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Wi-Fi 6 Updates

Wi-Fi 6 rollout updates, product certification, and preparation for new unlicensed spectrum

Wi-Fi 6 Networks and Devices are Rolling Out

NFL's biggest stadium will open with Wi-Fi 6

SoFi Stadium, where the LA Chargers and LA Rams will play starting next year, is getting the latest wireless service from Cisco.

Corinne Reichert | November 1, 2019 5:54 PM PDT

Extreme Networks' Wi-Fi 6 network goes live at BBVA Stadium in Houston

[NEWS GLOBAL] by Claus Hetting | September 18, 2019

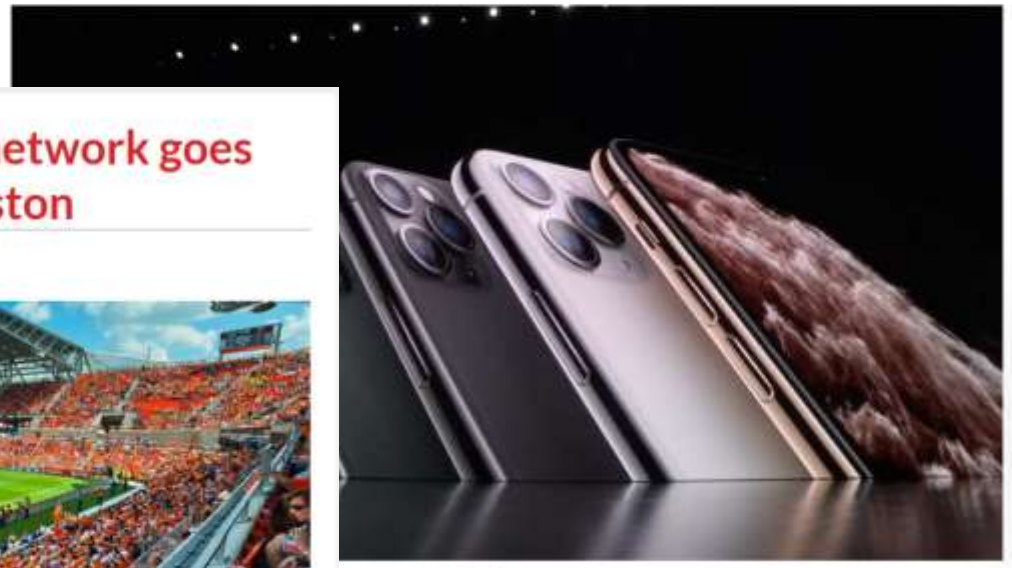
Above: Probably the world's first soccer stadium with Wi-Fi 6, the BBVA Stadium in Houston, Texas.

The iPhone 11 supports Wi-Fi 6. Here's what that means for you

The iPhone 11, 11 Pro and 11 Pro Max are the newest phones that support next-gen Wi-Fi 6 connections. Here's what you should know about that.

Ry Crist | September 16, 2019 6:38 AM PDT

ES



upport for Wi-Fi 6.

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Why Wi-Fi 6? U.S Super Bowl Wi-Fi Traffic Evolution

- ✓ Wi-Fi 6 improves Throughput and Latency in high density environments
- ✓ Wi-Fi 6 is the perfect technology to sustain traffic growth

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Wi-Fi 6 By The Numbers

- WiFi Alliance estimates that more than 13 billion Wi-Fi devices are being used worldwide currently, and the penetration rate of household Wi-Fi networks will reach 90% by 2020.
- Over 50% of global Wi-Fi devices in use in 2024 will support Wi-Fi 6 technology, WFA estimates.
- The penetration rate of Wi-Fi 6 technology is expected to reach 10% in 2020, with smartphone applications pioneering the adoption, followed by notebooks and smart household devices, according to industry sources.
- By 2022, about 56% connected end-devices will support Wi-Fi 6, Intel has estimated. It also noted that all new notebook models being developed by Lenovo, Dell, Acer and Asustek Computer will incorporate this new technology.

Source Digitimes

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Refresher: Key Changes in Wi-Fi 6

	802.11n	802.11ac	802.11ax	
Operating Bands	2.4 & 5GHz	5GHz	2.4 & 5GHz 6GHz*	*Optional
Technology	OFDM	OFDM	OFDMA	
MU-MIMO	No	DL MU-MIMO*	DL / UL MU-MIMO*	*Optional
Subcarrier Spacing	312.5kHz	312.5kHz	78.125kHz	
Modulation	64QAM	256QAM	1024QAM	
User Streams	4	Up to 8 user streams*		*Optional
Bandwidth	40 MHz	20, 40, 80, 80+80 and 160MHz		

Key changes impacting test:

- More radios: 1 or 2 moving to 4+
- More OFDMA configurations to test
- Power & timing control
- 6 GHz frequency band

Wi-Fi 6 Certification

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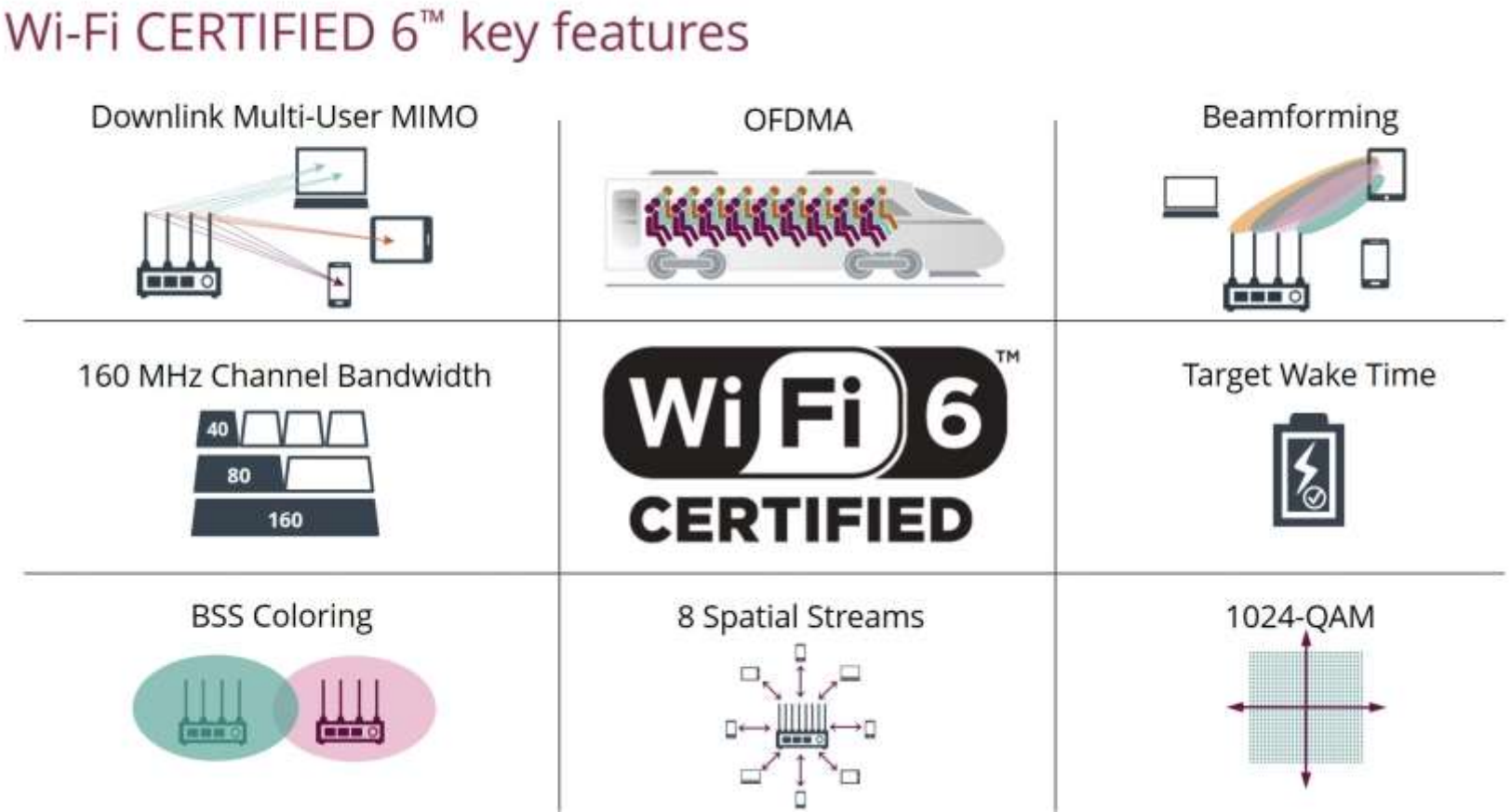
Wi-Fi CERTIFIED 6™: What does it mean?

