

Risoluzione dei problemi relativi alla velocità 802.11n

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[Introduzione](#)

Questo documento descrive i problemi più comuni da tenere in considerazione quando si risolvono i problemi relativi al throughput wireless. Questo documento include l'uso di strumenti per misurare le prestazioni e il throughput della rete wireless, con access point 802.11n (AP) di fornitori diversi rispetto all'access point Cisco 1252 in condizioni di test simili.

[Prerequisiti](#)

[Requisiti](#)

Cisco consiglia di rispettare i seguenti requisiti:

- Strumenti come iPerf e analizzatori di rete come OmniPeek e Cisco Spectrum Analysis
- 802.11n supporta i punti di accesso serie 1140, 1250, 3500 e 1260

[Componenti usati](#)

Le informazioni fornite in questo documento si basano sulle seguenti versioni software e hardware:

- Controller WS-SVC-WiSM con software versione 6.0.182
- AP AIR-LAP1142-A-K9

[Convenzioni](#)

Per ulteriori informazioni sulle convenzioni usate, consultare il documento [Cisco sulle convenzioni nei suggerimenti tecnici](#).

Premesse

802.11n è nato a causa di una serie di modifiche apportate all'aggregazione di frame degli access point: A-MPDU e A-MSDU.

- Dimensione ACK blocco
- MCS e collegamento canale
- MIMO
- Utilizzo di 5 GHz su 2,4 GHz: menzionare anche Wi-Fi certifica il collegamento del canale su 5 GHz

Risoluzione dei problemi relativi alla velocità 11n

Attenersi alla seguente procedura:

1. Verificare che il supporto 802.11n sia abilitato sul 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. I tassi N vengono raggiunti in due modi. È possibile raggiungere velocità fino allo schema MCS (Modulation Coding Scheme) 7 senza utilizzare il channel bonding. Per velocità MCS superiori a 7 e fino a 15, è necessario abilitare il channel bonding. È possibile verificare se l'associazione dei canali è abilitata utilizzando questo comando **show** sul 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. È inoltre possibile configurare la larghezza del canale per access point utilizzando i seguenti comandi:

```

(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. L'intervallo Guard e le velocità MCS corrispondenti consentono di determinare le velocità dati rilevate sui client 802.11n. Di seguito sono riportati i comandi per verificare questa configurazione:

```

(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

```

Garanzia di aggregazione dei pacchetti A-MPDU. Per ottenere risultati ottimali, i livelli QoS sono abilitati tramite questi comandi:**config 802.11a 11nSupporto a-mpdu tx priorità 0 abilitazioneconfig 802.11b 11nSupporto a-mpdu tx priorità 0 abilitazione**

5. Utilizzare tutte e tre le antenne della radio A. Assicurarsi che le antenne siano dello stesso modello.
6. Sulla WLAN configurata per la connettività client, WMM deve essere consentito o richiesto e deve essere utilizzata solo la crittografia AES o aperta. È possibile verificare questa condizione tramite il seguente output del comando:

```

(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. Diversità antenna: se si utilizzano solo due antenne per qualsiasi motivo, è necessario utilizzare l'antenna A e B per le porte del trasmettitore/ricevitore.

Sul lato client:

1. Supplicant utilizzato per controllare la scheda wireless, preferibilmente abbinare il fornitore del supplicant alla scheda wireless.
2. Driver client: è necessario verificare che i driver client più recenti siano in esecuzione sulle schede wireless.
3. Contattare il fornitore della scheda di rete wireless.
4. Per ottenere velocità di trasferimento dati 11n, assicurarsi di utilizzare una scheda di rete

certificata 11n.

