WLAN 11ax 信令测试指 南 v3.0

此版本适用于 CMW500/270 BASE FW >= 3.7.150, WLAN FW >= 3.7.70;





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1 信令连接

1.1 信令连接主要步骤

- 1. 按复位键"RESET",选择 Global(all Instruments),点击"Preset"。
- 2. 按 SIGNAL GEN 键后,选择 WLAN Signaling。
- 3. 在信令界面 Common Setting 下选择 Stardard "IEEE 802.11ax",在 Operating Chanel Width 下选择需要测试的带宽 20/40/80/160MHz(本文以 20Mhz 为例)。

Common Settings	Frequency Power	
Standard	IEEE 802.11ax	1
Operating Channel Wid	th 20MHz	-
Scenario	Standard Cell	Z
Base Band Unit	SUA1&2	7
Operation Mode	AP	-

4. 在 Frequency 下选择 Center Frequency/Chanel 中心频率或者信道(本文以 36 信道为例)。

Common Settings	Freque	ency	Pow	er		
Center Frequency / Cl	hannel	518	0.000	MHz	•	36

5. 在 Power 下设置合适的 Rx Expected PEP, 一般传导下设置 30dbm, 设置原则是调整 Rx Expected PEP 使 Approximate RX Burst Power 与左侧 RX Power Indicator 显示的值一致或者略大于它是比较合适的。

WLAN Signaling 1 - X3.7.60.104 - Base V 3.7.140					-
Connection Status		Common Setting	s Frequency	Power	
Cell		TX Burst Power		-	-40.0 dBm
Connection Status		RX Expected PEP			35.0 dBm
RX Power Indicator 14dBm In Range		Approximate RX B	urst Power		22.0 dBm
Event Log 10:07:49 000904C12D001 Associated	×				
10:07:26 Stack<->DAU connection updated		Connection Settin	gs		
10:07:25 Signaling Unit Startup		Security	Disabled		7
	•	SSID	CMW-AP		

6. "Config" hotkey > "RF Settings" 下设置 RF 端口和 External Attenuation 外置 线损。

⊡ RF Settings ⊡ RF Output		
Routing	Connector: RF1COM	Converter: RFTX1
External Attenuation	0.00 dB	
External Attenuation	0.00 dB	Converter: RFRX1

7. 打开 WLAN signaling -> ON, Connection Status 变为 Associated 后意味着连接成功。

WLAN Signaling 1 - X3.7.60.104 - Base V 3.7.140						3	WLAN
Connection Status	Commo	n Settings	Frequence	y Power			WLAN 1
Cell 💮	Standard	-	IEEE 802.11ax			-	Multi Evalua
Connection Status	Operating	Channel Wi	dth 20MH	lz		~	
RX Power Indicator 14dBm In Range	Scenario		Stan	dard Cell		-	WLAN 1
	Base Ban	id Unit	SUA1	82		*	PER
Event Log X	Operation	Mode	AP			*	
09:12:27 Stack<->DAU connection updated 09:12:27 00904C12D001 Associated							Go to
09:12:23 Signaling Unit Startup	Connectio	on Settings					
09:12:13 Signaling Unit Shutdown finished	Security	Di	isabled			*	Routing
09:12:12 Signaling Unit Shutdown	SSID	C LOTIN	MW-AP			00	
UUT / UE Into	beacon in	terval (10)			1	00	
UE IPv4 100.100.100.10	Packet (Generator	Data Tri	gger Meas	Control		
CMW IPv4 100.100.100.50	-	PG1		PG2		PG	
CMW IPv6 fe80::290:4ctt:re12:d001	able			~		₹	
Text a sector and	tocol	ICMP	•	ICMP	•	ICI	
RX Statistics		0	•	1	•	2	
Burst Power 8.3 dBm	Irval (TU)		100		100		
Data Rate HE MCS 11 20 MHz Nss1	e (Byte)		1472		1472		
Buffered Data (total) Buffered Data (TIDx) 77 Bit(TID 0) Buffered Data (ACx) ()	/load Type	Default	<u>•</u>	Default	-	De	WLAN Signaling
	<u> </u>		-			4	
Disconnect				-			Config

2 发射机测试

2.1 HE_SU PPDU 发射机测试

1. 在做发射机测试之前先把 PG1/2/3 都 勾上, Payload Size(Byte) 设置成最大 1472。

Packet Gen	erator	Data	Trigge	er Mo	eas Contro	ol		
Enable	PG1 I⊽			PG2 ▼			PG3 I⊽	
Protocol	ICMP		-	ICM	Р	•	ICMP	•
TID	0		•	1		•	2	•
Interval (TU)			20			20		20
Size (Byte)			1472			1472		1472
Payload Type	Defau	lt	<u>•</u>	Defa	ault	•	Default	•