- Certification program from Wi-Fi Alliance is now available and delivers the best user experience with devices based on IEEE 802.11ax
- Product vendors and service providers can trust Wi-Fi CERTIFIED™ will distinguish Wi-Fi 6 products and networks that meet the highest standards for security and interoperability



Source: Wi-Fi Alliance

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Wi-Fi 6 Certification

Wi-Fi Alliance
Wi-Fi 6 Test Suite

Wi Fi ALLIANCE AUTHORIZED TEST LABORATORY

Test Equipment

- ✓IQxel-MW support OFDMA Pre-correction test for Wi-Fi 6 Certification
- ✓OFDMA Pre-correction test is one of the key features for testing Uplink OFDMA interoperability
- ✓Authorized Test Labs for certification testing and Wi-Fi equipment vendors for pre-certification testing

Wi-Fi in Unlicensed 6 GHz Spectrum

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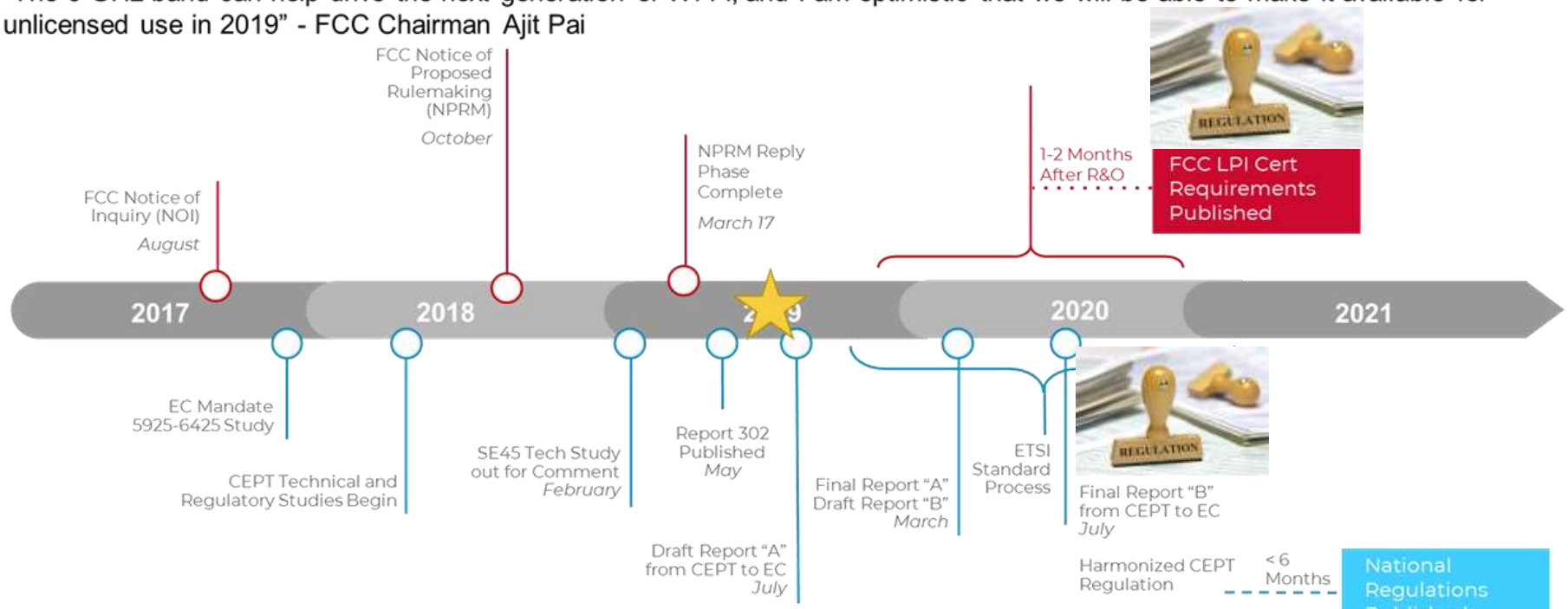
Regulatory Update

US R&O expected completion 2019/2020

"The 6 GHz band can help drive the next generation of Wi-Fi, and I am optimistic that we will be able to make it available for unlicensed use in 2019" - FCC Chairman Ajit Pai



