802.11n速度故障排除

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<u>簡介</u>

本文說明排除無線吞吐量問題時需要考慮的常見問題。本文包括使用工具來測量無線網路的效能和 吞吐量,其中包括在類似測試條件下與Cisco 1252 AP進行比較的不同供應商802.11n接入點(AP)。

必要條件

<u>需求</u>

思科建議您瞭解以下要求:

- •工具(如iPerf)和網路分析器(如OmniPeek和Cisco Spectrum Analysis)
- 支援802.11n的1140、1250、3500和1260系列AP

<u>採用元件</u>

本文中的資訊係根據以下軟體和硬體版本:

- 運行軟體版本6.0.182的WS-SVC-WiSM控制器
- AIR-LAP1142-A-K9 AP

<u>慣例</u>

如需文件慣例的詳細資訊,請參閱<u>思科技術提示慣例。</u>

<u>背景資訊</u>

802.11n產生的原因是對接入點幀聚合進行了大量更改:A-MPDU和A-MSDU。

- 塊確認大小
- MCS和通道繫結
- MIMO
- 在2.4 GHz上使用5 GHz:另外還提到Wi-Fi在5GHz上認證通道繫結

排除控制器11n速度的故障

1 驗證控制器上是否已啟田802 11n支援。

請完成以下步驟:

	(WiSM-slot3-2) >show 802.11a
	802.11a Network
	11nSupport Enabled
	802.11a Low Band Bnabled
	802.11a Mid Band Enabled
	802.11a High Band
	802.11a Operational Rates
	802.11a 6M Rate
	802.11a 9M Rate
	802.11a 12M Rate
	802.11a 18M Rate
	802.11a 24M Rate
	802.11a 36M Rate
	802.11a 48M Rate
	802.11a 54M Rate
	802.11n MCS Settings:
	MCS 0 Supported
	MCS 1 Supported
	MCS 2 Supported
	MCS 3 Supported
	MCS 4 Supported
	MCS 5 Supported
2	N速率有兩種方式。無需使用通道繫結即可達到調制編碼方案(MCS)7的速度。對於高於7且高
	達15的MCS速率,需要啟用通道繫結。您可以在控制器上使用以下show指令驗證是否已啟用
	·····································
	(WiSW alot 2) show advanced 802 11a abannel
	(WISM-SIDES-Z) >Show advanced ouz.lla channel
	Channel Assignment Mode
	Channel Undete Interval 600 seconds [startup]
	Anghor time (Hour of the day)
	Channel Undate Contribution SNI
	Channel Aggignment Leader 00:1d:45:f0:d2:c0
	Last Run 371 seconds ago
	DCA Sensitivity Level STARTUP (5 dB)
	DCA 802.11n Channel Width
	Channel Energy Levels
	Minimum
	Average
	Maximum
	Channel Dwell Times
	Minimum
	Average
	Maximum
	802.11a 5 GHz Auto-RF Channel List
	Allowed Channel List
	36,40,44,48,52,56,60,64,149,

153,157,161 Unused Channel List..... 100,104,108,112,116,132,136,

3. 您也可以使用以下命令配置每個AP的通道寬度: (WiSM-slot2-2) > config 802.11a disable AP0022.9090.8e97

(WiSM-slot2-2) >config 802.11a chan_width AP0022.9090.8e97 40 Set 802.11a channel width to 40 on AP AP0022.9090.8e97

4. Guard間隔和相應的MCS速率有助於確定802.11n客戶端上顯示的資料速率。以下是驗證此組 態的命令:

(WiSM-slot3-2) >show 802.11a
802.11a Network Enabled
11nSupport Enabled
802.11a Low Band Enabled
802.11a Mid Band Enabled
802.11a High Band Enabled
802.11a Operational Rates
802.11a 6M Rate
802 11a 9M Rate Supported
802 11a 12M Rate Disabled
802 11a 18M Rate Supported
802 11a 24M Rate Mandatory
802 11a 36M Rate Supported
802 11a 48M Rate Supported
802 11a 54M Rate
802 11n MCS Settings.
MCS 0 Supported
MCS 1 Supported
MCG 2 Gupported
MCG 2 Gupported
MCS 4
MCS 4 Supported
MCS 6
MCS 6 Supported
MCS / Supported
MCS 8 Supported
MCS 9 Supported
MCS 10 Supported
MCS 11 Supported
MCS 12 Supported
MCS 13 Supported
MCS 14 Supported
MCS 15 Supported
802.11n Status:
A-MPDU 'I'x:
Priority 0 Enabled
Priority 1 Disabled
Priority 2 Disabled
Priority 3 Disabled
Priority 4 Disabled
Priority 5 Disabled
Priority 6 Disabled
Priority 7 Disabled
Beacon Interval 100
CF Pollable mandatory Disabled
CF Poll Request mandatory Disabled
More or (q)uit
CFP Period 4
CFP Maximum Duration 60
Default Channel
Default Tx Power Level 1
DTPC Status Enabled
Fragmentation Threshold 2346
Pico-Cell Status Disabled
Pico-Cell-V2 Status Disabled

TI Threshold......-50 Traffic Stream Metrics Status..... Disabled Expedited BW Request Status..... Disabled World Mode..... Enabled EDCA profile type..... default-wmm Voice MAC optimization status..... Disabled Call Admission Control (CAC) configuration Voice AC - Admission control (ACM)..... Enabled Voice max RF bandwidth..... 75 Voice reserved roaming bandwidth..... 6 Voice load-based CAC mode..... Enabled Voice tspec inactivity timeout..... Disabled Video AC - Admission control (ACM)..... Disabled Voice Stream-Size..... 84000 Voice Max-Streams..... 2 Video max RF bandwidth..... Infinite Video reserved roaming bandwidth..... 0

