Product article



CMW500 WLAN Signaling 测试应用指南

该指南介绍了 CMW500 WLAN 信令测试,详细介绍了使用 CMW500 进行 WLAN 信令测试的基本参数设置,指定速率参数设置,WLAN 信令测试的自动化工具 CMWrun,以及 WLAN 信令的应用测试;方便大家比较容易的完成 WLAN 信令的不同速率的测试,希望读者逐步熟练掌握测试步骤。如在测试中,发现不当之处或者有疑问,请联系本地技术支持,欢迎指正!

Contents

CMW	500 V	VLAN Signaling 测试应用指南1
1.	CM\	W500 WLAN Signaling 测试好处3
2.	WL	AN Signaling 测试需要的配置3
2	.1	硬件选件
2	.2	软件选件3
2	.3	DAU(Data application Unit)选件3
3.	WL	AN Signaling 射频指标测试
3	.1	WLAN 802.11 a/b/g/n 制式4
3	.2	AP mode 的发射指标测试4
3	.3	Station mode 的发射指标测试14
3	.4	接收指标 PER 测试15
4.	WL	AN Signaling 自动化测试16
4	.1	多信道多速率测试用例16
4	.2	PER 探底测试用例19
5.	WL	AN 应用层测试
5	.1	Ping 包测试21
5	.2	lperf 灌包测试
5	.3	WLAN 物理层应用层速率比对
6.	参考	文档

版本	作者	备注
V1.0	Ren Xunli	2014.12 创建

1. CMW500 WLAN Signaling 测试好处



图 1 CMW500 WLAN 信令连接图

- 1.1 支持 802.11 a/b/g/n 的信令测试;
- 1.2 支持多种信令模式:

AP Mode: CMW500 模拟 AP,测试终端为 Station; Station Mode: CMW500 模拟 Station,测试终端为 AP; IBSS Mode: IBSS Station 模式; HotSpot 2.0 Mode: HotSpot 2.0 接入模式; WiFi Direct Mode: WiFi 直接模式;

- 1.3 在 AP mode 下,支持 802.11n 的 WLAN MIMO 2x2 信令测试;
- 1.4 支持数据应用测试;
- 1.5 支持多种加密方式;
- 1.6 支持 Message 分析;
- 1.7 CMWrun 自动化测试可以方便的完成 WLAN 信令多种制式射频测试.

2. WLAN Signaling 测试需要的配置

- 2.1 硬件选件
 - 1xB200A Signaling Unite Universal
 - 1xB270A WLAN Signaling Module
 - KB036 extend to 6GHz(depend on the number of B570B)
- 2.2 软件选件
 - CMW-KM650 "WLAN IEEE 802.11a/b/g, TX measurement"
 - CMW-KM651 "WLAN IEEE 802.11n SISO, TX measurement"
 - CMW-KM652 "WLAN IEEE 802.11n MIMO, composite TX measurement"
 - CMW-KM653 "WLAN IEEE 802.11n MIMO, switched TX measurement"
 - CMW-KM655 "WLAN IEEE 802.11p, TX measurement"
 - CMW-KM656 "WLAN IEEE 802.11ac SISO TX measurement"
 - CMW-KS650 "WLAN IEEE 802.11a/g basic signaling"
 - CMW-KS651 "WLAN IEEE 802.11n basic signaling"
 - CMW-KS660 "WLAN advanced signaling"
 - CMW-KS670 "WLAN IEEE 802.11n MIMO 2x2 DL 5GHz generic signaling AP"
 - CMW-KT650 "WLAN message analyzer"
 - CMW-KT057 "CMWrun WLAN BT"

2.3 DAU(Data application Unit)选件

- CMW-B450B (Data Application Unite Plus)
- CMW-B660A (Option Carrier Board)

- CMW-B661A (Ethernet Switch Module)
- CMW-KA100 (Enable IPV4 Data Interface)
- CMW-KA150 (Enable IPV6 Data Interface)
- CMW-KM050 (IP Based Measurement)
- CMW-KAA20 (SMS over IMS)

3. WLAN Signaling 射频指标测试

3.1 WLAN 802.11 a/b/g/n 制式

实现 IEEE802.11 的物理层标准有多种 802.11b, 802.11a, 802.11g, 802.11g(OFDM), 802.11n(GF), 802.11a/n, 802.11g/n, 802.11g(OFDM)/n。WLAN 用户手册(CMW_WLAN_UserManual_V3-2-70.pdf)的表 2-3 给出了详细比较。

		802.11 b	802.11 a	802.11 g	802.11 g(OFDM)	802.11 n(GF)	802.11 a/n	802.11 g/n	802.11 g(OFDM)/ n
Channel	20 MHz	x	x	x	x	x	x	x	x
Bandwidth	40 MHz	-	-	-	-	x ⁰⁾	-	-	x ⁰⁾
Frequency	2.4 GHz	x	-	x	x	-	-	x	x
1)	5 GHz	-	x	-	-	x	x	-	-
Transmis- sion	DSSS / CCK ²⁾	x	-	x	-	-	-	x	-
Scheme	OFDM 3)	-	x	x	x	-	x	x	x
	OFDM MCS 0-7 for 20 MHz SISO ⁴⁾	-	-	-	-	x	x	x	x
⁰⁾ not suppo	orted by the V	VLAN signaliı	ng application		·			·	

Table 2-3: Supported IEEE 802.11 physical layer properties

¹⁾ see table below; currently not limited: any channel frequency setting is possible; operation above 3.3 GHz requires option R&S CMW-KB036

²⁾ DSSS 1Mbps, DSSS 2Mbps, CCK 5.5 Mbps, CCK 11 Mbps

³⁾ BPSK 1/2 (6 Mbps), BPSK 3/4 (9 Mbps), QPSK 1/2 (12 Mbps), QPSK 3/4 (18 Mbps), 16-QAM 1/2 (24 Mbps), 16-QAM 3/4 (36 Mbps), 64-QAM 2/3 (48 Mbps), 64-QAM 3/4 (54 Mbps)

