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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

完成这些步骤 :

1. 验证是否在控制器上启用了 802.11n 支持。(WiSM-slot3-2) >show 802.11a802.11a  

```
Network.....
Enabled11nSupport..... Enabled802.11a Low
Band..... Enabled802.11a Mid Band.....
Enabled802.11a High Band..... Enabled802.11a Operational Rates802.11a
6M Rate..... Mandatory802.11a 9M
Rate..... Supported802.11a 12M Rate.....
Disabled802.11a 18M Rate..... Supported802.11a 24M
Rate..... Mandatory802.11a 36M Rate.....
Supported802.11a 48M Rate..... Supported802.11a 54M
Rate..... Supported802.11n MCS Settings:MCS
0..... SupportedMCS
1..... SupportedMCS
2..... SupportedMCS
3..... SupportedMCS
4..... SupportedMCS
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 channelAutomatic
Channel AssignmentChannel Assignment Mode..... AUTOChannel Update
Interval..... 600 seconds [startup]Anchor time (Hour of the
day)..... 0Channel Update Contribution..... SNI.Channel
Assignment Leader..... 00:1d:45:f0:d2:c0Last
Run..... 371 seconds agoDCA Sensitivity
Level..... STARTUP (5 dB)DCA 802.11n Channel
Width..... 40 MHzChannel Energy
LevelsMinimum.....
unknownAverage.....
unknownMaximum..... unknownChannel Dwell
TimesMinimum.....
unknownAverage.....
unknownMaximum..... unknown802.11a 5 GHz Auto-RF Channel
ListAllowed Channel
List..... 36,40,44,48,52,56,60,64,149,153,157,161Unused 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-slot3-2) >show advanced 802.11a
channelAutomatic Channel AssignmentChannel Assignment Mode.....
AUTOChannel Update Interval..... 600 seconds [startup]Anchor time (Hour
of the day)..... 0Channel Update Contribution..... SNI.Channel
Assignment Leader..... 00:1d:45:f0:d2:c0Last
Run..... 371 seconds agoDCA Sensitivity
Level..... STARTUP (5 dB)DCA 802.11n Channel
Width..... 40 MHzChannel Energy
LevelsMinimum.....
unknownAverage.....
unknownMaximum..... unknownChannel Dwell
TimesMinimum.....
unknownAverage.....
```

```

unknownMaximum..... unknown802.11a 5 GHz Auto-RF Channel
ListAllowed Channel
List.....36,40,44,48,52,56,60,64,149,153,157,161Unused Channel
List.....100,104,108,112,116,132,136,

```

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 802.11a802.11a Network.....
Enabled11nSupport..... Enabled802.11a Low
Band..... Enabled802.11a Mid Band.....
Enabled802.11a High Band..... Enabled802.11a Operational Rates802.11a
6M Rate..... Mandatory802.11a 9M
Rate..... Supported802.11a 12M Rate.....
Disabled802.11a 18M Rate..... Supported802.11a 24M
Rate..... Mandatory802.11a 36M Rate.....
Supported802.11a 48M Rate..... Supported802.11a 54M
Rate..... Supported802.11n MCS Settings:MCS
0..... SupportedMCS
1..... SupportedMCS
2..... SupportedMCS
3..... SupportedMCS
4..... SupportedMCS
5..... SupportedMCS
6..... SupportedMCS
7..... SupportedMCS
8..... SupportedMCS
9..... SupportedMCS
10..... SupportedMCS
11..... SupportedMCS
12..... SupportedMCS
13..... SupportedMCS
14..... SupportedMCS
15..... Supported802.11n Status:A-MPDU Tx:Priority
0..... EnabledPriority 1.....
DisabledPriority 2..... DisabledPriority
3..... DisabledPriority 4.....
DisabledPriority 5..... DisabledPriority
6..... DisabledPriority 7.....
DisabledBeacon Interval..... 100CF Pollable
mandatory..... DisabledCF Poll Request
mandatory..... Disabled--More-- or (q)uitCFP
Period..... 4CFP Maximum
Duration..... 60Default Channel.....
36Default Tx Power Level..... 1DTPC
Status..... EnabledFragmentation
Threshold..... 2346Pico-Cell Status.....
DisabledPico-Cell-V2 Status..... DisabledTI
Threshold..... -50Traffic Stream Metrics
Status..... DisabledExpedited BW Request Status.....
DisabledWorld Mode..... EnabledEDCA profile
type..... default-wmmVoice MAC optimization
status..... DisabledCall Admission Control (CAC) configurationVoice AC -
Admission control (ACM)..... EnabledVoice max RF bandwidth.....
75Voice reserved roaming bandwidth..... 6Voice load-based CAC
mode..... EnabledVoice tspec inactivity timeout.....
DisabledVideo AC - Admission control (ACM)..... DisabledVoice Stream-
Size..... 84000Voice Max-Streams.....
2Video max RF bandwidth..... InfiniteVideo reserved roaming
bandwidth.....

```

o 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 enable**  
**config 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 1WLAN

