

802.11n 速度故障排除

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简介

本文档介绍在解决无线吞吐量问题时应考虑常见问题。本文档包括用于测量无线网络的性能和吞吐量的工具的使用方法，其中包括不同的供应商 802.11n 接入点 (AP) 与 Cisco 1252 AP 在类似测试条件下的比较。

先决条件

要求

Cisco 建议您具有以下要求：

- iPerf 之类的工具以及 OmniPeek 和 Cisco 频谱分析之类的网络分析器
- 802.11n 支持的 1140、1250、3500 和 1260 系列 AP

使用的组件

本文档中的信息基于以下软件和硬件版本：

- 运行软件版本 6.0.182 的 WS-SVC-WiSM 控制器
- AIR-LAP1142-A-K9 AP

规则

有关文档规则的详细信息，请参阅 [Cisco 技术提示规则](#)。

背景信息

802.11n 因对 AP 帧聚合进行的大量更改而产生：A-MPDU 和 A-MSDU。

- 块确认大小
- MCS 和信道接合
- MIMO
- 使用 5 GHz 代替 2.4 GHz：还提到 Wi-Fi 确认 5 GHz 上的信道接合

11n 速度的控制器故障排除

请完成以下步骤：

1. 验证是否在控制器上启用了 802.11n 支持。

```
(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..... Mandatory
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..... Supported
802.11n MCS Settings:
MCS 0..... Supported
MCS 1..... Supported
MCS 2..... Supported
MCS 3..... Supported
MCS 4..... Supported
MCS 5..... Supported
```

2. 以两种方式获得 N 速率。可以获得高达调制编码方案 (MCS) 7 的速度，而无需使用信道接合。对于高于 7 一直到 15 的 MCS 速率，需要启用信道接合。可以在控制器上使用以下 **show 命令来验证是否启用了信道接合：**

```
(WiSM-slot3-2) >show advanced 802.11a channel
Automatic Channel Assignment
Channel Assignment Mode..... AUTO
Channel Update Interval..... 600 seconds [startup]
Anchor time (Hour of the day)..... 0
Channel Update Contribution..... SNI.
Channel Assignment Leader..... 00:1d:45:f0:d2:c0
Last Run..... 371 seconds ago
DCA Sensitivity Level..... STARTUP (5 dB)
DCA 802.11n Channel Width..... 40 MHz
Channel Energy Levels
Minimum..... unknown
Average..... unknown
Maximum..... unknown
Channel Dwell Times
Minimum..... unknown
Average..... unknown
Maximum..... unknown
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. 还可以使用以下命令来配置每个 AP 的信道宽度：

```
(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. 防护间隔和对应的 MCS 速率可帮助确定 802.11n 客户端上的数据速率。以下是用于验证此配置的命令：

```
(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..... Mandatory
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..... Supported
802.11n MCS Settings:
MCS 0..... Supported
MCS 1..... Supported
MCS 2..... Supported
MCS 3..... Supported
MCS 4..... Supported
MCS 5..... Supported
MCS 6..... Supported
MCS 7..... 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 Tx:
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..... 36
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

```

确保 A-MPDU 数据包聚合。为尽力工作，通过以下命令启用 QoS 级别：config 802.11a 11nSupport a-mpdu tx priority 0 enableconfig 802.11b 11nSupport a-mpdu tx priority 0 enable

5. 必须使用 A 无线电上的所有三个天线。确保天线是同一个型号。
6. 在为客户端连接配置的 WLAN 上，应该允许或需要 WMM，并且必须只使用 AES 或开放加密。这可以使用以下命令输出进行验证：

```

(WiSM-slot2-2) >show wlan 1
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..... 60 seconds
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:..... Open System
Static WEP Keys..... Disabled

```

```

802.1X..... Disabled
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. 天线多样性：如果因任何原因只使用两个天线，则您需要对发射器/接收器端口使用天线 A 和 B。

在客户端上：

1. 用于控制无线卡的请求方，最好使请求方的供应商与无线卡相匹配。
2. 客户端驱动程序：您需要确保无线卡上运行了最新的客户端驱动程序。
3. 联系您的无线适配器供应商。
4. 确保您使用 11n 认证适配器来实现 11n 数据速率。

Wi-Fi 认证产品：

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

如何提高性能：

1. 信道利用率 — 网络分析器以发射和接收帧所花的时间百分比形式来报告信道利用率。这帮助测量因与接入点的距离而可能发生的速度变化。这将帮助监控并了解（例如）如果信道被完全占用，则在理想条件下以 1Mbps 进行的传输将在 100% 利用率下以 0.94Mbps 执行。
2. 无线中使用的物理媒介也指示性能。使用 802.11g 或 802.11a 代替 802.11b 可提供更高吞吐量，通常比 802.11b 高 30 mbps，其中 6mpbs 无线电容分配在所有相关工作站之间。
3. 信元大小 — 建议缩小信元大小以让客户端尽可能接近 AP。这将有益于客户端连接到 AP 的数据速率。可通过将 AP 上的功率电平降低到最低来实现此目的。
4. 缩小信元大小还会降低同信道干扰。如果使用 RRM，则 AP 应该动态地为每个部署选取信道。不过，如果实现动态信道分配，请确保同一信道上没有相互靠近的两个高功率电平的 AP。

5. 保护也会影响吞吐量。

如何通过 iPerf 计算吞吐量

lperf 设置提示

对于未拥有 Chariot 的那些客户或测试人员，可以改用 lperf。可从 http://www.macalester.edu/crash/software/pc/iperf/kperf_setup.exe 获取它。

测量 TCP 吞吐量

在服务器端上运行以下命令：