⁴⁾ MCS 0 (BPSK1/2), MCS 1 (QPSK 1/2), MCS 2 (QPSK 3/4), MCS 3 (16-QAM 1/2), MCS 4 (16-QAM 3/4), MCS 5(64-QAM 2/3), MCS 6 (64-QAM 3/4), MCS 7 (64-QAM 5/6); OFDM MCSs 8-15 for 20 MHz MIMO

3.2 AP mode 的发射指标测试

接好终端与仪表之间的射频线后,设置相关参数,开启仪表信号,在终端与仪表完成"Association"后,可以开始射频指标测试。

3.2.1 设置基本参数

在 WLAN Signaling 界面下设置基本参数 Frequency/Channel: 2.4GHz 频段信道号范围 1~14, channel center frequency = 2407 + 5*channel number (MHz)

5GHz 频段信道号范围 0~200, channel center frequency = 5000 + 5*channel number (MHz)

Table 2	-4: IEEE	802.11	frequency	bands
---------	----------	--------	-----------	-------

Frequency Band	Channel Numbers	Carrier Frequencies	
2.4 GHz	1 to 14	2412 MHz to 2484 MHz	
5 GHz	0 to 200	5000 MHz to 6000 MHz	

Tx Burst Power 设置仪表发射的信号功率;

Rx Expected PEP 设置射频测量的峰值功率,类似于 LTE 信令测试中的 Reference Leve=expected power + Margin. 终端发送信号的峰值功率如果超过 Rx Expected PEP 将会"overflow",终端发送的信号峰值 功率太低,会影响测量准确度。在 WLAN 信令测试中一般设定为 25dBm。Approximate Rx Burst Power 与 Rx Expected PEP 之间的关系与选择的 Standard 有关。

Operation Mode 选择信令模式, CMW500 支持 AP Mode, Station Mode, IBSS Mode, HotSpot 2.0 Mode 和 WiFi Direct Mode。

Standard 选择需要测试的标准 802.11b, 802.11a, 802.11g, 802.11g(OFDM), 802.11n(GF), 802.11a/n, 802.11g/n 和 802.11g(OFDM)/n.

Beacon interval 在 AP mode 下设置该参数影响 CMW 广播 Beacon frame 的间隔时间,默认设置为 100(x1024us),减少该参数有利于"association"过程的应答,不过减小了 throughput。在 Station mode 下没有该 参数设置。

Packet Generator Configuration->State ON/OFF 使能 CMW 给终端发送 Packet, 建议在 association 之前 OFF, 在 association 之后 ON。

Packet Gnerator Configuration->Protocol Packet Protocol 协议有 ICMP 和 UDP。

Packet Gnerator Configuration->Interval Packet 发送的间隔时间,应该设定足够长来发送设定的 Payload Size。

Packet Gnerator Configuration->Payload Size Packet Payload 的大小, Interval 与 Payload size 要兼容, 如果 interval 设定太短不能发送比较大的 packet, 设定的 packet 发送会被取消。为了便于测试,设定适合的 interval 和 payload size, 建议设定 interval 为 20, Payload Size 为 500。

6

WLAN Signaling - V3.2.70 - Base V 3.2.60		300000			WLAN
Connection Status	Common Set Frequency / C	ttings hannel	2412.000 MHz	• 1	WLAN 1 Multi Evalua
Connection Status	TX Burst Power		-40.0 dBm		
	RX Expected F	PEP	2	5.0 dBm	WLAN 1
	Approximate F	X Burst Powe	er 11	9.0 dBm	PER
	Configuration	n le AP			Go to
UE Capabilities	Standard	IEEE 802.1	1b 🔫		Routina
MAC Address MAC Version RX Burst Power 12 dBm UE IP Address V4 UE IPV6 Prefix[0]	Bandwidth Beacon Interva	1	20 MHz 100	TU (1024 µs)	
	Packet Gene State	rator Config • Off	uration C On		
	Protocol	ІСМР	•		
	Interval		20	TU (1024 µs)	Message
	Payload Size		500	Byte(s)	Analyzer
	Payload Type	Default	•		WLAN Signaling
	T T	The second secon	Ť		Config

图 2 基本参数设定 part1

WLAN Signaling->Configuration->Connection->Security->Mode 根据终端支持的模式选择 security 机制,测试射频指标建议为 disable,如图 3。

Operation Mode	AP Station
Advanced RF Settings	
E Connection	
- Security	
Mode	Disabled 🔹
	Disabled
RX filter	Disabled WPA Personal
RX filter ⊞Trigger	Disabled WPA Personal WPA Enterprise
RX filter ⊕Trigger ⊕Packet Generator	Disabled WPA Personal WPA Enterprise WPA2 Personal
RX filter ⊞Trigger ⊞Packet Generator ⊞IPv4 Interface	Disabled WPA Personal WPA Enterprise WPA2 Personal WPA2 Enterprise

图 3 设置 security 模式

除了以上设定的 WLAN 信令基本参数外, 射频通道, 线损补偿在 WLAN Signaling->Configure->RF Settings 中设置, 根据连接方式确定, 如图 4 所示:



3.2.2 设置需要的测试速率

CMW WLAN 信令中能够对需要测试的速率进行控制, Supported Rate 可以设定发送的速率。

如图 5 是 WLAN Signaling->Configuration->Connection->Supported Rate 在 802.11g/n 下可设定的发送速率。

Supported Rates	
-User Defined	C Disable 📀 Enable
DSSS / CCK	
—DSSS 1Mbps	• Disabled C Mandatory C Optional
—DSSS 2Mbps	• Disabled C Mandatory C Optional
-CCK 5.5Mbps	• Disabled C Mandatory C Optional
CCK 11Mbps	• Disabled C Mandatory C Optional
□□·OFDM	
-BPSK 1/2 6Mbps	• Disabled C Mandatory C Optional
-BPSK 3/4 9Mbps	• Disabled C Mandatory C Optional
-QPSK 1/2 12Mbps	• Disabled C Mandatory C Optional
— QPSK 3/4 18Mbps	• Disabled C Mandatory C Optional
-16QAM 1/2 24Mbps	• Disabled
-16QAM 3/4 36Mbps	• Disabled
-64QAM 2/3 48Mbps	• Disabled C Mandatory C Optional
-64QAM 3/4 54Mbps	• Disabled
É-OFDM MCS	
-MCS 0	Not Supported C Supported
-MCS 1	Not Supported C Supported
-MCS 2	Not Supported C Supported
-MCS 3	Not Supported C Supported
MCS 4	Not Supported C Supported
MCS 5	Not Supported C Supported
-MCS 6	Not Supported C Supported
MCS 7	Not Supported O Supported

