



Wi-Fi 6 (802.11ax) is Rolling Out.  
Are You Ready?

## Wi-Fi Gets Rebranded...

# Wi-Fi 6 is coming to a router near you

The Wi-Fi alliance has changed the naming scheme for Wi-Fi standards, abandoning the 802.11 designations for simpler names like Wi-Fi 6, Wi-Fi 5, Wi-Fi 4, etc., but that may gloss over some of the finer points of the old IEEE system.



# Wi-Fi 6: What Does the Naming Mean for You?

- In reality, very little – this is meant to help with consumer confusion to indicate generations of technology.

– 6 is a bigger number than 5, it must be better!



- **Wi-Fi 6** to identify devices that support **802.11ax** technology
- **Wi-Fi 5** to identify devices that support **802.11ac** technology
- **Wi-Fi 4** to identify devices that support **802.11n** technology

| Generation of network connection | Sample user interface visual |
|----------------------------------|------------------------------|
| Wi-Fi 6                          |                              |
| Wi-Fi 5                          |                              |
| Wi-Fi 4                          |                              |



**Note that this is Wi-Fi Alliance branding, not IEEE branding!**  
(we will still use 802.11ax in the development community)

# Wi-Fi 6 AP Products Announced and Launching



**TP-LINK**

**NETGEAR**



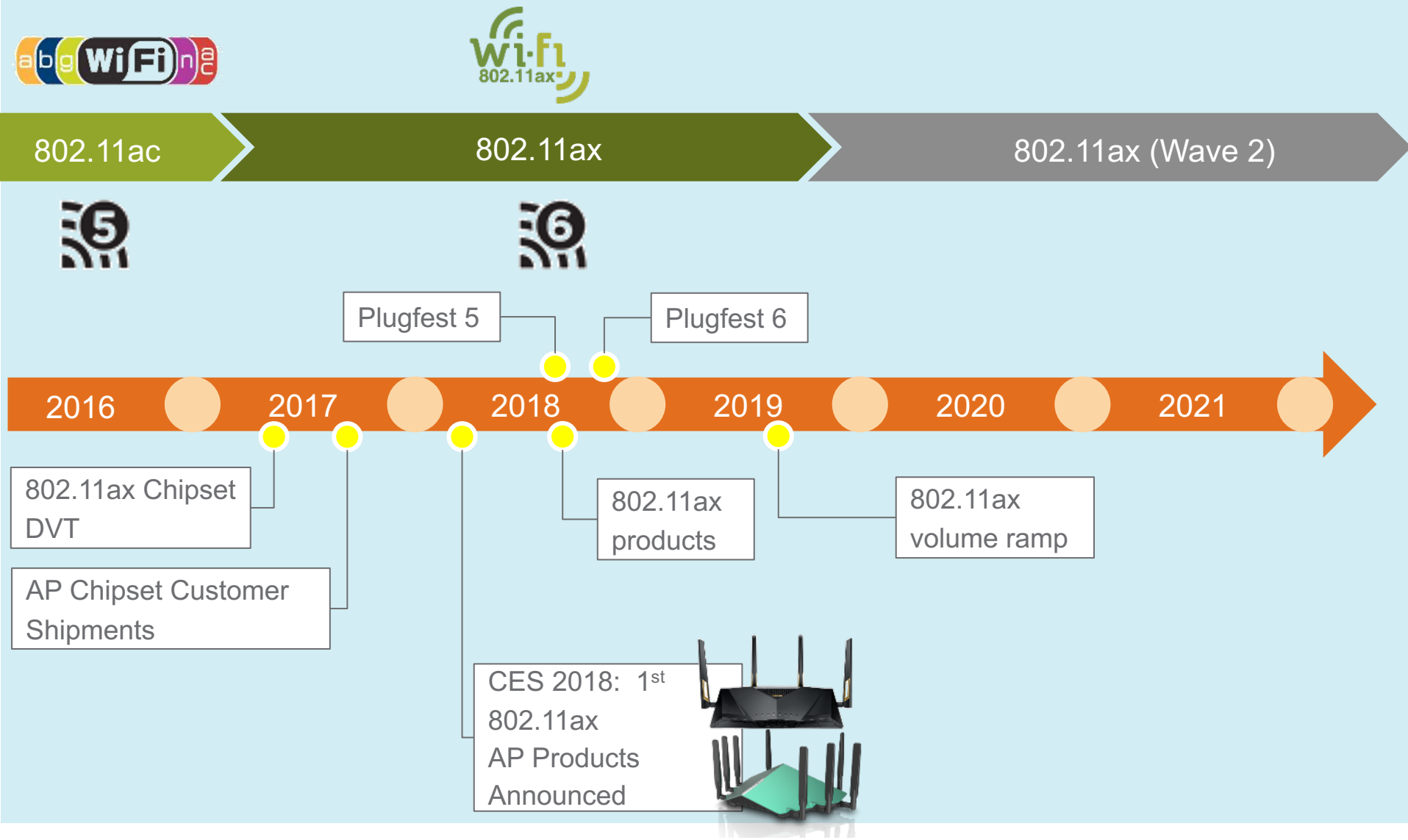
# Refresher: Key Changes in 802.11ax

|                           | 802.11n    | 802.11ac                     | 802.11ax         |           |
|---------------------------|------------|------------------------------|------------------|-----------|
| <b>Operating Bands</b>    | 2.4 & 5GHz | 5GHz                         | 2.4 & 5GHz       |           |
| <b>Technology</b>         | OFDM       | OFDM                         | OFDMA            |           |
| <b>MU-MIMO</b>            | No         | DL MU-MIMO*                  | DL / UL MU-MIMO* | *Optional |
| <b>Subcarrier Spacing</b> | 312.5kHz   | 312.5kHz                     | 78.125kHz        |           |
| <b>Modulation</b>         | 64QAM      | 256QAM                       | 1024QAM          |           |
| <b>User Streams</b>       | 4          | Up to 8 user streams*        |                  | *Optional |
| <b>Bandwidth</b>          | 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

# Market Update: 802.11ax Technologies Timeline



# Looking Ahead at New Wi-Fi Bands

## FCC puts gigabit Wi-Fi on the roadmap by opening up new wireless spectrum



Devin Coldewey @techcrunch / 1 week ago

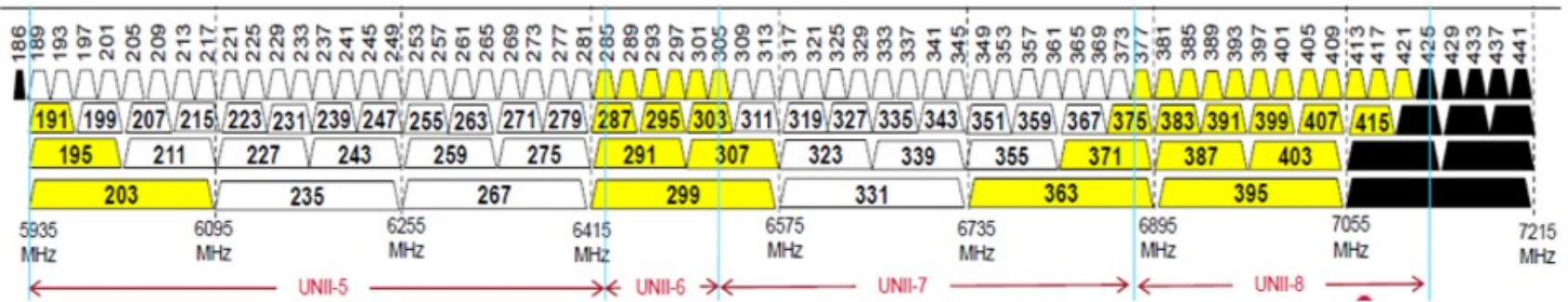
Comment



That's the purpose of the FCC proposing opening up what's generally called the 6 gigahertz band — 5,925 to 7,125 MHz — for similar purposes.

# 802.11ax “6 GHz” Band Allocations




















- U-NII-5: 5925-6425 MHz
- U-NII-6: 6425-6525 MHz
- U-NII-7: 6525-6875 MHz
- U-NII-8: 6875-7125 MHz



Yellow: may require reduced power for incumbent protection  
Black: not available in some locations



# 802.11ax Chipset Availability Roadmap

|   | 2018   | 2019   | 2020   |
|---|--|--|--|
| <b>Smartphones / Tablets</b><br>   | <b>802.11ax</b><br>   | <b>802.11ax</b><br>   | <b>802.11ax</b><br><br>U-NII-5/6/7/8  |
| <b>Laptops</b><br>                  | <b>802.11ax</b><br>   | <b>802.11ax</b><br>   | <b>802.11ax</b><br><br>U-NII-5/6/7/8  |
| <b>Access Point / Gateway</b><br> | <b>802.11ax</b><br>  | <b>802.11ax</b><br>  <br>U-NII-5/6/7/8 | <b>802.11ax</b><br>  <br>U-NII-5/6/7/8 |
|   |   |    |  |

802.11ax chipsets debut in Access Points in 2018 and move to mobile in 2019

# 802.11ax Feature Development

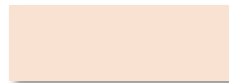
| 802.11ax Feature |                           |
|------------------|---------------------------|
| OFDMA            | Single-User OFDMA         |
|                  | Downlink Multi-User OFDMA |
|                  | Uplink Multi-User OFDMA   |
| MIMO             | Single-User MIMO          |
|                  | Multi-User MIMO           |



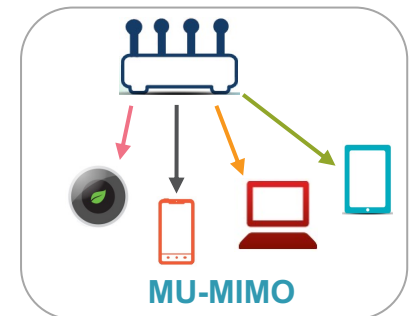
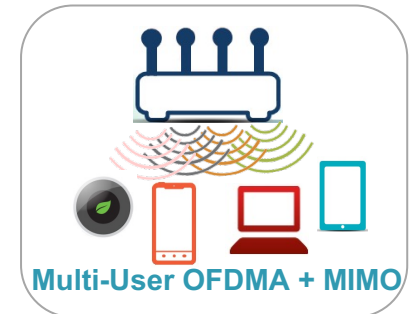
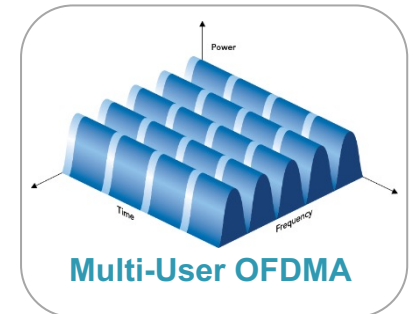
First focus for 802.11ax product development