```
Iperf -s -w 256k
```

在客户端上运行以下命令：

```
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 port 5001
[1820] local 10.10.10.20 port 1153 connected with 10.10.10.10 port 5001
[1868] local 10.10.10.20 port 1150 connected with 10.10.10.10 port 5001
[1836] local 10.10.10.20 port 1152 connected with 10.10.10.10 port 5001
[1804] local 10.10.10.20 port 1154 connected with 10.10.10.10 port 5001
[1852] local 10.10.10.20 port 1151 connected with 10.10.10.10 port 5001
[ ID] 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] 0.0-60.2 sec   110 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] 0.0-60.2 sec   86.3 MBytes  12.0 Mbits/sec
[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 port 2663
[1832] local 10.10.10.20 port 5001 connected with 10.10.10.10 port 2664
[1748] local 10.10.10.20 port 5001 connected with 10.10.10.10 port 2665
[1732] local 10.10.10.20 port 5001 connected with 10.10.10.10 port 2666
[1800] local 10.10.10.20 port 5001 connected with 10.10.10.10 port 2667
[1812] local 10.10.10.20 port 5001 connected with 10.10.10.10 port 2668
[ ID] Interval      Transfer      Bandwidth
[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
[SUM] 0.0-60.1 sec   672 MBytes   93.8 Mbits/sec
```

上图中第一个圈出的数字表示上游吞吐量，第二个圈出的数字表示下游（AP 到客户端）吞吐量。

测量 UDP 吞吐量

关闭服务器和客户端上以前的 Iperf 应用程序。二者都需要再次设置，但这次用于 UDP 性能测试。

在服务器端上运行以下命令：

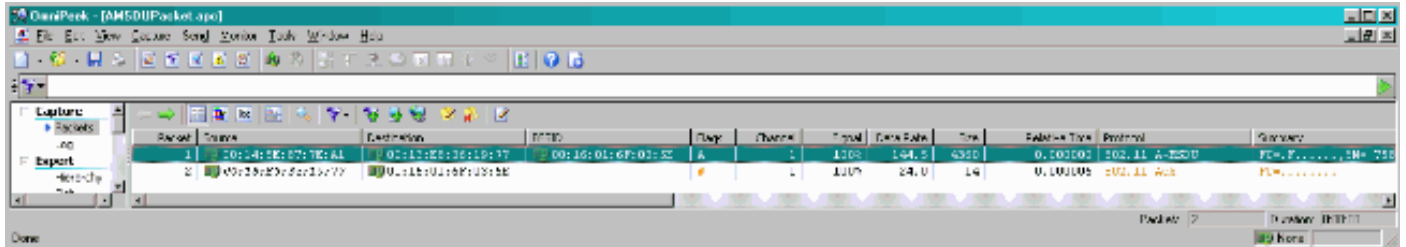
```
Iperf -s -u -l 56k
```

在客户端上运行以下命令：

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

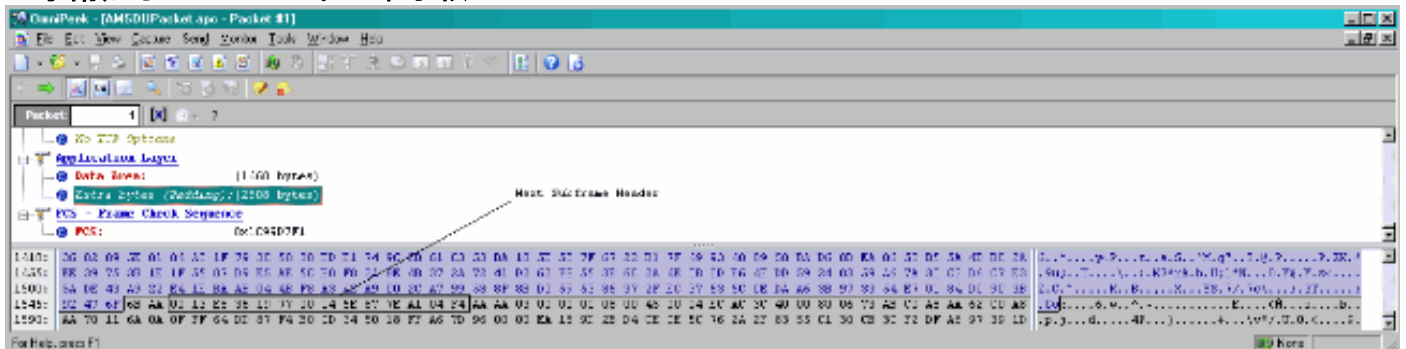
以下是用于分析聚合 MAC 服务数据单元的 Omnipcap 捕获示例：

A-MSDU 跟踪显示一个数据包

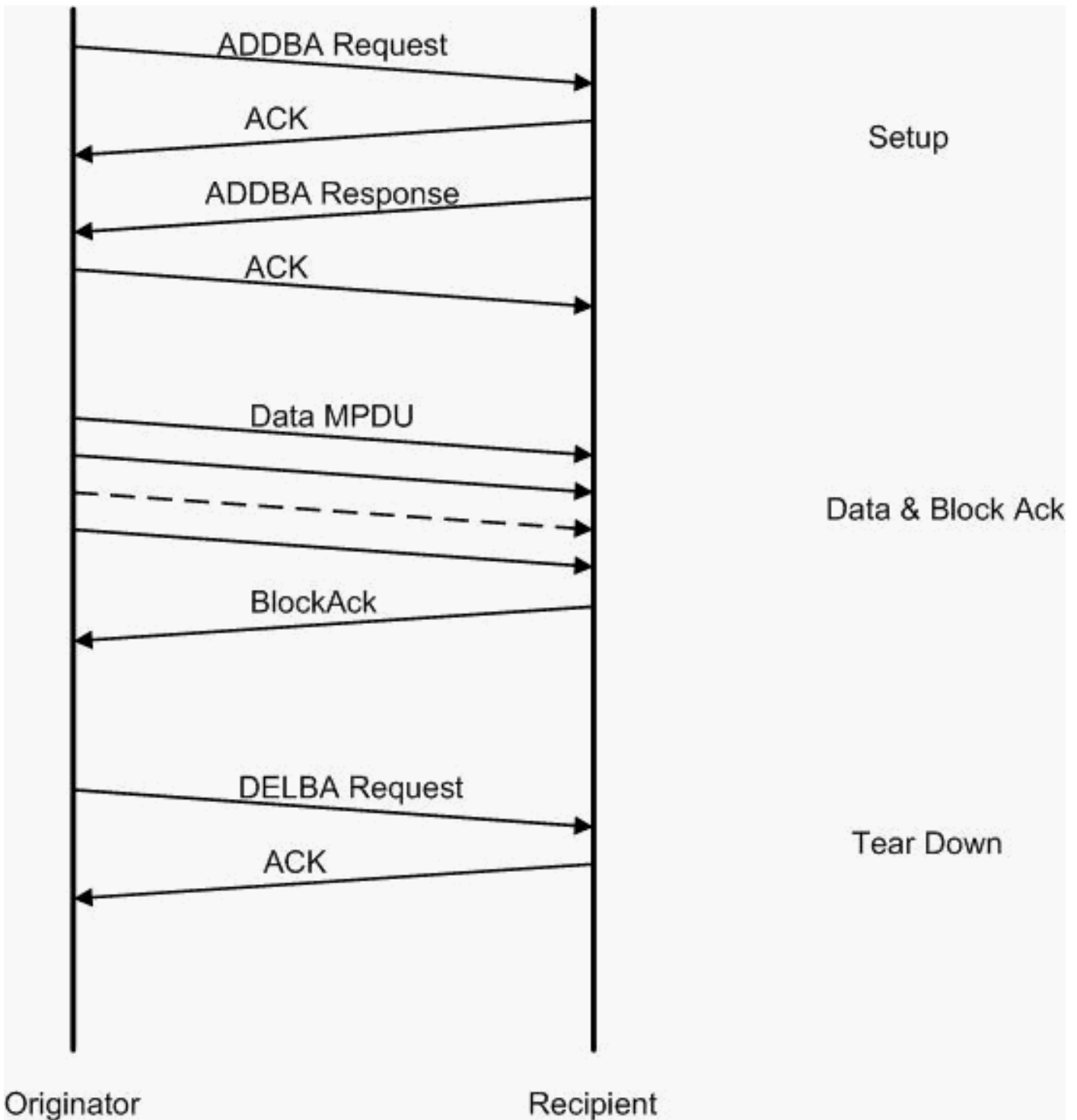


- 仅显示第一个子帧。
- 需要检查十六进制转储来查看其他子帧。

显示附加了 A-MSDU 下一个子帧

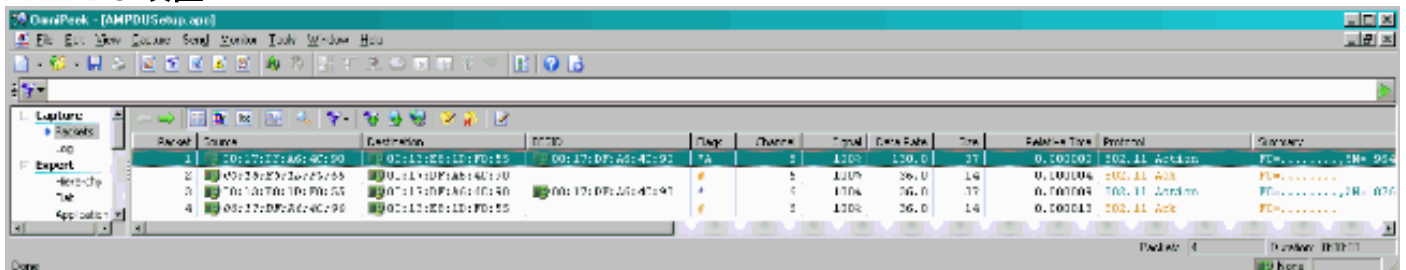


- A-MPDU 是包含多个 MPDU 的结构，PHY 将其作为单个 PSDU 进行传输。
- 指示数据包是物理层收敛过程 (PLCP) 中的数据 A-MPDU。



以下是用于分析聚合 MAC 协议数据单元的 Omnicap 捕获示例：

A-MPDU 设置



- ADDBA — 添加块确认
- ADDBA 请求 — 包含标识符、块确认策略、缓冲区大小等
- ADDBA 答复 — 可以更改策略和缓冲区大小。

A-MPDU 设置

