

**Project: IEEE P802.15 Working Group for Wireless Specialty Networks
(WSNs)**

Submission Title: [UWB Aggregation and Coexistence Testing]

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Re: [UWB Aggregation and WiFi 6E]

Abstract: [UWB Aggregation and Coexistence Testing with 802.11ax]

Purpose: [Discuss results of tests to determine impact of UWB on 802.11 ax and successors; and discuss aggregation of UWB transmissions]

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UWB Alliance Aggregation and Wi-Fi 6E coexistence Testing

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Goals of Tests

- Determine Aggregation Rate of IR UWB
 - Test multiple devices at different rates
 - with varying quantity of UWB devices operating
- Test Effects of UWB on Wi-Fi 6E
 - Do UWB Devices interfere with IEEE 802.11ax systems using the 6 GHz band?

Test Conditions



- Typical indoor business office environment
 - WeWork, Washington, DC
 - Busy work area with people coming and going using various computer/smart phone devices

Wi-Fi 6E Equipment for Tests

- Three models of APs were used
 - ASUS AXE6600 tri-band mesh Wi-Fi 6e system
 - Linksys MX8500 Wi-Fi 6e tri-band
 - TP-link AXE7800 tri-band 8-stream Wi-Fi 6e router
 - APs' bandwidth was autoconfigured
- Multiple PC notebook and smartphone clients
 - Set at nominal fixed distances of 8 ft to AP's
- NETGEAR Nighthawk Wi-Fi 6E client device was used with laptop computer as iPerf client

UWB Equipment for Tests

- 10 Qorvo DW3000 Development Kits
 - Set as ranging pairs
 - Each pair configured to transmit at a rate of one ranging exchange per second
- 10 Spark Microsystems SR1000 Series Evaluation Kits
 - Set as communications pairs
 - Each pair configured to transmit a continuous stream of data
 - 4k packets/second (Payload rate of 2 Mb/s; 64 octets payload/packet)
- AS-48461 Series Dual-polarized quad-ridged horn antenna was focused on the UWB transmitters to minimize reception from the Wi-Fi Access Points.

WiFi 6E Test Process

- Ambient environment baseline measured
 - Aircheck3 used to examine the ambient RF
 - Recorded 305 RF devices operating in the 2.4, 5, and 6GHz bands
- UWB devices introduced to environment 1 at a time
- Measurements taken at 1 m , 0.5 m and 0.012 m distance from APs'

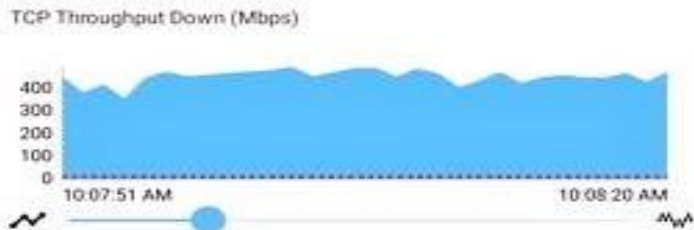
UWB Had No Measurable Effect on Wi-Fi 6E