Current focus for 802.11ax product development



Future development



# Wi-Fi Alliance Plugfest 5 Update



- Wi-Fi Alliance Plugfest 5 was held October 8-19, 2018.
- Participants:
  - 3 AP developers
  - 2 STA developer
  - 5 AP chipset providers
  - 8 STA chipset providers
  - 4 Equipment Vendors
- A total of 123 people participated in the 2 week event
- Plugfest 5 goal: validate **OFDMA** test cases, particularly **UL OFDMA**
  - Previous Plugfests focused on OFDM only
- Wi-Fi Alliance goal is to establish
- certification program in **Q3 2019**



# Wi-Fi Plugfest 5 Outcome and Next Steps

- OFDMA has proven to be **very complex** to implement!
- OFDMA Test Cases Validated:
  - AP: ~**20** of **41** cases validated (vendor dependent)
  - STA: ~**24** of **47** cases validated
  - PHY parameter “sniffer” validated on 2 of 4 cases
- Plugfest 6 Goal:
  - Complete remaining OFDMA test case validation
- Plugfest 6 scheduled for December 10-21, 2018



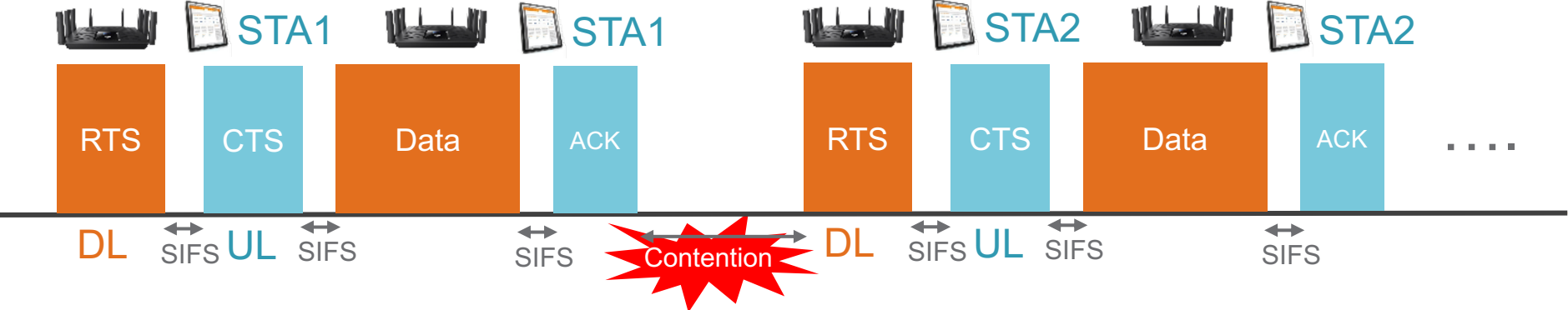
# 802.11ax Essential Tests for OFDMA

# OFDM vs. OFDMA: Downlink

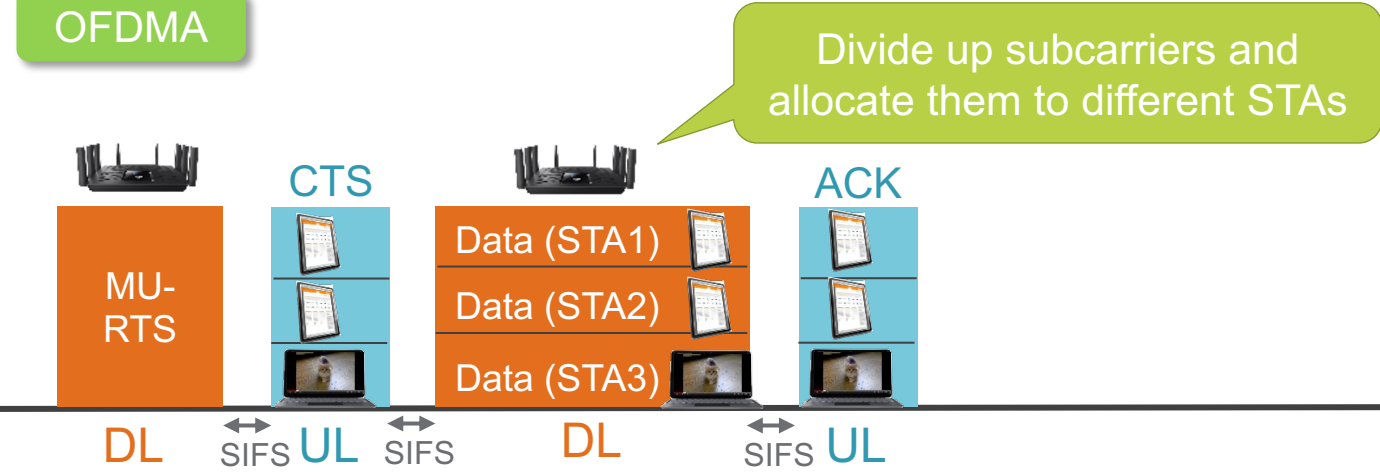


OFDMA improves overall network efficiency by serving multiple STAs

## OFDM

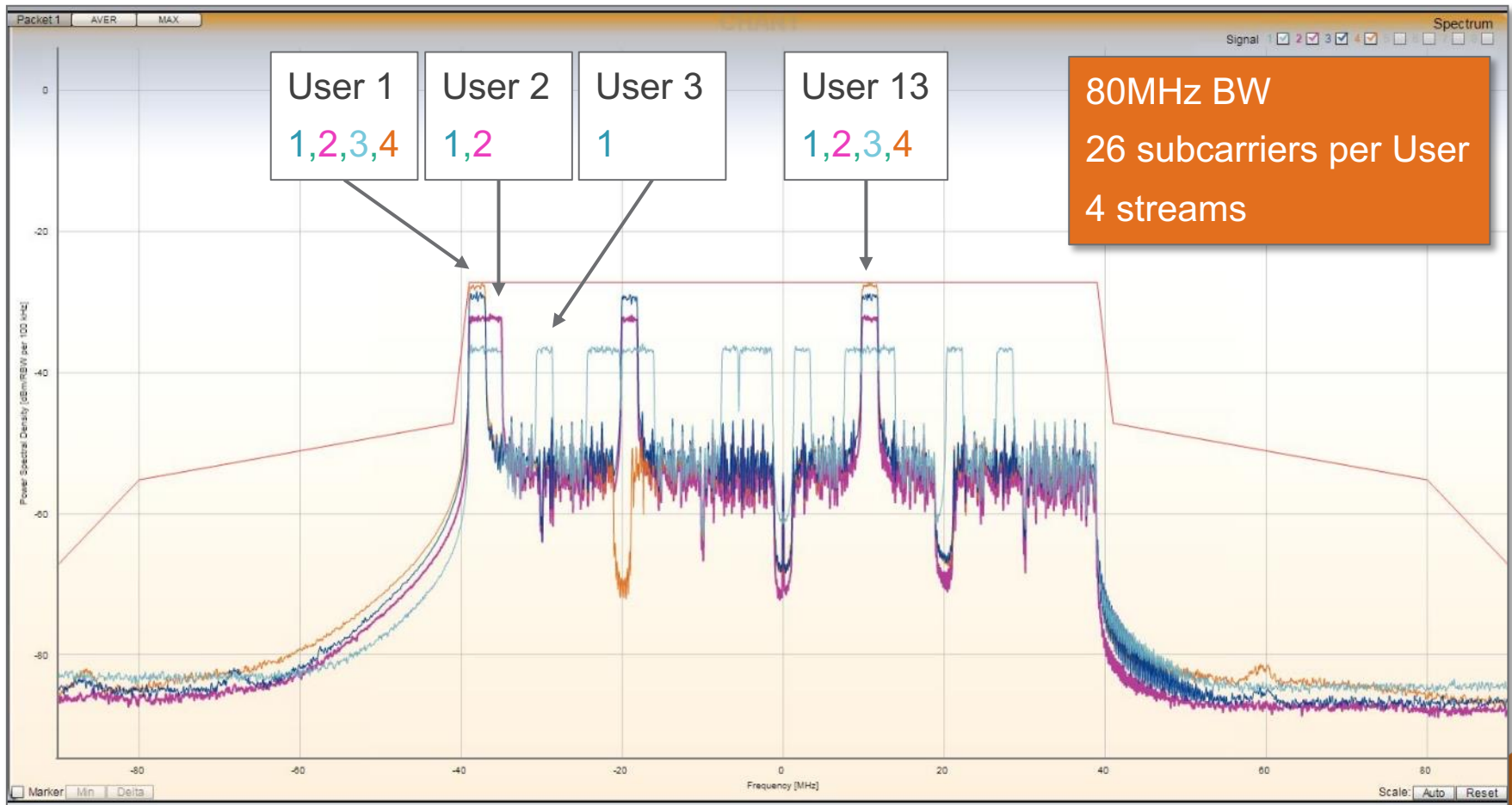


## OFDMA



# OFDMA Brings Large Number of Test Permutations

- AP simultaneously serves multiple users
  - Varying # of users, RU combinations, # of streams