 按信令界面 config 进入 Trigger 设置 MAC Frame RX Trigger,选择 Trigger Mode -> HE_SU Bursts,设置对应的带宽和速率(也可以选择 ALL),设置 Min Length symbol 为 User Defined = 16(20MHz BW),如果测试大带宽 80/160 MHz BW 可以适当减少 min symbol length = 8 or 4 or 1;(此时可能 测试界面会显示 payload symbol 小于 16 的情况,但实际上不影响射频测试结 果,请看本节注 1 解释)

3- Trigger	
⊞-MAC Frame TX Trigger	
🖻 MAC Frame RX Trigger	
-Trigger Mode	HE_SU Bursts 🔹
Trigger Bandwidth	All 🔻
Trigger Rate	All
-OFDM Payload Min Length (sym	User Defined 🔻 8
-Trigger Slope	RisingEdge 🔻
Pulse Length	Default 🔻

3. 按信令界面右上角 WLAN 1 Multi Evaluation 进入测量界面,打开测量 Multi Evaluation ON。若测量无信号,请检查 Trigger 和 input signaling 是否正确。



4. 可以通过 Display 按键选择 TX 具体测项,也可以直接双击进入每个测项的详 细界面,如下图进入 TX Measurement 可以看到当前测试的 Burst Power, EVM, Frequency error, MCS 等。

🚯 WLAN TX Measurement - X3.3	7.60.104 - Base V 3.7.140 -	Multi Evaluation			WLAN
Freq: 5180.00 MHz Ref.Lvl: 35.0	0 dBm Std.:802.11 ax	SISO		20MHz	Multi
TX Measurement (Scalar) S	ignal Fields Info OFI	DMA Results			Evaluation
MCS Index		11			RUN
Modulation	1024QAM CodeRa	te 5/6			RF
Payload Symbols		19			Settings
Measured Symbols		19			
Payload Bytes		NCAP			
Guard Interval		0.8 us			Trigger
LTF Size	2x LTF (6	5.4 us)			
Burst Type	ŀ	IE SU			
Spatial Streams		1			Input
Space Time Streams		1			Signal
Burst Rate [%]		NCAP			
Statistics	Currer	nt Ave	erage Max	StdDev	
Burst Power [dBm]	8.38	8 8	.34 8.58	0.10	Display
Peak Power [dBm]	18.26	18	.37 20.10	0.62	
Crest Factor [dB]	9.88	10	.02 11.73	0.61	
EVM All Carriers [dB]	-36.91	-36	.93 -36.13	0.23	
EVM Data Carriers [dB]	-36.91	-36	.94 -36.12	0.23	
EVM Pilot Carriers [dB]	-36.90	-36	.71 -34.71	0.53	
Center Frequency Error [Hz]	-175.18	-187	.35 -599.19	21.92	
Symbol Clock Error Innm1	0.000	• •	0.070 0.070	0.244	
Statistic Count Out of Tol	erance CFO Distr	ibution			
100 / 100	0.00 % 0.0	% Outside:	0		WIAN 1
Connection Status:	Associated	WLAN Standa IEEE 802.11ax	rd Operating 20MHz	g Channel Width	Signaling ON
Repetition Stop Condition	Statistic Count			Assign Views	Config

注 1: 当测试 11ac 或者 11ax 的大带宽 40/80/160Mhz 的时候,有时会出现 Payload Symbol 小于 16 的情况,这是因为大带宽高调制方式下,ICMP payload 最大为 1472 Bytes,此时传 这么多数据所用 symbol 数理论上就小于 16 个,而且也没法再通过增加 payload size 来增加 symbol 数,因此 CMW 设计了三个 PG 来尽可能快尽可能多的发 ICMP PING 包给 UE,就像本节步骤 1 那样设置将三个 PG enable, payload size 都设置为最大 1472 Bytes,减少三个 PG 发包间隔 Time Interval (TU) 比如都设置成 10,如果还不满足大于 16symbol,将 TU 设置成 0,这时候 CMW 连续不断的发 PING 包,只要 DUT 有足够的处理能力,它会以同样的 速率回包给 CMW。但此时不建议三个 PG TU 同时设置成 0,用其中一个 PG 即可,举例 PG1 enable,TU=0, Payload size = 1472, RX Frame Trigger 下 OFDM payload mini length = 16;