確保A-MPDU資料包聚合。為盡最大努力,可通過以下命令啟用QoS級別:**config 802.11a** 11n**支援a-mpdu tx priority 0 enableconfig 802.11b 11n支援a-mpdu tx priority 0 enable**

- 5. 必須使用A無線電上的所有三個天線。確保天線型號相同。
- 6. 在為客戶端連線配置的WLAN上,應該允許或需要WMM,且只能使用AES或開放加密。可以

使用以下命令輸出驗證這一點:

(WISM-SIOt2-2) > snow WIAN I
WLAN Identifier 1
Profile Name wlab5WISMip22
Network Name (SSID) wlab5WISMip22
Status Enabled
MAC Filtering Disabled
Broadcast SSID Enabled
AAA Policy Override Disabled
Network Admission Control
NAC-State Disabled
Quarantine VLAN 0
Number of Active Clients 0
Exclusionlist Timeout
Session Timeout 1800 seconds
CHD per WLAN Enabled
Webauth DHCP exclusion Disabled
Interface management
WLAN ACL unconfigured
DHCP Server Default
DHCP Address Assignment Required Disabled
Quality of Service Silver (best effort
WMM Allowed
CCX - AironetIe Support Enabled
CCX - Gratuitous ProbeResponse (GPR) Disabled
CCX - Diagnostics Channel Capability Disabled
Dot11-Phone Mode (7920) Disabled
Wired Protocol None
IPv6 Support Disabled
Peer-to-Peer Blocking Action Disabled
Radio Policy All
DTIM period for 802.11a radio 1
DTIM period for 802.11b radio 1
Radius Servers
Authentication Global Servers
Accounting Disabled
Local EAP Authentication Disabled
Security
802.11 Authentication:
Static WEP Keys Disabled
802.1XDisabled

Wi-Fi Protected Access (WPA/WPA2)..... Enabled WPA (SSN IE)..... Disabled WPA2 (RSN IE)..... Enabled TKIP Cipher..... Disabled AES Cipher..... Enabled Auth Key Management 802.1x.... Enabled PSK..... Disabled CCKM..... Disabled FT(802.11r)..... Disabled FT-PSK(802.11r).... Disabled FT Reassociation Timeout..... 20 FT Over-The-Air mode..... Enabled FT Over-The-Ds mode..... Enabled CKIP Disabled IP Security..... Disabled IP Security Passthru..... Disabled Web Based Authentication..... Disabled Web-Passthrough..... Disabled Conditional Web Redirect..... Disabled Splash-Page Web Redirect..... Disabled Auto Anchor..... Disabled H-REAP Local Switching..... Enabled H-REAP Learn IP Address..... Enabled Infrastructure MFP protection..... Enabled (Global Infrastructure MFP Disabled) Client MFP..... Optional Tkip MIC Countermeasure Hold-down Timer..... 60 Call Snooping..... Disabled Band Select..... Enabled Load Balancing..... Enabled

7. 天線分集:如果由於任何原因僅使用兩個天線,則需要對發射器/接收器埠使用天線A和B。

在客戶端:

- 1. 用於控制無線卡的請求方, 首選將請求方的供應商與無線卡匹配。
- 2. 客戶端驅動程式:您需要確保無線卡上運行最新的客戶端驅動程式。
- 3. 請與無線介面卡供應商聯絡。
- 4. 確保使用11n認證介面卡來獲得11n資料速率。

Wi-Fi認證產品:

http://www.wi-fi.org/certified_products.php

如何提高效能:

- 通道利用率 網路分析器報告通道利用率,以傳送和接收幀所花費時間的百分比表示。這有 助於測量由於距離接入點距離而產生的潛在速度差異。這將有助於監控和檢視通道是否完全被 佔用,例如,在理想條件下以1Mbps的速率傳輸,在100%的利用率下將以0.94Mbps的速度執 行。
- 無線中使用的物理介質也決定了效能。使用802.11g或802.11a over 802.11b可提供高得多的 吞吐量,通常在802.11b上最高可達30 mbps,其中6mpbs的無線電容量被分配給所有相關的 站點。
- 3. 單元格大小 建議縮小單元格大小,以使客戶端儘可能靠近AP。這將有利於客戶端連線到 AP的資料速率。這可以通過將AP上的電源級別降至最低來實現。
- 4. 縮小信元大小也能減少同通道干擾。如果使用RRM,AP應該根據部署動態選擇通道。但是 ,如果實施動態通道分配,請確保同一通道上不存在兩個功率級別較高的AP,並且這兩個接

入點彼此緊鄰在一起。

5. 保護也會導致吞吐量命中。

<u>如何通過iPerf計算吞吐量</u>

<u>Iperf設定提示</u>

對於不擁有Chariot的客戶或測試者,可以使用Iperf。可從 http://www.macalester.edu/crash/software/pc/iperf/kperf_setup.exe獲取該資訊。

<u> 測量TCP吞吐量</u>

在伺服器端運行此命令:

Iperf -s -w 256k 在客戶端運行此命令:

Iperf -c -P 6 -w 256k -r -t 60		
Server listening on TCP port 5001 TCP window size: 256 KByte		
Client connecting to 10.10.10.10, TCP port 5001 TCP window size: 256 KByte		
[1788] local 10.10.10.20 port 1155 connected with 10.10.10.10 [1820] local 10.10.10.20 port 1153 connected with 10.10.10.10 [1868] local 10.10.10.20 port 1150 connected with 10.10.10.10 [1836] local 10.10.10.20 port 1152 connected with 10.10.10.10 [1804] local 10.10.10.20 port 1154 connected with 10.10.10.10 [1852] local 10.10.10.20 port 1151 connected with 10.10.10.10 [190] Interval Transfer Bandwidth [1788] 0.0-60.1 sec 124 MBytes 17.3 Mbits/sec [1868] 0.0-60.1 sec 123 MBytes 17.1 Mbits/sec [1820] 0.0-60.1 sec 84.6 MBytes 15.4 Mbits/sec [1804] 0.0-60.1 sec 84.6 MBytes 11.8 Mbits/sec [1852] 0.0-60.1 sec 89.2 MBytes 12.4 Mbits/sec [1836] 0.0-60.1 sec 89.2 MBytes 12.4 Mbits/sec	port port port port port	5001 5001 5001 5001 5001 5001
<pre>[SUM] 0.0-60.2 sec 617 MBytes 86.0 Mbits/sec [1952] local 10.10.10.20 port 5001 connected with 10.10.10.10 [1832] local 10.10.10.20 port 5001 connected with 10.10.10.10 [1748] local 10.10.10.20 port 5001 connected with 10.10.10.10 [1732] local 10.10.10.20 port 5001 connected with 10.10.10.10 [1800] local 10.10.10.20 port 5001 connected with 10.10.10.10 [1812] local 10.10.10.20 port 5001 connected with 10.10.10.10 [1800] 0.0-60.0 sec 114 MBytes 15.9 Mbits/sec [1812] 0.0-60.0 sec 117 MBytes 16.3 Mbits/sec [1952] 0.0-60.1 sec 89.6 MBytes 12.5 Mbits/sec [1748] 0.0-60.1 sec 129 MBytes 18.1 Mbits/sec [1732] 0.0-60.1 sec 111 MBytes 15.5 Mbits/sec [1832] 0.0-60.1 sec 112 MBytes 15.6 Mbits/sec [1832] 0.0-60.1 sec 112 MBytes 15.6 Mbits/sec</pre>	port port port port port	2663 2664 2665 2666 2668

此影象中的第一個圈數字表示上游吞吐量,第二個圈數字表示下游(AP到客戶端)吞吐量。

<u>測量UDP吞吐量</u>

關閉伺服器和客戶端上先前的Iperf應用程式。兩者都需要重新設定,但這次是為了進行UDP效能測 試。

在伺服器端運行此命令:

Iperf -s -u -1 56k **在客戶端運行此命令**:

Iperf -c -u -b 50M -l 56k -P

以下是Omnipeek捕獲分析聚合MAC服務資料單元的示例:

A-MSDU跟蹤顯示一個資料包

🙀 OaniPeck - (AMSD	UPacket.apo]										
🔮 Ele Est New C	는 En En See Serve See Top Arton Hen 프로젝트										
🗋 - 🥙 - 🔛 🌫	■ · ● · ● · ● · ● · ● · ● · ● · ● ·										
*	4 5										
Capture A		898 ×8 2									
100,000	Renset Shume	Destination	05710	Flage	Channel	E gnal	Deta Rate	200	Relative Tixe	Protocol	Simolecy
E Parent	1 00:14:5E:57:7E:AL	P00:12:28:36:19:37	99 00:16:01:6F:01:5Z	Α	1	1008	144.5	4350	0.000000	102.11 A-3500	FD F
-lere-cha	2 📑 COr28rEDr8cr15r77	0151550156Fs0355E			1	1005	2 4 . U	14	0.000005	SU2.11 Ack	PD=
	4			11.13	-	1000	1993-019	0.000		AND AND	
										Packet/ 2	Duration: [B10:01]
Done											#9 Kora

- 僅顯示第一個子幀。
- •需要檢查十六進位制轉儲以檢視其他子幀。

A-MSDU下一子幀附加



• A-MPDU是一種包含多個MPDU的結構,由PHY作為單個PSDU傳輸。

• 在物理層融合過程(PLCP)中指示資料包為資料A-MPDU。



Originator

Recipient

以下是Omnipeek捕獲分析聚合MAC協議資料單元的示例:

A-MPDU設定

🕼 OwniPeek - (AMPDUSebup ape)													
🔮 Ele - Ecc - New	<u>_</u> 2a	çave Se	engl ⊻onitor ∐aalo Window –	Щар									그 문 프
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- * -													
L Laptore A	Ģ		🗄 🏝 🔤 🚳 🌾	18 3 18 × A 🗵									
100000		Receit	Cource	Destination	0000 C	Elege	Charge	Egnal	Deta Rate	200	Relative Time	Protocol	Summery
E Parent		1	0:17:17:A6:40:90	FP 00:12:28:10:F0:55	FP 00: 17: 07: 46: 40: 91	7A	:	1008	130.0	37	0.000000	502.11 Action	PT=
dencta	1	2	00:28:29:20:25:65	DUSTO BY ABORNAD SU			5	100%	36.0	14	0,000004	500.11 AOM	PD=
14		- 3	📑 10:10:70:10:70:55	B01:13:0F:A6:40:30	📑 00: 17: DF: A6: 40: 91	· ·	¢ .	1004	26.0	.17	0.101003	202.11 Actdim.	FC,28026
Apploation w	1.	4	B) 05:37:DF:Ac:40:99	B00:12:20:10:F0:55		1.	s.,	1008	36.0	14	0.000013	502.11 Ack	FD
	1					191	120.12		1 M M	10			A CONTRACTOR OF A CONTRACT OF
												Packets 4	Diretion: [H10:11]
Done													alg hora

- ADDBA 新增塊確認
- ADDBA Request 包含識別符號、塊確認策略、緩衝區大小等。
- ADDBA Response 可以更改策略和緩衝區大小。