图 5 可设置的速率

Supported Rate 控制终端发送的速率

Management Frame Rate 设置 CMW500 发射 Management Frame 的速率,不控制终端的速率 Data Frame Rate 设置 CMW500 发射 Data Frame 的速率,不控制终端的速率。 设定指定速率可以按照以下步骤操作,其中步骤 1 有两种方法: 步骤 1 设定 supported rate 在 supported rate 中设定 Basic rate + desired DUT TX data rate (2.4GHz 下 Basic rate 为 1Mbps; 5GHz 下 Basic rate 为 6Mbps; OFDM 的情况可以不用设置 Basic Rate) 或者在 supported rate 中使能所有低速率直到需要测试的速率。 步骤 2 设定 MAC Frame RX Trigger 在 802.11b 下 Trigger Mode = DSSS/CCK Bursts Min Length = 299 symbols or Same as Packet Generator Payload size 在 OFDM/802.11n 下 Trigger Mode = OFDM Bursts,

Min Length = 18 bytes

Payload Size of 500 bytes enable highest modulation can be measured.

需要注意修改速率配置需要信号关开重新 association。

如图 6 是按照 Basic rate + desired rate 的方法设定的 802.11b 的 5.5Mbps 速率配置。

E-Country Code	General Fit	Multi Evalua
Supported Rates	Olisable · Enable S C Disabled · Mandatory · Optional S • Disabled · Mandatory · Optional ss • Disabled · Mandatory · Optional se Rate Control Ontrol Disabled · Mandatory · Optional gger Disabled · Mandatory · Optional igger Person Default · • Message RisingEdge · Person Default · • WLAN IP V4 & V6 · • Onfig	
User Defined	C Disable 💿 Enable	WLAN 1
	C Dischlad C Mandatana C Ontinnal	PER
DSSS 1Mbps	C Disabled C Mandatory C Optional	
- CCK 5 5Mbps	C Disabled C Mandatory C Optional	Go to
- CCK 3.5MBps	C Disabled (• Mandatory C Optional	
Management Frame Rate Control Data Frame Rate Control Security	• Disabled C Mandatory C Optional	Routing
Mode	Disabled	
		"
	Default •	
□ □ Trigger		
Trigger Mode	DSSS/CCK Bursts -	
Min Length: Bytes or Symbols	User Defined 💌 299) Message
-Trigger Slope	RisingEdge 💌	Analyzer
Pulse Length	Default 👻	WLAN
-IP Version Support	IP V4 & V6 -	Signaling Off
		Config

图 6 802.11b 的速率设置

图 7 是按照 Basic rate+ desired rate 的方法设定的 802.11g 36Mbps 速率配置。

	n elter el ellinere	
Standard	IEEE 802.11g	
Beacon Interval	100 TU (1024 us)	
DTIM Period	1	
MAC-Address (BSSID)	000102030405 hex	
SSID	CMW-AP	
⊕Country Code		
E-Supported Rates		
	C Disable 🔅 Enable	
DSSS / CCK		
DSSS 1Mbps	⊂Disabled ⊙Mandatory ⊂Optional	
DSSS 2Mbps	• Disabled	
CCK 5.5Mbps	Tisabled C Mandatory C Optional	
CCK 11Mbps	🕫 Disabled 🤇 Mandatory 🔇 Optional	
DFDM		
BPSK 1/2 6Mbps	• Disabled	
BPSK 3/4 9Mbps	• Disabled	
-QPSK 1/2 12Mbps	• Disabled C Mandatory C Optional	
— QPSK 3/4 18Mbps	Tisabled C Mandatory C Optional	
	Optional C Mandatory C Optional	
	C Disabled 💽 Mandatory C Optional	
64QAM 2/3 48Mbps	• Disabled	
64QAM 3/4 54Mbps	© Disabled C Mandatory C Optional	•
Management Frame Rate Control Data Frame Rate Control Data Frame Rate Control P-Security RX filter Trigger MAC Frame TX Trigger MAC Frame RX Trigger	Default	
Trigger Mode	OFDM Bursts	
Min Length: Bytes or Symbols	User Defined - 18	
Trigger Slope	RisingEdge 💌	
Pulse Length	Default 👻	
	IP V4 & V6	
-Packet Generator		
General Settings		
É- Shortcut Softkey		•

图 7 802.11g 的速率设置

步骤 3 设置 Input Signal 和 Trigger

选择 WLAN Signaling ->Go To->WLAN Multi-Evaluation 进入 WLAN 信令测试界面 确认 WLAN Multi-Evaluation->Scenario-> Combined Signal Path(Signaling)

确认 Frequency 为需要测试的频点.

