

Probleemoplossing 802.11n snelheden

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Inleiding

Dit document behandelt gemeenschappelijke problemen die u kunt oplossen bij problemen met draadloze doorvoersnelheid. Dit document bevat gebruik van gereedschappen om de prestaties en doorvoersnelheid van het draadloze netwerk te meten, wat verschillende verkoper 802.11n access points (AP's) bevat in vergelijking met Cisco 1252 AP onder soortgelijke testomstandigheden.

Voorwaarden

Vereisten

Cisco raadt u aan deze vereisten te hebben:

- Tools zoals iPerf en netwerkanalyzers zoals OmniPeek en Cisco spectrumanalyse
- 802.11n ondersteund 1140, 1250, 3500 en 1260 Series AP's

Gebruikte componenten

De informatie in dit document is gebaseerd op de volgende software- en hardware-versies:

- WS-SVC-WiSM Controller software versie 6.0.18.2
- LUCHTLAP1142-A-K9 AP's

Conventies

Raadpleeg [Cisco Technical Tips Conventions \(Conventies voor technische tips van Cisco\)](#) voor meer informatie over documentconventies.

Achtergrondinformatie

802.11n wordt geboren als gevolg van een aantal wijzigingen die zijn aangebracht in de Frame Aggregation van AP's: A-MPDU en A-MSDU.

- Blok grootte
- MCS- en kanaalbundeling
- MIMO
- Gebruik van 5 GHz meer dan 2,4 GHz: Vermeld ook Wi-Fi-certificaten voor kanaalbinding op 5 GHz

Probleemoplossing voor de controller voor 11n snelheden

Voer de volgende stappen uit:

1. Controleer of ondersteuning op 802.11n ingeschakeld is op de controller.

```
(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. De N-tarieven worden op twee manieren bereikt. Snelheden tot het moduleringscoderingsschema (MCS) 7 kunnen worden bereikt zonder gebruik te maken van kanaalbundeling. Voor MCS-tarieven boven 7 en tot 15 moet kanaalbundeling worden ingeschakeld. U kunt controleren of kanaalbundeling is ingeschakeld met behulp van deze opdracht voor **show** op de controller:

```
(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. U kunt ook de kanaalbreedte per AP configureren met behulp van deze opdrachten:

```

(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. De Guard-interval en de corresponderende MCS-tarieven helpen de gegevenssnelheden te bepalen die op de 802.11n-klanten worden waargenomen. Dit zijn de opdrachten om deze configuratie te controleren:

```

(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

```

Verzeker een A-MPDU pakketaggregatie. Voor een optimale inspanning, worden de niveaus QoS geactiveerd via deze opdrachten:**configuratie 802.11a 11nOndersteuning voor a-mpdu-prioriteit 0 maakt het mogelijkconfiguratie 802.11b 11nOndersteuning voor a-mpdu-prioriteit 0 maakt het mogelijk**

5. Alle drie antennes op de A-radio moeten worden gebruikt. Zorg ervoor dat de antennes hetzelfde model hebben.
6. Op het WLAN-netwerk dat voor clientconnectiviteit is ingesteld, dient WMA toegestaan of vereist te zijn, en moet AES of open encryptie alleen worden gebruikt. Dit kan worden geverifieerd met behulp van deze opdrachtoutput:

```

(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. Antenna diversiteit: indien u om welke reden dan ook slechts twee antennes gebruikt, dient u antenne A en B te gebruiken voor zendpoorten/ontvangerpoorten.

Aan de kant van de client:

1. Leverancier gebruikt om de draadloze kaart te besturen, verkieslijker van de leverancier aan de draadloze kaart.
2. Clientbestuurders: je moet ervoor zorgen dat de laatste clientbestuurders op de draadloze kaarten actief zijn .
3. Neem contact op met uw verkoper van de draadloze adapter.
4. Zorg ervoor dat u 11n gecertificeerde adapter gebruikt om 11n gegevensnelheden te bereiken.