CEPT Response to EC Mandate & Harmonized Regulation by July 2020

Source Wi-Fi Now

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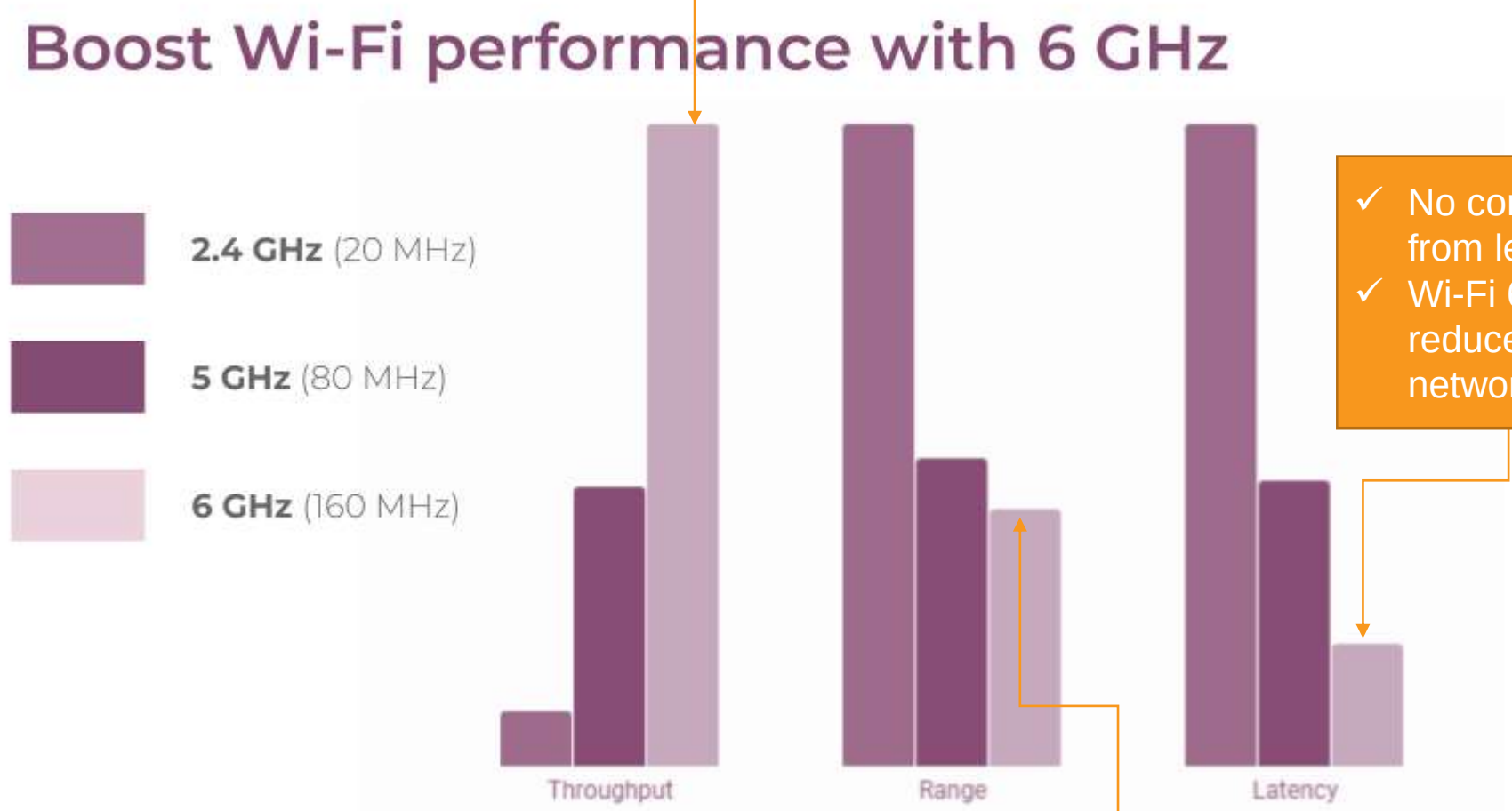
Why 6GHz Wi-Fi?

- ✓ Double the speed thanks to 160 MHz channels
- ✓ No Legacy (802.11a,b,g,n) Wi-Fi device allowed to operate in 6GHz band



- ✓ No congestion or interference from legacy devices
- ✓ Wi-Fi 6 OFDMA scheduling reduces latency in high density networks

- ✓ More attenuation at higher frequency. Slightly lower reach compared to 5G band

BROADCOM

Source: Broadcom

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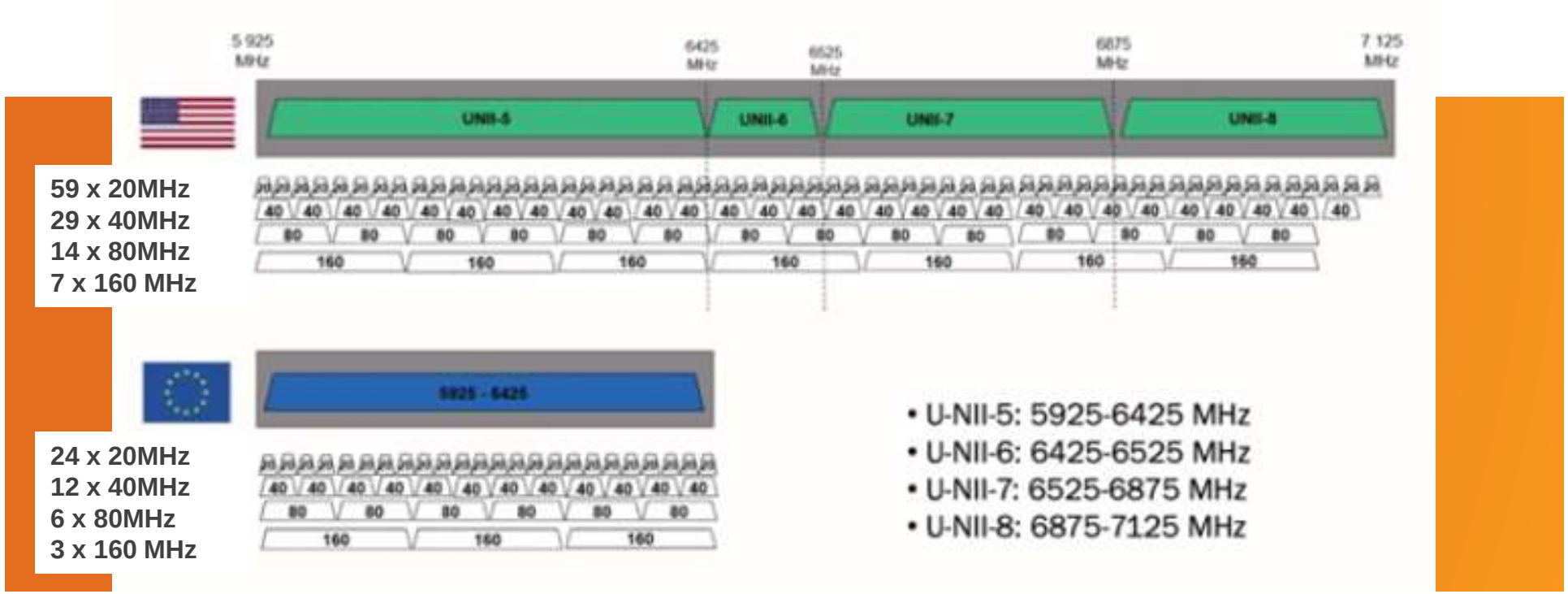
6 GHz Band WiFi 6 Allocations



Some frequency bands may require reduced power for incumbent protection

Some bands may required AFC (Automated Frequency Coordination) for incumbent protection

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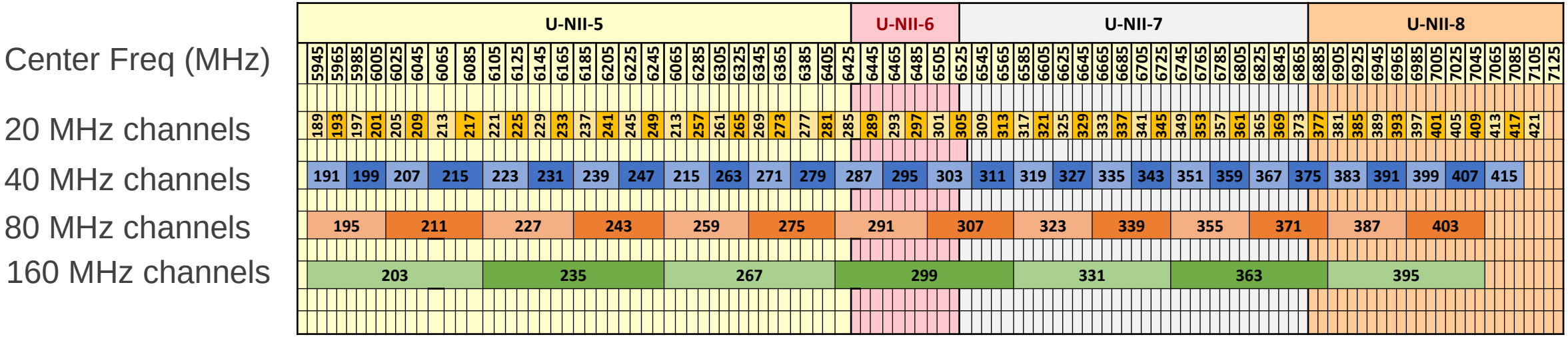
Channelization in 6 GHz