S WLAN TX Measurement -	(3.7.60.104 - Base V 3.7.	140 - Multi Ev	aluation		WLAN
Freq: 5190.00 MHz Ref.Lvl: 3	0.00 dBm Std.:802.11	ax	SISO	40MHz	Multi
TX Measurement (Scalar)	Signal Fields Info	OFDMA Re	sults		Evaluation
MCS Index		8			
Modulation	256QAM Co	deRate 3/4			RF
Payload Symbols		14	Standard require	es >= 16 symbols!	Settings
Measured Symbols		14			
Payload Bytes		NCAP			
Guard Interval		0.8 us			Trigger
LTF Size	2x L	TF (6.4 us)			
Burst Type		HE SU			

注 2: 有时候 EVM 测试结果差,怎么调试 DUT 都无法改善,可以尝试在测量界面的 Config > Modulation > Channel Estimation > payload,据经验,用 payload 做信道估计会比 preamble 测 EVM 好 2-3dB。IEEE 802.11 规定是用 Preamble 来做信道估计,所以尽量还是用 preamble 来调试。

2.2 HE_TB PPDU 发射机测试

1. 设置 Trigger Frame, Trigger Type 为 Basic Trigger, Number of Symbols, Ru Allocation, Coding Type, MCS 等内容(根据需要选择对应的参数);

Connection/Trigger Frame/Common Info/N	lumber of Symbols	WLAN 1
		Multi Evalua
HT Frame		
<u> <u> <u> </u> <u> </u></u></u>		WLAN 1
E-HE_MU Frame		PER
É-Common Info		
-Trigger Type	Basic Trigger 🔹	Go to
-Number of Symbols	200	
CS Required		
Bandwidth	20MHz 👻	Routing
GI and LTF	4x LTF + 3.2 µs GI ▼	livering
-MU-MIMO LTF	Single Stream 🔻	
-LDPC Extra Symbol		
AP Tx Power	22 (2 dBm)	
🖻-User Info		
-RU Allocation	26-tone RU[0]	
-Coding Type	LDPC -	
-MCS	MCS Index 0 💌	
DCM		
-Starting Spatial Stream	1	
-Number of Spatial Streams	1	
□-Target RSSI	90 (-20 dBm)	WLAN
Mode	Auto	Signaling
: · · · · · · · · · · · · · · · · · · ·		Run

2. 在测量界面下设置 Trigger Source 为 HE_TB Trigger, Trigger Timeout 设置长 一点,举例 60s;

Statistic Coun	t Out of T	olerance C	FO Distrib	ution	1	TE Distribu	ition	
A Trigger S	ource		0.0 %	Outside:	0	NCAP	Outside: NCAP	
WLAN Sig1: HE_TB Trigger			WLAN Standard IEEE 802.11ax			Operating Channel Width 20MHz		WLAN 1 Signaling Run
Trigger Source	Trigger Slope	Trigger Threshold		•	Trigger Timeout			Config

Statistic Count	Out of T	Out of Tolerance CFO Dist			TE Distri	bution	
Connection	on Status:	Associated	WLAN IEEE 80		Max = 300000 ms	Operating Channel Width	WLAN 1 Signaling Run
Trigger Source	Trigger Slope	Trigger Threshold .			Trigger Timeout		Config

3. 在进行测量前需要把 config下 Trigger Frame Transmission -> Periodic state 设置成 on 如下图所示,然后再回到 Multi Evaluation 下打开测量,当然 同样在打开测量前需要把 PG on 先打开;

Connection/Trigger Frame/Trigger Frame	Transmission/Periodic/State	WLAN 1
Bandwidth	20MHz 💌	A Multi Evalu
-GI and LTF	4x LTF + 3.2 µs GI ▼	
-MU-MIMO LTF	Single Stream	WLAN 1
-LDPC Extra Symbol	Г	PER
AP Tx Power	22 (2 dBm)	
E-User Info		Cata
-RU Allocation	26-tone RU[0]	G0 t0
Coding Type	LDPC -	
-MCS	MCS Index 0 💌	
-DCM	Г	Routing
-Starting Spatial Stream	1	
-Number of Spatial Streams	1	
E-Target RSSI	90 (-20 dBm)	
Mode	Auto 💌	
-Target RSSI Control	0 dB 💌	
Trigger Frame Transmission		
-Single-Shot	Send	
⊟-Periodic		
State	ĆOff (ĒOn	
-Interval (ms)	100	
∃-Security	Disabled	WE AN
∃-QoS Data TID		Signaling
∄-A-MPDU		Run