10

ath: Input Signal/Standard				
- Scenario	Combined Signal Path(Signaling) 🔻			
- Controlled by	WLAN Sig1 💌			
∃Controller Settings RF Routing (Input)	Connector: RF1COM 💌 Converter: RFRX1 💌			
Frequency	2412.0000000 MHz 🔻			
External Attenuation (Input)	0.00 dB FDCorr! TableName: Const_20dB			
Expected Nominal Power	25.00 dBm Ref.Level: 25.00 dBm			
User Margin	0.00 dB			
-Mixer Level Offset	8 dB			
-Frequency Offset	0 Hz			
	图 8 信今测量参数			

设置 WLAN Multi-Evaluation->Configuration->Input Signal->Standard 为正确的信号类型;

设置 WLAN Multi-Evaluation->Configuration->Trigger Source->WLAN Sig 1: RXFrame Trigger 例如图 9:

WLAH Multi Evaluation Configuration		X	WLAN
th: Input Signal/Evaluation Length			Multi
Mixer Level Offset Frequency Offset ∃Input Signal	8 dB 0 Hz		
Standard	802.11b (DSSS)		RF Settings
Burst Type	Auto		
- Evaluation Length	1000 Chips 💌		Trigger
-Band Width	20MHz		
IQ Swap Measurement Control 	Cantinuaus		Input Signal
Stop Condition	None		Disnlay
← Measure On Exception ⊕ Modulation ⊕ Spectrum	Statistic Count: 10		
⊕ Power ⊕ Assign Views ⊕ List Mode	Statistic Count: 10	<u> </u>	
B-Trigger			
Trigger Source	WLAN Sig1: RXFrameTrigger 🔻		
Trigger Slope Trigger Threshold	RisingEdge ▼ -20.000 dB		WLAN Signaling Off
etition Stop Condition Statistic		Assign Views	Config

图 9 设置 trigger

以上以 802.11b/g/n 速率测试为例, 802.11a 的信令测试设置与此相同。由于测试速率多,设置项多,为 了方便测试,我保存了各速率测试的配置文件 wifi_config.zip。解压后 copy 到 CMW500 中,调用这些配置文 件更容易完成测试。

3.2.3 终端连接仪表

完成了需要的参数设置后,打开 WLAN Signaling 信号,等待终端与 CMW500 完成"association"过程。 仔细观察在 WLAN Signaling 界面的"Connection Status"会有几个状态的变化 idle->Probed->Authenticated->associated。这几个状态的详细描述参见" CMW_WLAN_UserManual_V3-2-70.pdf"。

完成"association"之后, 如图 10 所示, UE Capabilities 中显示终端的 MAC Address/Version, Burst Power 以及获取的 IP 地址信息。

WLAN Signaling - V3.2.70 - Base V 3.2.60				WLAN
Connection Status Cell Connection Status	Common Settings Frequency / Channe TX Burst Power RX Expected PEP Approximate RX Bur	rst Power	▼ 1 0.0 dBm 5.0 dBm 9.0 dBm	WLAN 1 Multi Evalu WLAN 1 PER
UE Capabilities MAC Address 4C8BEF17BBB1 MAC Version 0 RX Burst Power 13 dBm UE IP Address V4 172.22.1.100	ConfigurationOperation ModeAPStandardIEEBandwidthBeacon Interval	E 802.11b 20 MHz 100	TU (1024 µs)	Go to Routing
JE IPV6 Prefix[0] TCUT:abab:cdcd:efeu::	Packet Generator State C Or Protocol ICMP Interval C Payload Size C	Configuration ff ○On 20 500	TU (1024 µs) Byte(s)	Message Analyzer
	Payload Type Defa	ult •		WLAN Signaling Run

图 10 associated

3.2.4 开启发射指标测试

设定 Packet Generator Configuration->State ON 之后,仪表发射设定的 Packet,建议设定 interval 为 20,Payload Size 为 500 保证最高速率也可以被测量。

点击 Go to ->WLAN Multi Evaluation 进入测量界面,开始进行发射指标测试。

图 11 是 802.11b CCK 11Mbps 的测试结果



图 11 802.11b 发射指标 part 1

双击 Tx Measurmenet(Scalar)显示更详细的内容,如图 12。

WLAN TX Measurement 1	- V3.2.70 - Base V 3.2.5	1 - Multi Evaluation				WLAN
eq: 2412.0000000 MH	z Ref.Lvl: 25.00 dBm	Std: 802.11b (DSSS)	Auto	20MHz		Multi
TX Measurement (Sca	lar) –					Evaluation
Modulation Type		TIMBps CCK				KON
PLCP Type Deuteed Leasth (bute)		Long PLCP				RE
Payload Length [byte]		14 Current	Austan	Ман	CtdDay	Settings
Puret Dewar [dDm]		6.70	C 79	C 70	0.01	
Durst Power jubrij		0.79	0.70	0.79	0.01	[
EVIVI PEAK [70]	· · · · · · · · · · · · · · · · · · ·	5.40	3.30	4.12	0.21	Trigger
EVIVI RIVIS [76]		0.59	1.01	1.14	0.03	
Center Frequency Error	[HZ]	0.000	3.32	13.76	3.33	
Chip Clock Error [ppm]		0.000	0.002	1.480	0.049	Input
Q Offiset (αΒ)	3	-69.51	-66.30	-01.//	1.80	Signal
Gain Imbalance (dB)		-0.06	-0.03	-0.14	0.04	
Quadrature Error [*]	11-12-14-14-14-14-14-14-14-14-14-14-14-14-14-	0.47	0.45	0.51	0.00	Disular
Statistic Count Ou	t of Tolerance					Display
10 / 10	0.00 %					<u></u>
Connection Status:	Associated		WLAN Stand	lard: IEEE 802.	11b	WLAN Signaling Run
epetition Stop Conditio	n Statistic Count				Assign Views	Config

图 12 802.11b 发射指标 part2

图 13 是 802.11n(SISO) QPSK Code rate3/4 测试结果

														WLAN
iq: Error V	2412.00 ector N	000000 I Aagnitu	MHZ RI de	ef.Lvi: :	25.00 dB	m Std: 80	02.11n (S	SISO)		Mixed	20MH	IZ		Multi Evaluation RUN
-20 dB				~~~							·····		Sym	RF
	10	20	30	40	50	60	70	80	90 100) 110	120	130	140	Settings
rror V VM vs C	ector N Carrier	Aagnitu	de											
-20 dB													Carrier	Trigger
	-25	-20	-1	15	-10	-5	0	e	i 11)	15 21)	25	
Q Cons	stellati	on	Q				S 0	dB	Flatness			101 		Input Signal
			<u>.</u>	•1 D 1				-25 -2	0 -15 -10) -5 (5 10	15	Carrier 20 25	Display
ower	vs. Tin	1e												
-50 dBm		<u>ч</u> п. – ,	1997 A.	1 Ju - 1	· · · · · ·		ү ү ч	1.1		· • • •		19 . FA	him	
L	0 :	20 4	10	60	80	100 1	20 14	160	180	200	220 24	0 20	μs 60	<u></u>
X Mea	asuren	nent (Sc	alar)											1
Burst P	ow. (dB	3m]	7.21	EVM	RMS [d	B] -32	.44 Fre	eq. Err. (Hz] 13901	.22 Clo	ck Err. (ppr	n]	5.120	
С	onnect	ion Stati	us:	Ass	ociated	-80.91			VVI	AN Stanc	lard: IEEE 80)2.11g/i	n	WLAN Signaling Run
licconn	nect	Ϋ́				T T				T T		Ŷ		Config