- Starting frequency of 5940 MHz
  - Only 10 MHz of Guard band for U-NII-5
  - Challenging filter design
- Channels can cross U-NII boundaries
- In case U-NII-5 and 6 work under different regulatory rules
  - No 80 MHz channel in U-NII-6
  - Only one 40 MHz channel in U-NII-6

Source: IEEE

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UL-OFDMA Testing

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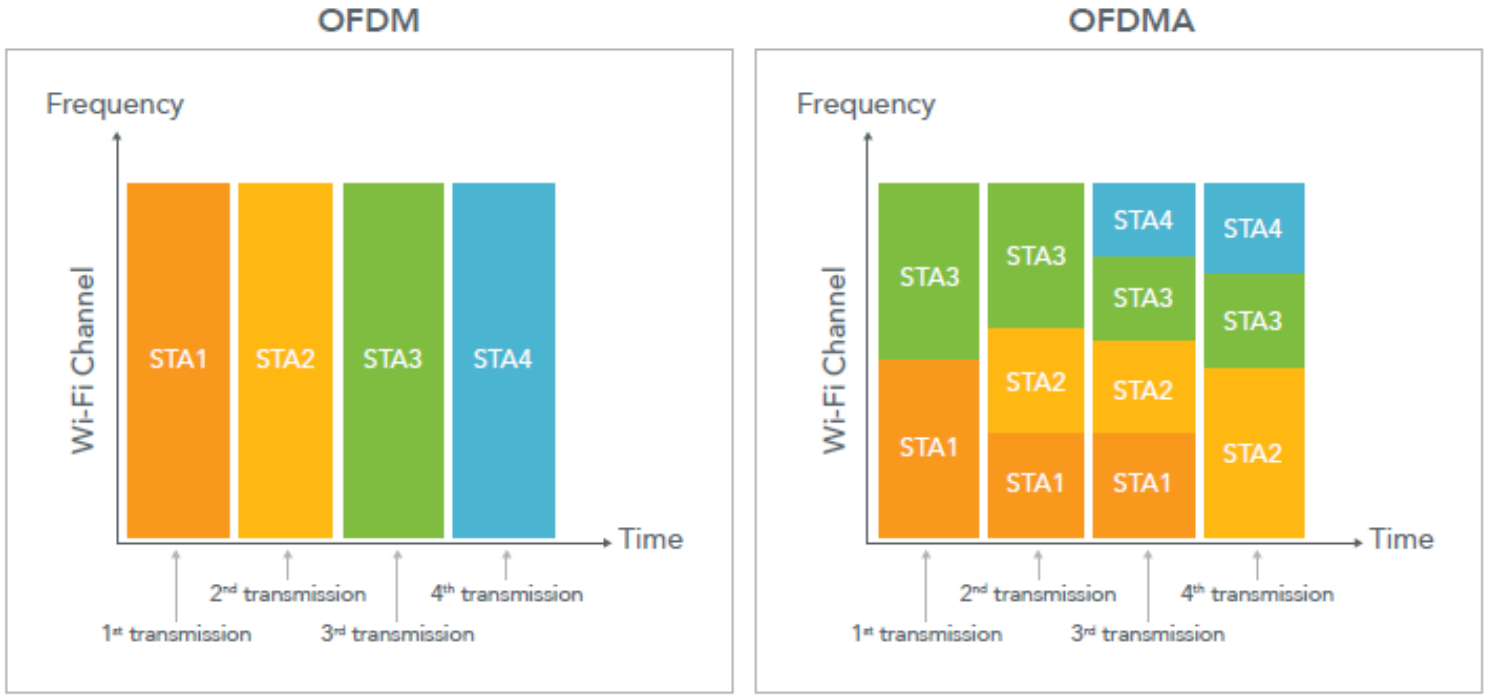
OFDMA vs. OFDM

- Orthogonal Frequency Division Multiplexing (OFDM)
- Orthogonal Frequency Division Multiple Access (OFDMA)
- OFDMA allow multiple users per bandwidth.
  - Each user is allocated a resource unit (RU).



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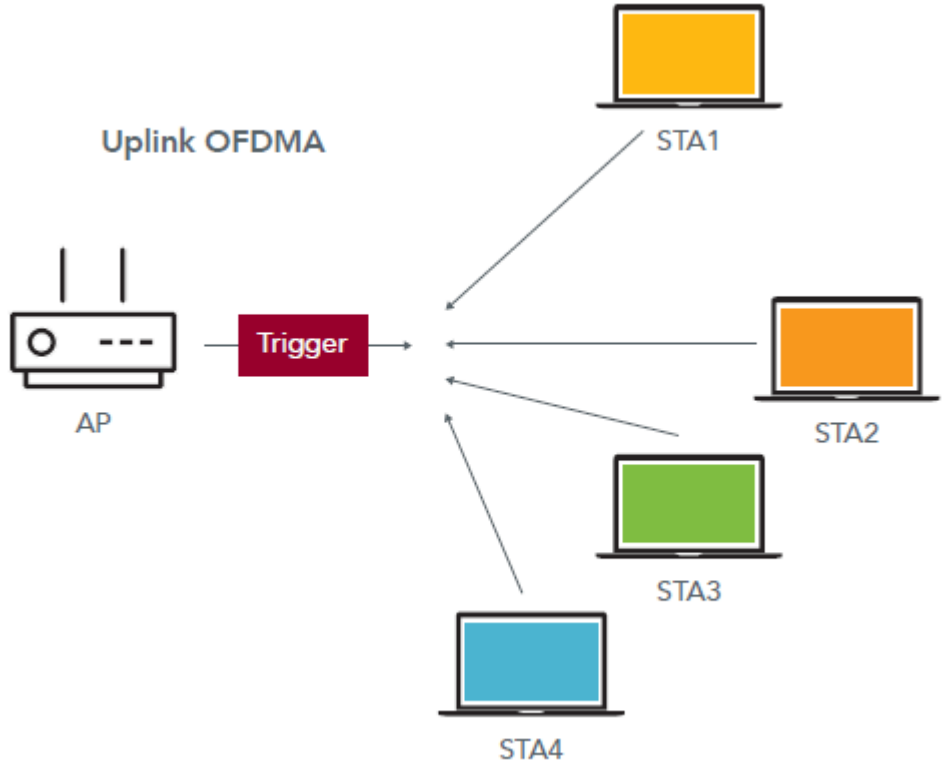
AP as Mini Base Station