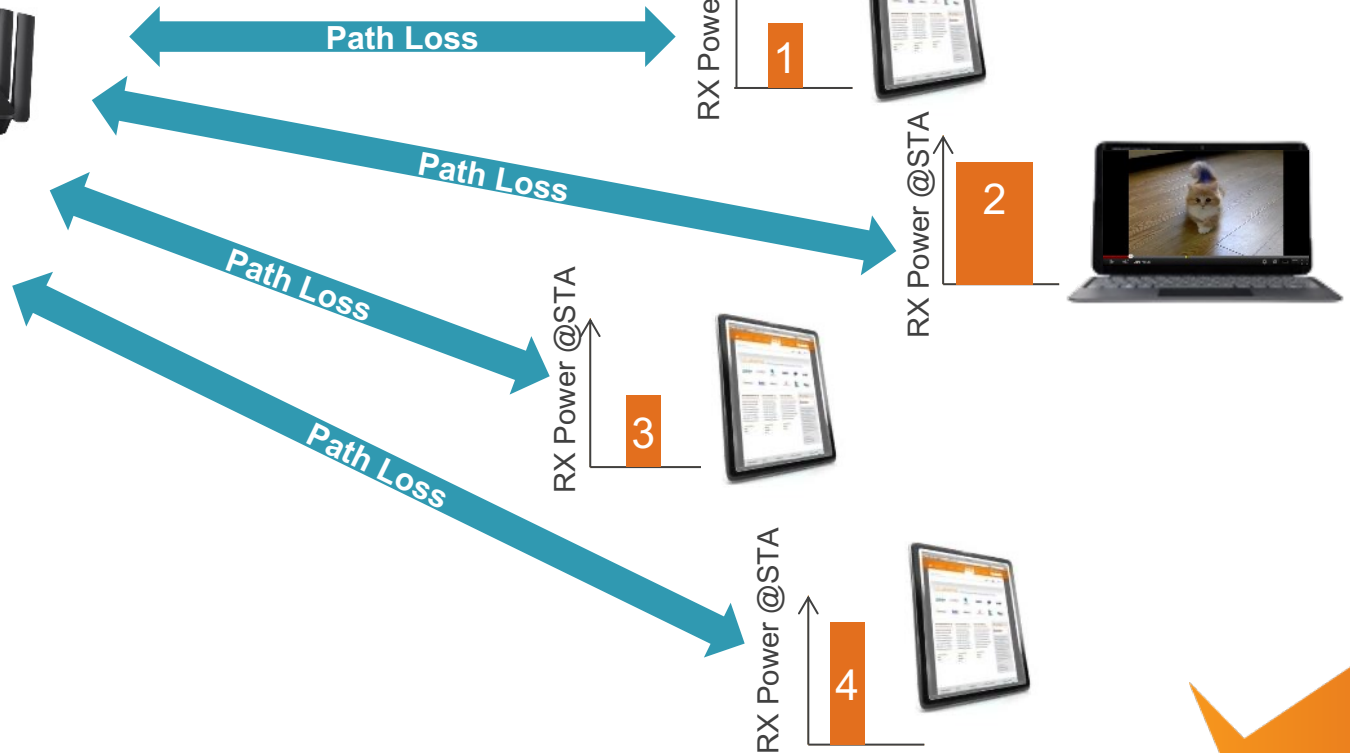
# Multi-User OFDMA Power Control ("Power Boost")



TX Power @AP



AP can adjust power level per RU so that Rx power at STAs are equal





# Creating 11ax Test Flow for AP with

Configure RU allocation for HE-MU

```
3.INITIALIZE_DUT
4.CONNECT_IQ_TESTER
5.LOAD_PATH_LOSS_TABLE
6.TEST_VERIFY EVM POWER 5180 MCS11 HE_SU BW-20 ANT1
7.TEST_VERIFY EVM POWER 5600 MCS11 HE_SU BW-20 ANT1
8.TEST_VERIFY EVM POWER 5700 MCS11 HE_SU BW-20 ANT1
9.TEST_VERIFY PER 5180 MCS9 HE_SU BW-20 ANT1
10.TEST_VERIFY PER 5600 MCS9 HE_SU BW-20 ANT1
11.TEST_VERIFY PER 5700 MCS9 HE_SU BW-20 ANT1
12.TEST_VERIFY SENS 5180 MCS9 HE_SU BW-20 ANT1
13.TEST_VERIFY SENS 5600 MCS9 HE_SU BW-20 ANT1
14.TEST_VERIFY SENS 5700 MCS9 HE_SU BW-20 ANT1
15.TEST_BUILD 5520 HE_MU BW-80 ANT1 ANT2 ANT3 ANT4
16.ADD_USER 1 MCS0 EVM MASK
17.ADD_USER 2 MCS0 EVM MASK
18.ADD_USER 3 MCS0 EVM MASK
19.ADD_USER 4 MCS0 EVM MASK
20.ADD_USER 5 MCS0 EVM MASK
21.TEST_RUN
22.TEST_BUILD 5520 HE_MU BW-40 ANT1 ANT2 ANT3 ANT4
23.ADD_USER 1 MCS0 PER
24.ADD_USER 2 MCS0 PER
25.ADD_USER 3 MCS0 PER
26.TEST_RUN
27.DISCONNECT_IQ_TESTER
28.REMOVE_DUT
```

Input Parameters

|   | Name                    | Value                                 | Type    | Unit |
|---|-------------------------|---------------------------------------|---------|------|
| 1 | TEST_CATEGORY           | AP_TX_DL_OFDMA                        | String  |      |
| 2 | NUM_USERS               | 5                                     | Integer |      |
| 3 | PACKET_FORMAT           | HE_MU                                 | String  |      |
| 4 | BSS_BANDWIDTH           | BW-80                                 | String  | MHz  |
| 5 | CH_BANDWIDTH            | CBW-80                                | String  | MHz  |
| 6 | BSS_FREQ_MHZ_PRIMARY    | 5520                                  | Integer | MHz  |
| 7 | CH_FREQ_MHZ             | 5520                                  | Integer | MHz  |
| 8 | NUM_USERS_PER_RU        | 1,0,0,0,0,0,1,0 0,0,0,0,1,0,0,0,0 ... | String  |      |
| 9 | RU_ALLOCATION_SIGNALING | RUx9 (00000000) 26-26-26-26-2...      | String  |      |

5 Users

WIFI 11AX

BSS\_BANDWIDTH BW-80

|                         | 1st 20MHz                                     | 2nd 20MHz                                     | 26 RU for 1s | 3rd 20MHz                                     | 4th 20MHz                                     |
|-------------------------|---|---|--------------|---|---|
| RU_ALLOCATION_SIGNALING | RUx9 (00000000) 26-26-26-26-26-26-26-26-26-26 | RUx9 (00000000) 26-26-26-26-26-26-26-26-26-26 | RUx0 (*)     | RUx9 (00000000) 26-26-26-26-26-26-26-26-26-26 | RUx9 (00000000) 26-26-26-26-26-26-26-26-26-26 |
| NUM_USERS_PER_RU        | 1,0,0,0,0,0,1,0                               | 0,0,0,0,1,0,0,0,0                             |              | 0,0,0,0,0,0,1,0                               | 0,0,1,0,0,0,0,0                               |
| STREAM_ALLOCATION       |   |   |              |   |   |

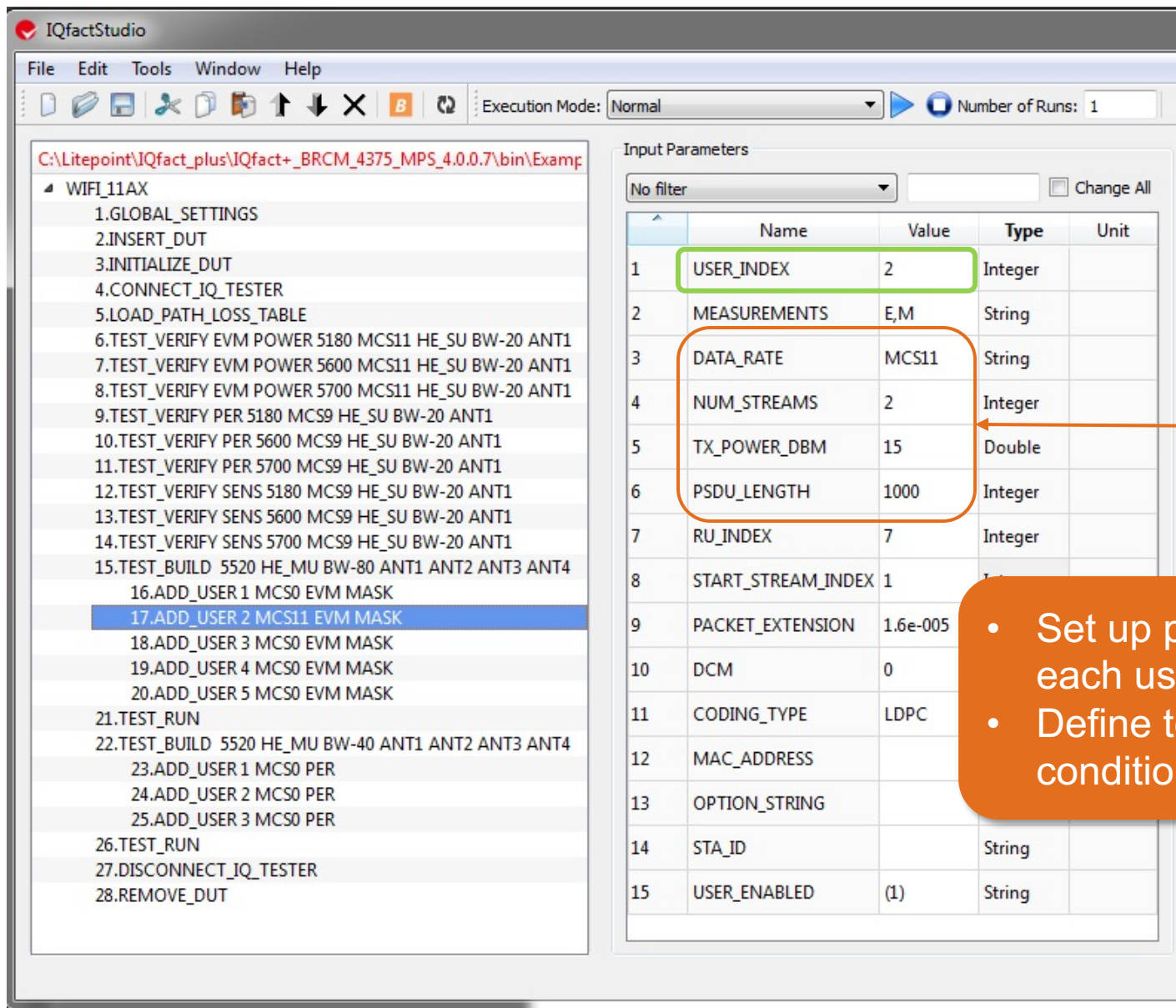
RU\_ALLOCATION\_SIGNALING  
RUx9 (00000000) 26-26-26-26-26-26-26-26-26-26|RUx9 (00000000) 26-26-26-26-26-26-26-26-26-26|RUx0 (\*\*\*\*\*\*) NA|RUx9 (00000000) 26-26-26-26-26-26-26-26-26-26|RUx9 (00000000) 26-26-26-26-26-26-26-26-26-26