```

Identifier..... 1Profile
Name..... wlab5WISMip22Network Name
(SSID).....
wlab5WISMip22Status..... EnabledMAC
Filtering..... DisabledBroadcast
SSID..... EnabledAAA Policy
Override..... DisabledNetwork Admission ControlNAC-
State..... DisabledQuarantine
VLAN..... 0Number of Active Clients.....
0Exclusionlist Timeout..... 60 secondsSession
Timeout..... 1800 secondsCHD per
WLAN..... EnabledWebauth DHCP
exclusion.....
DisabledInterface..... managementWLAN
ACL..... unconfiguredDHCP
Server..... DefaultDHCP Address Assignment
Required..... DisabledQuality of Service..... Silver
(best effort)WMM..... AllowedCCX - AironetIe
Support..... EnabledCCX - Gratuitous ProbeResponse (GPR).....
DisabledCCX - Diagnostics Channel Capability..... DisabledDot11-Phone Mode
(7920)..... DisabledWired Protocol.....
NoneIPv6 Support..... DisabledPeer-to-Peer Blocking
Action..... DisabledRadio Policy.....
AllDTIM period for 802.11a radio..... 1DTIM period for 802.11b
radio..... 1Radius ServersAuthentication.....
Global ServersAccounting..... DisabledLocal EAP
Authentication..... DisabledSecurity802.11
Authentication:..... Open SystemStatic WEP
Keys..... Disabled802.1X.....
DisabledWi-Fi Protected Access (WPA/WPA2)..... EnabledWPA (SSN
IE)..... DisabledWPA2 (RSN IE).....
EnabledTKIP Cipher..... DisabledAES
Cipher..... EnabledAuth Key
Management802.1x.....
EnabledPSK.....
DisabledCCKM.....
DisabledFT(802.11r)..... DisabledFT-
PSK(802.11r)..... DisabledFT Reassociation
Timeout..... 20FT Over-The-Air mode.....
EnabledFT Over-The-Ds mode..... EnabledCKIP
..... DisabledIP
Security..... DisabledIP Security
Passthru..... DisabledWeb Based Authentication.....
DisabledWeb-Passthrough..... DisabledConditional Web
Redirect..... DisabledSplash-Page Web Redirect.....
DisabledAuto Anchor..... DisabledH-REAP Local
Switching..... EnabledH-REAP Learn IP Address.....
EnabledInfrastructure MFP protection..... Enabled (GlobalInfrastructureMFP
Disabled)Client MFP..... OptionalTkip MIC Countermeasure
Hold-down Timer..... 60Call Snooping..... DisabledBand
Select..... EnabledLoad
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](http://www.wi-fi.org/certified_products.php)