- AP pre-coordinates/ pre-corrects with STAs to minimize interference by transmitting a Trigger frame
  - Power balance among STAs *Power*
  - System synchronization among STAs
  - Transmit at the same time (< **400ns** difference) *Timing*
  - Transmit at the same carrier frequency (< **350 Hz** difference) *Frequency*

Step 1: Downlink Trigger Frame transmitted by AP
Step 2: Uplink HE PPDU transmitted by stations



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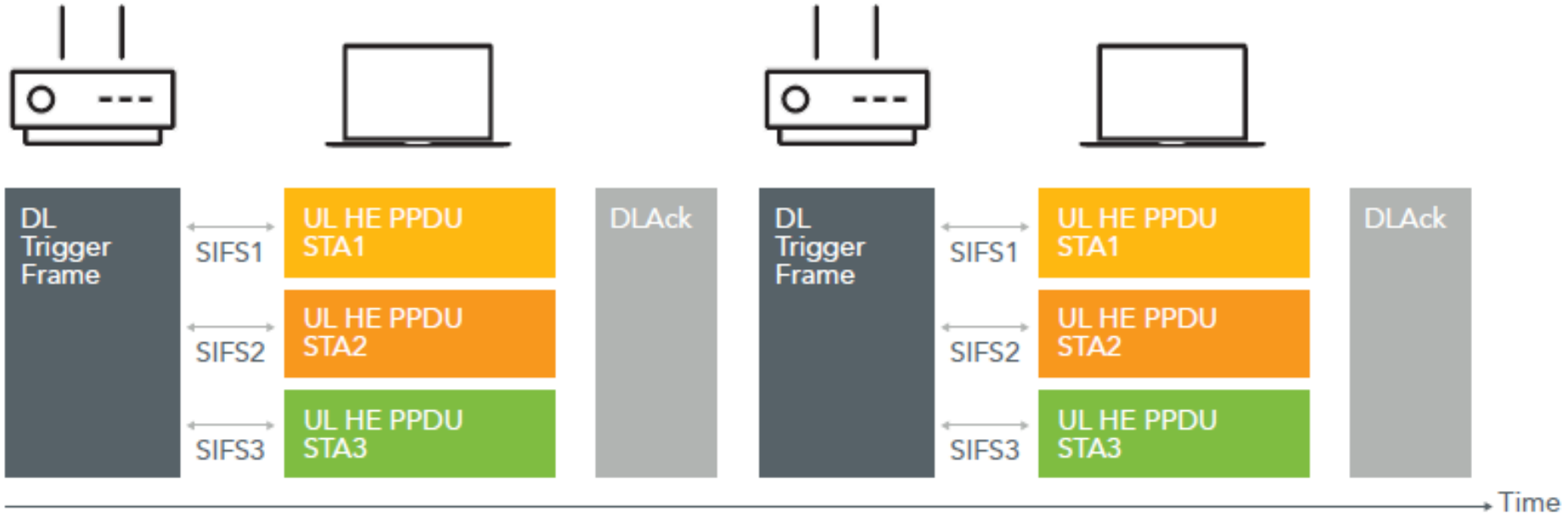
Timing Synchronization

- Participating STAs start transmission at SIFS (short interframe space) of 16 µs
- ± 400 ns at the end of the trigger frame



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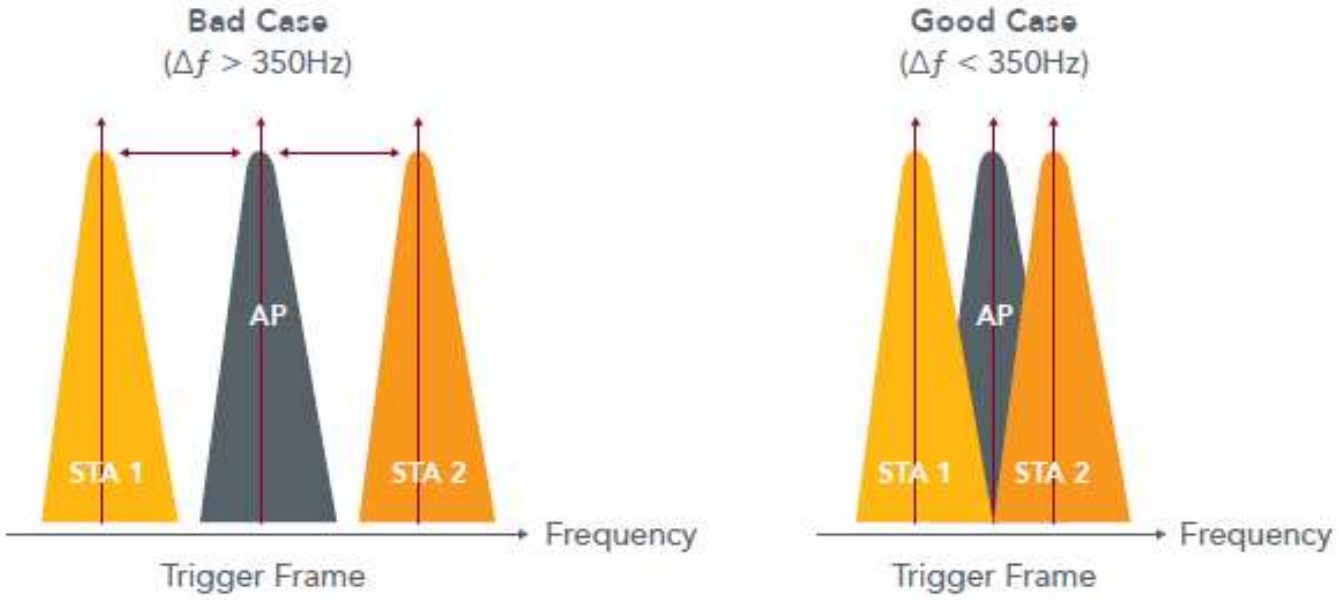
Frequency Synchronization

- STAs need to pre-compensate for carrier frequency offset (CFO) error based on the trigger frame received from the AP
- Residual CFO error after compensation must be less than 350 Hz.