NUM\_USERS\_PER\_RU 1,0,0,0,0,0,1,0|0,0,0,0,1,0,0,0,0|0,0,0,0,0,0,0,0,0|0,0,0,1,0,0,0,0,0|

STREAM\_ALLOCATION |||||

Apply

# Creating 11ax Test Flow for AP with



Execution Mode: Normal Number of Runs: 1

C:\Litepoint\IQfact\_plus\IQfact+\_BRM\_4375\_MPS\_4.0.0.7\bin\Examp

- WIFI\_11AX
  - 1.GLOBAL\_SETTINGS
  - 2.INSERT\_DUT
  - 3.INITIALIZE\_DUT
  - 4.CONNECT\_IQ\_TESTER
  - 5.LOAD\_PATH\_LOSS\_TABLE
  - 6.TEST\_VERIFY EVM POWER 5180 MCS11 HE\_SU BW-20 ANT1
  - 7.TEST\_VERIFY EVM POWER 5600 MCS11 HE\_SU BW-20 ANT1
  - 8.TEST\_VERIFY EVM POWER 5700 MCS11 HE\_SU BW-20 ANT1
  - 9.TEST\_VERIFY PER 5180 MCS9 HE\_SU BW-20 ANT1
  - 10.TEST\_VERIFY PER 5600 MCS9 HE\_SU BW-20 ANT1
  - 11.TEST\_VERIFY PER 5700 MCS9 HE\_SU BW-20 ANT1
  - 12.TEST\_VERIFY SENS 5180 MCS9 HE\_SU BW-20 ANT1
  - 13.TEST\_VERIFY SENS 5600 MCS9 HE\_SU BW-20 ANT1
  - 14.TEST\_VERIFY SENS 5700 MCS9 HE\_SU BW-20 ANT1
  - 15.TEST\_BUILD 5520 HE\_MU BW-80 ANT1 ANT2 ANT3 ANT4
  - 16.ADD\_USER 1 MCS0 EVM MASK
  - 17.ADD\_USER 2 MCS11 EVM MASK**
  - 18.ADD\_USER 3 MCS0 EVM MASK
  - 19.ADD\_USER 4 MCS0 EVM MASK
  - 20.ADD\_USER 5 MCS0 EVM MASK
  - 21.TEST\_RUN
  - 22.TEST\_BUILD 5520 HE\_MU BW-40 ANT1 ANT2 ANT3 ANT4
  - 23.ADD\_USER 1 MCS0 PER
  - 24.ADD\_USER 2 MCS0 PER
  - 25.ADD\_USER 3 MCS0 PER
  - 26.TEST\_RUN
  - 27.DISCONNECT\_IQ\_TESTER
  - 28.REMOVE\_DUT

|    | Name               | Value    | Type    | Unit |
|----|--------------------|----------|---------|------|
| 1  | USER_INDEX         | 2        | Integer |      |
| 2  | MEASUREMENTS       | E,M      | String  |      |
| 3  | DATA_RATE          | MCS11    | String  |      |
| 4  | NUM_STREAMS        | 2        | Integer |      |
| 5  | TX_POWER_DBM       | 15       | Double  |      |
| 6  | PSDU_LENGTH        | 1000     | Integer |      |
| 7  | RU_INDEX           | 7        | Integer |      |
| 8  | START_STREAM_INDEX | 1        | Integer |      |
| 9  | PACKET_EXTENSION   | 1.6e-005 | Double  |      |
| 10 | DCM                | 0        | Integer |      |
| 11 | CODING_TYPE        | LDPC     | String  |      |
| 12 | MAC_ADDRESS        |          | String  |      |
| 13 | OPTION_STRING      |          | String  |      |
| 14 | STA_ID             |          | String  |      |
| 15 | USER_ENABLED       | (1)      | String  |      |

Different for each RU / user

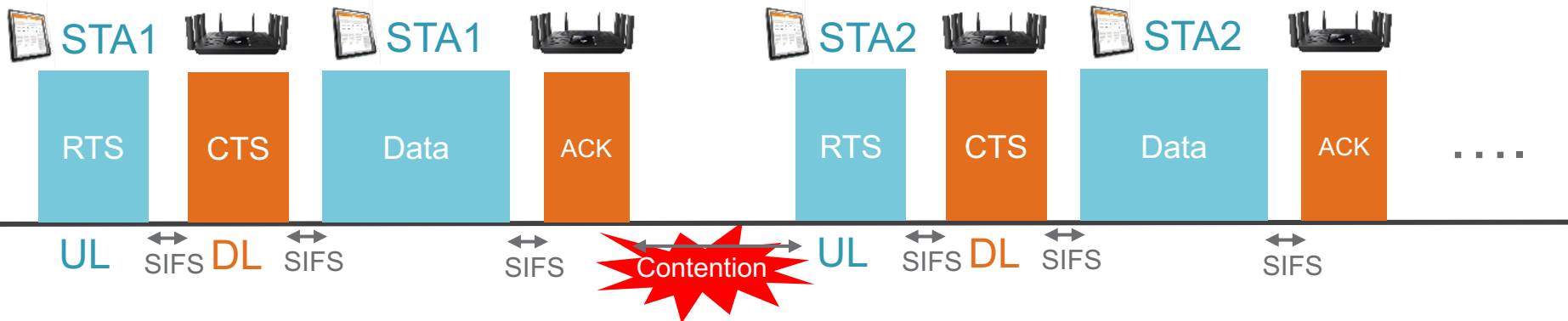
- Set up parameters for each user
- Define test types and conditions

# OFDM vs. OFDMA: Uplink

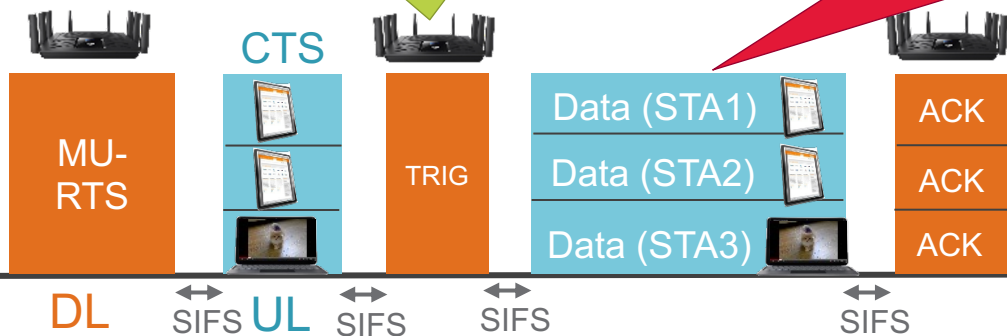


Uplink Tx requires precise frequency, timing, and power control

## OFDM



## OFDMA



AP must coordinate simultaneous STA transmission

Signals from STAs can interfere each other in Time / Frequency / Power

# AP as Mini Base Station



- AP pre-coordinates with STAs to minimize interference

- Power balance among STAs *Power*

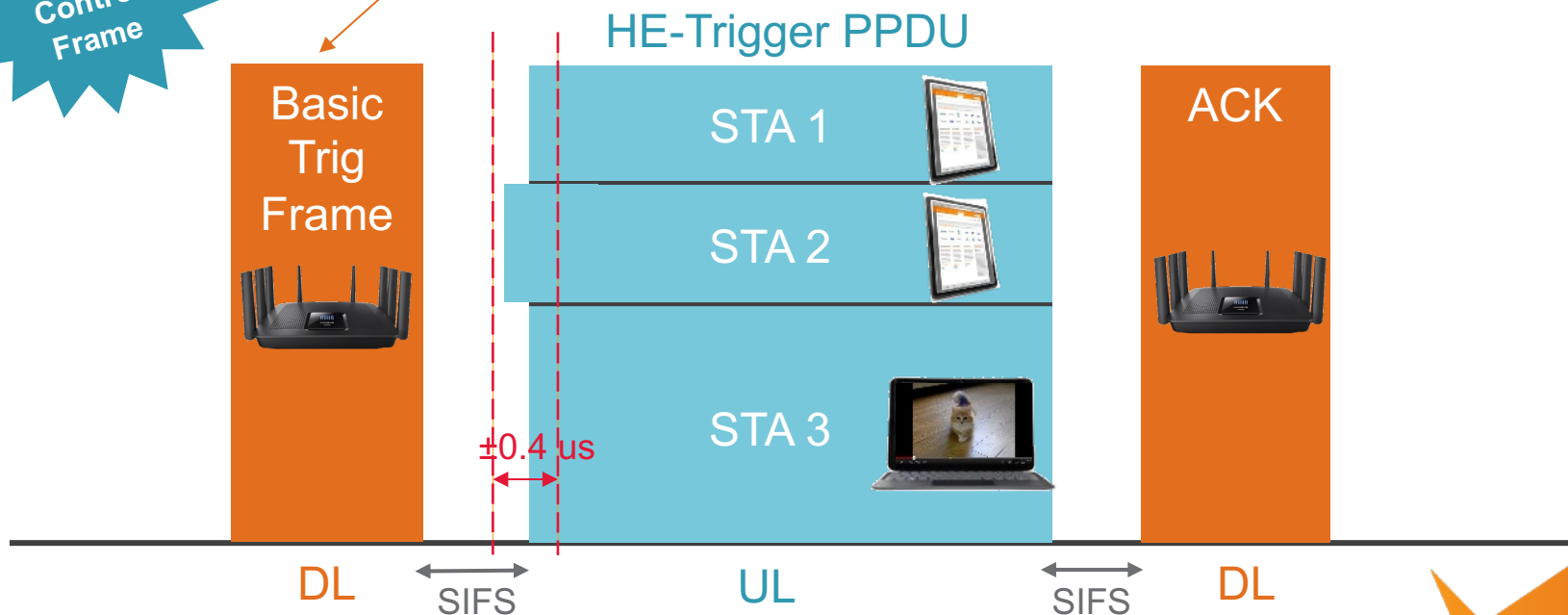
- System synchronization among STAs

- 1) Transmit at the same time ( $< 0.4\mu\text{s}$  difference) *Timing*

- 2) Transmit at the same carrier frequency ( $< 350\text{ Hz}$  difference) *Frequency*

