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Coexistence of DSRC and Wi-Fi

Implications to Wi-Fi Performance

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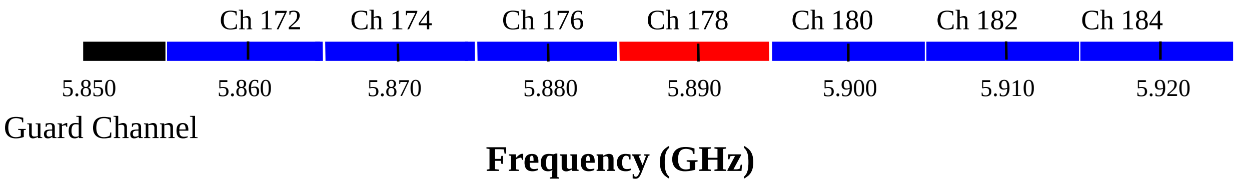
Motivation

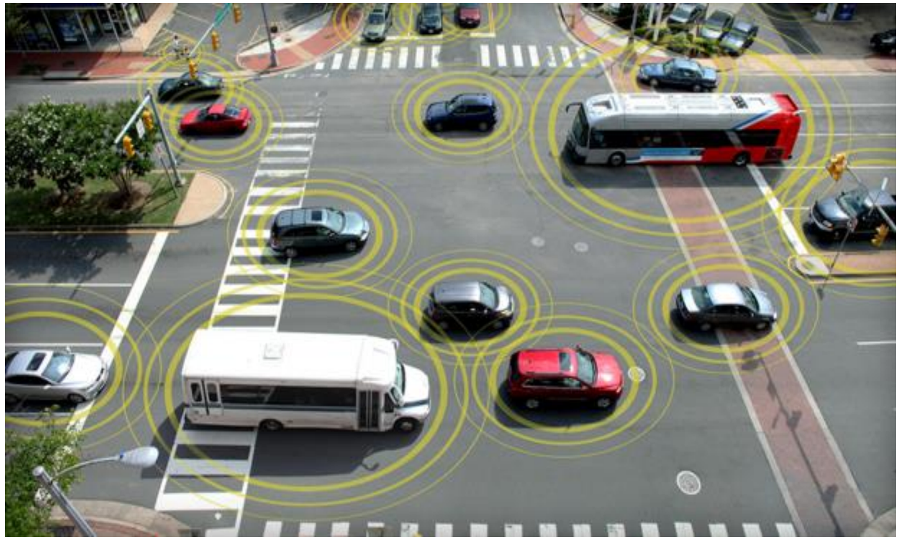
Dedicated Short Range Communications (DSRC) - short to medium ranged communication technology for V2V applications