- ADDBA 请求
- AP1250 使用超时零来指示没有超时。

OmniPeek - [AMPDUSetup.apc - Packet #1]

File Edit View Capture Send Monitor Tools Window Help

Packet: 1

802.11 MAC Header

- Version: 0
- Type: %00 Management
- Subtype: %1101 Management Action
- Frame Control Flags: %00000000
 - 0... .. Non-strict order
 - .0.. .. Non-Protected Frame
 - ..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
 -0 Not to the Distribution System
- Duration: 40 Microseconds
- Destination: 00:13:E8:1D:F0:55
- Source: 00:17:DF:A6:4C:90
- BSSID: 00:17:DF:A6:4C:90
- Seq Number: 964
- Frag Number: 0

802.11 Management - Action

- Category Code: 3 Block Ack
- Action Code: 0 ADDBA Request
- Dialog Token: 1
- BlockAck Param Set: %0001000000000010
 - --..... Buffer Size:64
 -0000.. TID: 0
 -1. BlockAck Policy: Immediate Block Ack
 -0 A-MSDU: Not Permitted
- BlockAck Timeout Value: 0 TUs
- BA Starting Sequence Control: %0000001001010000
 - ----.... Starting Seq Number: 37
 -0000 Fragment Number: 0

FCS - Frame Check Sequence

- FCS: 0x36E63FB9

0000: D0 00 28 00 00 13 E8 1D F0 55 00 17 DF A6 4C 90 00 17 DF A6 4C ..{.....U...L....L
0021: 90 40 3C 03 00 01 02 10 00 00 50 02 36 E6 3F B9 ..@<.....P.6.?.

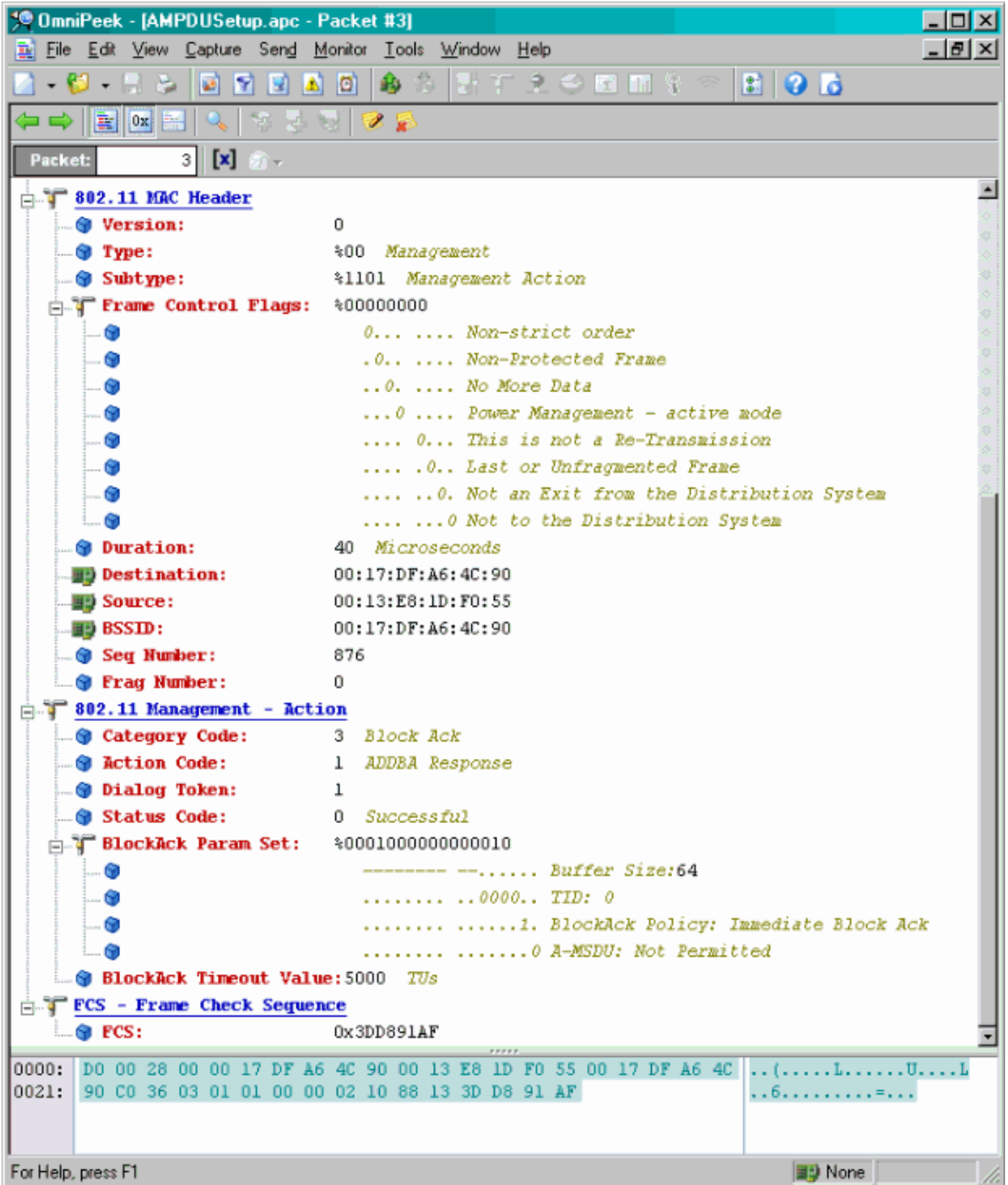
For Help, press F1

None

A-MPDU 设置

- ADDBA 答复

- 接收方需要指示已成功制定块确认协议。



A-MPDU 数据传输

- 块确认包含压缩的位图以指示已接收 MPDU。
- 有关发送块确认的信息，请参阅 IEEE 802.11n 节 9.10.7“HT 即时块确认扩展”。

Packet	Source	Destination	SSID	Rate	Channel	Signal	Data Rate	Size	Rate vs Time	Protocol
1	00:13:8E:26:19:77	00:14:5E:97:7E:A2	00:16:01:0F:03:5E	A	1	100%	130.0	78	0.000200	TCP
2	00:13:8E:26:19:77	00:14:5E:97:7E:A2	00:16:01:0F:03:5E	A	1	100%	130.0	78	0.000603	TCP
3	00:13:8E:26:19:77	00:14:5E:97:7E:A2	00:16:01:0F:03:5E	A	1	100%	130.0	78	0.000908	TCP
4	00:13:8E:26:19:77	00:14:5E:97:7E:A2	00:16:01:0F:03:5E	A	1	100%	130.0	78	0.000111	TCP
5	00:13:8E:26:19:77	00:14:5E:97:7E:A2	00:16:01:0F:03:5E	A	1	100%	130.0	78	0.000214	TCP