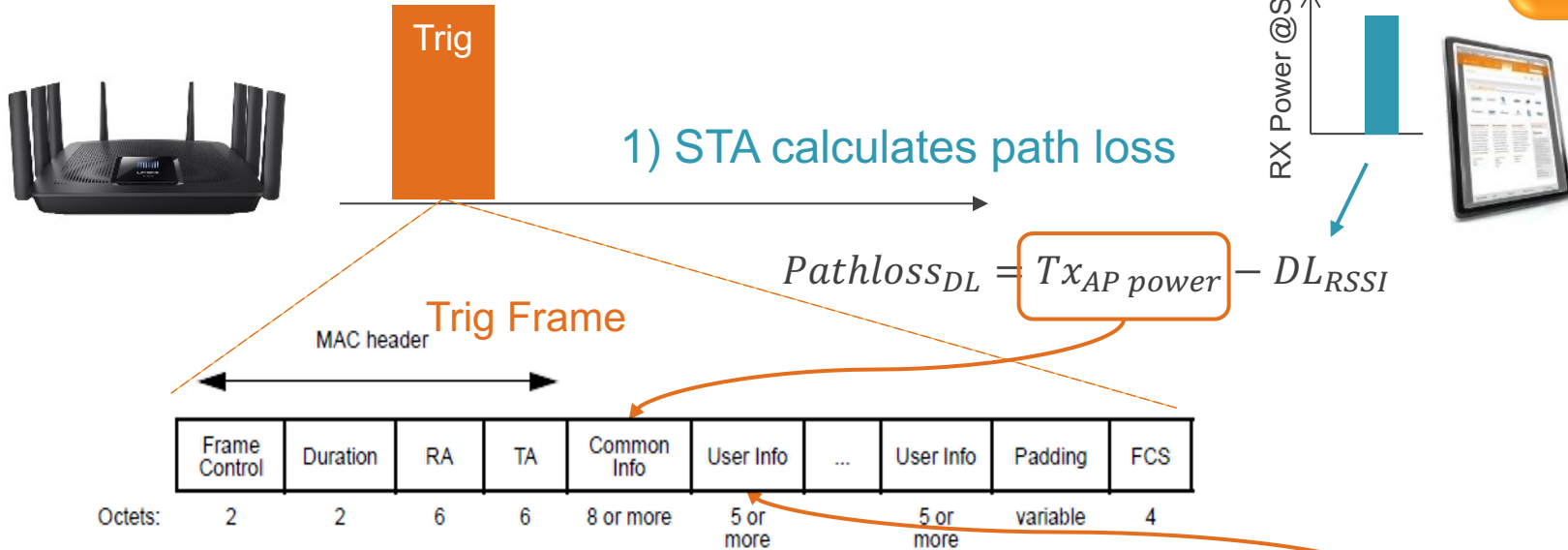


- Specifies UL window length, allowed users
- Allocates RUs, spatial streams, users' MCS



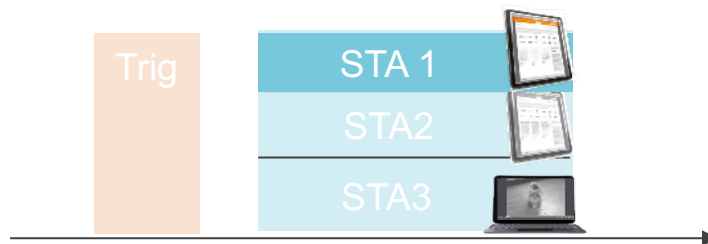
# How Does Power Pre-correction Work?

## Maintain power balance among STAs in Uplink



2) STA calculates UL transmit power  $Tx_{STA} \text{ power} = Pathloss_{DL} + Target_{RSSI}$

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



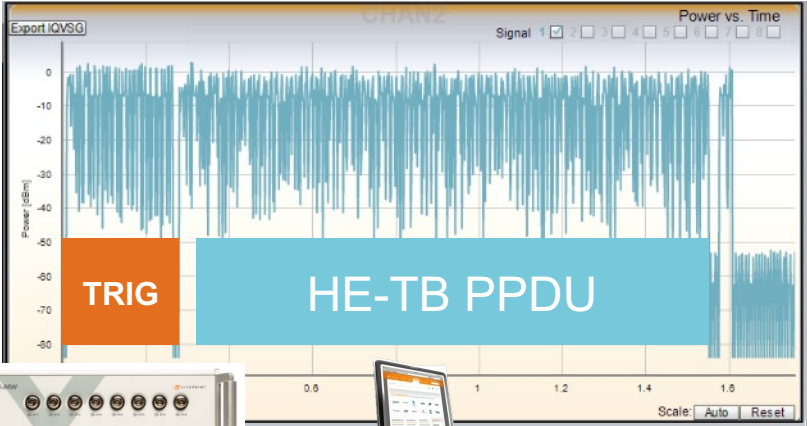
Ensures STA power does not interfere with other participating STAs

# IQfact+ Data Example: Trigger Based Testing

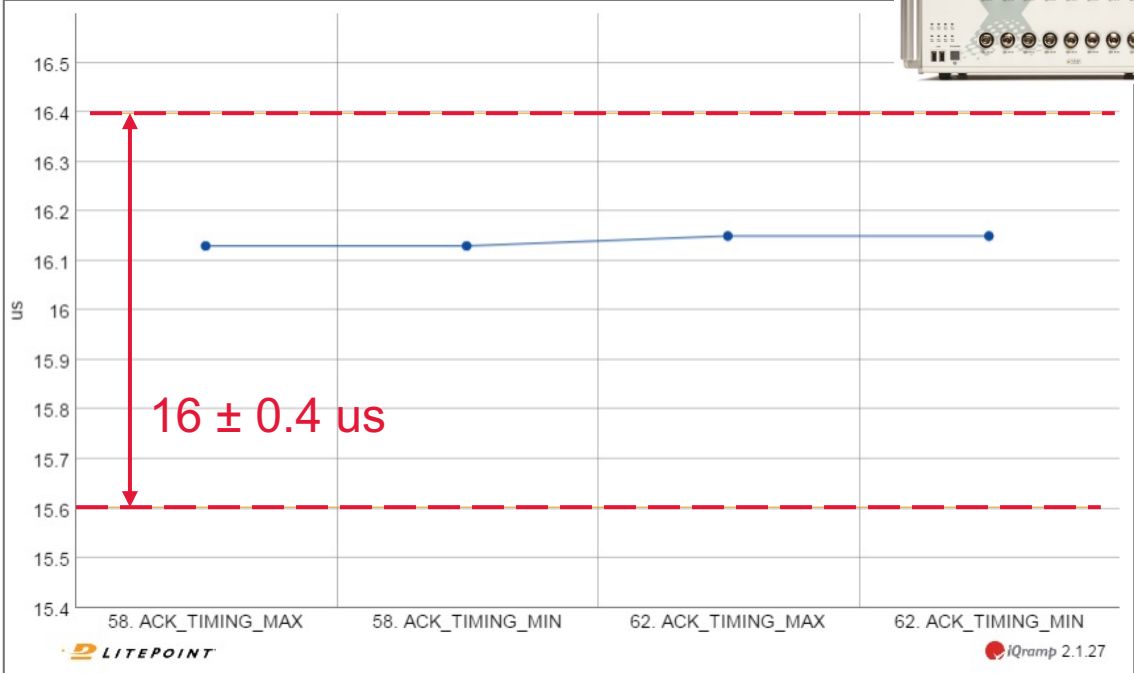


IQfact+ **automatically** handles precise timing control necessary for TBT

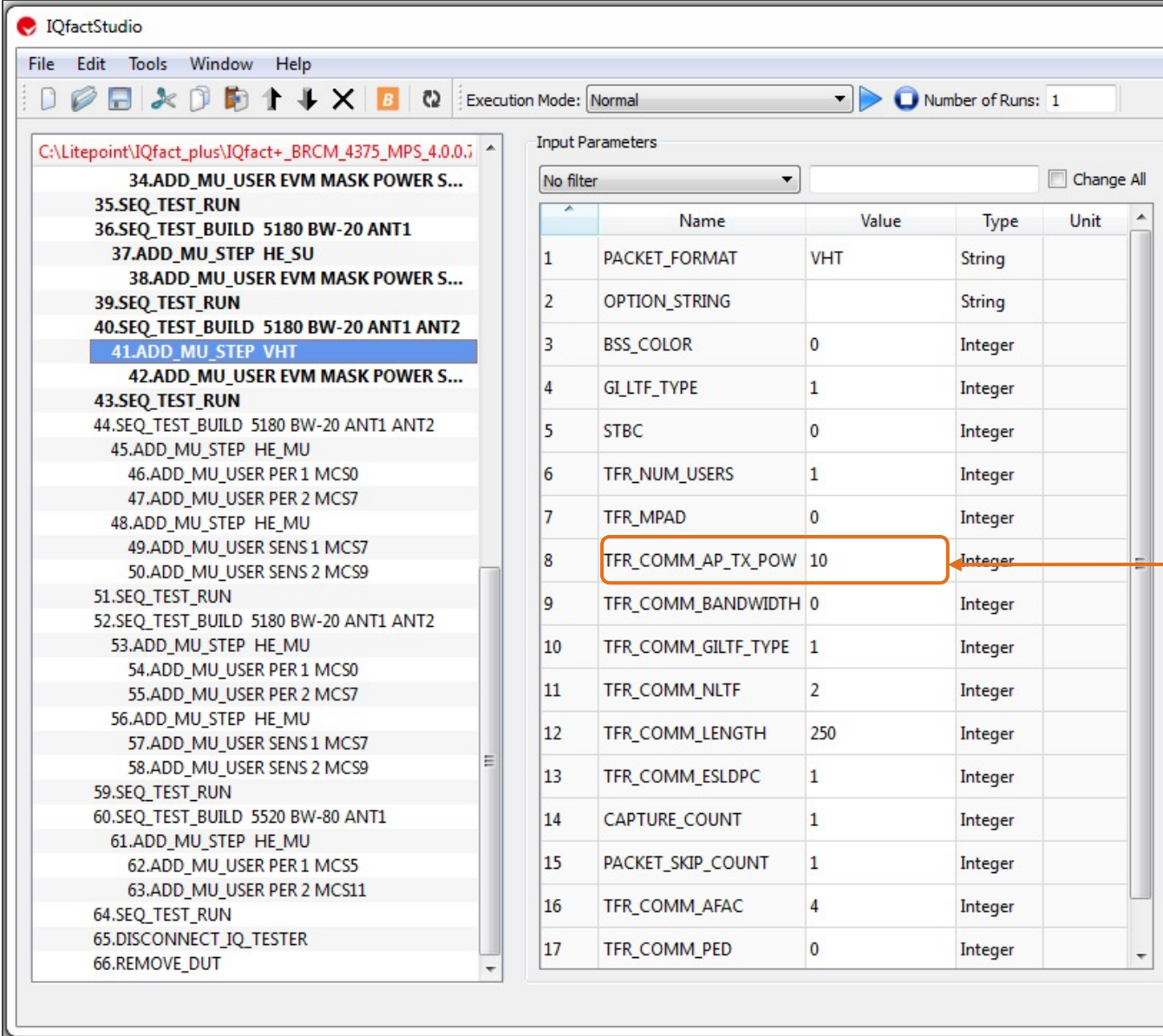
- 1. Tester VSG: Transmit a Trigger frame
- 2. Tester switches VSG to VSA
- 3. Tester VSA captures HE-TB from STA for analysis