The IEEE 802.11p standard

The spectrum band 5850 – 5925 MHz band is reserved for DSRC

- Seven channels of 10 MHz each



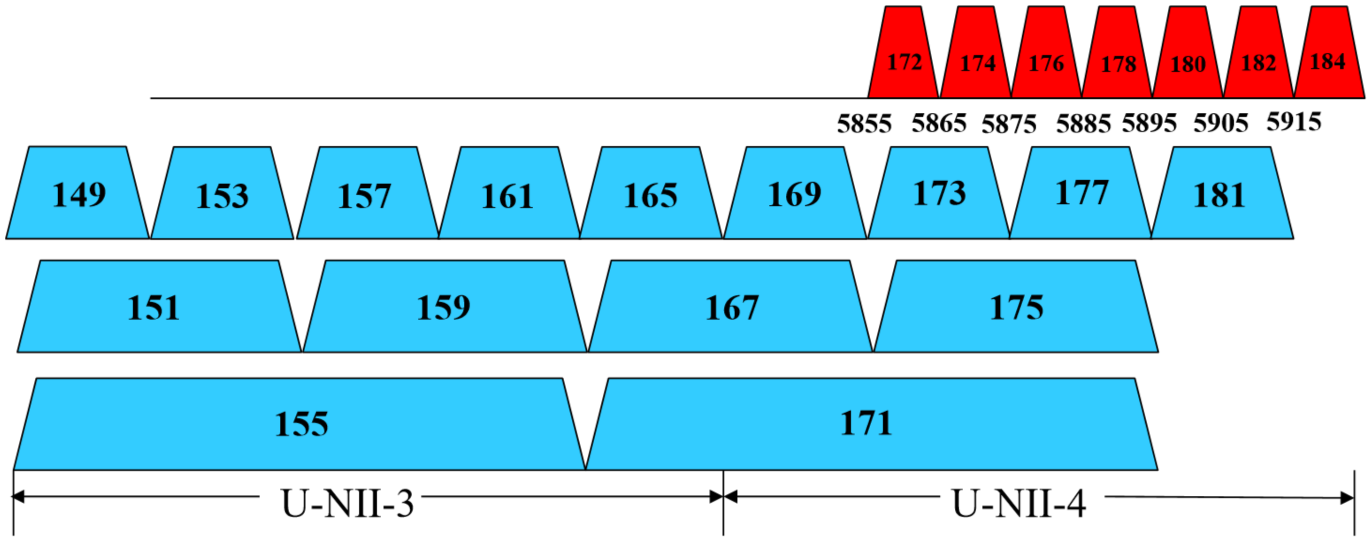


http://www.extremetech.com/extreme/176093-v2v-what-are-vehicle-to-vehicle-communications-and-how-does-it-work

In 2013, FCC issued a proposal to open up additional spectrum in the 5 GHz band for unlicensed operations (particularly Wi-Fi)

- Specifically, 5350 – 5470 MHz and 5850 – 5925 MHz bands

Wi-Fi Channelization in 5.9 GHz



DSRC channels

Wi-Fi 20 MHz channels

Wi-Fi 40 MHz channels

Wi-Fi 80 MHz channels

Related Work

DSRC Coexistence *Tiger Team* Proposals

- Proposal 1:
  - Detect 10 MHz preambles at Wi-Fi
  - Back-off for 10 seconds when DSRC activity is detected.
- Proposal 2:
  - Move safety critical applications to upper 30 MHz (non-shared)
  - The lower 40 MHz to be shared with Wi-Fi.

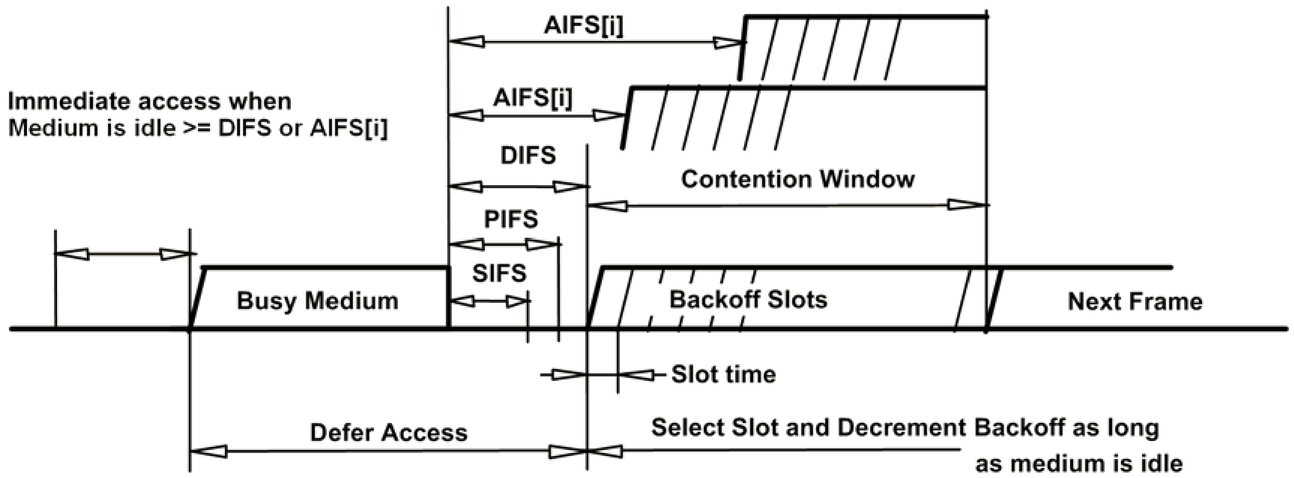
Two key Wi-Fi parameters that can facilitate DSRC – Wi-Fi coexistence [2, 3].