## 如何提高性能：

1. 信道利用？网络分析器在传送和接收帧的中花费的时间的百分比的报告信道利用。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 无线电容量分配在所有相关工作站之间。
3. 信元大小？推荐收缩信元大小有客户端和离AP较近尽可能。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](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：

```
(WiSM-slot2-2) >show wlan 1WLAN Identifier..... 1Profile
Name..... wlab5WISMip22Network Name
(SSID).....
wlab5WISMip22Status..... EnabledMAC
Filtering..... DisabledBroadcast
SSID..... EnabledAAA Policy Override.....
DisabledNetwork Admission ControlNAC-State.....
DisabledQuarantine VLAN..... 0Number of Active
Clients..... 0Exclusionlist Timeout..... 60
secondsSession Timeout..... 1800 secondsCHD per
WLAN..... EnabledWebauth DHCP
exclusion..... DisabledInterface.....
managementWLAN ACL..... unconfiguredDHCP
Server..... DefaultDHCP Address Assignment
Required..... DisabledQuality of Service..... Silver (best
effort)WMM..... AllowedCCX - AironetIe
Support..... EnabledCCX - Gratuitous ProbeResponse (GPR).....
DisabledCCX - Diagnostics Channel Capability..... DisabledDot11-Phone Mode
(7920)..... DisabledWired Protocol.....
NoneIPv6 Support..... DisabledPeer-to-Peer Blocking
Action..... DisabledRadio Policy..... AllDTIM
period for 802.11a radio..... 1DTIM period for 802.11b radio.....
1Radius ServersAuthentication..... Global
ServersAccounting..... DisabledLocal EAP
Authentication..... DisabledSecurity802.11
Authentication:..... Open SystemStatic WEP
Keys..... Disabled802.1X.....
```

```

DisabledWi-Fi Protected Access (WPA/WPA2)..... EnabledWPA (SSN
IE)..... DisabledWPA2 (RSN IE).....
EnabledTKIP Cipher..... DisabledAES Cipher.....
EnabledAuth Key Management802.1x.....
EnabledPSK..... DisabledCCKM.....
DisabledFT(802.11r)..... DisabledFT-
PSK(802.11r)..... DisabledFT Reassociation Timeout.....
20FT Over-The-Air mode..... EnabledFT Over-The-Ds
mode..... EnabledCKIP .....
DisabledIP Security..... DisabledIP Security
Passthru..... DisabledWeb Based Authentication.....
DisabledWeb-Passthrough..... DisabledConditional Web
Redirect..... DisabledSplash-Page Web Redirect.....
DisabledAuto Anchor..... DisabledH-REAP Local
Switching..... EnabledH-REAP Learn IP Address.....
EnabledInfrastructure MFP protection..... Enabled (GlobalInfrastructureMFP
Disabled)Client MFP..... OptionalTkip MIC Countermeasure Hold-
down Timer..... 60Call Snooping..... DisabledBand
Select..... EnabledLoad
Balancing..... Enabled

```

在客户端上运行以下命令：

```

(WiSM-slot2-2) >show wlan 1WLAN Identifier..... 1Profile
Name..... wlab5WISMip22Network Name
(SSID).....
wlab5WISMip22Status..... EnabledMAC
Filtering..... DisabledBroadcast
SSID..... EnabledAAA Policy Override.....
DisabledNetwork Admission ControlNAC-State.....
DisabledQuarantine VLAN..... 0Number of Active
Clients..... 0Exclusionlist Timeout..... 60
secondsSession Timeout..... 1800 secondsCHD per
WLAN..... EnabledWebauth DHCP
exclusion..... DisabledInterface.....
managementWLAN ACL..... unconfiguredDHCP
Server..... DefaultDHCP Address Assignment
Required..... DisabledQuality of Service..... Silver (best
effort)WMM..... AllowedCCX - AironetIe
Support..... EnabledCCX - Gratuitous ProbeResponse (GPR).....
DisabledCCX - Diagnostics Channel Capability..... DisabledDot11-Phone Mode
(7920)..... DisabledWired Protocol.....
NoneIPv6 Support..... DisabledPeer-to-Peer Blocking
Action..... DisabledRadio Policy..... AllDTIM
period for 802.11a radio..... 1DTIM period for 802.11b radio.....
1Radius ServersAuthentication..... Global
ServersAccounting..... DisabledLocal EAP
Authentication..... DisabledSecurity802.11
Authentication:..... Open SystemStatic WEP
Keys..... Disabled802.1X.....
DisabledWi-Fi Protected Access (WPA/WPA2)..... EnabledWPA (SSN
IE)..... DisabledWPA2 (RSN IE).....
EnabledTKIP Cipher..... DisabledAES Cipher.....
EnabledAuth Key Management802.1x.....
EnabledPSK..... DisabledCCKM.....
DisabledFT(802.11r)..... DisabledFT-
PSK(802.11r)..... DisabledFT Reassociation Timeout.....
20FT Over-The-Air mode..... EnabledFT Over-The-Ds
mode..... EnabledCKIP .....
DisabledIP Security..... DisabledIP Security
Passthru..... DisabledWeb Based Authentication.....
DisabledWeb-Passthrough..... DisabledConditional Web
Redirect..... DisabledSplash-Page Web Redirect.....
DisabledAuto Anchor..... DisabledH-REAP Local