• ADDBA請求

• AP1250使用零超時來指示無超時。

短 OmniPeek - [A	AMPDUSetup.apc - F	acl	ket #1]	_ U ×				
<u>≣</u> <u>F</u> ile <u>E</u> dit ⊻ie	ew <u>C</u> apture Sen <u>d M</u>	onit	or <u>T</u> ools <u>W</u> indow <u>H</u> elp	_ 8 ×				
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Packet:	1 [🖍 🕋 –							
802.11 1	GAC Header	-						
🖉 Versi	on:	0		8				
🕥 Type:		% 0	0 Management					
🔤 🐨 🐨 Subty	pe:	\$1	101 Management Action					
Erame	Control Flags:	% 0	0000000					
			0 Non-strict order					
- 🕥			.0 Non-Protected Frame					
- 3			0 No More Data					
🕲			0 Power Management - active mode					
🞯			0 This is not a Re-Transmission					
🞯			0 Last or Unfragmented Frame					
🞯			0. Not an Exit from the Distribution System					
🧐			Not to the Distribution System					
💮 🎯 Durat	ion:	40	Microseconds					
📰 Desti	nation:	00	:13:E8:1D:F0:55					
Sourc	e:	00	:17:DF:A6:4C:90					
BSSID):	00	:17:DF:A6:4C:90					
	lumber:	96	4					
👘 🕤 🖓 Frag	Number:	0						
802.11	lanagement – Acti	on						
G Categ	ory Code:	3	Block Ack					
G Actio	n Code:	0	ADDBA Request					
G Dialo	g Token:	1						
Block	Jick Param Set:	% 0	00100000000010					
			Buffer Size:64					
💆								
				CK				
	7 1 1 1 1 1							
BLOCK	ack fimeout valu	e:u	10s					
□ - 9 DA SC	arting Sequence	con	Crot: *000000000000000					
			2000 Frament Number: 0					
	rame Check Server	ce						
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0000: 00 00 2	28 00 00 13 E8 1D 30 03 00 01 02 10	10	00 50 02 36 E6 3F B9	· · · · · h				
00100								
For Help, press F1			III None					

A-MPDU設定

• ADDBA響應

• 接收方需要指示已成功建立塊確認協定。



A-MPDU資料傳輸

- 塊確認包含壓縮點陣圖,指示已接收的MPDU。
- 有關傳送塊確認的資訊,請參閱IEEE 802.11n第9.10.7節「HT-immediate Block Ack extensions」。

💯 OmniPask - (AMP	010 sts/adBlock/lck.epc						-				_ [0] X
😩 Eile Edit Mew	<u>Capture Send Monitor Took Window</u>	Hep									
🔄 - 😂 - 🖬 🌫	🖻 🕑 🖻 🖻 📣 🖧 😔 🕫	*************	1 🖓 🔂								
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Packets	Packet Source	Deab metion	85310	Hegs	Channel	Signal	Data Rata	Spe	Ralab ve Time	Protocol	
C Exact	1 00:13:E8:36:19:77	00:14:5E:67:7E:A1	00:16:01:6F:03:5E	1	1	100%	130.0	78	0.000000	TCP	
Hearth	2 📑 00:13:K6:36:19:77	📑 00: 14: 5K: 57: 70: A1	00:16:01:5F:03:5E	*	1	100%	130.0	75	0.000003	TEP	
Bu	3 💵 00:13:E8:36:19:77	■\$00:14:5E:67:7E:A1	00:16:01:6F:03:5E	à.	1	100%	130.0	78	0.000008	TCP	
Application	4 📑 00:13:K0:36:19:72	■●00:14:5K:57:7K:A1	B) 00:16:01:5F:03:5E		1	100%	130.0	75	0.000011	TICP	
I-I Visuals	5 💵 00:13:E8:36:19:77	■\$00:14:5E:67:7E:A1	00:16:01:6F:03:5E	A	1	100%	130.0	78	0.000014	TCP	
Peer Map	6 📑 00:13:80:36:19:72	■\$00:14:5K:07:7E:A1	B00:16:01:6F:00:5E	A	1	100%	130.0	7.0	0.000017	TCP	
Grants	7 📑 00:13:E8:36:19:77	BD 00:14:5E:87:7E:A1	BD 00:16:01:6F:03:5E	à.	1	100%	130.0	78	0.000020	TCP	
E Statistics	0 📑 00:16:01:07:03:55	B00:13:E0:36:15:77		1 C	1	100%	20.0	32	0.000023	002.11 88	
Banker I											
L	•								A. A. A. A. A. A.	R R R 9	
									Packets 8	Duration 0.0	0.00
Done										Bij None	1

<u>信標中通告的功能</u>

HI Capability Info	
	45 HT Capability Info
🎯 Length:	26
🖶 🍞 HT Capability Info:	%0001100001101110
🕥	0 L-SIG TXOP Protection Support: Not Supported
🎯	.0 AP allows use of 40MHz Transmissions In Neighboring BSSs
🕎	0 Device/BSS does Not Support use of PSMP
🝞	1 BSS does Allow use of DSSS/CCK Rates 840MHz
🗊	1 Maximal A-MSDU size: 7935 bytes
🕅	0 Does Not Support HT-Delayed BlockAck Operation
	00 No Rx STBC Support
V	0 Transmitter does Not Support IX SIBC
	11 Snakial Multinlaving Enabled
	1. Both 2009z and 4009z Operation is Supported
A-MPDU Parameters:	\$00011011
	xxx Reserved
	110 Minimum MPDU Start Spacing: 8 usec
	11 Maximum Rx A-MPDU Size: 64K
Supported MCS Set	
in T One Spatial Stream	: \$1111111
	ported - BPSK. Coding Rate: 1/2
🗑 MCS Index 1 Sup	ported - QPSK. Coding Rate: 1/2
MCS Index 2 Sup	ported - QPSK. Coding Rate: 3/4
🕤 MCS Index 3 Sup	ported - 16 QMM. Coding Rate: 1/2
MCS Index 4 Sup	ported - 16 QAM. Coding Rate: 3/4
	ported - 64 QAM. Coding Rate: 2/3
	ported - 64 QAM. Coding Rate: 3/4
MCS Index 7 Sup	ported - 64 QAM. Coding Rate: 5/6
Two Spatial Stream	s: %01111111
MCS Index 8 Sup	ported - BPSK. Coding Rate: 1/2
MCS Index 9 Sup	ported - QPSK. Coding Rate: 1/2
MCS Index 10 SU	pportea - QPSK. Coaing Rate: 3/4
MCS Index 11 Su	pported = 16 QAM. Coding Rate: 1/2
MUS INdex 12 Su	pported = 16 gAM. Coding Rate: 3/4
MCS Index 13 Sa	ppozted - 64 02M. Coding Rate: 2/3
MCS Index 14 St	t Sumported = 64 0MM. Coding Rate: 5/6
Rx Bitnesk b16-b23	* \$00000000
Rx Bitnask b24-b31	*0000000
Rx Bitnask b32-b39	\$0000000
📖 🍘 Rx Bitmask b40-b47	\$0000000
🐨 🐨 Rx Bitmask b48-b55	\$0000000