4. HE_TB PPDU 测试结果如下:

37.150 - WLAN	TX Measurement	- X3.7.70.75 - I	Multi Evalua	ation				WLAN	
Freq: 2412.00 MHz Ref.Lvl: 3	5.00 dBm Std.: 802	2.11 ax	SISO		BPSK	20MHz		Multi	
TX Measurement (Scalar)	Signal Fields I	nfo OFDMA	Results					Evaluation	
MCS Index			0					RUN	
Modulation	BPSK	CodeRate 1	12						
Payload Symbols		2	01					RF	
Measured Symbols		2	00					Setungs	
Payload Bytes		NCA	P					-	
Guard Interval		3.2	us					Tringor	
LTF Size 4x LTF (12.8 us)			is)					ingger	
Burst Type		HE 1	ГB						
Spatial Streams			1					Tanut	
Space Time Streams			1					Signal	
Burst Rate [%]		NCA	P					orginar	
Statistics		Current	1	Average	M	ax	StdDev	IDev	
Burst Power [dBm]		10.96 25.17		10.95	11.12 25.26		0.07	Display	
Peak Power [dBm]				25.16					
Crest Factor [dB]		14.21		14.22 1		.52	0.06		
EVM All Carriers [dB]		-37.52	-	-38.19	-36	.20	0.43		
EVM Data Carriers [dB]		-37.37		-38.05	-36	.08	0.43		
EVM Pilot Carriers [dB]		-40.03	-	40.45	-36	.75	1.33		
Center Frequency Error [Hz]	1	-1.70		2.57	-73	.57	25.74		
Sumbal Clack Error Innmi		0 477		0.004	0.5	77	0 420		
Statistic Count Out of	Tolerance C	FO Distributi	on	TE	Distribution		-		
100 / 100	0.00 %	0.0 %	Outside:	0	0.0 %	Outside:	0		
Connection Status: Associated WLAN Standard Operating Channel Width IEEE 802.11ax 20MHz							WLAN 1 Signaling Run		
Select View					LTF- 4 Powe	& Data- r: Show		Config	

5. HE_TB 的测试因具有 OFDMA 特性,因此多了 RU 的分配,多了 timing error 和 unused tone error,以及 OFDMA results。

TV Moscuromont (Scalar)	Signal Fields Info OFDWA	Deculta			Multi	
IN measurement (Scalar)	Signal Fields Into OFDMA	A Results			Evaluation	
TF Size	Ax TF (12.8)	(3)		-	KUN	
Burst Type	HF	IB			DE	
Spatial Streams		1			Settings	
Space Time Streams		1			-	
Burst Rate [%]	NCA	AP				
Statistics	Current	Averag	e Max	StdDev	Trigger	
Burst Power [dBm]	10.86	10.95	11.12	0.07		
Peak Power [dBm]	25.17	25.16	25.26	0.04		
Crest Factor [dB]	14.30	14.21	14.52	0.05	Input	
EVM All Carriers [dB]	-38.44	-38.17	-35.51	0.48	Signal	
EVM Data Carriers [dB]	-38.32	-38.03	-35.40	0.48		
EVM Pilot Carriers [dB]	-40.09	-40.33	-36.75	1.31		
Center Frequency Error [Hz]	29.08	4.84	-73.57	25.72	Display	
Symbol Clock Error [ppm]	0.179	0.001	-0.372	0.127		
Timing Error [µs]	0.237	0.232	0.287	0.030		
Q Offset [dB]	-61.60	-60.69	-58.05	1.32		
DC Power [dBm]	-50.73	-49.75	-47.10	1.32		
Gain Imbalance [dB]	NCAP	NCAP	NCAP	NCAP		
Quadrature Error [°]	NCAP	NCAP	NCAP	NCAP -		
tatistic Count Out of 1	Folerance CFO Distributi	on	TE Distribution			
100 / 100	0.00 % 0.0 %	Outside: 0	0.0 % Outside	0	-	
Connection Status:	Associated	WLAN Standard IEEE 802.11ax	Operating Cf 20MHz	annel Width	WLAN 1 Signaling Run	
Select /iew			LTF- & Data Power: Show	~	Config	