```

```
Switching..... EnabledH-REAP Learn IP Address.....
EnabledInfrastructure MFP protection..... Enabled (GlobalInfrastructureMFP
Disabled)Client MFP..... OptionalTkip MIC Countermeasure Hold-
down Timer..... 60Call Snooping..... DisabledBand
Select..... EnabledLoad
Balancing..... Enabled
```

```
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：

```
(WiSM-slot2-2) >show wlan 1WLAN Identifier..... 1Profile
Name..... wlab5WISMip22Network Name
(SSID).....
wlab5WISMip22Status..... EnabledMAC
Filtering..... DisabledBroadcast
SSID..... EnabledAAA Policy Override.....
DisabledNetwork Admission ControlNAC-State.....
DisabledQuarantine VLAN..... 0Number of Active
Clients..... 0Exclusionlist Timeout..... 60
secondsSession Timeout..... 1800 secondsCHD per
WLAN..... EnabledWebauth DHCP
exclusion..... DisabledInterface.....
managementWLAN ACL..... unconfiguredDHCP
```

```

Server..... DefaultDHCP Address Assignment
Required..... DisabledQuality of Service..... Silver (best
effort)WMM..... AllowedCCX - AironetIe
Support..... EnabledCCX - Gratuitous ProbeResponse (GPR).....
DisabledCCX - Diagnostics Channel Capability..... DisabledDot11-Phone Mode
(7920)..... DisabledWired Protocol.....
NoneIPv6 Support..... DisabledPeer-to-Peer Blocking
Action..... DisabledRadio Policy..... AllDTIM
period for 802.11a radio..... 1DTIM period for 802.11b radio.....
1Radius ServersAuthentication..... Global
ServersAccounting..... DisabledLocal EAP
Authentication..... DisabledSecurity802.11
Authentication:..... Open SystemStatic WEP
Keys..... Disabled802.1X.....
DisabledWi-Fi Protected Access (WPA/WPA2)..... EnabledWPA (SSN
IE)..... DisabledWPA2 (RSN IE).....
EnabledTKIP Cipher..... DisabledAES Cipher.....
EnabledAuth Key Management802.1x.....
EnabledPSK..... DisabledCCKM.....
DisabledFT(802.11r)..... DisabledFT-
PSK(802.11r)..... DisabledFT Reassociation Timeout.....
20FT Over-The-Air mode..... EnabledFT Over-The-Ds
mode..... EnabledCKIP .....
DisabledIP Security..... DisabledIP Security
Passthru..... DisabledWeb Based Authentication.....
DisabledWeb-Passthrough..... DisabledConditional Web
Redirect..... DisabledSplash-Page Web Redirect.....
DisabledAuto Anchor..... DisabledH-REAP Local
Switching..... EnabledH-REAP Learn IP Address.....
EnabledInfrastructure MFP protection..... Enabled (GlobalInfrastructureMFP
Disabled)Client MFP..... OptionalTkip MIC Countermeasure Hold-
down Timer..... 60Call Snooping..... DisabledBand
Select..... EnabledLoad
Balancing..... Enabled

```

在客户端上运行以下命令：