信標中通告的功能:

-	. 🕲	Rx Bitnask b64-b76:	\$00000000000
	. 🕲	Reserved:	\$000
		Highest Supported Rate	9:0 Maps
		Reserved:	*00000
		Tx Supported MCS Set:	30 Not Defined
	e.	Tx and Rx MCS Set:	40 Kmma3
	ě	Ty Navinun Number Shat	tial Streams Summerted: 500 / Smatial Stream
		Tx Unequal Fodulation:	*0 Not Sumported
		Received :	\$0000000000000000000000000000000000000
10	HT	Extended Canabilities	
1			TYTY Beserved
			0 Deverse Direction Recorder: Supported
			0 LITT Sumart. Sumart.
	2		00 M°C Zeefacts Supported
	2		with the respect of the second
-	2		An Transition Time We Transition
			A Transmitter Supration figure to Concerted
		Bern Receiver Counted Id.	
1	TX	Beam Forming Capabili	
-			xxx Keserved
			Charles Estration Capability: 1 Space like Stream
	. 🥶		CS1 Max Number of Kows: 2 Row of CS1
-	. 😅		
-	. 9		
-	. 🕲		O 0 CSI Number of BF Antennes: 1 TX Antenne Sounding
-	. 🕲		No Grouping)
-			Compressed BF Feedback Katrix: Not Supported
-	9		Uncompressed BF Feedback Matrix: Not Supported
-	0		TxBF CSI Feedback: Not Supported
-	. 🕲		
-	. 🔾		Uncompressed BF Feedback Matrix: Not Supported
	. 🕲		
-	. 🕲		Calibration: Not Supported
-	. 🕲		Implicit TxBF Capable: Not Supported
-	0		Tx NDP Capable: Not Supported
	0		NDP Capable: Not Supported
-	. 🕲		
-			
1.			0 Implicit TxBF Receiving Capable: Not Supported
۹T	Лn	tenna Selection Capabi	lity (ASEL): \$00000000
-			x Reserved
			.0 Tx Sounding PPDUs Capable: Not Supported
	0		Rx ASEL Capable: Not Supported
	0		0 Antenna Indices Feedback Capable: Not Supported
			0 Explicit CSI Feedback: Tx AS Capable: Not Supported
			0 Antenna Indices Feedback Based Tx ASEL Capable: Not Supported
			0. Re-Explicit CSI Feedback Tx ASEL Capable: Not Supported
	-		A Reference Collection Countries Web Commented

信標中通告的功能:

```
Blenent ID:
                    61 Additional HT Information
 🕤 Length:
                   22
 Primary Channel:
                   6
😨 PSNP STAs Only:
                  30 Association Requests are Accepted Regardless of PSMP Capability
 🗑 RIFS Mode:
                    31 Use of RIFS Permitted
 🗑 STA Channel Width:
                   %1 Use Any Channel Width Enabled Under Supported Channel Width Set
 2nd Channel Offset: 401 Above the Primary Channel
. 🗑
                      XXXXXXXX XXX.... Reserved
  --- 🗑
                      . 📾
                      .....0... Transmit Burst Limit: No Limit
  -- 🕲
                      . 🐨
                      HT Info Element 3:
                   $00000000000000000
  ... 📦
                      xxxx.... Reserved
                      ....0.... PCO Phase: Switch To/Continue Use 200Hz Phase
  --- 🗑
                      .....0.. ....... PCO Active: Not Active in the BSS
   - 🗑
  --- 🗑
                      .....0. ...... L-SIG THOP Protection: Not Full Support
  --- 😥
                      .....0 ...... Secondary Beacon: Primary Beacon
                      ..... 0..... Duel CTS Protection: Not Required
   . 🕤
                      0
   . 📦
                      - Basic MCS Set
 🗄 🍞 One Spatial Stream: 🛛 30000000
    ... 🜒 MCS Index 0 Not Supported - BPSK. Coding Rate: 1/2
    -- 😙 MCS Index 1 Not Supported - QPSK. Coding Rate: 1/2
    ... 📵 MCS Index 2 Not Supported - QPSK. Coding Rate: 3/4
    ... 🕲 MCS Index 3 Not Supported - 16 QAM. Coding Rate: 1/2
     📵 MCS Index 4 Not Supported - 16 QAM. Coding Rate: 3/4
     🌒 MCS Index 5 Not Supported - 64 QAM. Coding Rate: 2/3
     MCS Index 6 Not Supported - 64 QAM. Coding Rate: 3/4
    -- 🕲 MCS Index 7 Not Supported - 64 QAM. Coding Rate: 5/6
 🗄 🍸 Two Spatial Streams: 300000000
    -- 🎯 MCS Index 8 Not Supported - BPSK. Coding Rate: 1/2
    ... 🕤 MCS Index 9 Not Supported - QPSK. Coding Rate: 1/2
    ... MCS Index 10 Not Supported - QPSK. Coding Rate: 3/4
    ... 🕲 MCS Index 11 Not Supported - 16 QAM. Coding Rate: 1/2
    - 😚 MCS Index 13 Not Supported - 64 QAM. Coding Rate: 2/3
    ... 📵 MCS Index 14 Not Supported - 64 QAM. Coding Rate: 3/4
    -- 🕲 MCS Index 15 Not Supported - 64 GAM. Coding Rate: 5/6
   🞯 Rx Bitnask b16-b23: 🛛 %00000000
   🕲 Rx Bitnask b24-b31: 👘 \00000000
   🝘 Rx Bitnask b32-b39:
                      $00000000
   💼 Rx Bitnask b40-b47:
                     $00000000
```