•	CMW 50	0 V 3.7.	150 - WI	AN TX Me	asurement -)	(3.7.70.75 - N	Aulti Evalua	ation					WLAN
req: Fran	2412.0 smit Sp	0 MHz Dectru	Ref.Lvl m Masl	: 35.00 dB k	m Std.:802.1	l1 ax	SISO		В	PSK	20MHz		Multi Evaluation
•	×	Off	y:		◆ Q ×	Off	у:		• (9 x: 0	ff y:		RUN
0	dB				ľ	1		-				◆ Current	RF Settings
-20						Walway	II PATRINI PO	L L		-			
-40			-			1.4	Millard	rinn -					Trigger
40					N								
-60				~~~~~	mind			2					Input Signal
-80												MU-	
	-3	5 -:	30 -2	25 -20	-15 -10	-5	0 5	10	15	20	25 30	1 35	Display
		01		AD	BC	CD	D	-	50	DC		D DA	
Ma	rent	9		-18.26	-19.01	-22.60	-23.8	c 1 -3	ED 17.96	-30.17	-18.1	DA DA	Marker
Ave	rage			-18.96	-19.32	-22.46	-23.5	7 -3	8.24	-30.18	-18.1	18 -18.10	
Max	kimum			-17.60	-17.78	-21.07	-22.4	4 -3	7.12	-28.85	-16.7	78 -16.27	
Min	imum		_	-20.12	-20.61	-24.50	-25.1	7 -3	9.53	-31.56	-19.3	36 -19.1 7	
_		_			- Statistic	Count	10	0 / 100	Out of	Toloranco	-	0.00 %	
() T	SelectV ransmit	iew	trum M	ask 💌	ciated	V	VLAN Stan EEE 802.11	dard lax	Out of	Operati 20MHz	ng Chann	el Width	WLAN 1 Signaling Run
Sel Vie	ect w			G	raphs & largins	Select	Trace um	Display	Mode	Y Scale Spectru	m x	Scale	Config

🊯 CMW 500 V 3.7.150 - WLAN	TX Measurement - X3	.7.70.75 - Multi Evalu	uation			WLAN
Freq: 2412.00 MHz Ref.Lvl: 3 TX Measurement (Scalar)	5.00 dBm Std.:802.11 Signal Fields Info	ax SISO OFDMA Results]	BPSK 20MHz		Multi Evaluation
No of Users No of RUs Statistics EVM All [dB] EVM Data [dB] EVM Pilot [dB] RU 1 - Antenna Power E-User 1 - EVM All [dB] - EVM Data [dB] - EVM Pilot [dB]	1 1 -37. -37. -37. -39. RU Size: 26 11. MCS: 0 DCM: -37. -37. -39.	ent A 99 - 87 - 63 - RU Index: 07 0 NSTS: 1 99 - 87 - 63 -	Average 38.17 38.03 40.27 1 RU26 Ind 10.96 STA-ID: NCAF 38.17 38.03 40.27	Max -36.37 -36.20 -36.97 ex: 1 11.12 TxBf: NC Coding: -36.37 -36.20 -36.97	StdDev 0.41 0.43 1.21 0.06 NCAP 0.41 0.43 1.21	RF Settings Trigger Input Signal Display
Connection Status:	Associated	WLAN Sta IEEE 802.1	ndard 11ax	Operating Channe 20MHz	l Width	WLAN 1 Signaling Run
Disconnect						Config

 功率控制,11ax 通过 Target RSSI 来做功率控制,Mode 可以选择 Auto, Manual,max power 三种,如果选择 Manual 可以调整 Target RSSI Control 来调节 station 的发送功率,功率测量结果变化可在 TX measurement 下查 看。



注1: 针对功率控制规范解释如下

27.3.15.2 Power pre-correction

Each STA that is scheduled in a triggering frame calculates the UL transmit power, Tx_{pwr}^{STA} , of the HE TB PPDU for the assigned HE-MCS using Equation (27-124).

$$Tx_{pwr}^{STA} = PL_{DL} + Target_{RSSI}$$
(27-124)
where
$$PL_{DL} = PL_{DL} + Target_{RSSI}$$

PLDL represents DL pathloss

Target_{RSSI} represents the target receive signal power of the HE TB PPDU averaged over the AP's antenna connectors. Target_{RSSI} is the value, in dBm, indicated in the UL Target RSSI subfield of User Info field in Trigger frame or the TRS control field.

NOTE—A value of 127 in the UL Target RSSI subfield indicates that the HE TB PPDU is transmitted at its maximu transmit power for the assigned HE-MCS, and Equation (27-124) is not used.

Each STA computes PL_{DL} using Equation (27-125).

$$PL_{DL} = Tx_{pwr}^{AP} - DL_{RSSI}$$
(27-125)

where

- Tx_{pwr}^{AP} is in dBm and represents the AP's transmission power and is equal to the value of the AP Tx Power subfield of the Common Info field in the Trigger frame, the encoding of which is specified in 9.3.1.22 (Trigger frame format) or the DL Tx Power subfield of the TRS Control field as specified in 9.2.4.6a.1 (TRS Control).
- DL_{RSSI} represents the RSSI at the antenna connector(s) of the STA of the triggering PPDU normalized to 20 MHz bandwidth. DL_{RSSI} in dBm is an average of the received power over the antennas on which the average PL_{DL} is being computed. If the triggering PPDU is a HT-mixed, VHT or HE PPDU, then the received power is measured from the fields prior to the HT-STF, VHT-STF or HE-STF, respectively.