- Sensing range
- Inter-frame Spacing (IFS)

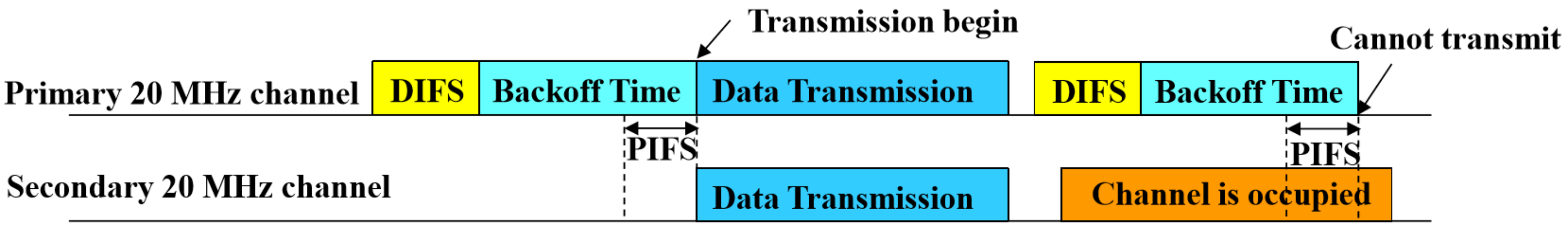
[2] J. LANSFORD ET AL., "COEXISTENCE OF UNLICENSED DEVICES WITH DSRC SYSTEMS IN THE 5.9 GHZ ITS BAND," IN IEEE VNC, 2013.
[3] Y. PARK AND H. KIM, "ON THE COEXISTENCE OF IEEE 802.11 AC AND WAVE IN THE 5.9 GHZ BAND," IEEE COMM. MAG., VOL. 52, ISSUE 6, 2014.