與為A-MPDU新增塊確認設定的關聯相似:

194	🕎 00:13:E8:1D:F0:55	BO:17:DF:A6:4C:90	802.11 Ack			100%	6.0	14
195	EE 00:17:DF:A6:4C:90	FgEthernet Broadcast	802.11 Beacon	m 00:17:DF:A6:4C:90	*	100%	6.0	204
196	E 00:13:28:1D:F0:55	FP Ethernet Broadcast	802.11 Probe Reg	Ethernet Broadcast	*	100%	1.0	81
197	FE 00:17:DF:A6:4C:90	P2 00:13:E8:1D:F0:55	802.11 Probe Rsp	FP 00:17:DF:A6:4C:90	*+	100%	6.0	204
198	📰 00:13:E8:1D:F0:55	00:17:DF:A6:4C:90	802.11 Ack		¥	100%	6.0	14
199	00:13:CE:89:DC:A2	Ethernet Broadcast	802.11 Probe Req	Ethernet Broadcast		100%	1.0	87
200	N:13:E8:36:19:77	Ethernet Broadcast	802.11 Probe Req	Ethernet Broadcast	*	100%	1.0	81
201	00:17:DF:A6:4C:90	00:13:E8:36:19:77	802.11 Probe Rsp	B) 00:17:DF:A6:4C:90	*+	100%	6.0	204
202	Image: 00:13:E8:36:19:77	00:17:DF:A6:4C:90	802.11 Ack		¥	100%	6.0	14
203	BO:13:E8:36:19:77	Ethernet Broadcast	802.11 Probe Req	Ethernet Broadcast	*	100%	1.0	74
204	00:13:E8:36:19:77	Ethernet Broadcast	802.11 Probe Req	Ethernet Broadcast	*	100%	1.0	81
205	B 00:17:DF:A6:4C:90	00:13:E8:36:19:77	802.11 Probe Rsp	B00:17:DF:A6:4C:90	*+	100%	6.0	204
206	00:13:E8:36:19:77	B) 00:17:DF: A6:4C:90	802.11 Ack		#	100%	6.0	14
207	00:13:CE:89:DC:A2	Ethernet Broadcast	802.11 Probe Req	Ethernet Broadcast	*	52%	1.0	55
208	00:13:CE:89:DC:A2	Ethernet Broadcast	802.11 Probe Req	Ethernet Broadcast	*	97\$	1.0	55
209	B) 00:13:CE:89:DC:A2	Ethernet Broadcast	802.11 Probe Req	Ethernet Broadcast	*	100%	1.0	87
210	D0:13:CE:89:DC:A2	Ethernet Broadcast	802.11 Probe Req	Ethernet Broadcast		100%	1.0	55
211	00:17:DF:A6:4C:90	Ethernet Broadcast	802.11 Beacon	00:17:DF:A6:4C:90	*	100%	6.0	204
212	00:13:CE:89:DC:A2	Ethernet Broadcast	802.11 Probe Req	Ethernet Broadcast	*	95%	1.0	55
213	00:13:CE:89:DC:A2	Ethernet Broadcast	802.11 Probe Req	Ethernet Broadcast	*	100%	1.0	87
214	00:13:CE:89:DC:A2	Ethernet Broadcast	802.11 Probe Reg	Ethernet Broadcast	*	100%	1.0	55
215	E 00:13:E8:1D:F0:55	F 00:17:DF:A6:4C:90	802.11 Auth	FE 00:17:DF:A6:4C:90	*	100%	36.0	34
216	E2 00:17:DF:A6:4C:90	F 00:13:E8:1D:F0:55	802.11 Ack		<i>i</i> i	100%	36.0	14
217	E 00:17:DF:A6:4C:90	E 00:13:E8:1D:F0:55	802.11 Auth	E 00:17:DF:A6:4C:90	×	100%	36.0	34
218	🕎 00:13:E8:1D:F0:55	F2 00:17:DF:A6:4C:90	802.11 Ack		ÿ	100%	36.0	14
219	FE 00:13:E8:1D:F0:55	FE 00:17:DF:A6:4C:90	802.11 Assoc Req	FE 00:17:DF:A6:4C:90	*	100\$	36.0	134
220	E 00:17:DF:A6:4C:90	E 00:13:E8:1D:F0:55	802.11 Ack		ÿ	100%	36.0	14
221	FE 00:17:DF:A6:4C:90	FP 00:13:E8:1D:F0:55	802.11 Assoc Rsp	FP 00:17:DF:A6:4C:90		100%	130.0	180
222	📰 00:13:E8:1D:F0:55	B 00:17:DF:A6:4C:90	802.11 Ack		¥.	100%	36.0	14
223	3 192.168.170.89	3224.0.0.1	IGNP	B00:17:DF:A6:4C:90		100%	130.0	84
224	🕎 00:13:E8:1D:F0:55	00:17:DF:A6:4C:90	802.11 Ack		#	100%	36.0	14
225	192.168.170.89	3224.0.0.1	IGNP	B) 00:17:DF:A6:4C:90	+	100%	130.0	84
226	00:13:E8:1D:F0:55	00:17:DF:A6:4C:90	802.11 Ack		9	100%	36.0	14
227	00:17:DF:A6:4C:90	00:13:E8:1D:F0:55	WLCCP	E) 00:17:DF:A6:4C:90		100\$	130.0	92
228	00:13:E8:1D:F0:55	00:17:DF:A6:4C:90	802.11 Ack		¥.	100%	36.0	14
229	E 00:17:DF:A6:40:90	F 00:13:E8:1D:F0:55	802.11 Action	Per 00:17:DF:A6:40:90		100%	130.0	37
230	00:13:E8:1D:F0:55	B 00:17:DF:16:4C:90	802.11 Ack		¥	100%	36.0	14
231	EE 00:13:28:1D:F0:55	00:17:DF:A6:4C:90	802.11 Action	00:17:DF:A6:4C:90	×	100%	36.0	37
232	00:17:DF: 16:4C:90	B00:13:E8:1D:F0:55	802.11 Ack		ý.	100%	36.0	14