2.3 信令 True MIMO 发射机测试

1. 基本信令设置,选择 2x2 MIMO 场景,设置频点和期望功率,设置原则跟 SISO 下一样;

onnection Status			Common Settings	Frequency	Power	
cell 🙀		Standard	IEEE 80	IEEE 802.11ax		
Connection Status	connection Status		Operating Channel Width	dth 20MHz	20MHz	
RX Power Indicator	18dBm	In Range	Scenario	MIMO 2	×2	
RX2 Power Indicator	18dBm	In Range	Base Band Unit	SUA1&2	2	
			Operation Mode	AP		



Common Settings Freque		Power		
TX Burst Power			-40.0	dBm
RX Expected PEP			35.0	dBm
Approximate RX Burs	t Power		22.0	dBm
RX2 Expected PEP			35.0	dBm
Approximate RX2 Bu	rst Power		22.0	dBm

2. 设置 RX frame trigger 如下,包括 RX format, MCS 以及空间流为 2;



3. 同样在测 TX 前将 PG ON 打开,测试结果如下,可以看到两路 TX 的 EVM, power 等结果。

😚 WLAN TX Measurement - V3.7	.60 - Base V 3.7.150	- Multi Evalu	ation		-	WLAN	
Freq: 2412.00 MHz	Std.: 802.11	lax	True MIMO	20	OMHz	Multi	
TX Measurement (Scalar) Si	gnal Fields Info	OFDMA F	Results			Evaluation	
Spatial Streams	2					RUN	
Space Time	2						
Data Symbols	12					RF	
Statistics	C	urrent	Average	Max	StdDev	Securitys	
Overview							
EVM All [dB]	-	37.85	-37.48	-35.92	0.46		
EVM Data [dB]		37.87	-37.47	-35.87	0.47	Ingger	
EVM Pilot [dB]	-	37.44	-37.85	-36.73	0.42		
Power Total [dBm]		19.08	19.03	19.14	0.04		
Symbol Clock Error [ppm]	-	-3.244	-3.101	-3.788	0.241	Input	
Center Frequency Error [Hz]	-147	92.17	-14969.41	-15896.59	425.49	Signai	
Streams					_		
EVM All 1 [dB]	-	37.58	-37.37	-35.46	0.51	Disalau	
EVM All 2 [dB]	-	38.14	-37.60	-35.19	0.65	Display	
EVM Data 1 [dB]		37.61	-37.36	-35.43	0.52		
EVM Data 2 [dB]	-	-38.15	-37.58	-35.10	0.66		
EVM Pilot 1 [dB]		36.93	-37.52	-35.86	0.56		
EVM Pilot 2 [dB]	-	-38.02	-38.21	-36.49	0.60		
Antenna							
Rurst Power 1 [dRm]		16 18	16 18	16 29	0.05		

🚸 WLAN TX Measurement -)	V3.7.60 - Base V 3.7.150 - M	Multi Evaluation				WLAN	
Freq: 2412.00 MHz	Std.: 802.11 at	k True	MIMO	20MHz		Multi	
TX Measurement (Scalar)	Signal Fields Info	OFDMA Results				Evaluation	
	JI	.00	JI.JU	JJ.1J	0.04	RUN	
EVM Data 1 [dB]	-35	.26	-37.30	-34.96	0.59		
EVM Data 2 [dB]	-37	.64	-37.56	-35.10	0.65	RF Settings	
EVM Pilot 1 [dB]	-37	.65	-37.55	-35.86	0.55		
EVM Pilot 2 [dB]	-38	.86	-38.21	-36.49	0.60		
Antenna							
Burst Power 1 [dBm]	16	.15	16.18	16.29	0.05	Trigger	
Burst Power 2 [dBm]	15	.90	15.85	16.03	0.05		
Peak Power 1 [dBm]	25	.74	25.67	26.68	0.36		
Peak Power 2 [dBm]	25	.32	25.30	26.47	0.39	Input	
Crest Factor 1 [dB]	9	.59	9.49	10.51	0.35	Signal	
Crest Factor 2 [dB]	9	.42	9.45	10.61	0.38		
IQ Offset 1 [dB]	-42	.79	-42.98	-42.05	0.35		
IQ Offset 2 [dB]	-46	.17	-46.53	-44.71	0.69	Display	
DC Power 1 [dBm]	-26	.63	-26.80	-25.88	0.36		
DC Power 2 [dBm]	-30	.27	-30.67	-28.94	0.69		
Gain Imbalance 1 [dB]	0	.00	0.00	-0.01	0.00		
Gain Imbalance 2 [dB]	0	.02	0.01	0.03	0.00		
Quad. Error 1 [°]	0	.41	0.38	0.46	0.03		
Quad. Error 2 [°]	0	.04	0.07	0.19	0.03 -		