6	00:13:8E:26:19:77	00:14:5E:97:7E:A2	00:16:01:0F:03:5E	A	1	100%	130.0	78	0.000317	TCP
7	00:13:8E:26:19:77	00:14:5E:97:7E:A2	00:16:01:0F:03:5E	A	1	100%	130.0	78	0.000420	TCP
8	00:16:01:0F:03:5E	00:13:8E:26:19:77		A	1	100%	35.0	33	0.000523	003.11 BA

在 Beacon 中宣布的功能

HT Capability Info

Element ID: 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 @40MHz
-1... Maximal A-MSDU size: 7935 bytes
-0.. Does Not Support HT-Delayed BlockAck Operation
-00..... No Rx STBC Support
-0..... Transmitter does Not Support Tx STBC
-1..... Short GI for 40 MHz: Supported
-1..... Short GI for 20 MHz: Supported
-0.... Device is Not Able to Receive PPDU with GF Preamble
-11.. Spatial Multiplexing Enabled
-1. Both 20MHz and 40MHz Operation is Supported
-0 LDPC coding capability: Not Supported

A-MPDU Parameters: %00011011

- xxx..... Reserved
- ...110.. Minimum MPDU Start Spacing: 8 usec
-11 Maximum Rx A-MPDU Size: 64K

Supported MCS Set

One Spatial Stream: %11111111

- MCS Index 0 Supported - BPSK. Coding Rate: 1/2
- MCS Index 1 Supported - QPSK. Coding Rate: 1/2
- MCS Index 2 Supported - QPSK. Coding Rate: 3/4
- MCS Index 3 Supported - 16 QAM. Coding Rate: 1/2
- MCS Index 4 Supported - 16 QAM. Coding Rate: 3/4
- MCS Index 5 Supported - 64 QAM. Coding Rate: 2/3
- MCS Index 6 Supported - 64 QAM. Coding Rate: 3/4
- MCS Index 7 Supported - 64 QAM. Coding Rate: 5/6

Two Spatial Streams: %01111111

- MCS Index 8 Supported - BPSK. Coding Rate: 1/2
- MCS Index 9 Supported - QPSK. Coding Rate: 1/2
- MCS Index 10 Supported - QPSK. Coding Rate: 3/4
- MCS Index 11 Supported - 16 QAM. Coding Rate: 1/2
- MCS Index 12 Supported - 16 QAM. Coding Rate: 3/4
- MCS Index 13 Supported - 64 QAM. Coding Rate: 2/3
- MCS Index 14 Supported - 64 QAM. Coding Rate: 3/4
- MCS Index 15 Not Supported - 64 QAM. Coding Rate: 5/6

Rx Bitmask b16-b23: %00000000

Rx Bitmask b24-b31: %00000000

Rx Bitmask b32-b39: %00000000

Rx Bitmask b40-b47: %00000000

Rx Bitmask b48-b55: %00000000

在 Beacon 中宣布的功能：