TBT (Timing measurement)



# Configuring Trigger Based Test with

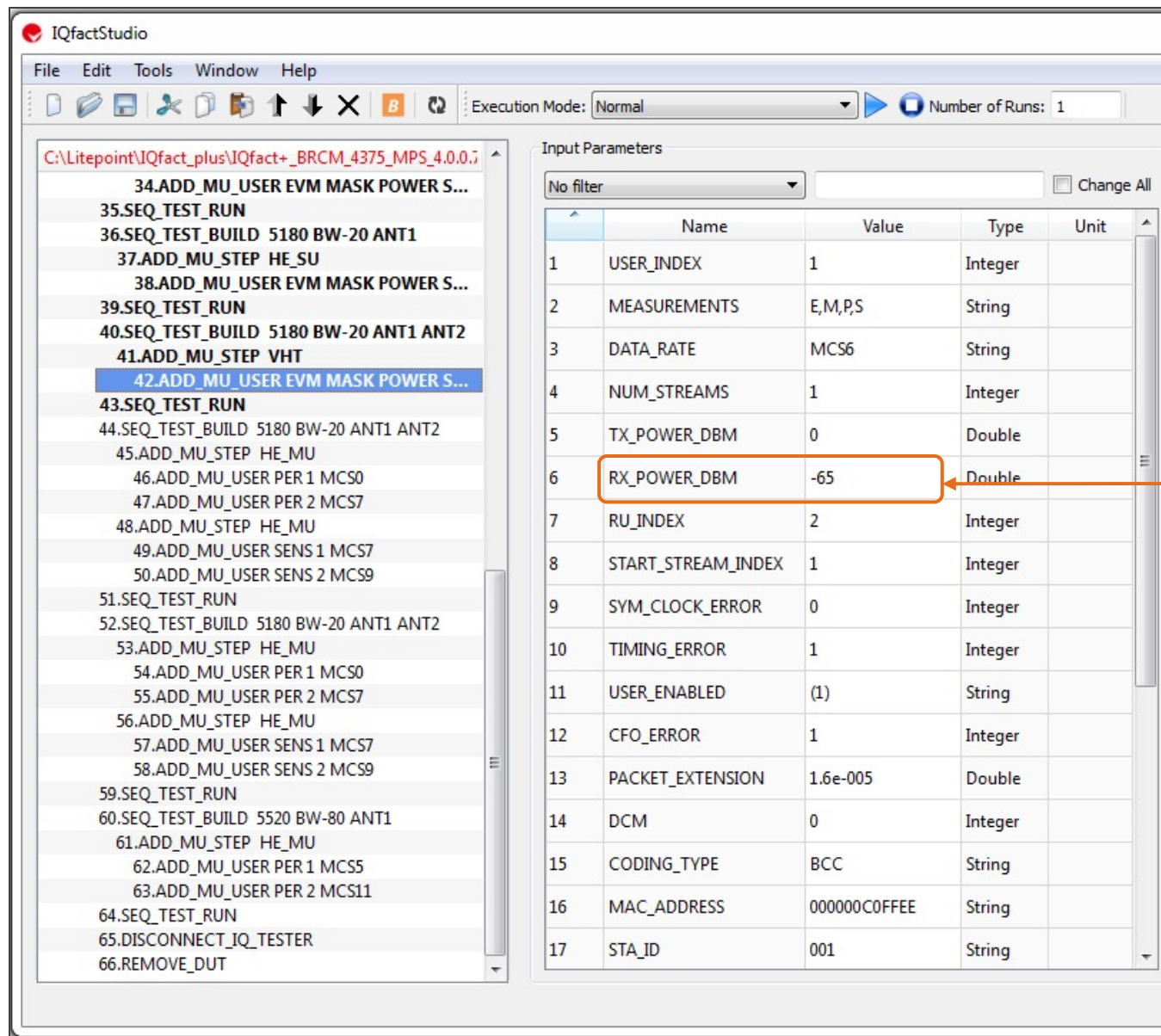


The screenshot shows the IQfactStudio interface. On the left, a test sequence is listed, with step 41, "41.ADD\_MU\_STEP VHT", highlighted in blue. On the right, the "Input Parameters" table is displayed. The table has columns for Name, Value, Type, and Unit. The parameter "TFR\_COMM\_AP\_TX\_POW" is highlighted with an orange box, and its value is "10". An orange arrow points from the text on the right to this parameter.

|    | Name                | Value | Type    | Unit |
|----|---------------------|-------|---------|------|
| 1  | PACKET_FORMAT       | VHT   | String  |      |
| 2  | OPTION_STRING       |       | String  |      |
| 3  | BSS_COLOR           | 0     | Integer |      |
| 4  | GI_LTF_TYPE         | 1     | Integer |      |
| 5  | STBC                | 0     | Integer |      |
| 6  | TFR_NUM_USERS       | 1     | Integer |      |
| 7  | TFR_MPAD            | 0     | Integer |      |
| 8  | TFR_COMM_AP_TX_POW  | 10    | Integer |      |
| 9  | TFR_COMM_BANDWIDTH  | 0     | Integer |      |
| 10 | TFR_COMM_GILTF_TYPE | 1     | Integer |      |
| 11 | TFR_COMM_NLTF       | 2     | Integer |      |
| 12 | TFR_COMM_LENGTH     | 250   | Integer |      |
| 13 | TFR_COMM_ESLDPC     | 1     | Integer |      |
| 14 | CAPTURE_COUNT       | 1     | Integer |      |
| 15 | PACKET_SKIP_COUNT   | 1     | Integer |      |
| 16 | TFR_COMM_AFAC       | 4     | Integer |      |
| 17 | TFR_COMM_PED        | 0     | Integer |      |

**Sets AP Tx power  
in Trigger frame  
(dBm)**

# Configuring Trigger Based Test with



The screenshot shows the IQfactStudio interface. On the left, a test sequence is listed, with step 42, '42.ADD\_MU\_USER EVM MASK POWER S...', highlighted in blue. On the right, the 'Input Parameters' table is displayed. The table has columns for Name, Value, Type, and Unit. The row for 'RX\_POWER\_DBM' is highlighted with an orange box, and an orange arrow points from the right towards this row.

|    | Name               | Value        | Type    | Unit |
|----|--------------------|--------------|---------|------|
| 1  | USER_INDEX         | 1            | Integer |      |
| 2  | MEASUREMENTS       | E,M,P,S      | String  |      |
| 3  | DATA_RATE          | MCS6         | String  |      |
| 4  | NUM_STREAMS        | 1            | Integer |      |
| 5  | TX_POWER_DBM       | 0            | Double  |      |
| 6  | RX_POWER_DBM       | -65          | Double  |      |
| 7  | RU_INDEX           | 2            | Integer |      |
| 8  | START_STREAM_INDEX | 1            | Integer |      |
| 9  | SYM_CLOCK_ERROR    | 0            | Integer |      |
| 10 | TIMING_ERROR       | 1            | Integer |      |
| 11 | USER_ENABLED       | (1)          | String  |      |
| 12 | CFO_ERROR          | 1            | Integer |      |
| 13 | PACKET_EXTENSION   | 1.6e-005     | Double  |      |
| 14 | DCM                | 0            | Integer |      |
| 15 | CODING_TYPE        | BCC          | String  |      |
| 16 | MAC_ADDRESS        | 000000C0FFEE | String  |      |
| 17 | STA_ID             | 001          | String  |      |

**Sets target Rx signal power in Trigger frame (dBm)**



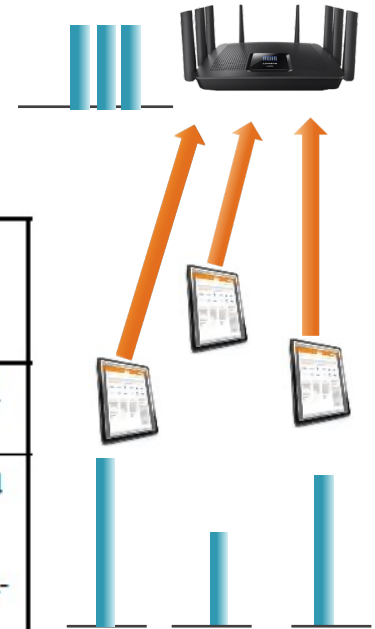
# STA Device Calibration

## More Stringent Requirement in 11ax

- Transmit power accuracy : For uplink Tx accuracy
- RSSI measurement accuracy : To correctly calculate pathloss