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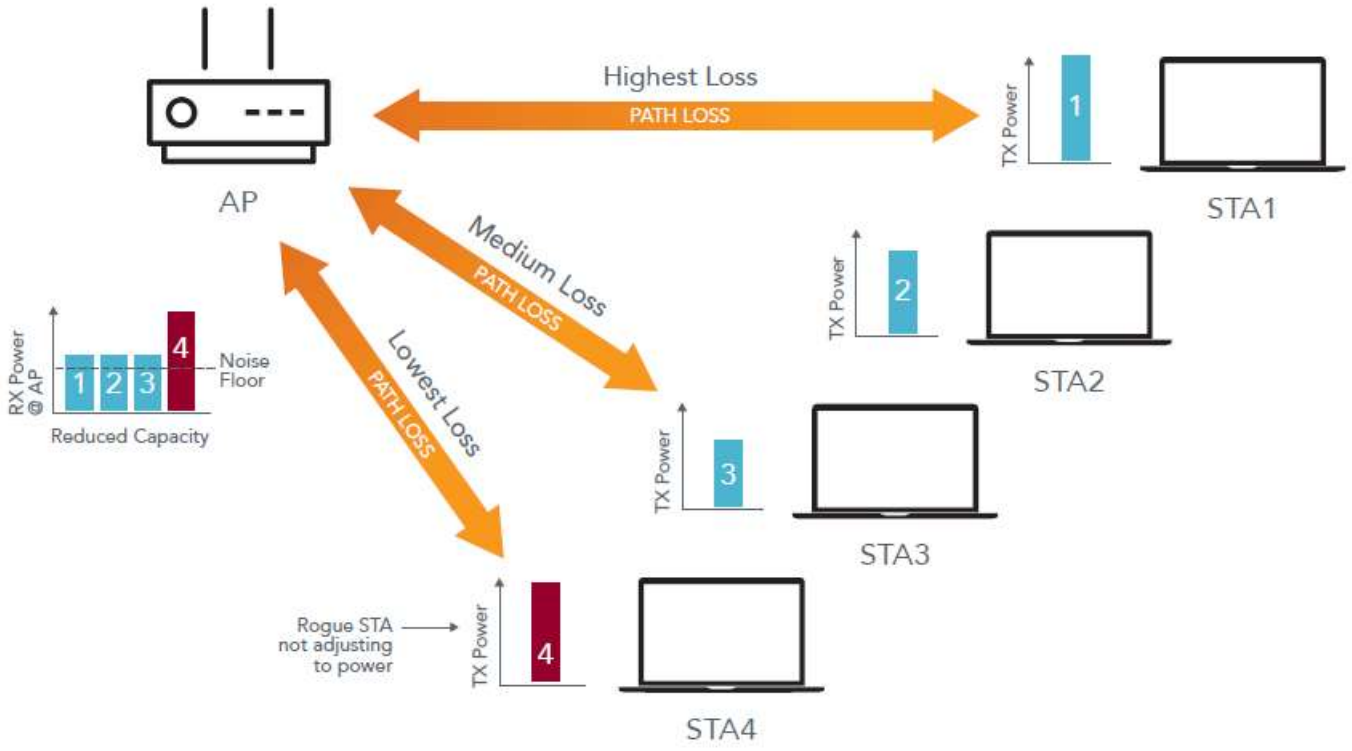
Power Pre-correction

- STA must adjust the TX Power
- Ensures that STA Power does not interfere with other participating STAs



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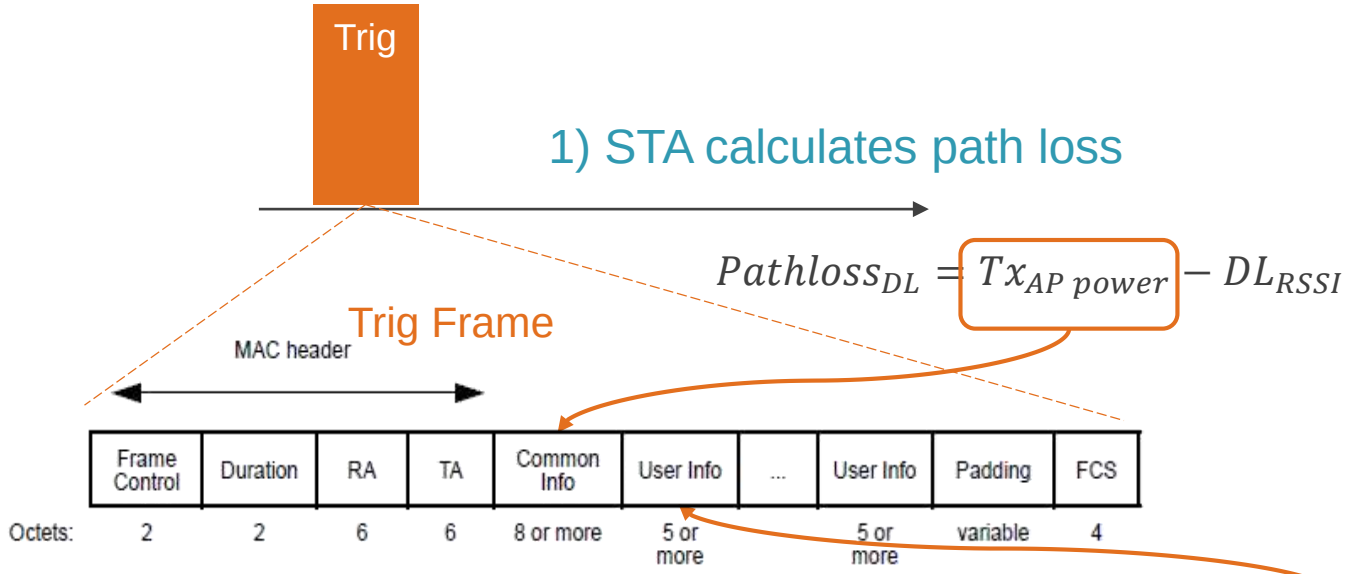
Power Pre-correction



3) STA sends HE TB PPDU in response to AP Trig at Tx $_{\text{STA power}}$

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Power Pre-correction Accuracy Requirements

Parameter	Minimum Requirement		Comments
	Class A	Class B	
Absolute transmit power accuracy	±3 dB	±9 dB	Accuracy of achieving a specified transmit power.
RSSI measurement accuracy	±3 dB	±5 dB	The difference between the RSSI and the received power. Requirements are valid from minimum Rx to maximum Rx input power.
Relative transmit power accuracy	N/A	±3 dB	Accuracy of achieving a change in transmit power for consecutive HE TB PPDU. The relative transmit power accuracy is applicable only to Class B devices.

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IQsniffer – WiFi PHY Traffic Analysis Simplified

IQsniffer + IQxel-MW integrated solution for PHY and MAC layer analysis

- PHY layer analysis – Uncovers timing information and behavior not visible to MAC layer based tools
  - Parametric measurements(EVM, Power, Spectrum, etc.)
  - Timing information
  - PPDU information:
    - Packet format, such as HE-SU, HE-MU, HE-TRIG, etc.
    - Coding info, such as LDPC, BBC
    - Spatial stream number
- MAC layer information:
  - Packet type, sub-type
  - MAC addresses
  - Full PSDU capture
- Packet information exported in CSV format for easy processing