```
● Rx Bitmask b64-b76: %00000000000000
● Reserved: %000
● Highest Supported Rate: 0 Mbps
● Reserved: %000000
● Tx Supported MCS Set: %0 Not Defined
● Tx and Rx MCS Set: %0 Equal
● Tx Maximum Number Spatial Streams Supported: %00 1 Spatial Stream
● Tx Unequal Modulation: %0 Not Supported
● Reserved: %00000000000000000000000000000000 b101-b127
HT Extended Capabilities Info: %000000000000000000
● XXXX . . . . . Reserved
● . . . . 0 . . . . . Reverse Direction Responder: Supported
● . . . . .0. . . . . +HTC Support: Supported
● . . . . .00 . . . . . MCS Feedback: STA Does Not Provide MCS Feedback
● . . . . . XXXX X . . . . . Reserved
● . . . . . .00. . . . . Transition Time: No Transition
● . . . . . . . .0 . . . . . Transmitter Supports PCO: Supported
Tx Beam Forming Capability (TxBF): %000000000000000000000000000000000
● XXX. . . . . . Reserved
● . . .0 . . . . . Channel Estimation Capability: 1 Space Time Stream
● . . . .00. . . . . CSI Max Number of Rows: 1 Row of CSI
● . . . . . .0 0 . . . . . Compressed BF Feedback Matrix: 1 TX Antenna Sounding
● . . . . . .00. . . . . Uncompressed BF Feedback Matrix: 1 TX Antenna Sounding
● . . . . . . . .0 0 . . . . . CSI Number of BF Antennas: 1 TX Antenna Sounding
● . . . . . . . .00. . . . . Minimal Grouping: STA Supports Groups of 1 (No Grouping)
● . . . . . . . . .0 0 . . . . . Compressed BF Feedback Matrix: Not Supported
● . . . . . . . . .00. . . . . Uncompressed BF Feedback Matrix: Not Supported
● . . . . . . . . . . .0 0 . . . . . TxBF CSI Feedback: Not Supported
● . . . . . . . . . . .0. . . . . Compressed BF Feedback Matrix Capable: Not Supported
● . . . . . . . . . . .0. . . . . Uncompressed BF Feedback Matrix: Not Supported
● . . . . . . . . . . .0 . . . . . Explicit CSI TxBF Capable: Not Supported
● . . . . . . . . . . .00. . . . . Calibration: Not Supported
● . . . . . . . . . . .0 . . . . . Implicit TxBF Capable: Not Supported
● . . . . . . . . . . .0 . . . . . Tx NDP Capable: Not Supported
● . . . . . . . . . . .0 . . . . . Rx NDP Capable: Not Supported
● . . . . . . . . . . .0. . . . . Tx Staggered Sounding Capable: Not Supported
● . . . . . . . . . . .0. . . . . Rx Staggered Sounding Capable: Not Supported
● . . . . . . . . . . .0 . . . . . Implicit TxBF Receiving Capable: Not Supported
Antenna Selection Capability (ASEL): %00000000
● X . . . . . Reserved
● .0 . . . . . Tx Sounding PPDUs Capable: Not Supported
● .0 . . . . . Rx ASEL Capable: Not Supported
● .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
● . . . . .0 . . . . . Antenna Selection Capable: Not Supported
```

在 Beacon 中宣布的功能：