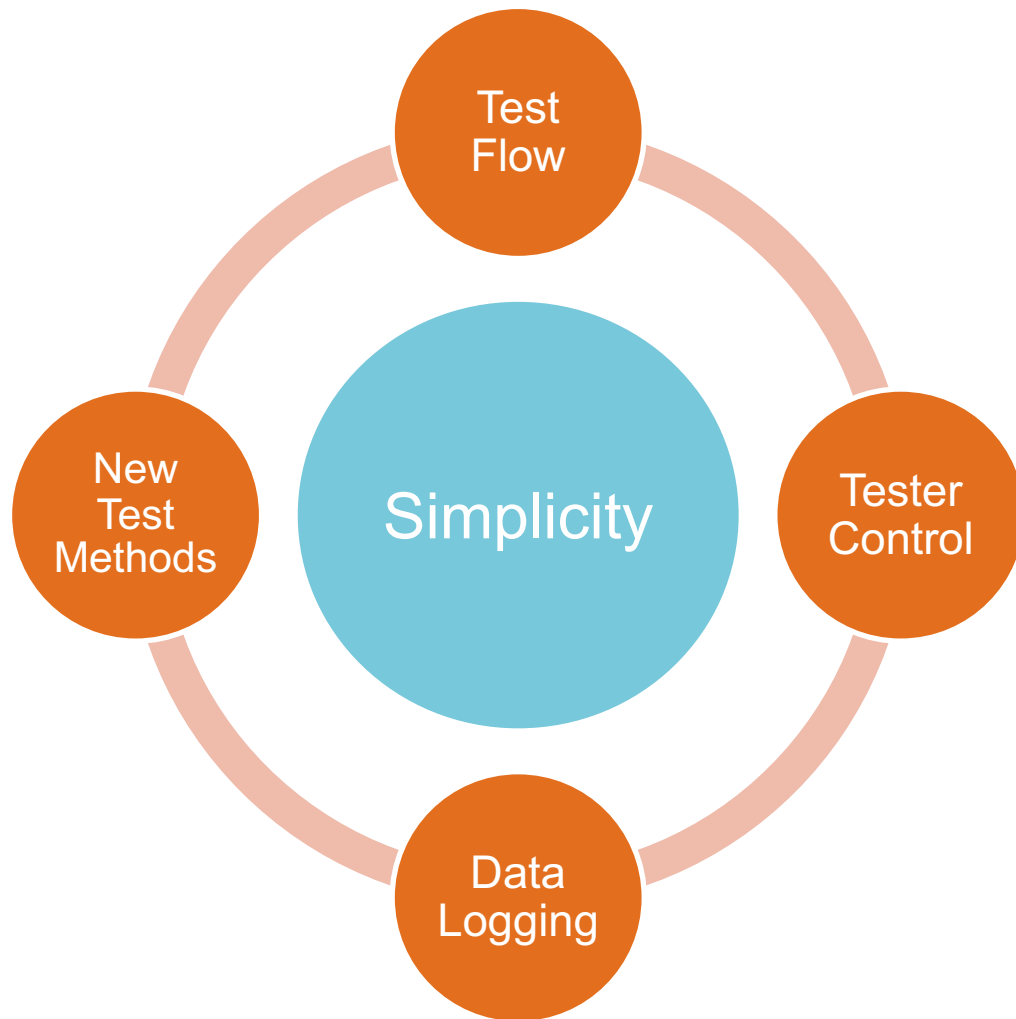
Accurate power control is critical in ensuring power received from STAs at AP is equal



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

# Automation Reduces 802.11ax Test Complexity

11ax has more test combinations and test requirements than previous Wi-Fi standards



# IQsniffer: PHY Layer Packet Analysis

# IQsniffer – WiFi PHY Traffic Analysis Simplified



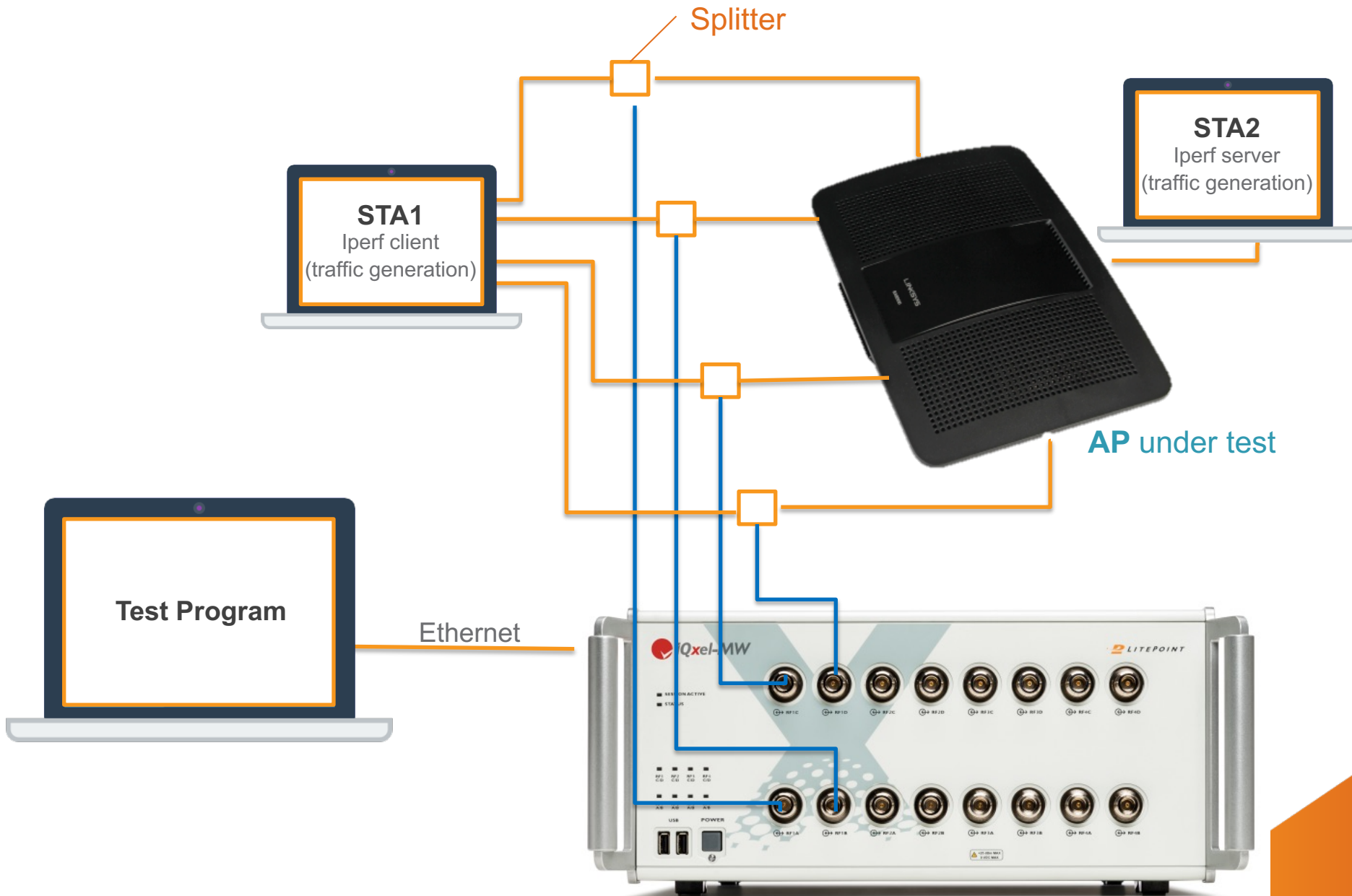
- IQsniffer is useful for **product characterization** and Wi-Fi Alliance **certification**

- **Key Features:**

- **PHY layer analysis:** Uncovers timing information and behavior not visible at MAC layer
  - Parametric measurements(EVM, Power, Spectrum, etc.)
  - Timing information
  - PPDU information: packet format, coding, spatial stream info
- **MAC layer information available:**
  - Packet type, sub-type
  - MAC address(es)
  - Whole PSDU



# IQsniffer PHY Traffic Monitoring (4x4) on IQxel-MW



# IQsniffer Return Interface – Simple to Use

- IQsniffer Interface

- IQsniffer provides a simple SCPI interface over socket:

```
SNIF:CONF:OUTP ALL
SNIF:CONF:BAS 1
SNIF:CONF:PDTH 30
SNIF:CALC

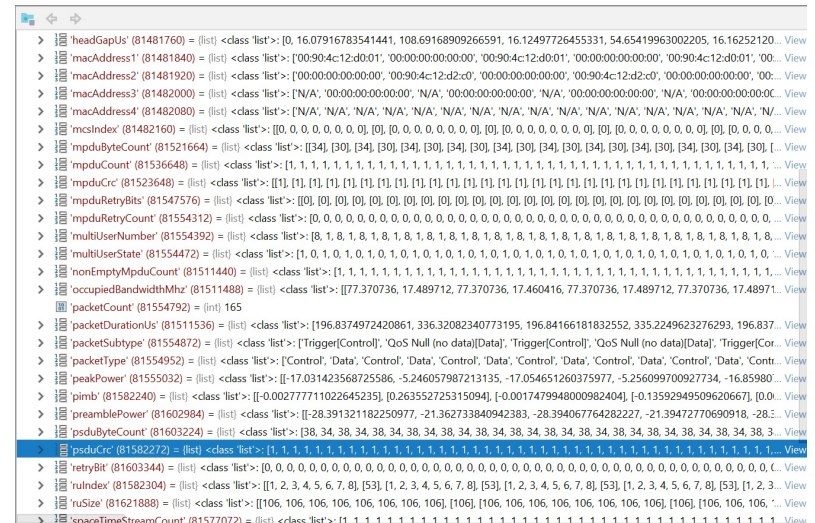
SNIF:FETC:ALL:JSON ?
```

- Results all included in a JSON object:

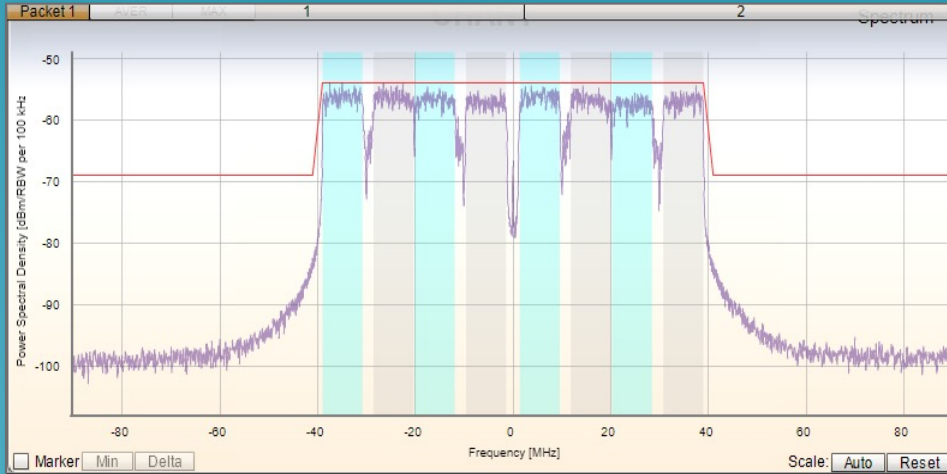
- Easy to load into a dictionary data type
  - Each key has a list of values
  - Each “value” could be a list of users

- Python example source code is proved

- JSON returns saved into .CSV file
  - The .CSV file can be loaded in Excel or IQramp



