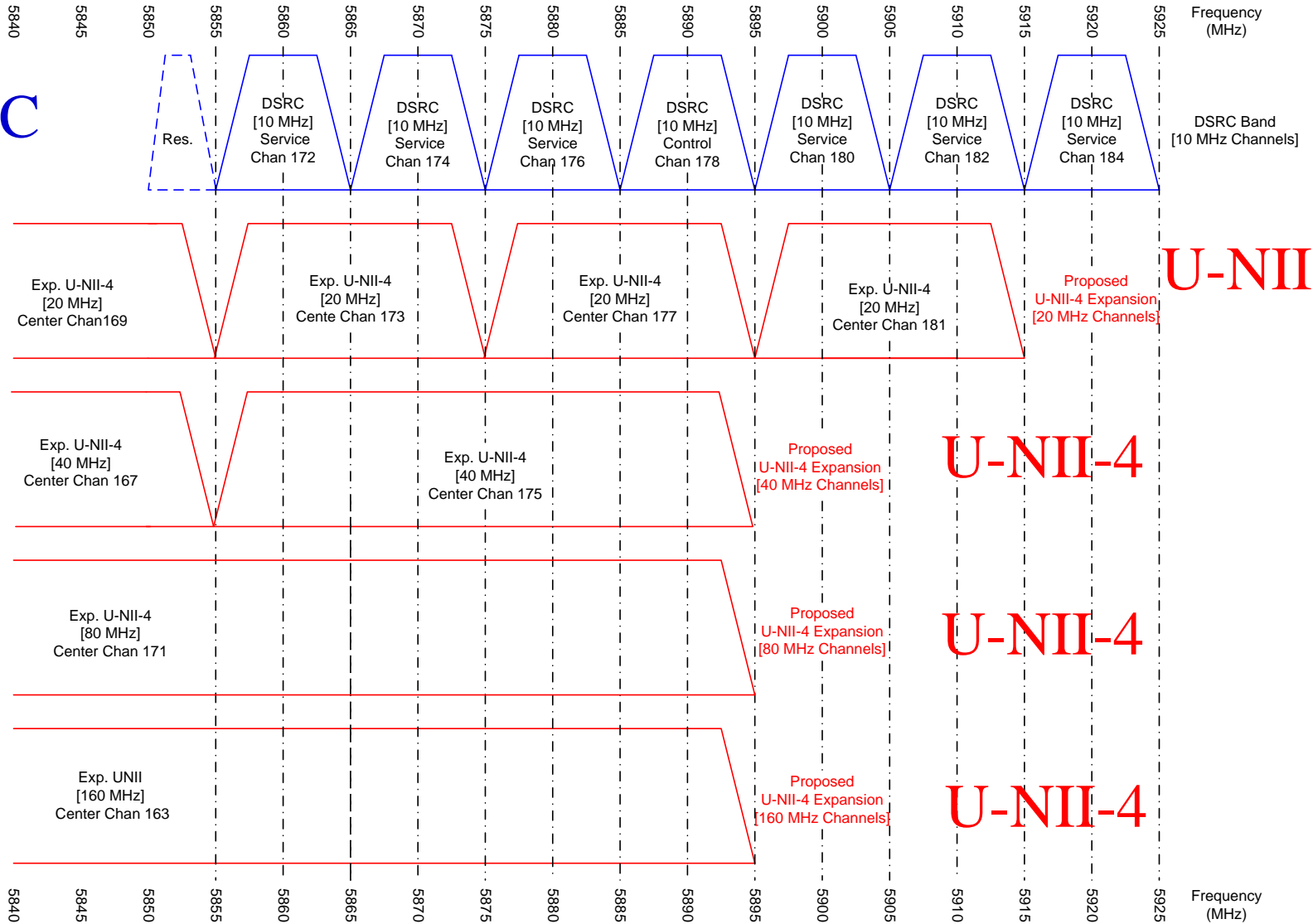
Possibly shared between DSRC and WLAN



DSRC and U-NII-4 Devices in 5.9 GHz Band

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DSRC



Possible DSRC coexistence techniques (1/2)

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802.11ac in the U-NII-4 band detects 802.11p preambles during CCA

– Pros:

- Leverages existing primary/secondary-n CCA
- 802.11p/DSRC doesn't have to do anything
- Better solution than energy detection
 - False alarms from energy detection are very undesirable
 - Exact CCA detection level is TBD, but must be at least as low as DSRC chipsets

– Cons:

- Preambles of 802.11p are twice as long as 11a/n
- May have to detect all seven channels in parallel
 - Increased complexity in Wi-Fi chips could make this a non-starter
- Adjacent and alternate channels cannot be sensed by CCA
- May make U-NII-4 unusable in many environments – like DFS

– After detection, what?