Wi-Fi Channel Access – A Primer

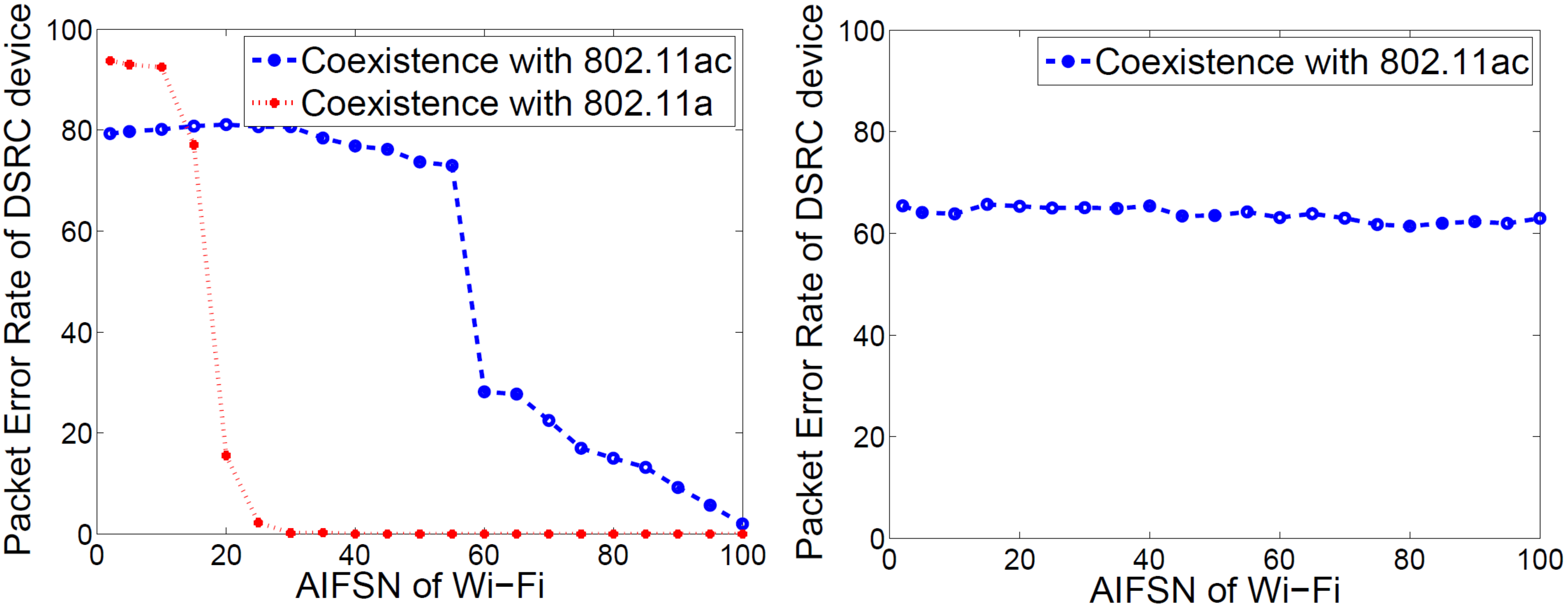
Primary Channel



Secondary Channel



How to protect DSRC nodes?

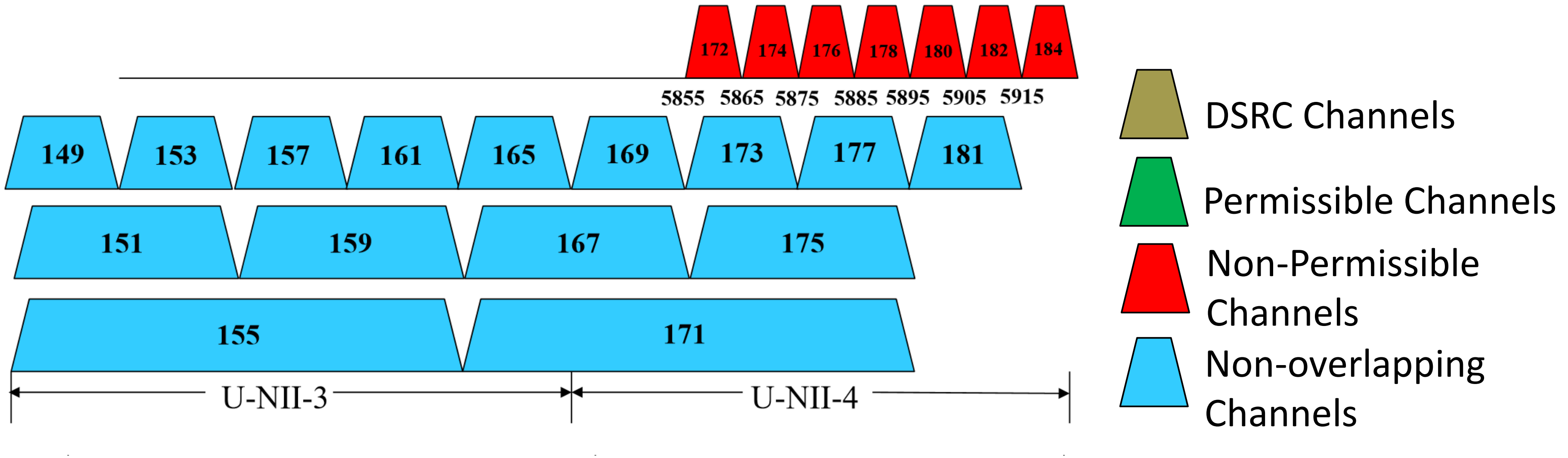


Wi-Fi AIFS can be increased to alleviate interference caused to DSRC

DSRC nodes operating in secondary Wi-Fi channels suffer significant degradation

Takeaway Point

Any Wi-Fi channel configuration where DSRC nodes operate in Wi-Fi secondary channels non-permissible.



To share or not to share?