```

① Element ID: 61 Additional HT Information
① Length: 22
① Primary Channel: 6
① Srvc Int Granularity: 4000 5ms
① PSMP STAs Only: 40 Association Requests are Accepted Regardless of PSMP Capability
① RIFS Mode: 41 Use of RIFS Permitted
① STA Channel Width: 41 Use Any Channel Width Enabled Under Supported Channel Width Set
① 2nd Channel Offset: 401 Above the Primary Channel
① HT Info Element 2: 40000000000000100
①
①          xxxxxxxx xxx..... Reserved
①          ..... 0.... OBSS Non-HT STAs: Use of Protection for Non-HT STAs Not Needed
①          ..... 0.... Transmit Burst Limit: No Limit
①          ..... 1.. Non-Greenfield STAs: One or more HT STAs are Not Greenfield Capable
①          ..... 00 Operating Mode: Pure HT (No Protection) - All STAs in the BSS are 20/40 MHz HT
① HT Info Element 3: 40000000000000000
①
①          xxxx..... Reserved
①          ..... 0.... PCO Phase: Switch To/Continue Use 2GHz Phase
①          ..... 0.. PCO Active: Not Active in the BSS
①          ..... 0. L-SIG TNDP Protection: Not Full Support
①          ..... 0 Secondary Beacon: Primary Beacon
①          ..... 0..... Dual CTS Protection: Not Required
①          ..... 0..... Dual Beacon: No Secondary Beacon Transmitted
①          ..... .xxxxxx Reserved
① Basic MCS Set
① One Spatial Stream: 400000000
①
① MCS Index 0 Not Supported - BPSK, Coding Rate: 1/2
① MCS Index 1 Not Supported - QPSK, Coding Rate: 1/2
① MCS Index 2 Not Supported - QPSK, Coding Rate: 3/4
① MCS Index 3 Not Supported - 16 QAM, Coding Rate: 1/2
① MCS Index 4 Not Supported - 16 QAM, Coding Rate: 3/4
① MCS Index 5 Not Supported - 64 QAM, Coding Rate: 2/3
① MCS Index 6 Not Supported - 64 QAM, Coding Rate: 3/4
① MCS Index 7 Not Supported - 64 QAM, Coding Rate: 5/6
① Two Spatial Streams: 400000000
①
① MCS Index 8 Not Supported - BPSK, Coding Rate: 1/2
① MCS Index 9 Not Supported - QPSK, Coding Rate: 1/2
① MCS Index 10 Not Supported - QPSK, Coding Rate: 3/4
① MCS Index 11 Not Supported - 16 QAM, Coding Rate: 1/2
① MCS Index 12 Not Supported - 16 QAM, Coding Rate: 3/4
① MCS Index 13 Not Supported - 64 QAM, Coding Rate: 2/3
① MCS Index 14 Not Supported - 64 QAM, Coding Rate: 3/4
① MCS Index 15 Not Supported - 64 QAM, Coding Rate: 5/6
① Rx Bitmask b16-b23: 400000000
① Rx Bitmask b24-b31: 400000000
① Rx Bitmask b32-b39: 400000000
① Rx Bitmask b40-b47: 400000000

```

与 A-MPDU 的块确认设置的添加类似的关联：

194	00:13:E8:1D:F0:55	00:17:DF:A6:4C:90	802.11 Ack		#	100%	6.0	14
195	00:17:DF:A6:4C:90	Ethernet Broadcast	802.11 Beacon	00:17:DF:A6:4C:90	*	100%	6.0	204
196	00:13:E8:1D:F0:55	Ethernet Broadcast	802.11 Probe Req	Ethernet Broadcast	*	100%	1.0	81
197	00:17:DF:A6:4C:90	00:13:E8:1D:F0:55	802.11 Probe Rsp	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	00:13: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	00:17:DF:A6:4C:90	*+	100%	6.0	204
202	00:13:E8:36:19:77	00:17:DF:A6:4C:90	802.11 Ack		#	100%	6.0	14
203	00:13: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	00:17:DF:A6:4C:90	00:13:E8:36:19:77	802.11 Probe Rsp	00:17:DF:A6:4C:90	*+	100%	6.0	204