Verifying A-MPDU is enabled on the controller

in the second second second		
a a strongenerity mes	AL AND AN AND A MARK AND A MARK	
Element ID:	45 HT Capability Date (81)	
- Unigth:	26 (04)	
T HT Capability Info:	4000110000110110 (05-06)	
- 9	0 Supported	
	.0 30 allows use of 4000x Transmissions In Meighboring SDDs	
- •	Device/855 does Not Support use of 25MP	
	d Transmitter does Not Support Ty SIDC	
	1. Both 1984s and 4985s foresting is forested	
	A 1997 radius analyticity for Personal	
100 0 0000		A-MPDU enabled and seen in the
- T A-RPDU Facameters	V00011011 [177]	+ here
	REF Beserved [07 Bank Octo]	beacon
	210 Miniaum MNDV Flart Specing: # usec [87 Bask DolC]	
	11 Mexianm Rx 3-0000 Sine: 64K [07 Back 0x00]	
T Supported BCS Set		

Above is a beacon frame from an SSID enabled for n rates

- interface Dot11Radio1
- Radio AIR-RM1252A, Base Address 00119ea6.8520, BBlock version 0.00, Software version 2.10.20
- Serial number: FOC1212405A
- Number of supported simultaneous BSSID on Dot11Radio1: 16
- Carrier Set: Americas (OFDM) (US) (-A)
- Uniform Spreading Required: Yes
- Configured Frequency: 5180 MHz Channel 36 40MHz, extended above
- Compared Prequency: 5159 MHz Channel 36 40MHz, extended above Allowed Frequencies: 5180(36) 5200(40) 5220(44) 5240(48) *5260(52) *5280(56) *5300(60) *5320(64) *5500(100) *5520(104) *5540(108) *5560(112) *5590(116) *5660(132) *5680(136) *5700(140) 5745(148) 5765(153) 5785(157) 5805(161) 5825(165) * = May only be selected by Dynamic Frequency Selection (DFS) Listen Frequencies: 5180(36) 5200(40) 5220(44) 5240(48) 5260(52) 5280(56) 5300(60) 5320(64) 5500(100) 5520(104) 5540(108) 5560 (112) 5580(116) 5660(132) 5680(136) 5700(140) 5745(149) 5765(153) 5785(157) 5805(161) 5825(165) Beacon Flags: 0, Interface Flags 20105; Beacons are enabled; Probes are enabled Compared Brance Methy Allow (12)

- Configured Power: 14 dBm (level 1)
- Active power levels by rate
- 6.0 to 54.0 , 14 dBm
- 6.0-bf to 54.0-b, 8 dBm, changed due to regulatory maximum m0. to m15.-4, 11 dBm, changed due to regulatory maximum
- OffChnl Power: 14, Rate 6.0
- Allowed Power Levels: -1 2 5 8 11 14 --More--
- --More--Allowed Client Power Levels: 2 5 8 11 14
- Receive Antennas : right-a left-b middle-c
- Transmit Antennas : right-a left-b, ofdm single
- Antenna: external, Gain: Allowed 11, Reported 0, Configured 0, In Use 11
- Active Rates: basic-6.0 9.0 basic-12.0 18.0 basic-24.0 36.0 48.0 54.0
- Current Rates: basic-6.0 9.0 basic-12.0 18.0 basic-24.0 36.0 48.0 54.0
- Allowed Rates: 6.0 9.0 12.0 18.0 24.0 36.0 48.0 54.0
- All Rates: 6.0 9.0 12.0 18.0 24.0 36.0 48.0 54.0 m0. m1. m2. m3. m4. m5. m6. m7. m8. m9. m10. m11. m12. m13. m14. m15.
- Default Rates: basic-6.0 9.0 basic-12.0 18.0 basic-24.0 36.0 48.0 54.0 m0. m1. m2. m3. m4. m5. m6. m7. m8. m9. m10. m11. m12. m13. m14. m15.
- Best Range Rates: basic-6.0 9.0 12.0 18.0 24.0 36.0 48.0 54.0 m0. m1. m2. m3. m4. m5. m6. m7. m8. m9. m10. m11. m12. m13. m14. m15.
- Best Throughput Rates: basic-6.0 basic-9.0 basic-12.0 basic-18.0 basic-24.0 basic-36.0 basic-48.0 basic-54.0 m0. m1. m2. m3. m4. m5. m6. m7. m8. m9. m10. m11. m12. m13. m14. m15.