Wi-Fi devices seem to be at loss

- Can’t use high bandwidth options
- Must operate at AIFS ~ 1msec when sharing to mitigate interference to DSRC users

We propose a simple Real-time Channelization Algorithm (RCA)

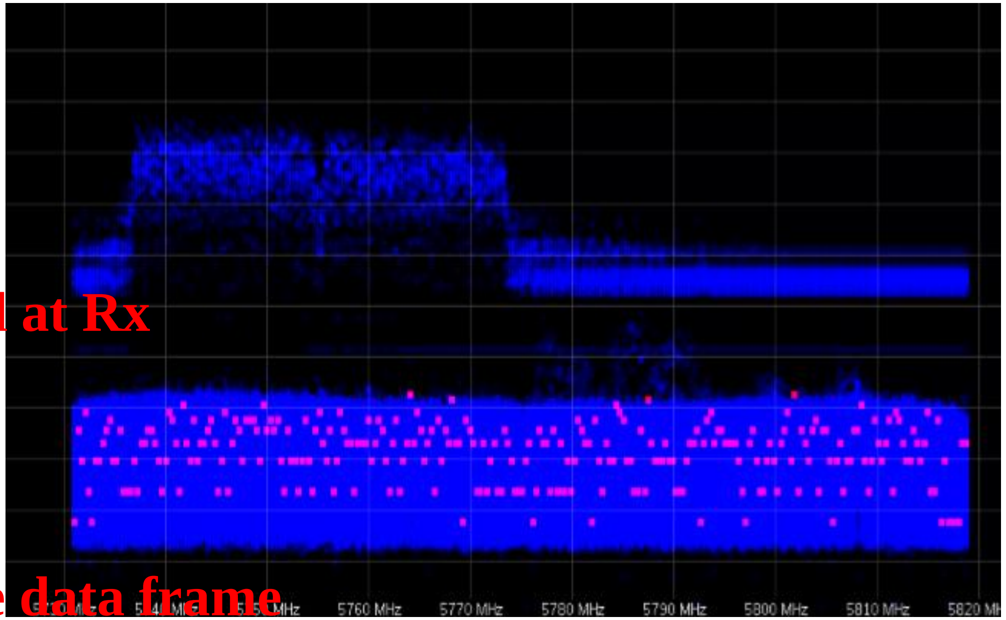
Key ideas

- Spectrum utilization available at *every* Wi-Fi node
- Each node can crudely compute its expected throughput