Wi-Fi gecertificeerde producten:

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

Prestaties verbeteren:

1. Kanaalgebruik—Netwerkanalysatoren rapporteren kanaalgebruik in procenten van de tijd die besteed wordt aan het verzenden en ontvangen van frames. Dit helpt de mogelijke snelheidsvariantie te meten die te wijten is aan de afstand tot een toegangspunt. Dit zal helpen controleren en bijvoorbeeld, als een kanaal volledig bezet overbrengend op 1 Mbps onder ideale omstandigheden is zou uitvoeren bij 0,94 Mbps onder 100% gebruik.
2. Het fysieke medium dat gebruikt wordt in draadloze verbindingen bepaalt ook de prestaties. Het gebruik van 802.11g of 802.11a biedt meer dan 802.11b veel hogere doorvoersnelheid, vaak tot 30 mbps over 802.11b, waarbij een radiocapaciteit van 6 mpb over alle aangesloten stations wordt verdeeld.
3. Cell Sizes-het wordt aanbevolen om de celgrootte te verkleinen om de clients zo dicht bij de APs te laten liggen. Dit zal de gegevenssnelheden ten goede komen waarmee de klant op AP kan verbinden. Dit kan worden gedaan door de stroomniveaus op het AP te verlagen tot het laagste.
4. De grootte van een cel slinken vermindert ook de interferentie met meerdere kanalen. Als u RRM gebruikt, moeten APs dynamisch kanalen per de plaatsing kiezen. Als u dynamische kanaaltoewijzing toepast, zorg er dan voor dat u geen twee AP's hebt op hoog vermogensniveau op hetzelfde kanaal vlak naast elkaar.
5. Bescherming veroorzaakt ook een doorvoerslag.

[Doorvoersnelheid berekenen via iPerf](#)

[Tips voor installatie van IPS](#)

Voor klanten of testers die geen Chariot bezitten, kan in plaats daarvan Iperf worden gebruikt. Dit is beschikbaar op http://www.macalester.edu/crash/software/pc/iperf/kperf_setup.exe.

[TCP-doorvoersnelheid meten](#)

Start deze opdracht op de serverzijde:

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

Start deze opdracht aan de clientzijde:

```
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

```

Het eerste omcirkelde nummer in deze afbeelding representeert de upstream doorvoersnelheid, het tweede omcirkelde nummer de downstream-doorvoersnelheid (AP naar client).

UDP-doorvoersnelheid meten

Sluit de vorige Iperf-toepassingen aan op zowel de server als de client. Beide moeten opnieuw worden opgezet, maar dit keer voor de prestatietests van het UDP.

Start deze opdracht op de serverzijde:

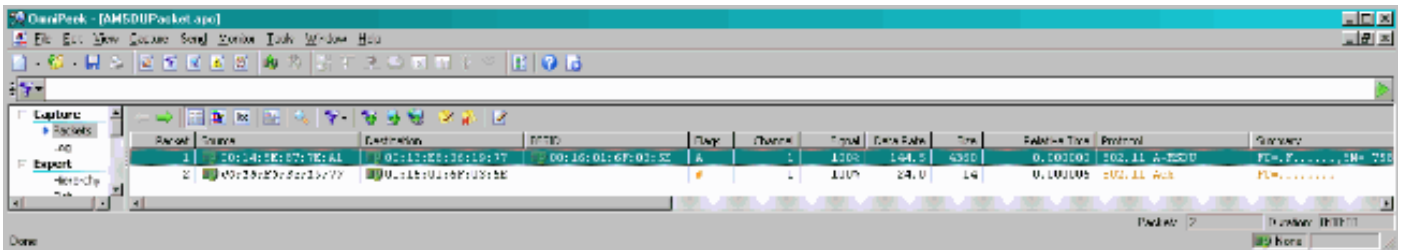
```
Iperf -s -u -l 56k
```

Start deze opdracht aan de clientzijde:

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

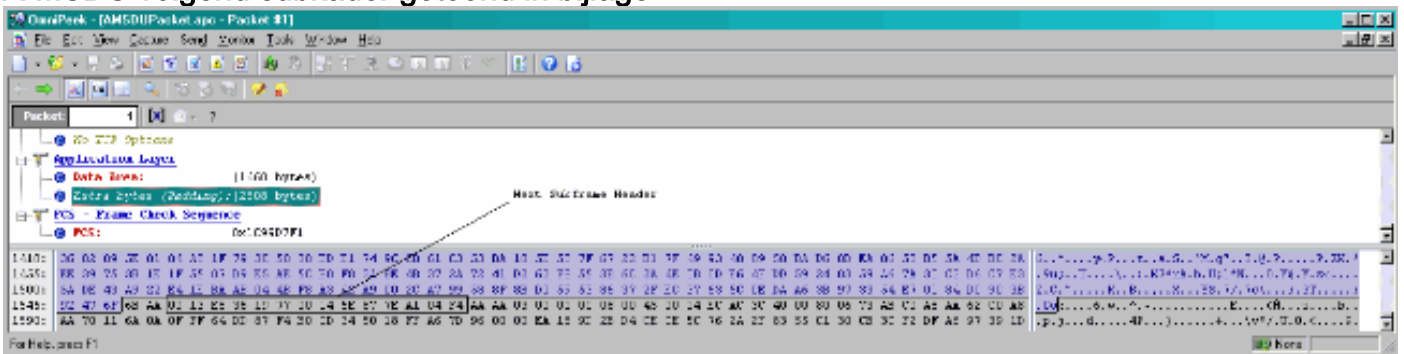
Dit is een voorbeeld van Omnippeek om de Aggregate MAC-service gegevensseenheid te analyseren:

A-MSDU-sporen tonen één pakje

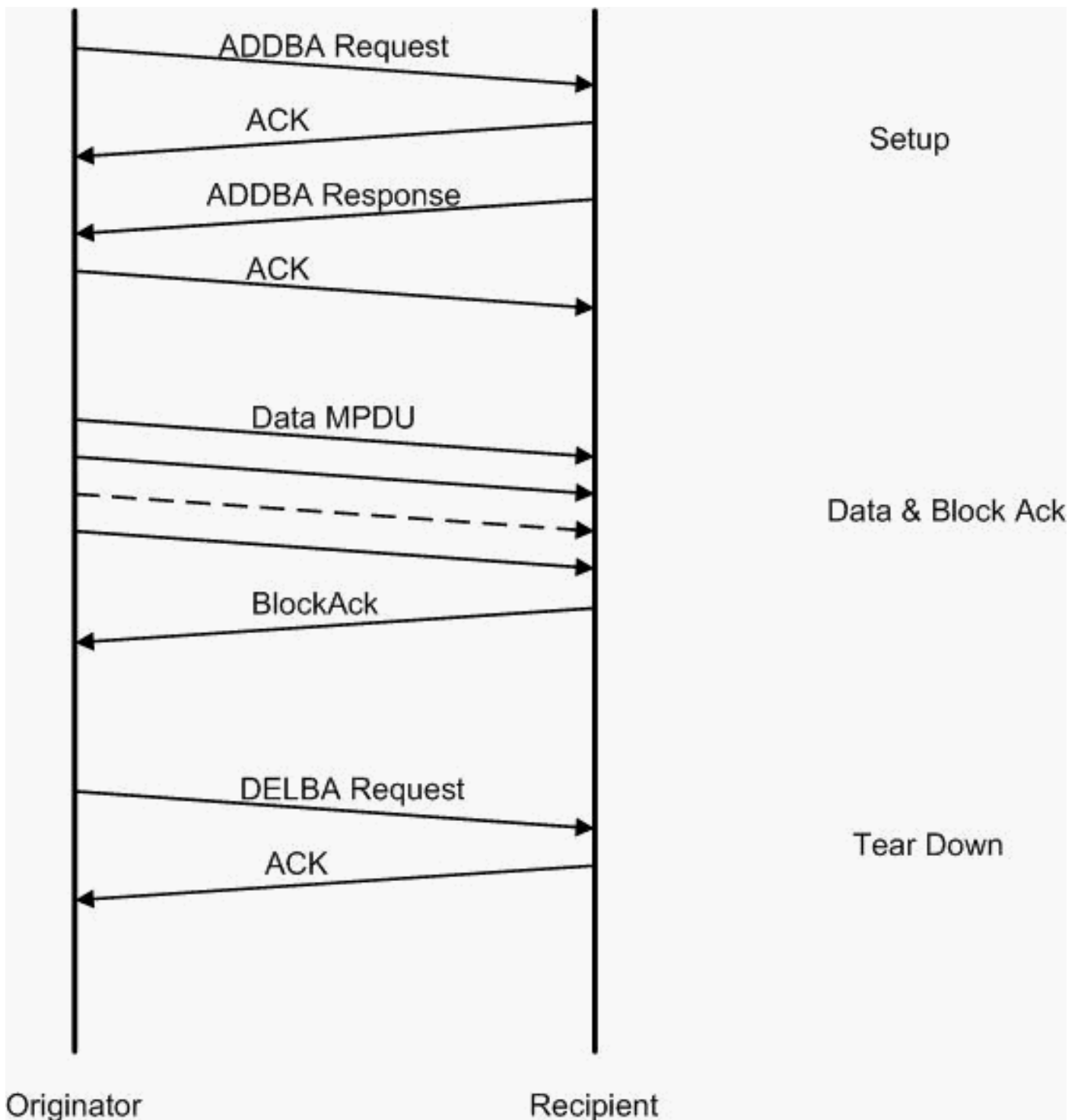


- Alleen het eerste sub frame wordt getoond.
- Moet worden geïnspecteerd om extra sub-frames te zien.

A-MSDU volgend subkader getoond in bijlage

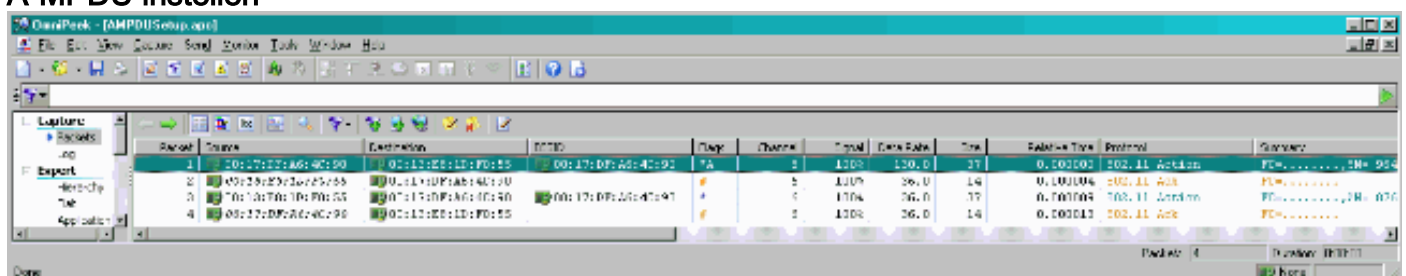


- Een A-MPDU is een structuur die meerdere MPDU's bevat, die door de PHY als één PSDU worden getransporteerd.
- Indicatie dat het pakket Data A-MPDU is in Physical Layer Convergence procedure (PLCP).



Dit is een voorbeeld van Omnipcap om de geaggregeerde MAC protocol gegevensseenheid te analyseren:

A-MPDU instellen



- ADDBA-Blokbevestiging toevoegen
- ADDBA-aanvraag: bevat identifier, blogbeleid, buffergrootte, enzovoort.

- ADDBA-respons kan beleid en buffergrootte wijzigen.

A-MPDU instellen

- ADDBA-aanvraag
- AP1250 gebruikt een tijd van nul om geen tijd aan te geven.

The screenshot shows the OmniPeek interface for packet #1. The main pane displays the following details:

- 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
 - ..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

At the bottom, the raw packet data is shown in hexadecimal and ASCII:

```

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.?

```

A-MPDU instellen

- ADDBA-respons
- Ontvanger moet aangeven dat de Blokkenovereenkomst is gesloten.