206	00:13:E8:36:19:77	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	00:13:CE:89:DC:A2	Ethernet Broadcast	802.11 Probe Req	Ethernet Broadcast	*	100%	1.0	87
210	00:13: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 Req	Ethernet Broadcast	*	100%	1.0	55
215	00:13:E8:1D:F0:55	00:17:DF:A6:4C:90	802.11 Auth	00:17:DF:A6:4C:90	*	100%	36.0	34
216	00:17:DF:A6:4C:90	00:13:E8:1D:F0:55	802.11 Ack		#	100%	36.0	14
217	00:17:DF:A6:4C:90	00:13:E8:1D:F0:55	802.11 Auth	00:17:DF:A6:4C:90	*	100%	36.0	34
218	00:13:E8:1D:F0:55	00:17:DF:A6:4C:90	802.11 Ack		#	100%	36.0	14
219	00:13:E8:1D:F0:55	00:17:DF:A6:4C:90	802.11 Assoc Req	00:17:DF:A6:4C:90	*	100%	36.0	134
220	00:17:DF:A6:4C:90	00:13:E8:1D:F0:55	802.11 Ack		#	100%	36.0	14
221	00:17:DF:A6:4C:90	00:13:E8:1D:F0:55	802.11 Assoc Rsp	00:17:DF:A6:4C:90	*	100%	130.0	180
222	00:13:E8:1D:F0:55	00:17:DF:A6:4C:90	802.11 Ack		#	100%	36.0	14
223	192.168.170.89	224.0.0.1	IGMP	00:17: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	224.0.0.1	IGMP	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		#	100%	36.0	14
227	00:17:DF:A6:4C:90	00:13:E8:1D:F0:55	WLCPP	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	00:17:DF:A6:4C:90	00:13:E8:1D:F0:55	802.11 Action	00:17:DF:A6:4C:90	*	100%	130.0	37
230	00:13:E8:1D:F0:55	00:17:DF:A6:4C:90	802.11 Ack		#	100%	36.0	14
231	00:13:E8:1D: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:A6:4C:90	00:13:E8:1D:F0:55	802.11 Ack		#	100%	36.0	14

Verifying A-MPDU is enabled on the controller

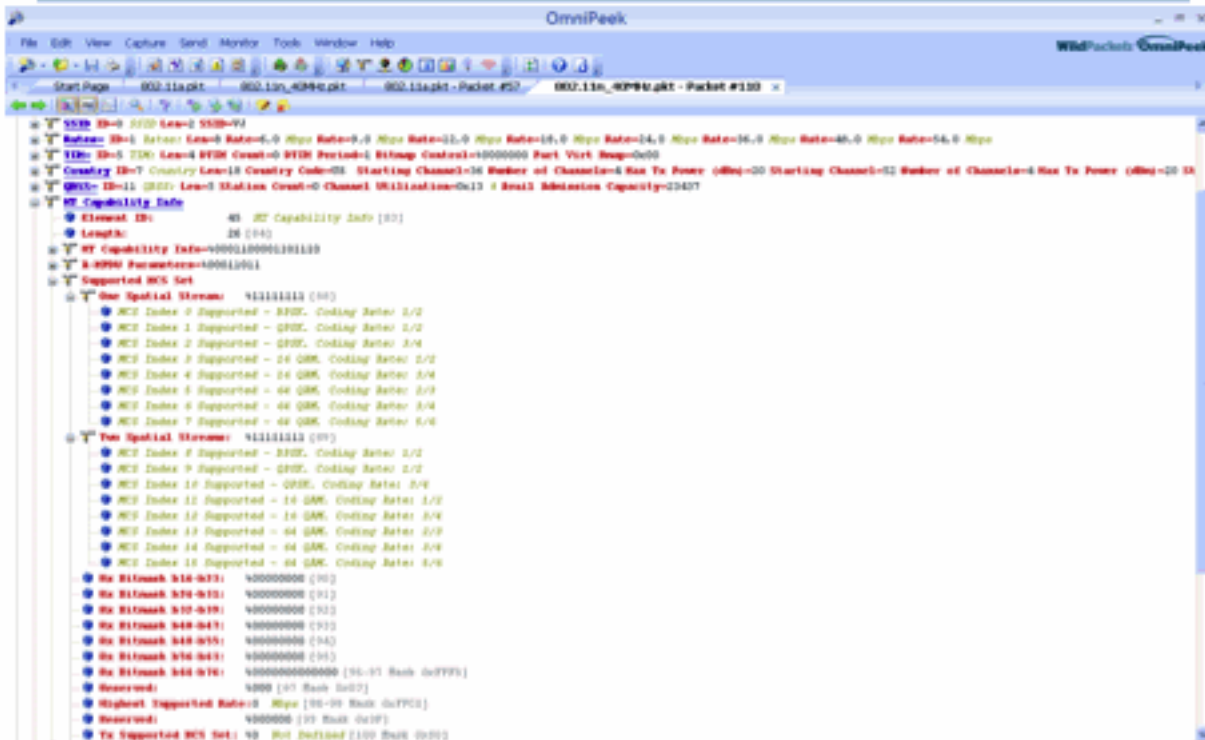
The image shows a Wireshark packet capture of an 802.11 Beacon frame. The 'HT Capability Info' section is expanded, showing the following details:

- Element ID: 45 HT Capability Info [63]
- Length: 26 [64]
- HT Capability Info: 0000100001101110 [65-96]
 - 0..... 1-STS TXOP Protection Support: Not Supported
 - ..0..... AP allows use of 4096u Transmissions In Neighboring BSS
 - ...0..... Device/BSS does Not Support use of TXOP
 - ...1..... BSS does Allow use of 802.11e Rates (4096u)
 -1.... Maximal A-MPDU size: 7935 bytes
 -0..... Does Not Support HT-Delayed BlockAck Operation
 -00..... No Rx STBC Support
 -0..... Transmitter does Not Support Tx STBC
 -1..... Short GI for 40 Mbit/s Supported
 -1..... Short GI for 20 Mbit/s Supported
 -0..... Device is Not Able to Receive TXOPs with GI Freeable
 -11... Spatial Multiplexing Enabled
 -1... Both 20MHz and 40MHz Operation is Supported
 -0..... LDPC coding capability: Not Supported
- A-MPDU Parameters: 00001011 [97]
 - ...0.... Reserved [87 Sub 0x0]
 - ...110.. Minimum MPDU Start Spacing: 2 used [87 Sub 0x1]
 -11 Maximum Rx A-MPDU Size: 64K [87 Sub 0x2]
- Supported MCS Set

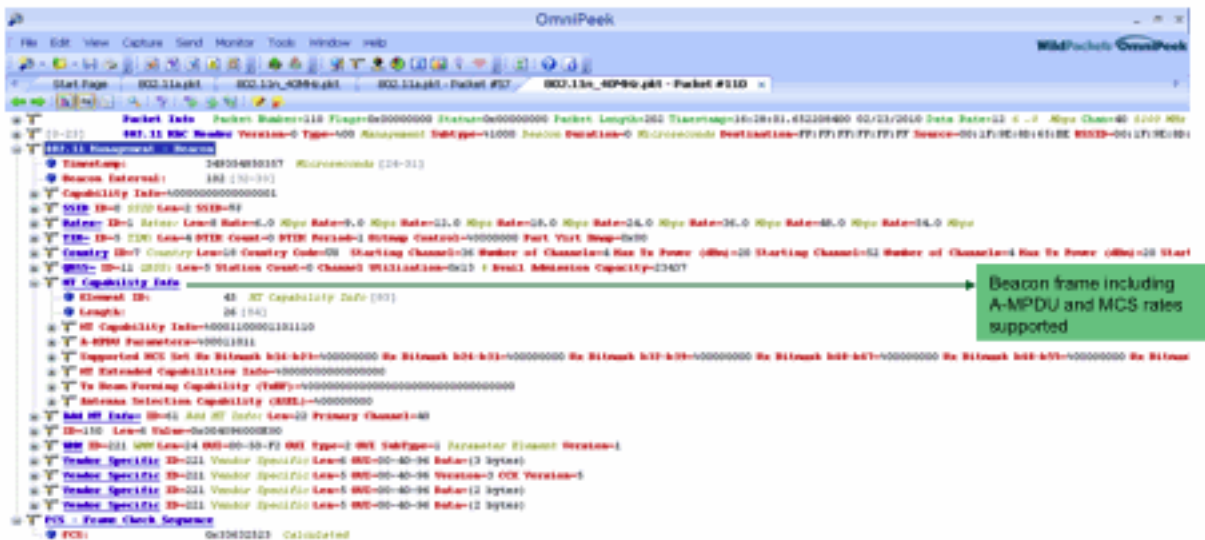
An arrow points from the 'A-MPDU Parameters' section to the text 'A-MPDU enabled and seen in the beacon'.

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

Supported MCS rates



802.11a with N rates Enabled



802.11A Beacon frame

