

6 GHz CBP TESTING

Laboratory Division Office of Engineering and Technology Dusmantha Tennakoon

Note: The views expressed in this presentation are those of the authors and may not necessarily represent the views of the Federal Communications Commission.

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October 16, 2024

- Devices tested
 - 3 certified 6ID Access Points (APs) tested at FCC lab
 - APs tested were purchased by the lab and directly requested from the manufacturer
 - AP1: Sample request only
 - AP2: Sample request and lab purchase device tested
 - AP3: Sample request and lab purchase device tested
 - APs were tested without factory test mode enabled
 - Purpose:

-Verify Contention Based Protocol (CBP) requirement for 6 GHz low power indoor APs in a real-world scenario.

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CBP Test procedures:

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- Radiated testing performed
- AWGN source calibrated for power level of -62 dBm at AP placement
- Client connected to AP via 6 GHz band
 - Client was physically located outside of AWGN transmit envelope during testing to insure only AP was detecting AWGN signal
- Laptop connected to AP via ethernet cable
 - iPerf ran between client and laptop via AP to generate traffic on 6 GHz band



CBP Test procedures(cont.)

- All APs tested operating on 160 MHz BW
 - 10 MHz wide AWGN signal center frequency (F_center) injected at AP on different frequencies with AP OBW
 - F_low of OBW (AWGN F_center = +5 MHz from OBW low edge)
 - F_center of OBW
 - F_high of OBW (AWGN F_center = -5 MHz from OBW high edge)
- 2 out of 3 APs provided end user ability to adjust AP OBW down to 20 MHz
 - 10 MHz wide AWGN signal F_center injected at EUT on OBW 20 MHz center frequency
- Additional AWGN F_centers tested if AP did not beacon across entire OBW (160 MHz mode)
 - 10 MHz wide AWGN signal injected at AP on beaconing channel

Center Frequency (MHz)	6595	6615	6635	6655	6675	6695	6715	6735
20 MHz Channel	129	133	137	141	145	149	153	157
EUT OBW 160 MHz Channel	143							
EUT Beacon Channel		Х						
10 MHz AWGN F_center		X						

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- CBP Test procedures(cont.)
 - Power levels of APs were not investigated
 - No timing measurements were made
 - Lab purchased devices were updated to the latest publicly available firmware from the manufacturer
 - 10 MHz wide AWGN signal was monitored during testing
 - Verify that AP ceased all transmissions at AWGN power level of -62 dBm or greater
 - Monitor behavior of AP as AWGN power increased up to the appropriate threshold power
 - Monitor behavior of AP as AWGN signal is removed (or power level reduced to below the threshold)

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Test results

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- AP1 (sample request only)
 - Utilized adaptive data rate to maintain link with client at a lower throughput in presence of AWGN
 - Modulation reduction did not trigger until AWGN power level > -62 dBm
 - All traffic would not cease on 10 MHz AWGN band until AWGN power level -58 dBm
 - Utilized BW reduction from 160 MHz -> 80 MHz in some test cases
 - AP1 would still transmit beacons within 10 MHz AWGN band after BW reduction and AWGN power level of -62 dBm greater

Adaptive data rate (Throughput with no AWGN present)



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Adaptive data rate

(Throughput with AWGN present at different power levels)

-40 dBm										
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-50 dBm				AWGN IN	crease t	rom -		7950-230 60 sec		218 Mbits/sec
							51 28	81.00-282.00 sec	13.0 MBvtes	109 Mbits/sec
							5] 28	82.00-283.00 sec	: 14.8 MBvtes	123 Mbits/sec
							5]28	83.00-284.01 sec	: 15.5 MBytes	130 Mbits/sec
-60 dBm							[5] 28	84.01-285.01 sec	: 14.8 MBytes	124 Mbits/sec
							[5] 28	85.01-286.00 sec	: 14.6 MBytes	123 Mbits/sec
							[5] 28	86.00-287.00 sec	: 12.9 MBytes	108 Mbits/sec
		· · ·					[5] 28	87.00-288.00 sec	: 14.5 MBytes	122 Mbits/sec
-70 dBm							5] 28	88.00-289.00 sec	: 12.9 MBytes	108 Mbits/sec
		l li					5]28	89.00-290.01 sec	: 12.8 MBytes	106 Mbits/sec
								90.01-291.01 sec	: 12.5 MBytes	105 Mbits/sec
								91.01-292.00 sec	11.4 MBytes	96.2 Mbits/sec
-80 dBm				WGNLM	<u>crease in</u>					87.0 Mbits/sec
			{ {					95.00-294.00 Sec	14.9 Hoyces	31 / Mbits/sec
								95 01-296 00 sec	2 AA MBytes	16 9 Mbits/sec
							51 29	96.00-297.00 sec	1.50 MBytes	12.5 Mbits/sec
-90 dBm							5] 29	97.00-298.01 sec	1.50 MBvtes	12.6 Mbits/sec
A walke was well only a	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	marken was		many and the second		- 0141 4	5]29	98.01-299.01 sec	: 1.50 MBytes	12.5 Mbits/sec
				and dame and	/*		5] 29	99.01-300.00 sec	2.00 MBytes	16.9 Mbits/sec
							[5] 30	00.00-301.00 sec	: 0.00 Bytes (0.00 bits/sec
-100 dBm							[5] 30	01.00-302.00 sec	: 1.25 MBytes	10.5 Mbits/sec
							[5] 30	02.00-303.01 sec	: 512 KBytes	4.18 Mbits/sec
							5] 30	03.01-304.01 sec	: 0.00 Bytes	0.00 bits/sec
							5] 30	04.01-305.00 sec	: 1.12 MBytes	9.49 Mbits/sec
-110 dBm							5] 30	05.00-306.00 sec	: 1.00 MBytes	8.38 Mbits/sec
							5] 30	06.00-307.00 sec	2.75 MBytes	23.1 Mbits/sec
							5] 30	07.00-308.00 sec	2.00 MBytes	16.7 MDits/sec