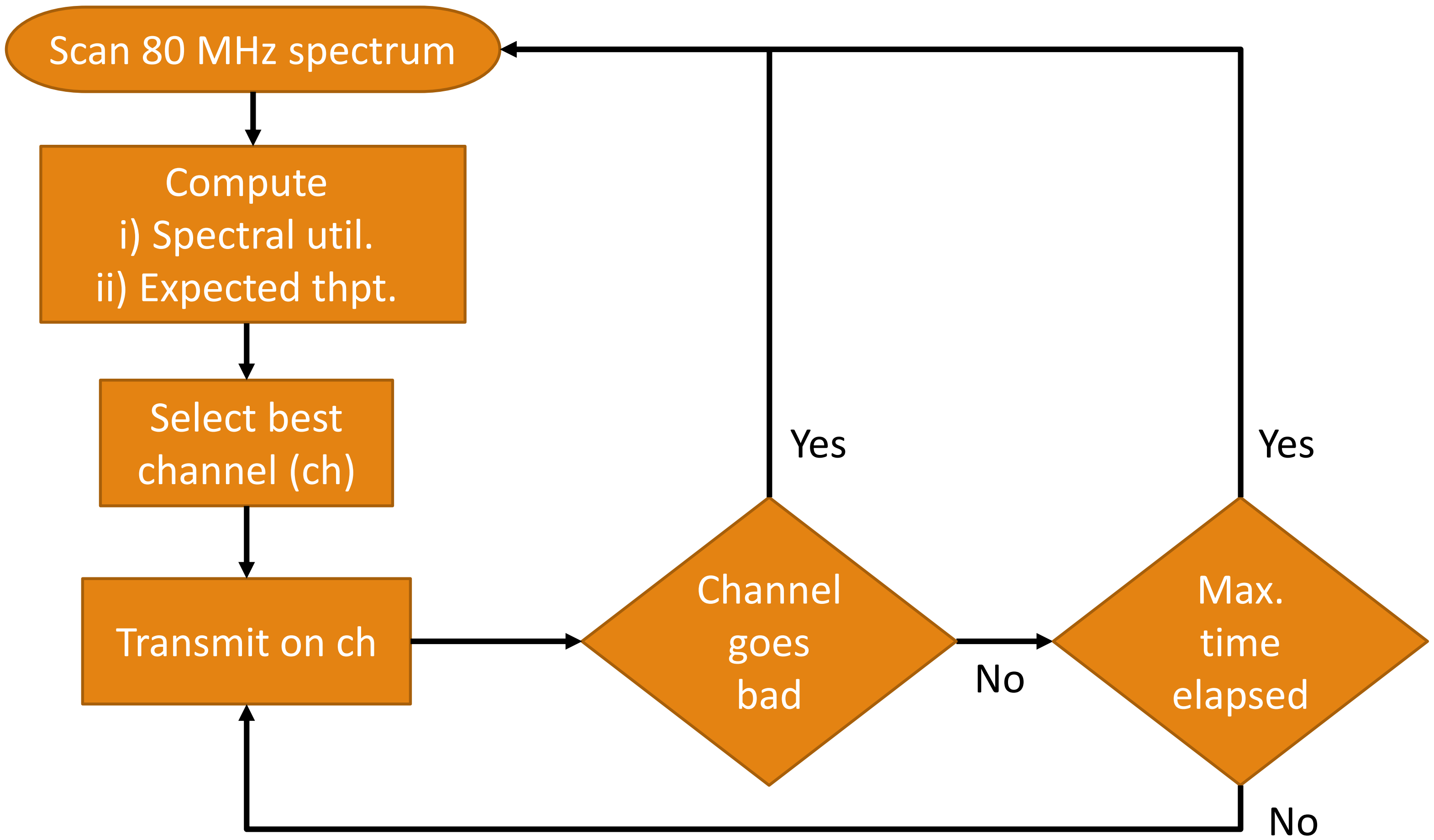
Data (in bytes) received at Rx

$$E^{i}_{Th} = \frac{K \cdot L_{data} \cdot (1 - U_i) \cdot PRR}{AIFS + t_{BO} + t_{data} + SIFS + t_{ack}}$$