The screenshot shows the OmniPeek interface for packet #3. The main pane displays the following details:

- 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
 - --..... Buffer Size:64
 -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 bytes of the packet:

```

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-gegevensoverdracht

- Blok Ack bevat gecomprimeerde bitmap om de ontvangen MPDU's aan te geven.
- Raadpleeg de sectie 9.10.7 van IEEE 802.11n van "HT-wet-extensies" voor informatie over het verzenden van de blokkzak.

Packet	Source	Destination	Protocol	Flags	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	0.00065	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	0.00098	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	0.00011	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	0.00014	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	0.00017	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	0.00020	TCP
8	00:16:01:0F:03:5E	00:13:8E:26:19:77			1	100%	35.0	33	0.00073	003.11 BA

In wissels geadverteerde vermogens

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

Beknopte vermogens in beacons:

```

Rx Bitmask b64-b76: %0000000000000000
Reserved: %000
Highest Supported Rate:0 Mbps
Reserved: %0000000
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):%00000000000000000000000000000000
xxx. .... Reserved
...0 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 PPDU's 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
.... .... Antenna Selection Capable: Not Supported
  
```

Beknopte vermogens in beacons:


```

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 2GHz Phase
....0.. PCO Active: Not Active in the BSS
....0. L-SIG TNDP 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