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Full 160 MHz spectrum before BW reduction,

no AMGN present

Spectrum	no AWGN present							
Att SGL	0 dB ● SWT 100 ms ● VBW 3 MHz Mode Auto Sweep							
●1Rm Clrw								
-40 dBm								
-50 dBm								
-60 dBm		40						
		(Y)	M	MMM	m M	N.N.P	1.	
-70 dBm								
-80 dBm	1	1						
-90 dBm	manhandha	Mund how	under halfet			wall have	I have have have here here here here here here here he	man human hand me
-100 dBm								
-110 dBm								
-120 dBm								
CF 6.985 GHz		I		691	pts			Span 320.0 MHz

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(AWGN present at power level of -62 dBm)



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• Test results

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- AP2 (lab purchase/sample request)
 - Lab purchase
 - Would cease network traffic at AWGN power levels of -62 dBm or greater
 - Beacons from AP2 would remain regardless of AWGN power level
 - Sample request
 - Would cease network traffic at AWGN power levels of -62 dBm or greater
 - No beacons would remain

6ID Testing 10 MHz AWGN band at -56 dBm with AP beacons

1	Spectrum									
	RefLevel -30.00 dBm Offset -6.00 dB ● RBW 1 MHz Att 0 dB ● SWT 100 ms ● YBW 3 MHz Mode Auto Sween									
	SGL									
	1Rm Clrw									
	-40 dBm									
	-50 dBm									
	60 dBm			h						
	-00 08m							n		
-								1		
	-70 dBm									
-										
	-80 dBm	month	mm	man har	un have been all	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~			wards.	
		a de la companya de l							and the second	
	mont									mar -
	-90 dBm									and a second
	-100 dBm									
	110 dBm									
	-110 0811									
	-120 dBm									
	CF 6.345 GHz				691	pts				Span 15.0 MHz

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Test results

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- AP3 (lab purchase/sample request)
 - Lab purchase
 - Would cease network traffic at AWGN power levels of -62 dBm
 - No beacons would remain
 - Sample request
 - Would cease network traffic at AWGN power levels of -62 dBm
 - No beacons would remain





CBP Testing Results Summary (AWGN Power level -62 dBm)

	AP1	AP2	AP3
Lab Purchased	NA	Fail	Pass
Sample Request	Fail	Pass	Pass
Failure Mode	Tx network traffic and beacons	Tx beacons	NA

Observations

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- Adaptive data rate to maintain link
- If AP has multiple 6 GHz radios it had the ability to move network traffic to radio 2 when AWGN present on radio 1 on a different 6 GHz channel
- BW reduction
- Channel move for a single radio AP
- Some FCC IDs had multiple units tested
 - Lab purchased unit and a sample request to the manufacturer
 - AP2: There was a clear difference found on CBP testing between what the manufacturer provided as a sample request and the unit the lab purchased on the open market.
 - The manufacturer provided sample request unit was able to pass CBP
 - The unit the lab purchased on the open market failed CBP
 - AP3: Both units met CBP requirements and had similar test results

Conclusions

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- APs must cease all transmissions on incumbent occupied band at appropriate threshold power level (> -62 dBm)
 - This includes all management packets. Reference KDB 987594 D03:
 - Q15. During contention-based protocol testing, once the EUT has detected an AWGN signal and ceased transmission is it allowed to send intermittent control signals?
 - > A15. No. Signals of any kind are not allowed to be sent.
 - BW reduction is allowed
 - If the AP is utilizing BW reduction to clear the incumbent band, it must make sure to cease all transmissions within occupied band once the signal is detected at the appropriate threshold power level.
- More testing on 6 GHz devices planned





THANK YOU

October 16, 2024