注 1: 此设置方法同样适合 11n 和 11ac 信令 true MIMO 测试;

注 2: 硬件需要 1*SUA(H500I)+2*H570H+1*MUA

注 3: 软件需要 KM654+KS657+KS670

注 4: 11ax MU_MIMO 需要 KS671

2.4 Rate Restriction 测试(指定速率测试)

1. 按常规信令连接的方法,将 11ax 速率自然协商到最高 MCS。

Connection Status							
	Common Setting	s Frequenc	y Power		WIAN 1		
Cell (M)	TX Burst Power	-40.0 dBm	Multi Evaluat				
Connection Status	RX Expected PEP						
Associated	Approximate RX Bu	17.0 dBm					
RX Power Indicator 20dBm In Range	_		PER				
Event Loa X							
04:15:45 Signal ON							
04:14:54 🕤 Signal OFF			Go to				
04:14:45 Stack<->DAU connection updated	Connection Setting	ne an					
04:14:44 Signal ON	Security	lane and					
04:11:57 Stack<->DAU connection updated	SSID	CMW-AP			Routing		
DUT / UE Info	Beacon Interval (TU)			100			
MAC 02FFD408BF15							
UE IPv4 100.100.10	Packet Generato	r Data Trig	ger Mea	s Control			
CMW IPv4 100.100.50							
CMW IPv6 fe80::201:2ff:fe03:405							
	RX Format	HE S	U Bursts	•			
RX Statistics	RX Bandwidth	20MH	7 -		_		
Devil Device and the	RX Rate	All		-			
Data Rate HE MCS 11 20 MHz Nss1	Rate Restriction	Г					
Buffered Data (total)	RX Spatial Streams	1 -					
Buffered Data (TIDx) 73 Bit (TID 0)					WLAN		
Buffered Data (ACx) ()					Signaling		
					Run		
Disconnect					Config		

2. 在 Meas Control 下勾上 Rate Restriction, 然后改变 RX Rate, 然后再从 Multi Evaluation 下查看指定速率测试的结果。

🊸 WLAN Signaling 1 - X3.7.70.75 - Base V 3.7.150					WLAN			
Connection Status	Common Setti	ngs Frequency	Power		WLAN 1			
Cell 🙀	TX Burst Power			-40.0 dBm	Multi Evalua			
Connection Status	RX Expected PE	P		30.0 dBm				
PV Power Indicator 2040m In Range	Approximate RX	Approximate RX Burst Power 17.0 dBm						
RA Power Indicator 2008m In Range								
Event Log	×							
04:15:45 Signal ON								
04:14:54 Signal OFF								
04:14:45 Stack<->DAU connection updated	Connection Sett	inas			·			
04:14:44 Signal OFF	Security	Security Disabled						
04:11:57 1 Stack<->DAU connection updated	SSID	SSID CMW-AP						
DUT / UE Info	Beacon Interval (1	U)		100	-			
MAC 02FFD408BF15								
UE IPv4 100.100.100	Packet Genera	tor Data Trig	ger Mea	s Control				
CMW IPv4 100.100.50 LIE IPv6 fc01:abab:cdcd:efe0:8d87:7f2b:bdb2:c975								
CMW IPv6 fe80::201:2ff:fe03:405								
	RX Format	HE_SU	Bursts	•				
RX Statistics	RX Bandwidth	20MH	. •					
Burst Power 10.1 dBm	RX Rate	MCSI	ndex 7	-				
Data Rate HE MCS 7 20 MHz Nss1	Rate Restriction	V						
Buffered Data (total)	RX Spatial Stream	ns 1 🔻			-			
Buffered Data (TIDx) 79 Bit(TID 0) Buffered Data (ACx) ()								
Disconnect					Config			