图 13 802.11n 发射指标 part 1

双击 Tx Measurement(Scalar)显示更详细的测试内容,如图 14.

g: 2412.0000000 MHz Ref.Lvl: 25.00 dBm TX Measurement (Scalar)	n Std: 802.11n (SISO)	Mixed	20MHz		Multi
Modulation Type				RUN	
^D ayload Length (symbol)	59				
Guard Interval	Long				RF
Statistics	Current	Average	Max	StdDev	Settings
Burst Power [dBm]	7.14	7.11	7.66	0.24	<u>}</u>
EVM All Carriers [dB]	-32.56	-32.44	-30.40	0.41	Triccor
EVM Data Carriers [dB]	-32.44	-32.33	-30.22	0.41	rnyyer
EVM Pilot Carriers (dB)	-34.43	-34.15	-31.95	0.61	<u>}</u>
Center Frequency Error [Hz]	13902.60	13900.57	13908.30	3.87	Innut
Symbol Clock Error [ppm]	6.469	6.005	6.944	0.384	Signal
Q Offset [dB]	-50.78	-50.02	-44.05	1.80	
∋ain Imbalance (dB)	-0.06	-0.05	-0.10	0.02	
Quadrature Error [°]	-0.04	-0.08	-0.24	0.00	Display
atistic Count Out of Folerance					
10 / 10 60.00 %					
Connection Status: 📥 Associated		WLAN Stand	ard: IEEE 802.	11gn	WLAN Signaling Run
Y Y	Y	Y	Y		

图 14 802.11n 发射指标 part 2

3.3 Station mode 的发射指标测试

CMW500 的 station mode 可以测试终端的 AP,测试方法与 AP mode 下测试终端 Station 类似。Station mode 的测试需要注意以下几点:

(1)设置 CMW500 的 channel number 必须与终端 AP 的相同, 因为 CMW500 的 station mode 还不能扫描 AP.

(2)设置的标准要与终端 AP 的一致;

(3)终端 AP 的 WLAN Security 禁用,现在的版本(3.2.70)station mode 下还不支持 WLAN Security;

(4)Supported rate 在 station mode 下也可以使用,但是不是所有的 AP 支持该功能,如果终端不支持该功能,可以通过终端的命令,强制终端 AP 发射需要的速率。

Supported rate 的设定方法是 enable rate(1,2.5.5,6,12,24Mbps) + desired DUT TX data rate(higher than 16QAM 1/2),如下图 15 所示.

WLAN Signaling Configuration		<u></u>	-	
Path: Trigger/MAC Frame RX Trig	ger/Min Length: By	ytes or Symbols	1	1.4
SSIU	h3	· ·	12 •	1
Ilser Defined	c	Disable 🛈 Enable	-40.0 dBn	า
			25.0 dBn	1
DSSS 1Mbps	с	Disabled @ Mandatory C Optional	12.0 dBm	
DSSS 2Mbps	С	Disabled @ Mandatory C Optional		
CCK 5.5Mbps	С	Disabled @ Mandatory C Optional		
CCK 11Mbps	С	Disabled 💿 Mandatory 🔿 Optional		
BPSK 1/2 6Mbps	C	Disabled 📀 Mandatory 🔿 Optional		
BPSK 3/4 9Mbps	œ	Disabled C Mandatory C Optional		
— QPSK 1/2 12Mbj	s C	Disabled 🏽 Mandatory 🗢 Optional		
-QPSK 3/4 18Mbj	is 🔎	Disabled C Mandatory C Optional		
	ps C	Disabled 🕫 Mandatory 🔿 Optional		
	ps 📀	Disabled C Mandatory C Optional	-	
	ps 📀	Disabled C Mandatory C Optional		
64QAM 3/4 54MI	ps 📀	Disabled C Mandatory C Optional	-	
D-OFDM MCS			2	
MCS 0	¢	Not Supported C Supported	20 TU (102	24 µs)
-MCS 1	(i	Not Supported C Supported)O Byte	(S)
MCS 2	c	Not Supported C Supported	-	
MCS 3	(•	Not Supported C Supported 👻		
			U	
Disconnect	Reconnect	T T	Config.	4

图 15 station mode 的 supported rate 设置

(5)在 CMW500 上可以设置允许 CMW500 接入的 SSID(图 16)。

∮… C	Connection	
	-Connection Mode	• Auto Connect C Manual
	SSID Connection	⊖ Any ⊙ SSID
	Standard	IEEE 802.11g/n
	MAC-Address (BSSID)	000102030405 hex
	SSID	AndroidAP
. r	Sunnorted Dates	

图 16 station mode 的 SSID 设置

图 17 是 CMW500 在 station mode 下完成 association 过程

🚯 WLAII Signaling -	V3.2.70 - Base V 3.2.51					WLAN
Connection Statu	S	Common Se	ttings			-
Cell	(m)	Frequency / C	hannel	2447.000 MHz	• 8	WLAN 1 Multi Evalua
Connection Status	Associated	TX Burst Pow	er	-4().0 dBm	
Station SSID	HUAWEI-J6XXJZ	RX Expected	PEP	25	5.0 dBm	WLAN 1
		Approximate I	RX Burst Pov	wer 11	2.0 dBm	PER
		Configuratio				Go to
		Operation Mo	de Station			
UE Capabilities MAC Address MAC Version BX Burst Power	00664BF8F96C 0 2 dBm	Standard IEEE 802.11g (OFDM) Bandwidth 20 MHz				Routing
UE IP Address V4 UE IPV6 Prefix[0]	100.100.100.10	Packet Gene	erator Confi	quration		
		State	⊂ Off	• On		
		Protocol	ICMP	-		
		Interval		20	TU (1024 µs)	Message
		Payload Size		500	Byte(s)	Analyzer
		Payload Type	Default	<u>.</u>		WLAN Signaling <mark>Run</mark>
Disconnect	Reconnect		Ĩ			Config