```
Packet Info Packet Number=57 Flags=0x00000000 Status=0x00000000 Packet Length=150 Timestamp=17:29:12.36369900 01/21/2010 Data Rate=11.4 Mbit/sec Channel=36 SSID=
[0-23] 802.11 Beacon Header Version=0 Type=00 Management SubType=11000 Beacon Duration=0 Microseconds Destination=FF:FF:FF:FF:FF:FF Source=00:14:97:8A:84:8E BSSID=00:14:97:8A:
802.11 Management - Beacon
  TimeStamp: 37648868 Microseconds [10-11]
  Beacon Interval: 200 [10-11]
  Capability Info=0000000000000000
  Rates: ID=1 Rates: Len=0 Rate=0.0 Mbit/sec Rate=0.0 Mbit/sec Rate=12.0 Mbit/sec Rate=18.0 Mbit/sec Rate=24.0 Mbit/sec Rate=36.0 Mbit/sec Rate=48.0 Mbit/sec Rate=54.0 Mbit/sec
  TIM: ID=5 TIM: Len=4 TIM Count=0 TIM Period=1 Bitmap Control=00000000 Part Virt. Sleep=0x00
  Country ID=7 Country Len=18 Country Code=00 Starting Channel=36 Number of Channels=4 Max Tx Power (dBm)=20 Starting Channel=36 Number of Channels=4 Max Tx Power (dBm)=20 Start
  BSS: ID=11 BSS: Len=5 Station Count=0 Channel Utilization=0x10 / 2048 Admission Capacity=2047
  ID=150 Len=6 Value=0x00409600F00
  ID=221 MW Len=24 MIC=00-50-F2 MIC Type=2 MIC SubType=1 Parameter Element Version=1
  Vendor Specific ID=221 Vendor Specific Len=4 MIC=00-40-94 Data=(3 bytes)
  Vendor Specific ID=221 Vendor Specific Len=4 MIC=00-40-94 Version=0 CCX Version=1
  Vendor Specific ID=221 Vendor Specific Len=4 MIC=00-40-94 Data=(2 bytes)
  Vendor Specific ID=221 Vendor Specific Len=4 MIC=00-40-94 Data=(2 bytes)
  FCS - Frame Check Sequence
    FCS: 0x51420932 Calculated
```

相关信息

- [技术支持和文档 - Cisco Systems](#)