eq. 2412.00 MHZ Ref.LVI. 30.000	IBm Std.: 802.11 ax	SISO		20MH	t .	Multi	
X Measurement (Scalar) Signal Fields Info OFDMA Re			esults				
ICS Index		7				RUN	
Modulation 64QAM CodeRate 5/						-	
Payload Symbols 11		11 Stand	Standard requires >= 16 symbols!			RF Settings	
Measured Symbols 11		11					
Payload Bytes NCAP						-	
Suard Interval	0	.8 us	us				
TF Size	2x LTF (6.	4 us)				nigger	
urst Type	HE	HE_SU					
patial Streams		1				Inout	
pace Time Streams	1				Signal		
urst Rate [%]	N	CAP					
tatistics	Current	1	Average	Max	StdDev	Display	
urst Power [dBm]	14.96		14.62	15.14	0.73		
eak Power [dBm]	24.75		24.30	26.59	0.97		
rest Factor [dB]	9.79		9.67	11.73	0.55		
VM All Carriers [dB]	-38.72	-	-38.95	-36.82	0.52		
VM Data Carriers [dB]	-38.73		-38.96	-36.82	0.52		
VM Pilot Carriers [dB]	-38.46	-	-38.80	-36.34	0.77		
enter Frequency Error [Hz]	-226.78	-2	221.98	-247.78	8.42		
umbol Clock Error [nom]	0 000		0.224	4 007	0 0 0 0		
atistic Count Out of Tolera	ance CFO Distrib	ution					
100 / 100	0.00 % 0.0 %	Outside:	0				
Connection Status: 📥 As	sociated	WLAN Stan IEEE 802.11	dard Iax	Operating Char 20MHz	inel Width	Signaling	

注 1: 此速率控制方法仅适用于 11ac 和 11ax, 无需重新信令断开在连接,可以直接切 MCS 速率, 11a/b/g/n 还是原有的 support rate 下控制;

注 2: 因 UE 芯片平台众多,每家平台的做法不尽一样,因此 rate restriction 有一定的兼容适配 性。

3 接收机测试

11ax 接收机测试与 11a/b/g/n/ac 测试方法一致,进入 RX measurement,设置 TX Burst Power Level(DL power),在 PER setting 下面设置 GI,MCS, Coding type 和 Data Packets 个数,打开 PER > ON,读取 PER 结果。



具体设置要求和最小灵敏度指标见下图规范说明:

The requirements on receiver minimum input sensitivity in 27.3.20.2 (Receiver minimum input sensitivity), adjacent channel rejection in 27.3.20.3 (Adjacent channel rejection) and nonadjacent channel rejection in 27.3.20.4 (Nonadjacent channel rejection) apply to PPDUs that meet all the following conditions:

- STBC is not used
- 0.8 µs GI is used
- If the PPDU bandwidth is 20 MHz and the HE-MCS is less than 10, then BCC is used.
 LDPC is used.
- The PPDU is an HE SU PPDU

The packet error rate (PER) shall be less than 10% for a PSDU with the rate-dependent input levels listed in Table 27-51 (Receiver minimum input level sensitivity). The PSDU length shall be 2048 octets for BPSK modulation with DCM or 4096 octets for all other modulations.

Modulation			Minimum	Minimum	Minimum	Minimum
Without DCM	With DCM	Rate (R)	sensitivity (20 MHz PPDU) (dBm)	sensitivity (40 MHz PPDU) (dBm)	sensitivity (80 MHz PPDU) (dBm)	sensitivity (160 MHz or 80+80 MHz PPDU) (dBm)
N/A	BPSK	1/2	-82	-79	-76	-73
BPSK	QPSK	1/2	-82	-79	-76	-73
QPSK	16-QAM	1/2	-79	-76	-73	-70
QPSK	16-QAM	3/4	-77	-74	-71	-68
16-QAM	N/A	1/2	-74	-71	-68	-65
16-QAM	N/A	3/4	-70	-67	-64	61
64-QAM	N/A	2/3	-66	-63	<mark>6</mark> 0	-57
64-QAM	N/A	3/4	-65	-62	-59	-56
64-QAM	N/A	5/6	-64	-61	-58	-55
256-QAM	N/A	3/4	-59	-56	-53	-50
256-QAM	N/A	5/6	<u>-57</u>	<mark>-</mark> 54	<mark>-5</mark> 1	-48
1024-QAM	N/A	3/4	-54	-51	-48	-45
1024-QAM	N/A	5/6	-52	-49	-46	-43

Table 27-51—Receiver minimum input level sensitivity

详细步骤请参考:《CMW500 操作快速入门:WLAN 信令测试》

4 小结

本文主要介绍了 WLAN 11ax (WIFI 6) station 的信令测试方法,对 11ax 不同于 传统技术的测试如 HE_TB PPDU,信令 True MIMO,指定速率 Rate Restriction 功能等提供了详细的测试步骤,并且注明了测试注意事项。如对本文有任何疑问,<u>请联系 kai.hu@rohde-schwarz.com</u>或者当地 R&S 的技术支持。谢谢。