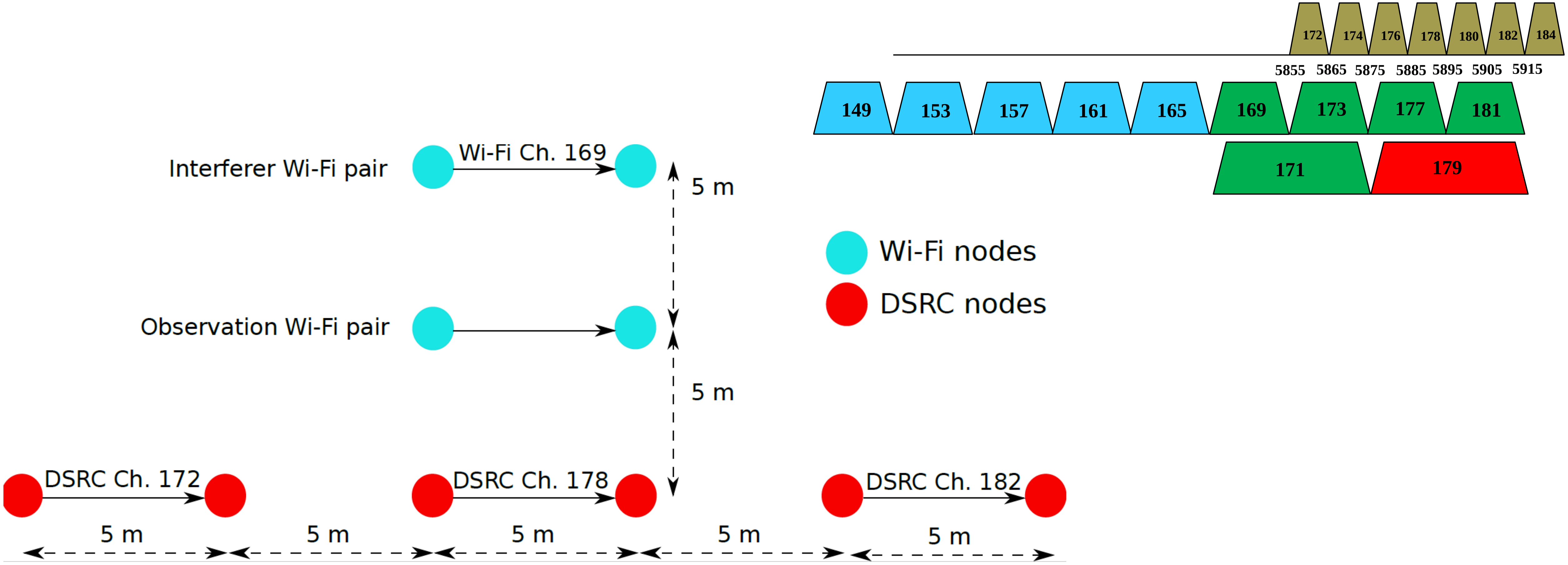
Time taken to transmit one data frame



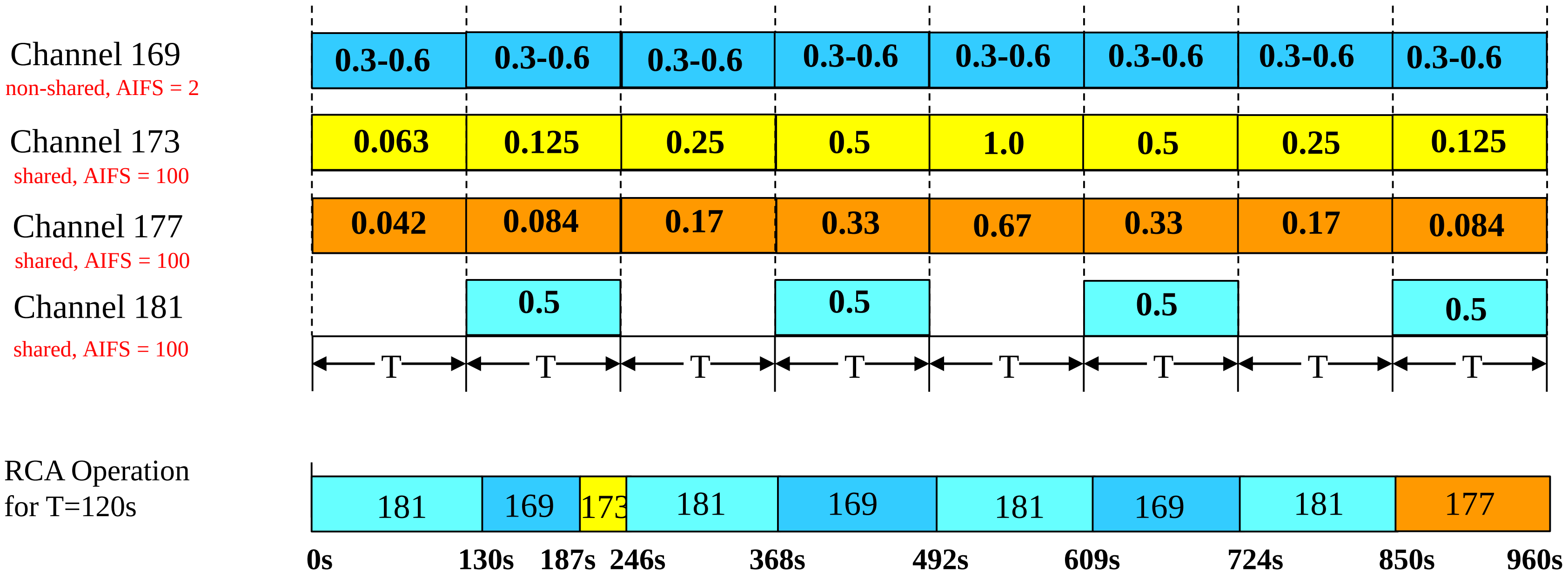
Real-time Channelization Algorithm (RCA)