```

(WiSM-slot2-2) >show wlan 1WLAN Identifier..... 1Profile
Name..... wlab5WISMip22Network Name
(SSID).....
wlab5WISMip22Status..... EnabledMAC
Filtering..... DisabledBroadcast
SSID..... EnabledAAA Policy Override.....
DisabledNetwork Admission ControlNAC-State.....
DisabledQuarantine VLAN..... 0Number of Active
Clients..... 0Exclusionlist Timeout..... 60
secondsSession Timeout..... 1800 secondsCHD per
WLAN..... EnabledWebauth DHCP
exclusion..... DisabledInterface.....
managementWLAN ACL..... unconfiguredDHCP
Server..... DefaultDHCP Address Assignment
Required..... DisabledQuality of Service..... Silver (best
effort)WMM..... AllowedCCX - AironetIe
Support..... EnabledCCX - Gratuitous ProbeResponse (GPR).....
DisabledCCX - Diagnostics Channel Capability..... DisabledDot11-Phone Mode
(7920)..... DisabledWired Protocol.....
NoneIPv6 Support..... DisabledPeer-to-Peer Blocking
Action..... DisabledRadio Policy..... AllDTIM
period for 802.11a radio..... 1DTIM period for 802.11b radio.....
1Radius ServersAuthentication..... Global
ServersAccounting..... DisabledLocal EAP
Authentication..... DisabledSecurity802.11
Authentication:..... Open SystemStatic WEP
Keys..... Disabled802.1X.....