# Using IQsniffer: PHY Parameters for 802.11ax HE-MU



Packet 1 CHANT TxQuality Multi-User

| User | RU Idx | RU Size | Mod Ty.. | MCS | #Stream | EVM (dB) | Power (dBm) |
|------|--------|---------|----------|-----|---------|----------|-------------|
| 1    | 1      | 106     | BPSK     | 0   | 1       | -42.65   | -36.95      |
| 2    | 2      | 106     | BPSK     | 0   | 1       | -42.13   | -36.92      |
| 3    | 3      | 106     | BPSK     | 0   | 1       | -42.03   | -37.41      |
| 4    | 4      | 106     | BPSK     | 0   | 1       | -41.74   | -37.90      |
| 5    | 5      | 106     | BPSK     | 0   | 1       | -42.57   | -37.12      |
| 6    | 6      | 106     | BPSK     | 0   | 1       | -41.88   | -37.35      |
| 7    | 7      | 106     | BPSK     | 0   | 1       | -40.88   | -38.24      |
| 8    | 8      | 106     | BPSK     | 0   | 1       | -41.47   | -37.63      |

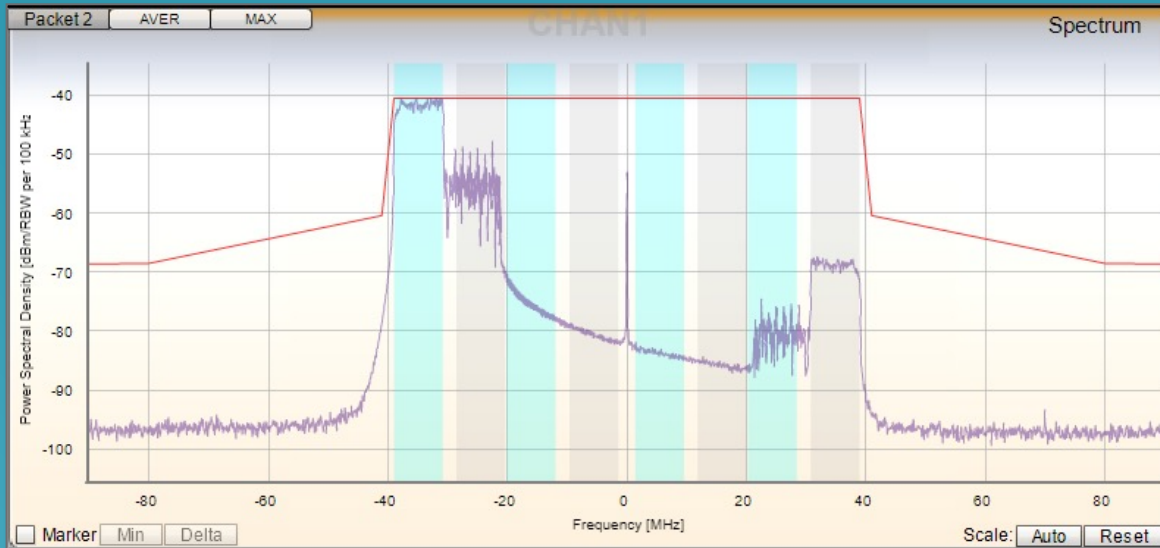
Packet 1 CHANT TxQuality Info OFDM

Packet Info Type: 802.11ax Format: HE-MU Chan BW: 80MHz

Export PSDU

| Measurement           | Value  | User: 1             | Value  |
|-----------------------|--------|---------------------|--------|
| # Analyzed Signals    | 1      | # of Streams        | 1      |
| Space-Time Streams    | 1      | Mod. Coding Scheme  | 0      |
| Has Multi-User        | Yes    | Coding Type         | LDPC   |
| # of Users            | 8      | Coding Rate         | 1/2    |
| Symbols               | 7      | Data Rate (Mbps)    | 3.80   |
| Tones                 | 1024   | Modulation Type     | BPSK   |
| Guard Interval        | Long   | PSDU Length (Bytes) | 38     |
| HE-SIG CRC            | Passed | PSDU CRC            | Passed |
| L-SIG Parity          | Passed | HE-SIG-B CRC        | Passed |
| L STF Periods         | 10     | RU Index            | 1      |
| HE LTF Size           | 2      | RU Size             | 106    |
| A-factor              | 3      | DCM                 | 0      |
| Guard Interval (us)   | 0.80   | Station ID          | 53     |
| Packet Extension (us) | 0      | Beamforming Bits    | 0      |

# Using IQsniffer: PHY Parameters for 802.11ax HE-TRIG



Packet 2 TxQuality Info OFDM [Export PSDU](#)

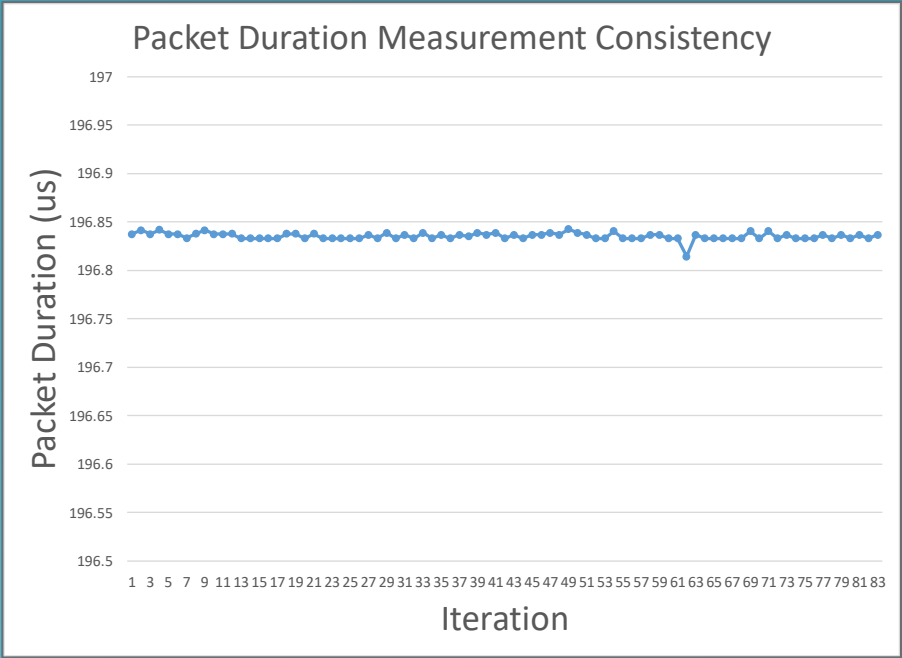
Packet Info Type: 802.11ax Format: HE-TRIG Chan BW: 80MHz

| Measurement           | Value  | User: 1             | Value  |
|-----------------------|--------|---------------------|--------|
| # Analyzed Signals    | 1      | # of Streams        | 1      |
| Space-Time Streams    | 1      | Mod. Coding Scheme  | 0      |
| Has Multi-User        | NO     | Coding Type         | LDPC   |
| # of Users            | 1      | Coding Rate         | 1/2    |
| Symbols               | 16     | Data Rate (Mbps)    | 3.50   |
| Tones                 | 1024   | Modulation Type     | BPSK   |
| Guard Interval        | Short  | PSDU Length (Bytes) | 34     |
| HE-SIG CRC            | Passed | PSDU CRC            | Passed |
| L-SIG Parity          | Passed | HE-SIG-B CRC        | --     |
| L STF Periods         | 9      | RU Index            | 53     |
| HE LTF Size           | 2      | RU Size             | 106    |
| A-factor              | 3      | DCM                 | 0      |
| Guard Interval (us)   | 1.60   | Station ID          | 0      |
| Packet Extension (us) | 0      | Beamforming Bits    | 0      |

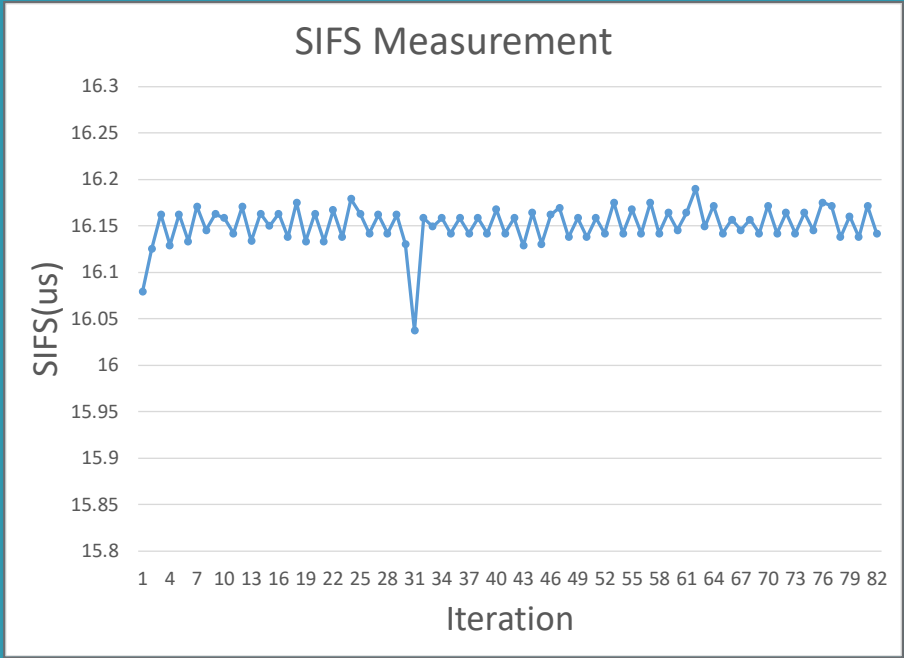
Common Bits: ..



# IQsniffer Packet Duration Measurement



# IQsniffer SIFS Measurement



# Delivering High Performance Wi-Fi 6 (802.11ax) Test

DVT



Mobile (STA) Manufacturing



Access Point Manufacturing



## Performance

- Exceeds stringent 802.11ax EVM requirements
- 80+80, 160MHz and dual-band concurrent on a single port
- 11ax Trigger-based packet detection and timing

## Manufacturing Quality

- Smart front-end eliminates external components
- True MIMO and Simultaneous Dual-Band
- Easy test program migration from IQxel-M8/M16

## Manufacturing Throughput

- Complete turnkey solutions with IQfact+
- Sequence-based and trigger-based testing
- True MIMO reduces test time, ensures quality