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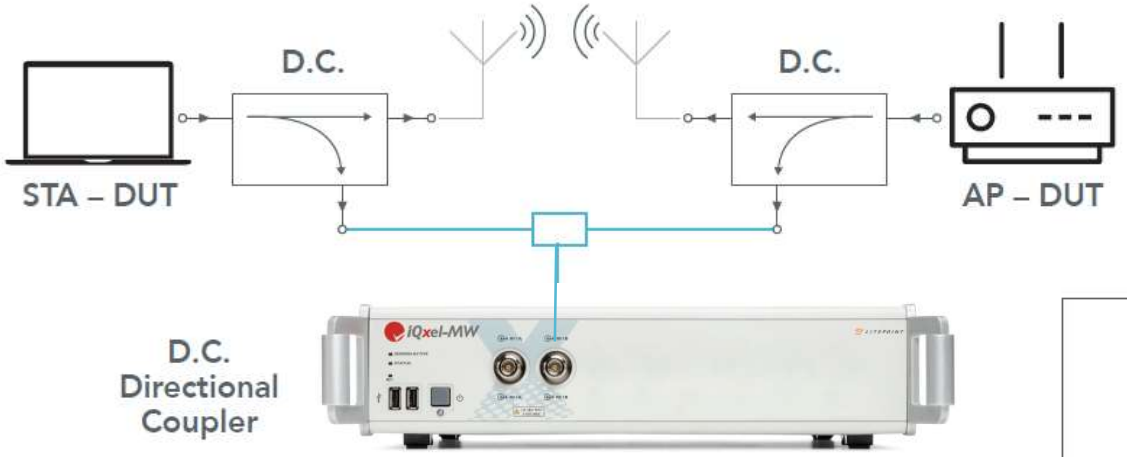
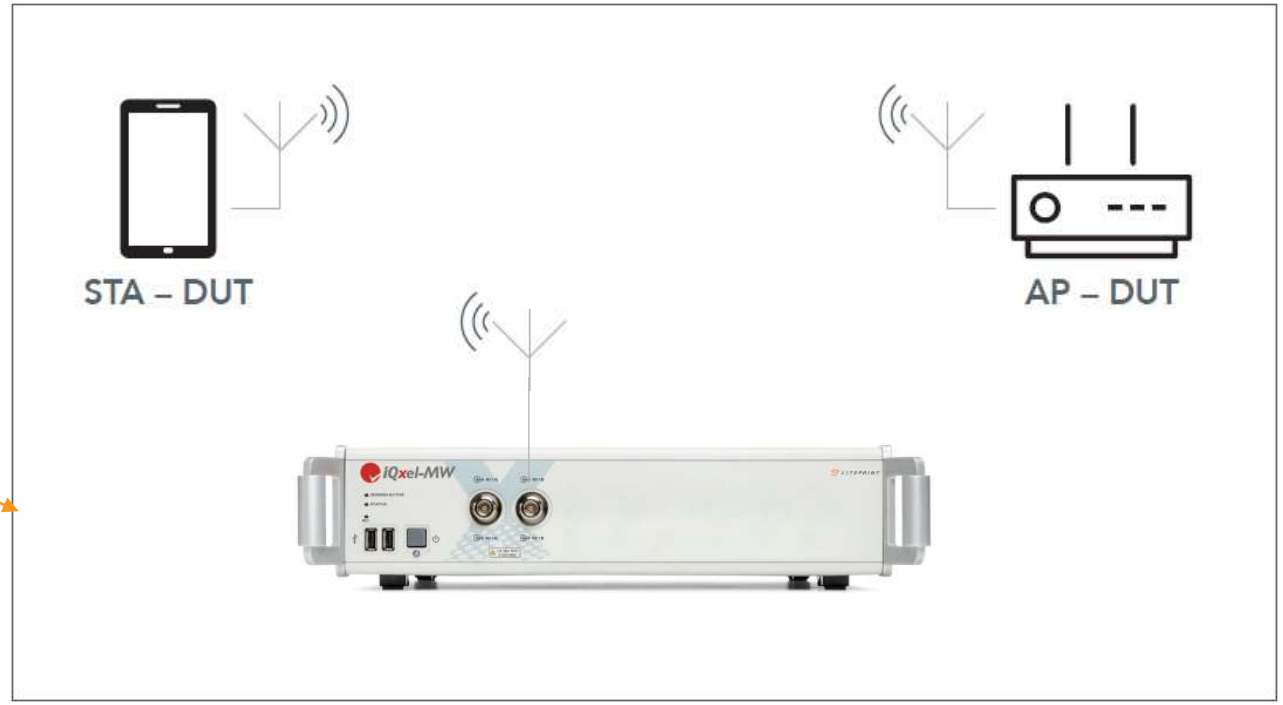
OFDMA Pre-correction Test Setup