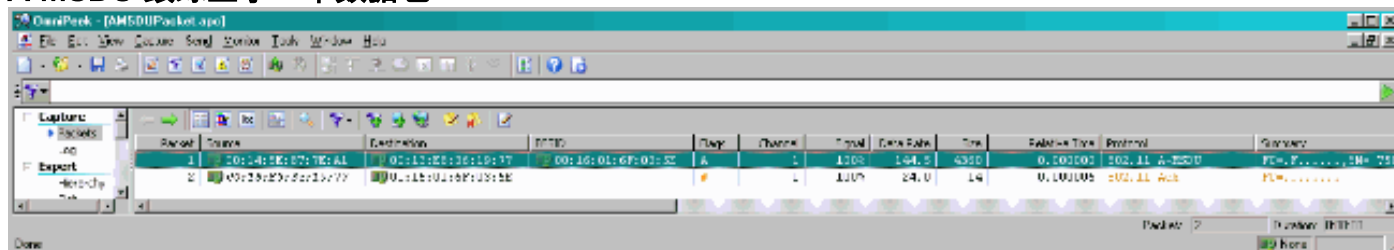
```



DisabledWi-Fi Protected Access (WPA/WPA2)..... EnabledWPA (SSN IE)..... DisabledWPA2 (RSN IE)..... EnabledTKIP Cipher..... DisabledAES Cipher..... EnabledAuth Key Management802.1x..... EnabledPSK..... DisabledCCKM..... DisabledFT(802.11r)..... DisabledFT-PSK(802.11r)..... DisabledFT Reassociation Timeout..... 20FT Over-The-Air mode..... EnabledFT Over-The-Ds mode..... EnabledCKIP ..... DisabledIP Security..... DisabledIP Security Passthru..... DisabledWeb Based Authentication..... DisabledWeb-Passthrough..... DisabledConditional Web Redirect..... DisabledSplash-Page Web Redirect..... DisabledAuto Anchor..... DisabledH-REAP Local Switching..... EnabledH-REAP Learn IP Address..... EnabledInfrastructure MFP protection..... Enabled (GlobalInfrastructureMFP Disabled)Client MFP..... OptionalTkip MIC Countermeasure Hold-down Timer..... 60Call Snooping..... DisabledBand Select..... EnabledLoad Balancing..... Enabled

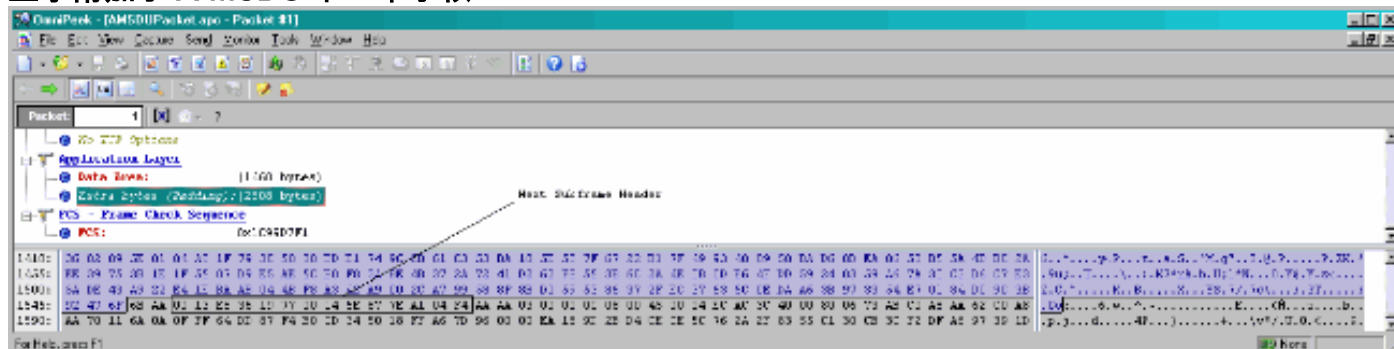
以下是用于分析聚合 MAC 服务数据单元的 Omnippeek 捕获示例：

### A-MSDU 跟踪显示一个数据包

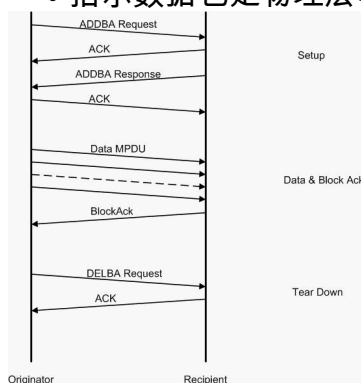


- 仅显示第一个子帧。
- 需要检查十六进制转储来查看其他子帧。

### 显示附加了 A-MSDU 下一个子帧

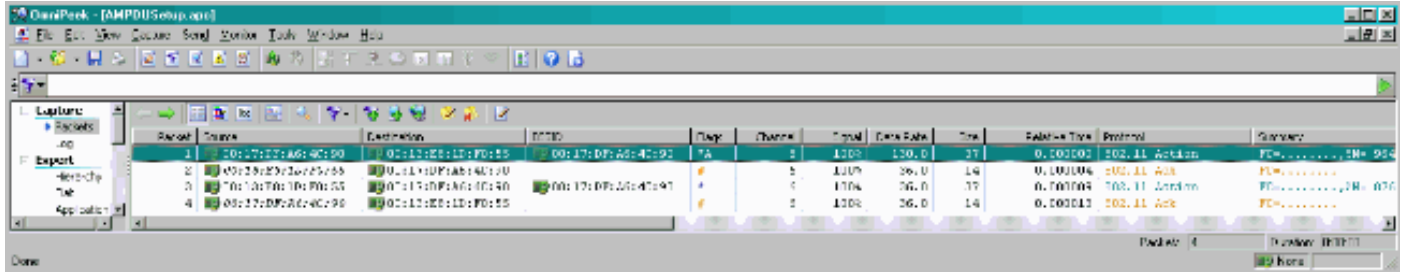


- A-MPDU 是包含多个 MPDU 的结构，PHY 将其作为单个 PSDU 进行传输。