图 17 station mode 测试

3.4 接收指标 PER 测试

完成 association 之后点 Go To->WLAN PER 进入 PER 接收测试,如图 18 所示 Tx Burst Power 设置 CMW500 发送信号的功率 Modulation Coding Rate 设置需要测试速率 PER 显示测试到的 Packet Error Rate Packets, Packets Lost 显示测试了 Packet 的个数和错误的包数 RX Burst Power Ack Frame 的平均功率 Last Ack Rate Ack Frame 的发射速率

PER 测试注意:

15

- (1) 不要与发射指标同时测试;
- (2) 不要使能 Packet Generator



图 18 PER 测试

4. WLAN Signaling 自动化测试

CMWrun 测试自动化软件能够很方便的进行 WLAN 信令的各种测试,并输出测试结果,可以提高测试效率。 CMWrun 的基本使用方法请参考文档" CMWrun 快速使用_V1.1.pdf"。

4.1 多信道多速率测试用例

WLAN Tx Measurement Loop Rates and Channel with Att Table.rstp(图 19), 该测试用例很方便进行多个信道, 多个速率的配置, 并完成射频测试。

	-		J
	Wlar	n Tx Measurement Loop Rates and Channel with Att Table	
÷	1	BasicInitializing	
÷	2	Attenuation Tables	
÷	3	WLANConnectionSetup	
		CcessPointConfiguration	
		CcessPointEnable	
		TrableWiFiPrompt	
		Association Process	
: 	- 4	lf (Step3.ConnectionSucceeded)	
		5 bool LoopContinueChannel = True;	
		6 bool LoopContinueRate = True;	
		7 While (Step5.LoopContinueChannel)	
		turner with the second	Set channel to test
		10 Step6.LoopContinueRate = Step8.PerformTest;	
			Set rates to test
		i⊒···· <mark>13</mark> If (Step12.PerformTest)	
		⊞ 15 WLANSignalingTxMeasurement	Tx Measurement
		16 Step6.LoopContinueRate = Step12.LoopTestStatus;	
		17 Step5.LoopContinueChannel = Step8.LoopTestStatus;	
	÷	18 WLANSignalingDisconnect	

图 19 CMWrun 测试用例

右键点击 WLANSignalingSetChannel 进行需要测试的信道设置(图 20)

Frequency Band	2.4 GHz 🚽		Reconnect a	fter frequency change
1 [2412 MHz]	GHz 4 [2427 MHz]	🔲 7 [2442 MHz]	10 [2457 MHz]	13 [2472 MHz]
📃 2 [2417 MHz]	📃 5 [2432 MHz]	🔲 8 [2447 MHz]	11 [2462 MHz]	14 [2484 MHz]
🔲 3 [2422 MHz]	V 6 [2437 MHz]	9 [2452 MHz]	12 [2467 MHz]	
5 GHz				
36 [5180 MHz]	48 [5240 MHz]	🔲 104 [5520 MHz]	128 [5640 MHz]	157 [5785 MHz]
38 [5190 MHz]	52 [5260 MHz]	108 [5540 MHz]	132 [5660 MHz]	📃 161 [5805 MHz]
40 [5200 MHz]	56 [5280 MHz]	112 [5560 MHz]	136 [5680 MHz]	165 [5825 MHz]
42 [5210 MHz]	60 [5300 MHz]	116 [5580 MHz]	140 [5700 MHz]	
44 [5220 MHz]	64 [5320 MHz]	120 [5600 MHz]	🔲 149 [5745 MHz]	
46 [5230 MHz]	100 [5500 MHz]	124 [5620 MHz]	153 [5765 MHz]	

图 20 CMWrun 设置信道

Settings Rates Multiple	•	
802.11b	802.11a/g(OFDM)	802.11n
I Mbps	G Mbps	MCS 0
2 Mbps	9 Mbps	MCS 1
5.5 Mbps	12 Mbps	MCS 2
11 Mbps	18 Mbps	MCS 3
	24 Mbps	MCS 4
	36 Mbps	MCS 5
	48 Mbps	MCS 6
	54 Mbps	MCS 7
Signaling Off Wait Time	e [s] 3	

右键点击 WLANSignalingTxMeasRate 进行需要测试速率设置(图 21)

图 21 CMWrun 设置速率

右键点击 WLANSignaling TxMeasurement 显示测试项(图 22).

Packet Generator	Results		-
Packet Interval 20		Scalar	Traces
Packet Size (Byte) 500	Power vs. Time		
	Burst Power	1	
Data Frame Rate DSSS 1 Mbps -	Rise/Fall Time (DSSS)	1	
Measurements	EVM vs Chip (DSSS)		
Scalar Results 🔲 Current 🔽 Average 🥅 Maximum	EVM Peak (DSSS)	1	
Trace Display 🔲 Current 💟 Average 📃 Maximum	EVM RMS (DSSS)	V	
Evaluation Length 💿 Whole Burst 💿 1000 Chips	EVM vs Symbol		
(For DSSS only)	EVM vs Carrier		
Statistic Count 20 🚔	EVM All Carriers	V	
	EVM Data Carriers	V	
Measure Type Set by TxMeasRate	EVM Pilot Carriers	V	
DSSS Minimum Bytes 299 🚔	Center Frequency Error	1	
OEDM Minimum Sumbols 16	Chip/Symbol Clock Error	1	
	IQ Offset	1	
	Gain Imbalance	1	
	Quadrature Error	1	
	Spectrum Flatness	V	