Conducted Test



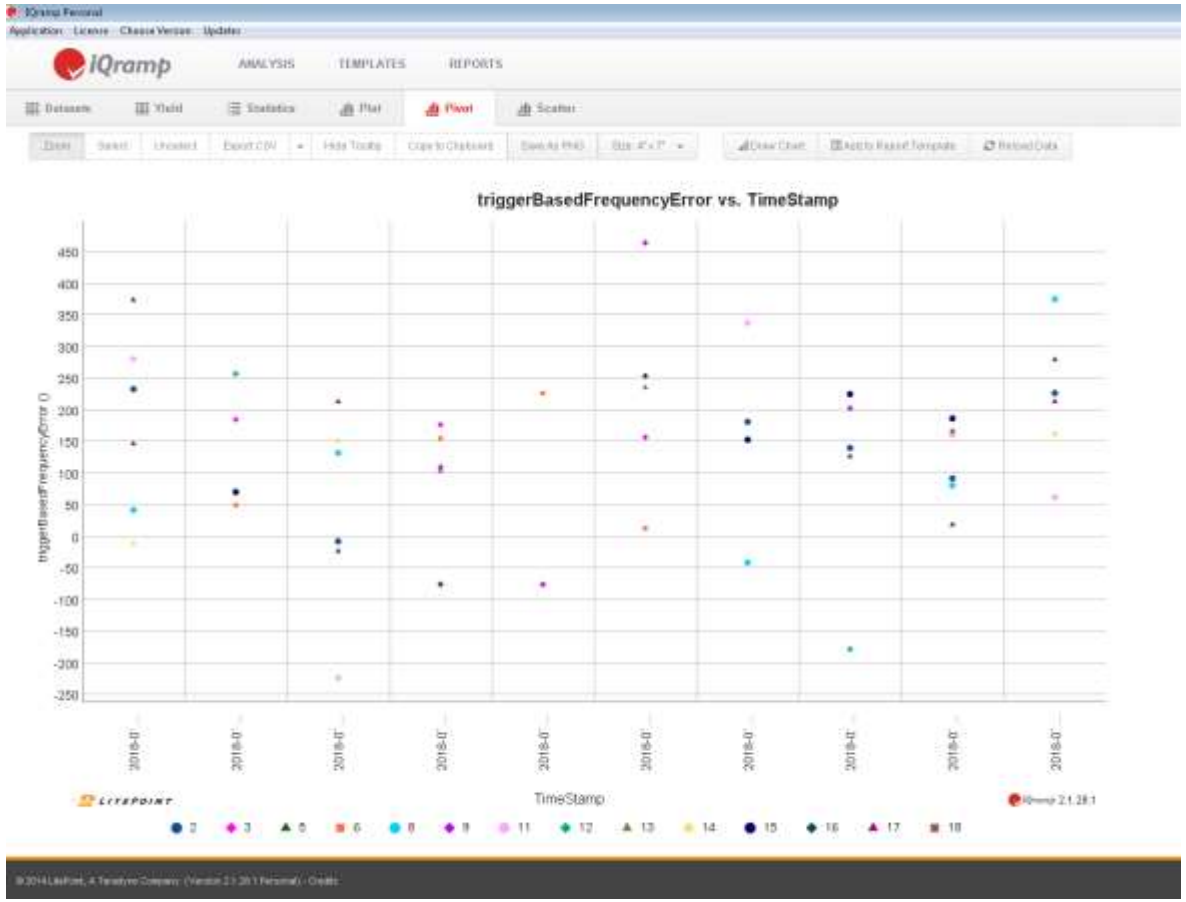
OTA Test in RF chamber



Example IQsniffer CFO Error

CFO error requirements < 350 Hz

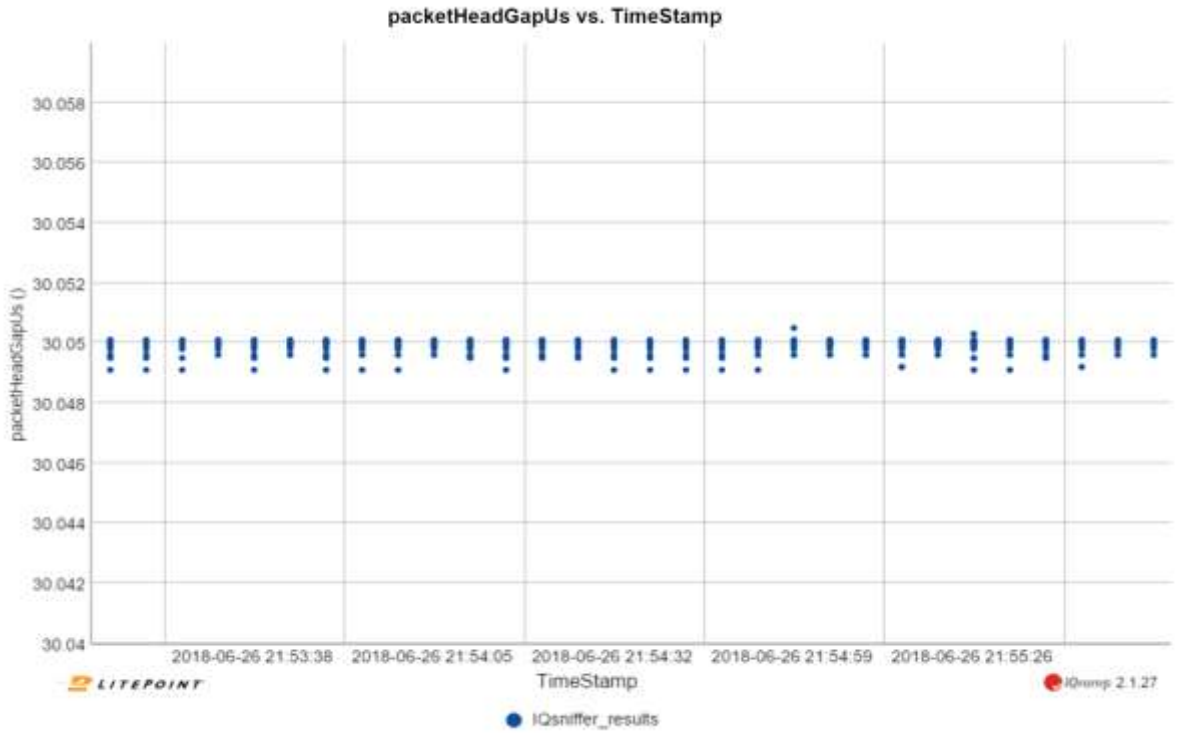
Results processed with IQramp



IQsniffer SIFS Timing Measurement

Timing Requirements: 16 µs +/- 400 ns

Results processed with IQramp



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Wi-Fi 6 Tester for 2.4, 5 and 6 GHz Bands: IQxel-MW 7G

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First fully integrated tester for Wi-Fi 6 in the 6 GHz band

IQxel-M2W 7G for DVT

IQxel-M8W 7G for Mobile (STA) Manufacturing

IQxel-M16W 7G for Access Point Manufacturing

IQxel-M2W 7G

- For DVT
- 2 VSA/VSG and 2 ports active

IQxel-M8W 7G

- For STA manufacturing
- Multi-DUT
- Configurations available:
  - 2x4: 2 VSA/VSG and 4 ports active
  - 2x8: 2 VSA/VSG and 8 ports active

IQxel-M16W 7G

- For AP manufacturing
- Configurations available:
  - 4x4: 4 VSA/VSG and 4 ports active
  - 4x8: 4 VSA/VSG and 8 ports active
  - 4x16: 4 VSA/VSG and 16 ports active
- Designed for True MIMO testing up to 4x4 on a single unit and up to 8x8 with extension.

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IQxel-MW 7G Product Highlights

The *IQxel-MW 7G* is LitePoint's test solution for advanced Wi-Fi 6 testing on 2.4GHz, 5 GHz and 6 GHz frequency bands

- Frequency range from 400 MHz to 7300 MHz
- Addresses the requirements of the IEEE 802.11ax (Wi-Fi 6) and 802.11ac (Wi-Fi 5) specifications and tests all IEEE 802.11 legacy specifications
- Native support for per-port 160 MH, 80+80 MHz and future 160+160 MHz signal combinations
- Exceptional residual EVM performance for 1024 QAM
- Single-user OFDMA, Trigger based Test multi-user OFDMA, Uplink and Downlink testing with easy-to-edit RU allocations
- Wi-Fi 6 Carrier Frequency Offset (CFO), power and timing control verification
- Tests all Bluetooth device standards (1.x, 2.x, 3.0, 4.x, 5) and the newly released BT 5.1
- Test support for DECT (ETSI EN 300 176-1), ZigBee, Z-Wave and WiSUN and LPWAN technologies LoRa and Sigfox

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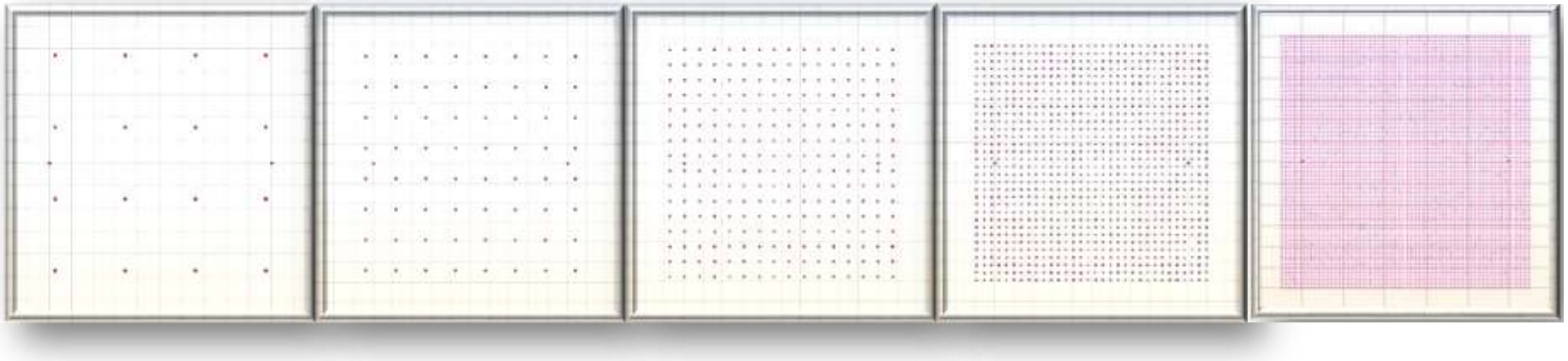
Higher Tester Performance for Linearity and Signal to Noise to make sure the EVM accuracy, so that insure the CPK and pass rate in MFG



16 QAM	64 QAM	256 QAM	1024 QAM	4096QAM
-19 dB	-27 dB	-32 dB	**-35 dB**	**-38 dB**

IQxel-MW 7G EVM accuracy < -48dB in loopback measurement with LTF channel estimation, and reach up to < -51dB with full packet channel estimation.

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Thank you

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