- 指示数据包是物理层收敛过程 (PLCP) 中的数据 A-MPDU。



以下是用于分析聚合 MAC 协议数据单元的 Omnipeek 捕获示例：

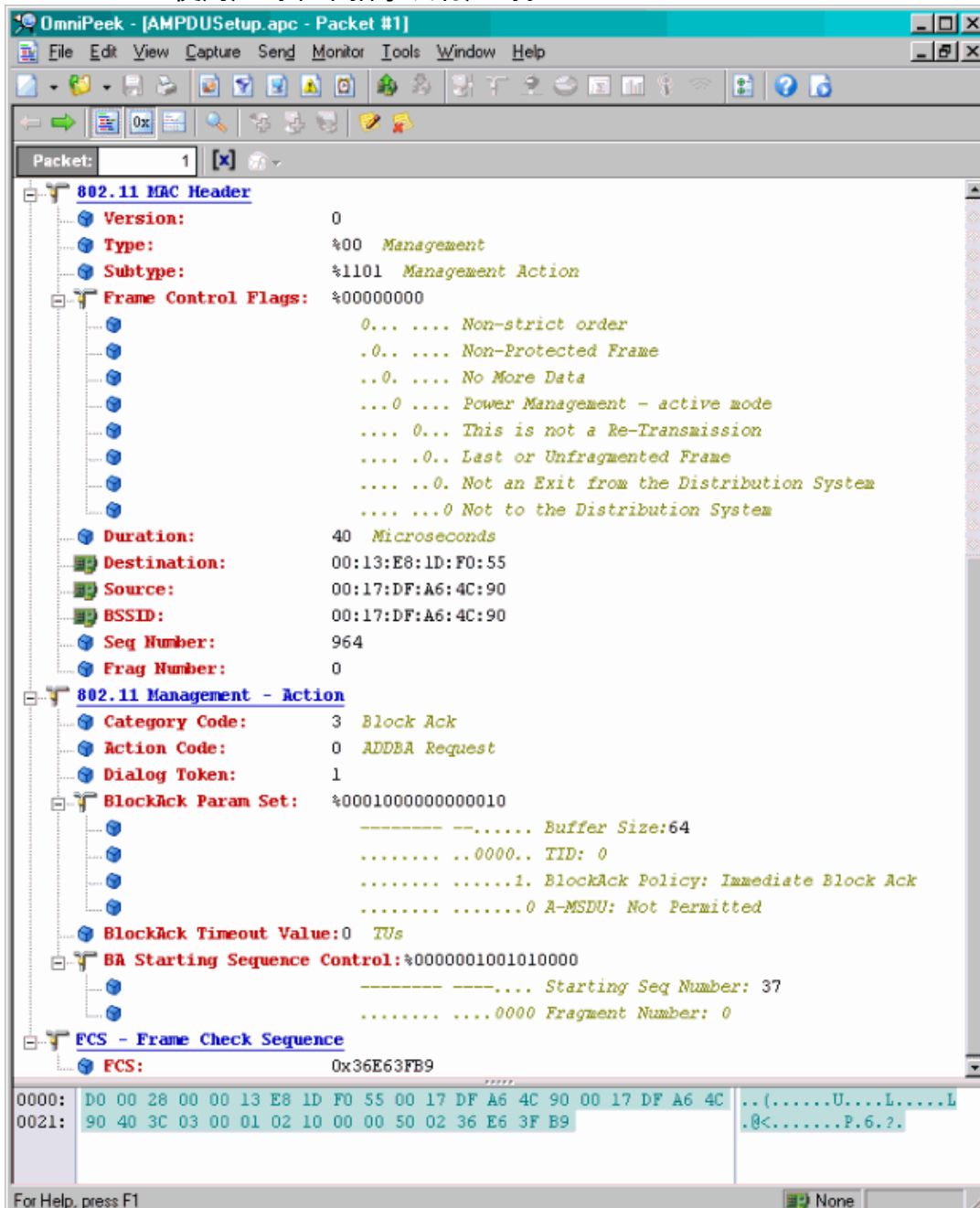
## A-MPDU 设置



- ADDBA ? 添加块确认
- ADDBA请求 ? 包含标识符、块Ack策略、缓冲区大小等等。
- ADDBA答复 ? 能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。



## A-MPDU 设置

- ADDBA 答复
- 接收方需要指示已成功制定块确认协议。

The screenshot shows the OmniPeek network analyzer interface. The title bar reads "OmniPeek - [AMPDUSetup.apc - Packet #3]". The menu bar includes File, Edit, View, Capture, Send, Monitor, Tools, Window, and Help. The toolbar contains various icons for navigation and analysis. The main window displays the details of Packet 3, which is an 802.11 Management Action.

**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: 00:17:DF:A6:4C:90
- Source: 00:13:E8:1D:F0:55
- BSSID: 00:17:DF:A6:4C:90
- Seq Number: 876
- Frag Number: 0

**802.11 Management - Action**

- Category Code: 3 Block Ack
- Action Code: 1 ADDBA Response
- Dialog Token: 1
- Status Code: 0 Successful
- BlockAck Param Set: %0001000000000010
  - ..0000.. TID: 0
  - ..... 1. BlockAck Policy: Immediate Block Ack
  - ..... 0 A-MSDU: Not Permitted
- BlockAck Timeout Value: 5000 TUs

**FCS - Frame Check Sequence**

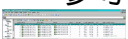
- FCS: 0x3DD891AF

At the bottom, a hex dump shows the raw packet data:

```
0000: D0 00 28 00 00 17 DF A6 4C 90 00 13 E8 1D F0 55 00 17 DF A6 4C ..{.....L.....U....L
0021: 90 C0 36 03 01 01 00 00 02 10 88 13 3D D8 91 AF ..6.....=...
```

## A-MPDU 数据传输

- 块确认包含压缩的位图以指示已接收 MPDU。
- 参考IEEE 802.11n第9.10.7部分？HT立即块Ack扩展？关于发送块Ack的信息。



## 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 PPDUs 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
```

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...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 PPDUs with GF Preamble
......11.. Spatial Multiplexing Enabled
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......0 LDPC coding capability: Not Supported
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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：

```

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

```

## 与 A-MPDU 的块确认设置的添加类似的关联：

194	00:12:82:1D: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	00:13:88:1D:F0:55	Ethernet Broadcast	802.11 Probe Req	Ethernet Broadcast	*	100%	1.0 81
197	00:17:DF:A6:4C:90	00:13:88:1D:F0:55	802.11 Probe Rsp	00:17:DF:A6:4C:90	*/+	100%	6.0 204
198	00:12:82:1D: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	00:13:88:1D:F0:55	Ethernet Broadcast	802.11 Probe Req	Ethernet Broadcast	*	100%	1.0 81
201	00:17:DF:A6:4C:90	00:13:88:1D:F0:55	802.11 Probe Rsp	00:17:DF:A6:4C:90	*/+	100%	6.0 204
202	00:12:82:1D:F0:55	00:17:DF:A6:4C:90	802.11 Ack		100%	6.0 14	
203	00:13:CE:89:DC:A2	Ethernet Broadcast	802.11 Probe Req	Ethernet Broadcast	*	100%	1.0 74
204	00:13:88:1D:F0:55	Ethernet Broadcast	802.11 Probe Req	Ethernet Broadcast	*	100%	1.0 81
205	00:17:DF:A6:4C:90	00:13:88:1D:F0:55	802.11 Probe Rsp	00:17:DF:A6:4C:90	*/+	100%	6.0 204
206	00:12:82:1D:F0:55	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	00:13:88:1D: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	00:13:88:1D:F0:55	802.11 Ack		100%	36.0 14	
217	00:17:DF:A6:4C:90	00:13:88:1D:F0:55	802.11 Auth	00:17:DF:A6:4C:90	*	100%	36.0 34
218	00:12:82:1D:F0:55	00:17:DF:A6:4C:90	802.11 Ack		100%	36.0 14	
219	00:13:88:1D: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	00:13:88:1D:F0:55	802.11 Ack		100%	36.0 14	
221	00:17:DF:A6:4C:90	00:13:88:1D:F0:55	802.11 Assoc Rsp	00:17:DF:A6:4C:90	*	100%	130.0 180
222	00:12:82:1D: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	00:12:82:1D: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	00:12:82:1D:F0:55	00:17:DF:A6:4C:90	802.11 Ack		100%	36.0 14	
227	00:17:DF:A6:4C:90	00:13:88:1D:F0:55	MLD	00:17:DF:A6:4C:90	+	100%	130.0 92
228	00:12:82:1D:F0:55	00:17:DF:A6:4C:90	802.11 Ack		100%	36.0 14	
229	00:17:DF:A6:4C:90	00:13:88:1D:F0:55	802.11 Action	00:17:DF:A6:4C:90	*	100%	130.0 37
230	00:12:82:1D:F0:55	00:17:DF:A6:4C:90	802.11 Ack		100%	36.0 14	
231	00:13:88:1D: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	00:13:88:1D:F0:55	802.11 Ack		100%	36.0 14	