No UWB

3 UWB devices



	Cur	Min	Max	Avg
Throughput Up	577.4	477.3	621.4	568.1
Limit				10.0



	Cur	Min	Max	Avg
Throughput Down	467.4	347.0	492.0	448.1
Limit				10.0



	Cur	Min	Max	Avg
Throughput Up	627.2	496.9	677.7	626.8
Limit				10.0



	Cur	Min	Max	Avg
Throughput Down	494.1	461.0	521.5	494.3
Limit				10.0

No Statistically Significant Difference in Up or Down Throughput

Worst Case 6E Test



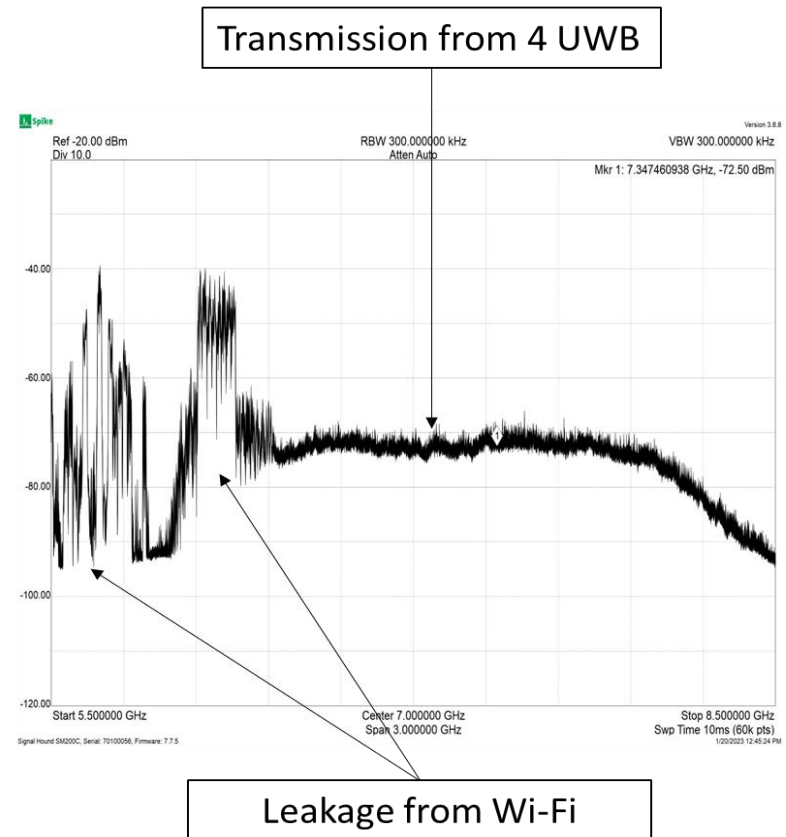
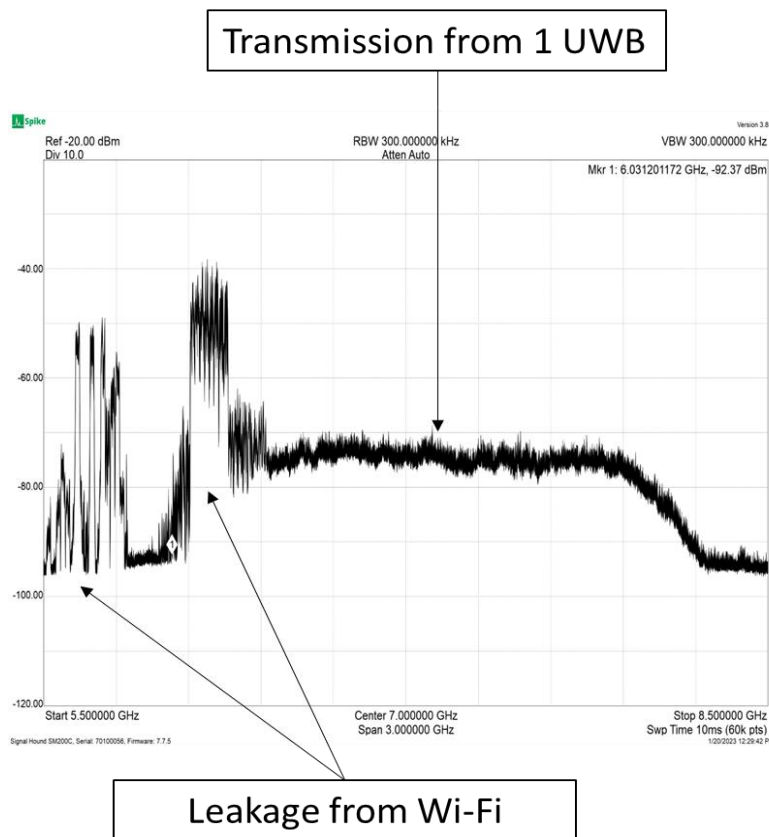
- 8 Spark UWB
 - 10 cm from the AP
 - Streaming
-
- No measurable impact on the Wi-Fi 6E performance

Test Results of UWB Effect on Wi-Fi 6E

- UWB did not have any measurable impact on 802.11ax performance
- Factors that did impact Wi-Fi 6E
 - Quantity of Wi-Fi 6E devices operating in the area
 - Presence of people near the Access Points
 - Positioning of the people throughout the room

Detecting UWB and aggregation of UWB

- No significant aggregation detected



Next Steps

- Additional Aggregation Tests
 - Increase quantity of UWB devices
 - 100+ devices
 - Increase duty cycle of UWB devices
 - Test at international facility
 - Joint Research Center – Ispra, Italy

Summation of Results of Tests

- Determine Aggregation Rate of IR UWB
 - Even when operated at high transmission rates UWB power did not aggregate linearly with the number of devices.
- Test Effects of UWB on Wi-Fi 6E
 - UWB did not have any measurable impact on 802.11ax performance
 - Factors that did impact Wi-Fi 6E
 - Quantity of Wi-Fi 6E devices operating in the area
 - Presence of people near the Aps
 - Positioning of the people throughout the room