图 22 CMWrun 设置测试指标

除了该测试用例,	其他几个测试	(用例逐步简单化,	可以根据自己需要选择使	ī用。
		AN		
	🖬	PER Search with Att Table.rst	tp	
	🖬	PER Search.rstp		
	🖬	PER vs Channel with Att Tabl	le.rstp	
	🖬	PER vs Channel.rstp		
	🖬	PER vs MCS (11a).rstp		
	🖬	PER vs MCS (11a_n).rstp		
	🖬	PER vs MCS (11b).rstp		
	🖬	PER vs MCS (11g).rstp		
	🖬	PER vs MCS (11gOFDM).rstp	1	
	🖬	PER vs MCS (11gOFDM_n).rs	stp	
	🖬	PER vs MCS (11g_n).rstp		
	🖬	PER vs MCS (11nGF).rstp		
	🗖	PER vs Tx Power (11a).rstp		
	· 🗖	PER vs Tx Power (11a_n).rstp	0	
	· 🗖	PER vs Tx Power (11b).rstp		
	📼	PER vs Tx Power (11g).rstp		
		PER vs Tx Power (11gOFDM)).rstp	
		PER vs Tx Power (11gOFDM	_n).rstp	
		PER vs Tx Power (11g_n).rstp	0	
		PER vs Tx Power (11nGF).rst	p	
		WLAN Rx Sensitivity.rstp		
		Wian Tx Measurement Loop I	Rates and Channel with Att Table.rstp	
		Wian Tx Measurement Loop I	Rates with Att Table.rstp	
		Wian Tx Weasurement Loop I	Rates.rstp	
		Wian Tx Weasurement Loop.r	stp	
	····· 44	vvian ix ivieasurement.rstp		

图 23 CMWrun 的测试用例

4.2 PER 探底测试用例

PER Search.rstp 可以进行 PER 接收电平探底测试(图 24).

Sensitivity Search		802.11b		802.11n	
Number of Packets	500	Reference	Sensitivity [dBm]	Reference	Sensitivity [dBm]
D 1 10 (D 1 1		DSSS 1 Mbps	-86 🌲	MCS 0 [6.5 Mbps]	-82 🌲
Payload Size [Bytes]	200	DSSS 2 Mbps	-83 🌲	MCS 1 [13 Mbps]	-79 🚔
Data Interval	19 🚔	CCK 5.5 Mbps	-79 🌲	MCS 2 [19.5 Mbps]	-77 🚖
Target PER [%]	10 🚔	CCK 11 Mbps	-76 🌲	MCS 3 [26 Mbps]	-74 🌲
Start Level [dBm]	-50 🌲			MCS 4 [39 Mbps]	-70 🚔
Fixed Power Step [dB]	0.5			MCS 5 [52 Mbps]	-66 🌲
Fast Mode				MCS 6 [58.5 Mbps]	-65 🌲
Less Packet @ low PE	R			MCS 7 [65 Mbps]	-64 🌲
Fixed Packet, Min 1 dB		802.11a/g(OFDM)		802.11n(MIMO)	
Break Search on Limit I	PASS 📃	BPSK 1/2 [6 Mbps]	-82 🌲	MCS 8 [13 Mbps]	-82 🌲
		BPSK 3/4 [9 Mbps]	-81 🌲	MCS 9 [26 Mbps]	-79 🚖
		QPSK 1/2 [12 Mbps]	-79 🌲	MCS 10 [39 Mbps]	-77 🚖
		QPSK 3/4 [18 Mbps]	-77 🌲	MCS 11 [52 Mbps]	-74 🚖
		16QAM 1/2 [24 Mbps]	-74 🚔	MCS 12 [78 Mbps]	-70 🚖
		16QAM 3/4 [36 Mbps]	-70 🚖	MCS 13 [104 Mbps]	-66 🚔
	Default	64QAM 2/3 [48 Mbps]	-66 🚖	MCS 14 [117 Mbps]	-65 🌲
	Sensitivity	64QAM 3/4 [54 Mbps]	-65 🚔	MCS 15 [130 Mbps]	-64 🌲

图 24 CMWrun PER 探底设置

其他 PER 的测试用例可以完成过个信道及速率的不同功率,或者不同速率以及不同的 PER 测试(图 25)。



图 25 CMWrun PER 测试用例

图 26 是进行 11g 下的 1Mbps 和 48Mbp 的两种速率测试结果.

WLAN Signaling Tx Measurement: TX Measurement

Trigger Source = RX Frame Trigger

TX Measurement	Lower Limit	Upper Limit	Measured	Unit	Status
TX Measurement @ Frequency = 2412 MHz (Chan	nel 1), Packet I	nterval = 20, P	acket Size = 50	0, 11g	(DSSS)
Modulation Type			1 Mbps, DBPSK		Passed
Burst Type			Long PLCP		Passed
Payload Length	1	4095	564	Byte	Passed
Burst Power (Average)	-100	30	-5.06	dBm	Passed
EVM Peak (Average)		35	23.87	%	Passed

Tx Measurement Rate: 48 Mbps, 64QAM 2/3 Trigger Source = RX Frame Trigger

TX Measurement	Lower Limit	Upper Limit	Measured	Unit	Status					
TX Measurement @ Frequency = 2412 MHz (Channel 1), Packet Interval = 20, Packet Size = 500, 11g (OFDM										
Modulation Type			48 Mbps, 64-		Passed					
			QAM							
Payload Length	1	1366	24	symbol	Passed					
Burst Power (Average)	-100	30	-6.25	dBm	Passed					
EVM All Carriers (Average)		-22	-26.29	dB	Passed					
EVM Data Carriers (Average)		-22	-26.23	dB	Passed					
EVM Pilot Carriers (Average)		-8	-27.13	dB	Passed					