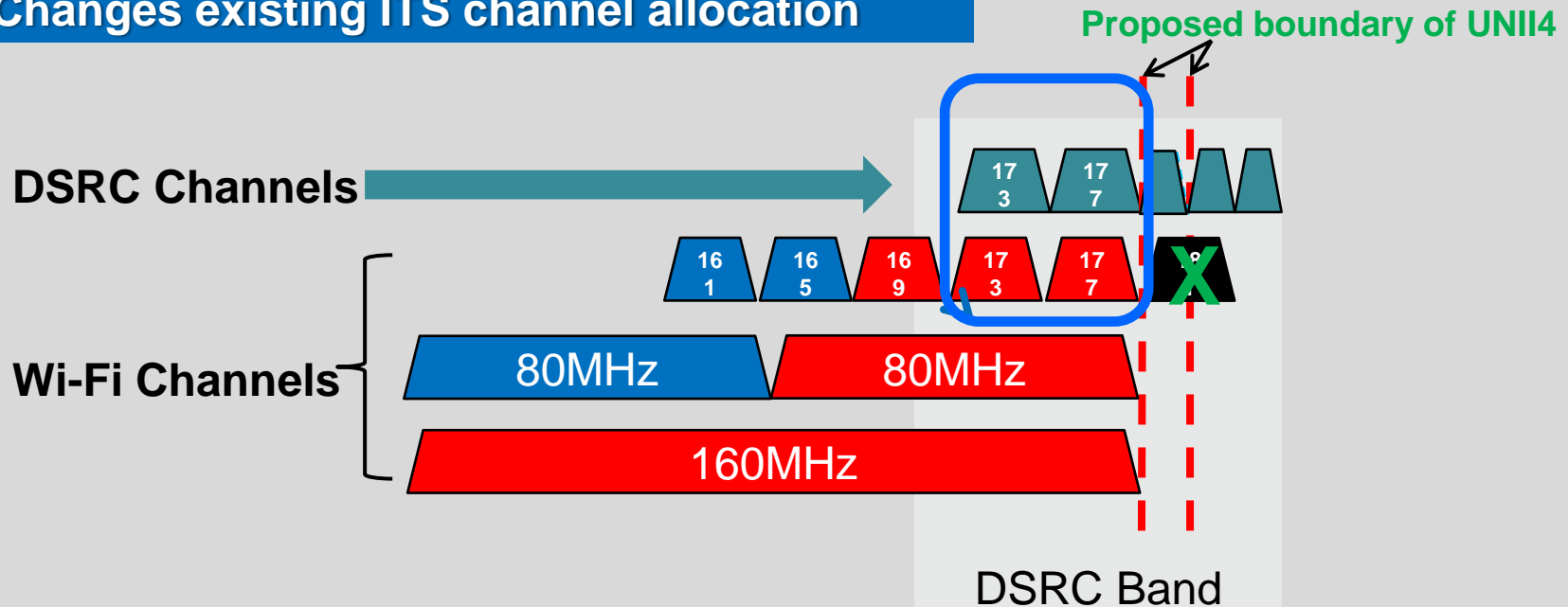
- Channel transition interval
- Non-occupancy interval

– **Summary of Proposal #1: silent for 10 seconds after the last 11p preamble detect – similar to setting a NAV for CCA_true+10 seconds**

Possible DSRC Sharing Techniques (2/2)

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- Repacking the DSRC band
 - “Important” channels (current 172, 178, 184) would be moved to upper part of band
 - DSRC would not share upper 30MHz – reserved for BSM and other priority traffic (Europe has partially overlapping 30MHz for ITS)
- Minimal impact to 802.11ac and allows 160MHz channels
- Impacts to existing DSRC equipment and FCC rulemaking
 - Proposes mixture of 10 and 20MHz channels
 - Changes existing ITS channel allocation



Summary

- **Wi-Fi is growing rapidly in automotive**
- **Video streaming use cases need 802.11ac**
- **IEEE 802.11 “Tiger Team” examined 5.9GHz band sharing issues**
- **Tiger Team did not adopt a consensus position**
 - Two proposals examined by the group
 - Draft report not ratified
 - Straw poll in Berlin indicated support for band repacking
- **Field tests needed**
 - Could be done under CAMP or other groups
- **Regulatory process will play out from here**

Thank you!

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