```

Associatie vergelijkbaar met toevoeging van bloggen voor A-MPDU:

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

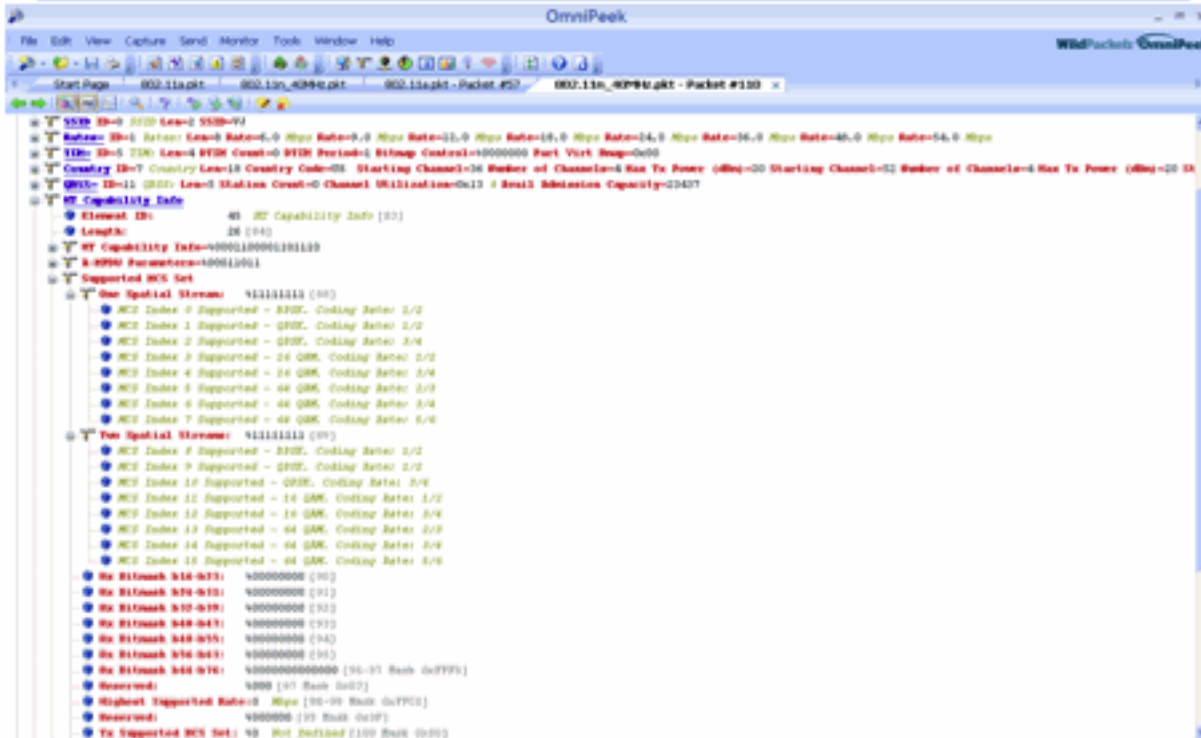
The image shows a Wireshark packet capture of an 802.11 Beacon frame. The 'HT Capability Info' section is expanded, showing the following details:

- 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 BSSs
 - ...0..... Device/BSS does Not Support use of TXOP
 -2..... BSS does Allow use of 2000u CCK 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 Back 0x00]
 - ...110... Minimum MPDU Start Spacing: 2 used [87 Back 0x1C]
 -11 Maximum Rx A-MPDU Size: 64K [87 Back 0x03]
- Supported MCS Set

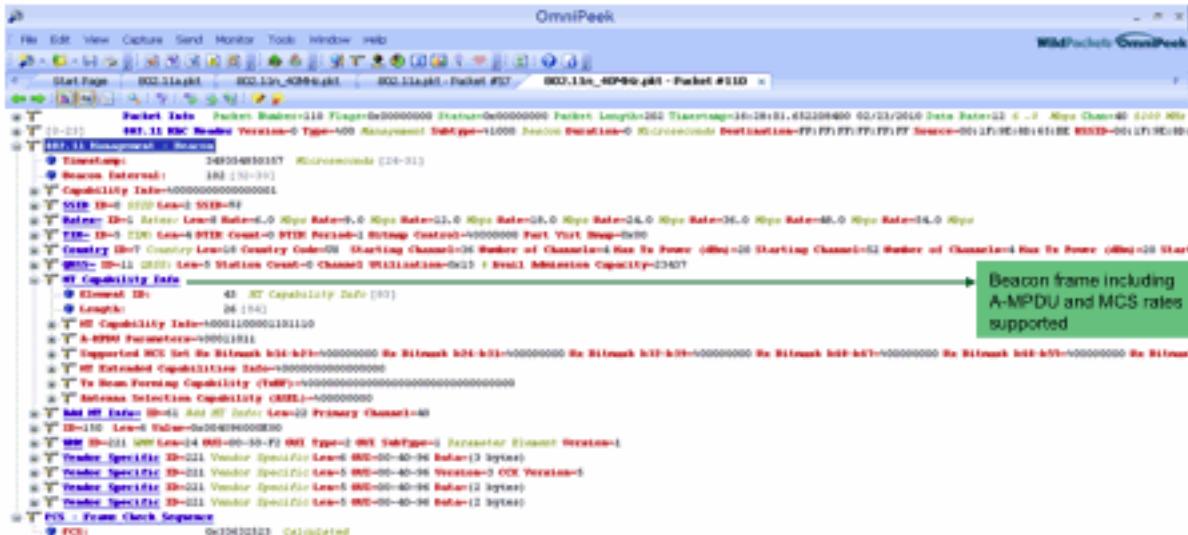
An arrow points from the 'A-MPDU Parameters' section to the text 'A-MPDU enabled and seen in the beacon'.

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 Chan=36 SSID=
802.11 MAC Header Version=0 Type=00 Management SubType=4100 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 [10-10]
  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 BITM Count=0 BITM 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=32 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=0x00409600P00
  MIB: ID=221 MIB Len=24 MIB=00-50-F2 MIB Type=2 MIB SubType=1 Parameter Element Version=1
  Vendor Specific ID=211 Vendor Specific Len=4 MIB=00-40-94 Data=(3 bytes)
  Vendor Specific ID=211 Vendor Specific Len=4 MIB=00-40-94 Version=0 CCX Version=1
  Vendor Specific ID=211 Vendor Specific Len=4 MIB=00-40-94 Data=(2 bytes)
  Vendor Specific ID=211 Vendor Specific Len=4 MIB=00-40-94 Data=(2 bytes)
  FCS - Frame Check Sequence
    FCS: 0x51420932 Calculated
```

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