图 26 CMWrun 测试报告

5. WLAN 应用层测试

WLAN 的应用测试与其他制式的应用测试方法相同,

步骤 1 终端 associated 到 CMW500 上

步骤2 启动应用测试

5.1 Ping 包测试

🤯 Data Applica	tion Measure	ment 1 - V3.	.2.40													Ping
Select RAN:	WLAN Sig	naling 1		•	Ma Ma	x. pos x. pos	sible ⁻ sible ⁻	Throu <u>c</u> Throu <u>c</u>	hput I hput I	Jplink Downl	(RAN) link (R/	c AN):	150. 15.	000	Mbit/s kbit/s	Ping
Overview	😑 Ping	🕕 IPerf	📔 💿 Th	rough	put		DNS 1	req.	01	P Lo	gging	10	IP An	alysis	;	RUN
Ping																Configure
Request: ms	0 Times	tamp: 04:14:2	20 Later	icy:		- 112										Services
20			1									1	-			
15																
10																Network Impairm. OFF
5 0														Re	quests	Display
-95	-90 -85 -1	30 -75 -	70 -65	-60	-55	-50	-45	-40	-35	-30	-25	-20	-15	-10	-5	
Average:	4,255	5 ms	Mini	mum:			2.38	6 ms			Maxim	ium:		12.	931 ms	Marker
Config -																
Destination I	P: 172.22.1.	100			'N	lo Rec	oly' Co	ount:							1	1
Interval:		1000 m	s				JIMG:	Ding	imod	out						Signaling
Timeout:		2 s				WARI	VIIVO.	Filly	lineu	out						Parameter
Payload:		100 By	te													WLAN 1
Ping count:		100														Run Run

图 27 Ping 包测试结果

5.2 Iperf 灌包测试

需要注意下行的速率修改在 Data Frame Rate Control 中(图 29).

at Adn	ninistrator: C:\W	lindows	\system	32\cmd.exe								×	Γ
[160]	0.0-375.6	5 sec	199	datagra	ns ree	ceived out-	of-orde	r	-				
read f	failed: Cor	necti	ion re	set by	ocer								
read f	failed: Cor	necti	ion re	set by	peer								L
[160]	local 192.	.168.1	3.100	port 5	001 со	onnected wi	th 172.	22.	1.201	port	37234		
[[D]	Interval		Trans	fer	Bandy	width	Jitter		Lost/]	fotal	Datagrams		
[160]	0.0-1.0	sec	2.89	MBytes	24.2	Mbits/sec	0.830	ns	4688/	6548	(72%)		
[160]	1.0- 2.0	sec	3.02	MBytes	25.3	Mbits/sec	0.465	ns	1261/	3416	(37%)		١.
[160]	2.0-3.0	sec	2.93	MBytes	24.6	Mbits/sec	0.515	ns	1302/	3394	(38%)		
[160]	3.0-4.0	sec	2.96	MBytes	24.8	Mbits/sec	0.612	ns	1300/	3411	(38%)		
[160]	4.0-5.0	sec	3.07	MBytes	25.7	Mbits/sec	0.555	ns	1200/	3387	(35%)		
[160]	5.0-6.0	sec	2.98	MBytes	25.0	Mbits/sec	0.788	ns	1275/	3399	(38%)		
[160]	6.0- 7.0	sec	2.95	MBytes	24.7	Mbits/sec	0.578	ns	1291/	3395	(38%)		
[160]	7.0- 8.0	sec	2.88	MBytes	24.2	Mbits/sec	0.527	ns	1358/	3414	(40%)		
[160]	8.0- 9.0	sec	3.03	MBytes	25.4	Mbits/sec	0.700	ns	1233/	3392	(36%)		
[160]	9.0-10.0	sec	3.02	MBytes	25.4	Mbits/sec	0.721	ns	1260/	3416	(37%)		
[160]	10.0-11.0	sec	2.79	MBytes	23.4	Mbits/sec	0.702	ns	1409/	3401	(41%)		
[160]	11.0-12.0	sec	2.55	MBytes	21.4	Mbits/sec	1.141	ns	1587/	3408	(47%)		
[160]	12.0-13.0	sec	2.95	MBytes	24.7	Mbits/sec	0.658	ns	1288/	3391	(38%)		
[160]	13.0-14.0	sec	2.78	MBytes	23.3	Mbits/sec	0.728	ns	1416/	3400	(42%)		
[160]	14.0-15.0	sec	2.79	MBytes	23.4	Mbits/sec	0.713	ns	1423/	3411	(42%)		
[160]	15.0-16.0	sec	2.68	MBytes	22.5	Mbits/sec	0.583	ns	1490/	3401	(44%)		
[160]	16.0-17.0	sec	2.76	MBytes	23.2	Mbits/sec	0.454	ns	1428/	3399	(42%)		
[160]	17.0-18.0	sec	2.79	MBytes	23.4	Mbits/sec	0.860	ns	1414/	3407	(42%)		
[160]	18.0-19.0	SEC	2.57	MBytes	21.5	Mbits/sec	0.526	ns	1566/	3397	(46%)		
	¥:											-	

图 28 lperf 灌包测试结果

🚸 WLAN Signaling Configuration		× 1	THEFT
Path: Connection/Data Frame Rate Control/Ra	te	1	WLAN 1
-Operation Mode	AP		Multi Evalua
Advanced RF Settings			WLAN 1
Connection			PER
Standard	IEEE 802.11g		
-Beacon Interval	100 TU (1024 µs)	-	Data 1
DTIM Period	1		Meas
-MAC-Address (BSSID)	000102030405 hex		
-SSID	CMW-AP		Routing
E Supported Rates			
Management Frame Rate Control		5)	
	C Nachla C Fachla		
Date		-	<u> </u>
E-Security	D333 Ziviups		
RX filter	Default 🔻		
⊕- Trigger		\$)	Message
-IP Version Support	IP V4 & V6		Analyzer
Packet Generator			<u>}</u>
🖶 General Settings			NLAN
Shortcut Softkey		•	Run

图 29 下行速率设置

5.3 WLAN 物理层应用层速率比对

WLAN 的应用层速率与物理层速率差别较大,下面是物理层与应用层的速率比对(图 30)。



6. 参考文档

6.1 CMW_WLAN_UserManual_V3-2-70.pdf

6.2 CMWrun 快速使用_V1.1.pdf

6.3 CMW500 FDD-LTE DAU 应用测试图解.pdf