MCS Rates on 802.11n beacon

In a state for each other and the state of t
a T Capacitod MIX Set.
(a) T the Spectral Property Sections (10)
- With Dames & Damparted - ANDL, Contag Bater 1/3
- · · · · · · · · · · · · · · · · · · ·
- BIT Dates (Deposited - USE, Colleg Beter Ave
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Wit index a furgerand - as just coming factor dive
- But Dates i Dagestied - of UBR, Colling Relet 2/7
. · With Dasher & Degenerated - of GBK, Conting Rates 2.14
BCS (balas 7 Suggesting - of UBE, Colong Balas 1/4
The lastic Barrier Allinger Allinger
- Bill Bader & Segmented - 3858. Contag Bater 3/0
- WH Dates > Departed - QUIL, Colling Beter 2/0
. S With Dasher 24 Regenerations - GARL Continue Refers Arts
- The second sec
- · · · · · · · · · · · · · · · · · · ·
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Self Dates 10 Supervised - 68 100. College Select 1/6
- * Ba Stimus \$15.671 \$0000000 [70]
• The Bit Reads \$200 to 12: 400000000 [11]
Be Bulland Std of 1 Stormond (11)
Be Bullegash 242-675- 400000000 [14]
- * He Street 255-621: 10000000 [11]
Bu Bu Bu hand bee to be Bootstooooss (100-17) Back (0.0779)
- Budent Supported Balant Rev (10-51 Bark def703)
 Beautient: +000000 (20 Nucl. In/P)
In Suggestant MIS Sale we for Suffrand (1970 Sales 1980)
The and the MCS Select No. Speed 1200 Starth doubt
. In Francisco Particle Design Descent Section 1997 A Social Diverse 1997 Bull Avenue

Supported MCS rates

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	OmniPeek _ =	ж
6 B	Idt Verw Capture Send Monitor Tools Window Help Wild Packada Capture Send Monitor Tools Window Help	ek.
-	Rat Page 002.11a.pkt 000.130,4094.pkt 000.11a.pkt - Packet #57 000.11m_40994.pkt - Packet #100 ×	х.
-		
8.7	SSD Bird Afen State SSD-Vi	-
* 7	andrean 19-1: Satasa Lemand Rate-5.0 Maps Rate-5.0 Maps Rate-52.0 Maps Rate-54.0 Maps Rate-54.0 Maps Rate-54.0 Maps Rate-56.0 Maps	г
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14	With Brill (Diff Level Muttin Grant & Changel Millington (0) 1 Prola Manager (9) 3007	h
11	Clowest Die 40 27 Canability 2nds 1821	
	• Length: 26 (04)	
1.4		
	- 1 * 1. 2000 Parameters-100012011	
	T Supported MIS Set	
	G The Spatial Stream + 1111111 (***)	
	We cannot a supported - state. Contry where 1/2	
	Ref Dates 2 Supporter - 0027, Colling Barty 3/4	
	Will Index 3 Supported - 16 GMM, Coding Rate: 1/1	
	- Will Index 4 Supported - 14 GMK, Coding Reter 1/4	
	- 🗣 MCF Index 6 Supported - 66 QBM. Coding Ante: 2/9	
	- • MCF Index 6 Supported - 46 QMK, Coding Actor 3/4	
	La ACE Jonda 7 Supported - 42 QMA, Coding Arter 5/4	
	We special intervent transmission (17)	
	REL Dates 9 Supported - OVE. Collar lates 1/2	
	WET Index 10 Supported - OFER, Colling Rate: 3/4	
	- 🖉 MCF Index 12 Supported - 14 GAM. Collar Aste: 1/2	
	With Index 12 Supported - 14 GAM. Coding Bates 3/4	
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	Bit Bitmark bit should be separate to be a second bit	۳
	- R Bitmack b19-0101 V00000000 [11]	
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	- Sx Eltman b48 0151 V000000 (14)	
	- The Billmank bill bill 19 00000000 (2013)	
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	• Nuclear Transition Robert Rose (201701)	
	9 Reserved) 940000 (17 Ball 0217)	
	The Supported MCS Set: VB. Dot Decision 2100 Basis (2001)	*

802.11a with N rates Enabled

p OmniPeek	. * ×
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a T the B-3 DM Loss-4 BTH Forst-0 BTH Forst-0 Bitter Control - Control For York Rep-Child South Control - Control	and these lines in the second s
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T II Canadity Infe	earon frame including
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T IT Trianked Constitution Informationson	
The Beam Forming Capability (TallF)	
* T Astemas Selection Capability (BEE)-40000000	
- T his of Index Book Add of Index America Primary Channel-40	
T B-10 Let March 000000000	
a T the second set is the set of the second set of the set of t	
T Version Investigation In-Cold Version States (199-40-40-40 Version-5 COL Version-5	
a " Wenker Specific 20-021 Vender Specific Leard 600-00-06 Balan(2 Spins)	
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T FIS - Frame Check Segment	
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802.11A Beacon frame

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2-0-HA RERE 44 ST20001* 2003	
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🛊 🎢 (0-21) 🔰 🗰 1.12 KK Kealer Version-O Type+00 Anteprest Subtype+1100 Jeson Duration-V Alteresconis Destination-Ph/Ph/Ph/Ph/Ph/Ph/Ph/Ph/Ph/Ph/Ph/Ph/Ph/P	7:84:
G T HIZ 11 Nanagement - Beaces	
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- Descen Enterval: 100 [22-53]	
a T capacity inter-second	
a 1 Marco are accessioned balance and balance and balance and balance are appressively approximately appressive approximately	
3. The set of the s	St and
T Con Built (Stringer Station Control Charael Billington-Station Constitution)	
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T um Ib-021 WW Leads 600-00-50-72 001 fgge-2 601 Subfgge-1 Annualis Element Ferning-1	
a T Weeke Specific D-221 Venter Specific Least 00-40-36 data=(3 bytes)	
T Under Specific D-221 Worder Specific Lead 000-00-40-96 Version-5 000 Version-5	
※ Y vender Specific ID-221 Vender Specific Land 000-00-40-98 Outa-(2 hyper)	
a T Weake Specific De-Cli Vender Specific Least 000-00-40-96 Datas(2 bytes)	
FT 103 - Frame Clark Separate	
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