RCA Evaluation Topology

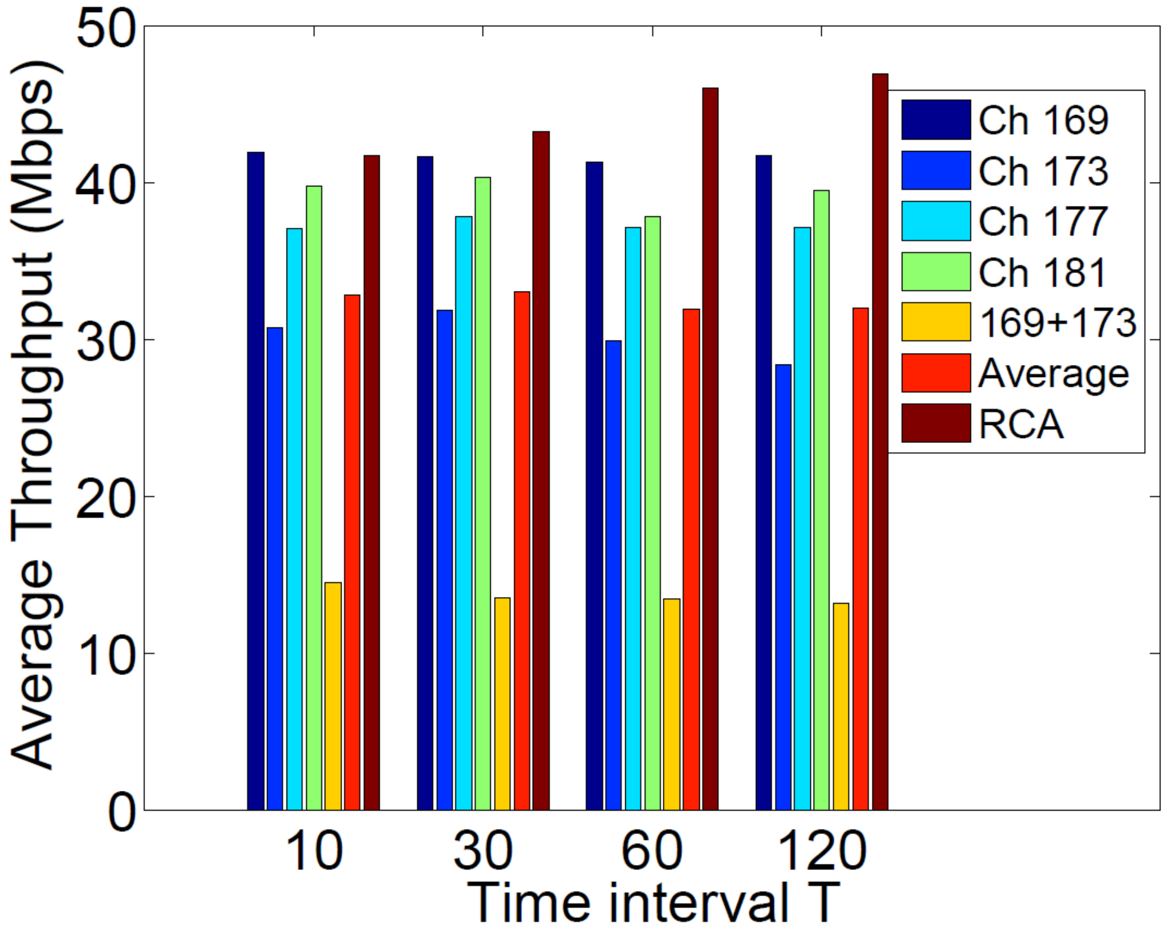


RCA Evaluation



RCA Evaluation …

- RCA outperforms all static channel allocation schemes
  - For T = 120s, RCA beats best static allocation by 12%
  - Better than average across all static channelizations by 50%
- Gain diminishes as T gets smaller, i.e. traffic changes rapidly.
  - Caused due to high response time of RCA
  - Can be eliminated with efficient implementation



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Final Thoughts

Wi-Fi channel access mechanism needs to be conservative when sharing

The current 802.11ac standard is incapable of protecting DSRC nodes in secondary channels

- Wi-Fi channel access mechanism in the secondary channels can be modified

Informed channel and bandwidth selection can provide some gains when sharing

Thank You for listening!