Prodotti certificati Wi-Fi:

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

Come migliorare le prestazioni:

1. Utilizzo dei canali: gli analizzatori di rete segnalano l'utilizzo dei canali in percentuale del tempo impiegato per la trasmissione e la ricezione dei frame. In questo modo è possibile misurare la variazione potenziale di velocità dovuta alla distanza da un punto di accesso. Ciò aiuterà a monitorare e a vedere, ad esempio, se un canale è completamente occupato trasmettendo a 1 Mbps in condizioni ideali si otterrebbe a 0,94 Mbps con un utilizzo del 100%.
2. Anche il supporto fisico utilizzato nel wireless determina le prestazioni. L'uso di 802.11g o 802.11a su 802.11b offre un throughput molto più elevato, spesso fino a 30 mbps su 802.11b, dove una capacità radio di 6 mbps è divisa tra tutte le stazioni associate.
3. Dimensioni celle: si consiglia di ridurre le dimensioni delle celle per avvicinare il più possibile i client agli access point. In questo modo si otterranno vantaggi in termini di velocità di trasferimento dati con cui il client può connettersi all'access point. A tale scopo, è possibile ridurre al minimo i livelli di alimentazione dell'access point.
4. La riduzione delle dimensioni della cella riduce anche l'interferenza del co-canale. Se si utilizza RRM, gli access point devono scegliere i canali in modo dinamico per ogni distribuzione. Tuttavia, se si implementa l'assegnazione dinamica dei canali, verificare che non vi siano due punti di accesso a livelli di alimentazione elevati sullo stesso canale adiacenti.
5. La protezione causa anche un impatto sul throughput.

[Come calcolare il throughput mediante iPerf](#)

[Suggerimenti Per L'Installazione Di Iperf](#)

Per i clienti o i tester che non possiedono Chariot, è possibile utilizzare Iperf. Il documento è disponibile all'indirizzo http://www.macalester.edu/crash/software/pc/iperf/kperf_setup.exe.

[Misurazione della velocità effettiva TCP](#)

Eseguire questo comando sul lato server:

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

Eseguire questo comando sul lato client:

```
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

```

Il primo numero cerchiato in questa immagine rappresenta la velocità effettiva a monte, il secondo numero cerchiato rappresenta la velocità effettiva a valle (da punto di accesso a client).

Misurazione del throughput UDP

Chiudere le applicazioni Iperf precedenti sul lato server e client. Entrambi devono essere configurati di nuovo, ma questa volta per il test delle prestazioni UDP.

Eseguire questo comando sul lato server:

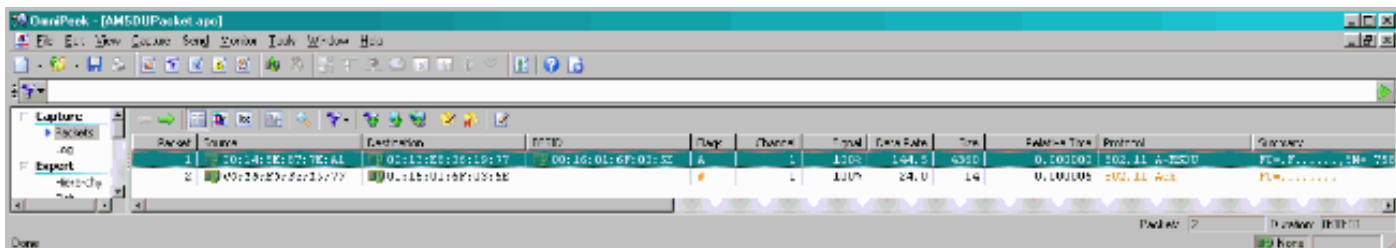
```
Iperf -s -u -l 56k
```

Eseguire questo comando sul lato client:

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

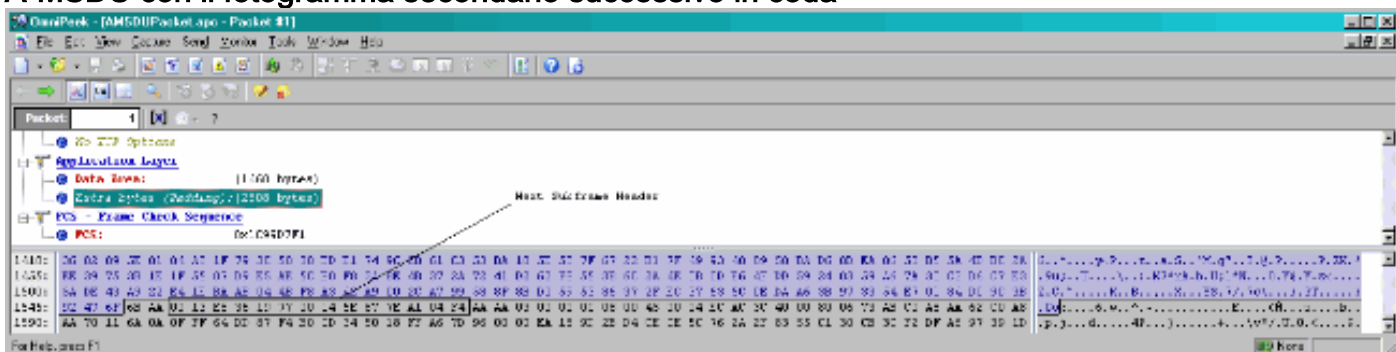
Questo è un esempio di acquisizioni Omnipcap per analizzare l'unità di dati del servizio MAC aggregata:

La traccia A-MSDU mostra un pacchetto

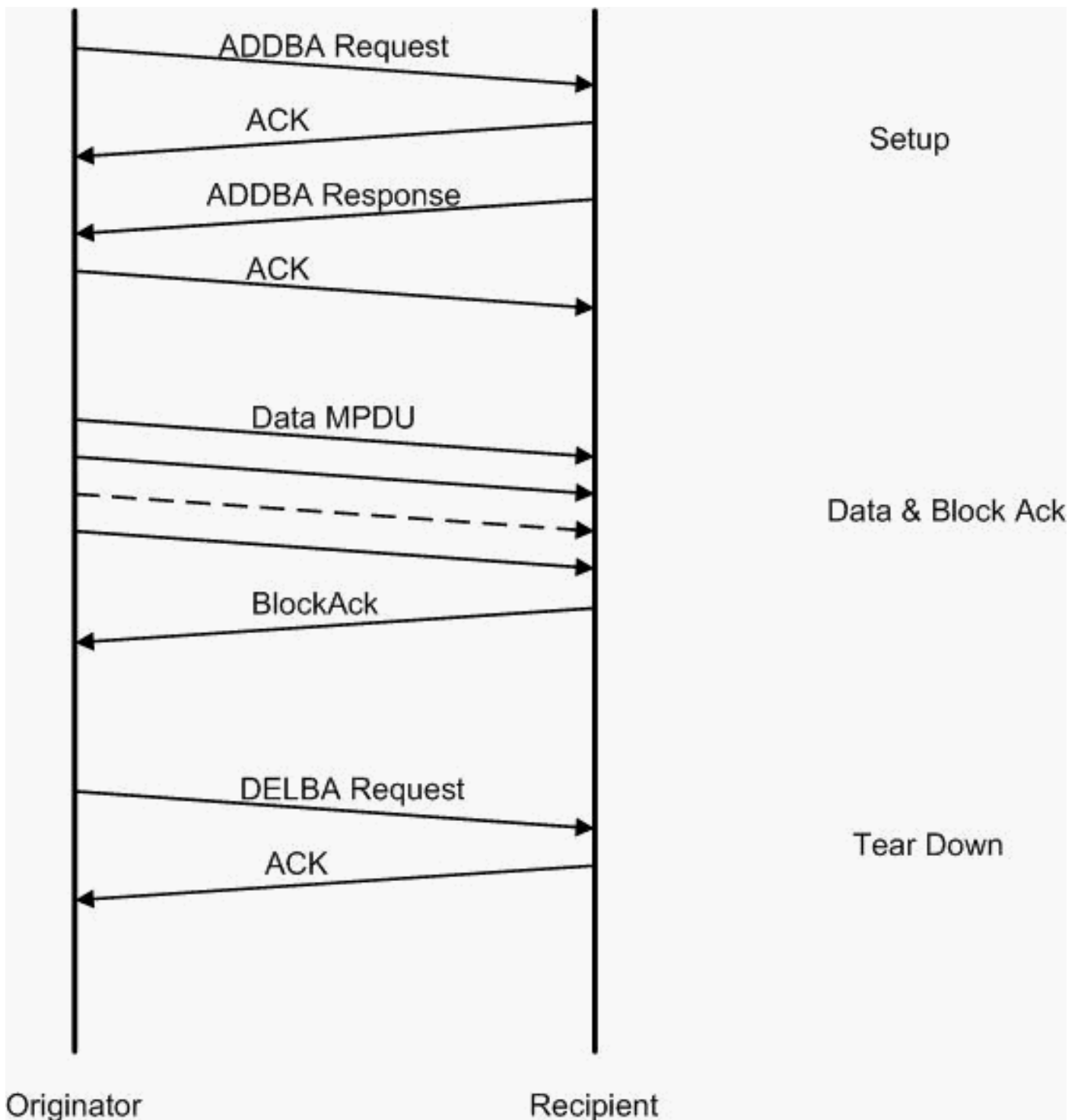


- Viene visualizzato solo il primo fotogramma secondario.
- È necessario ispezionare il dump esadecimale per visualizzare altri sottoframe.

A-MSDU con il fotogramma secondario successivo in coda

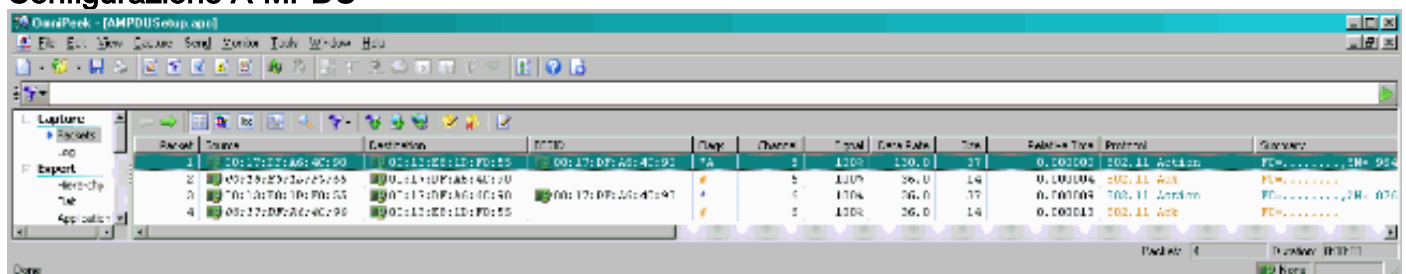


- Una A-MPDU è una struttura che contiene più MPDU, trasportata come singola PSDU dal PHY.
- Indica che il pacchetto è di tipo A-MPDU dati nella procedura di convergenza del livello fisico (PLCP).



Questo è un esempio di acquisizioni Omnipcap per analizzare l'unità di dati del protocollo MAC aggregato:

Configurazione A-MPDU



- ADDBA: conferma blocco aggiunta
- Richiesta ADDBA: contiene l'identificatore, il criterio di blocco ACK, la dimensione del buffer e

così via.

- Risposta ADDBA: consente di modificare i criteri e le dimensioni del buffer.

Configurazione A-MPDU

- Richiesta ADDBA
- AP1250 utilizza un timeout pari a zero per indicare l'assenza di timeout.

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
 - ..0000 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.?
```

Configurazione A-MPDU

- Risposta ADDBA
- Il ricevente deve indicare che il Contratto del blocco del codice è stato stabilito correttamente.

The screenshot shows the OmniPeek interface for packet #3. The main display area is divided into three sections:

- 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.....=...

```

Trasferimento dei dati A-MPDU

- L'ACK di blocchi contiene una bitmap compressa per indicare la ricezione di MPDU.
- Fare riferimento alla sezione 9.10.7 "HT-immediate Block Ack extensions" dello standard IEEE 802.11n per informazioni sull'invio del Block Ack.

No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000	00:13:8E:06:19:77	00:14:5E:97:7E:A2	TCP	78	0.000000
2	0.000000	00:13:8E:06:19:77	00:14:5E:97:7E:A2	TCP	78	0.000000
3	0.000000	00:13:8E:06:19:77	00:14:5E:97:7E:A2	TCP	78	0.000000
4	0.000000	00:13:8E:06:19:77	00:14:5E:97:7E:A2	TCP	78	0.000000
5	0.000000	00:13:8E:06:19:77	00:14:5E:97:7E:A2	TCP	78	0.000000
6	0.000000	00:13:8E:06:19:77	00:14:5E:97:7E:A2	TCP	78	0.000000
7	0.000000	00:13:8E:06:19:77	00:14:5E:97:7E:A2	TCP	78	0.000000
8	0.000000	00:16:01:07:00:00	00:13:8E:06:19:77	TCP	33	0.000000

Funzionalità annunciate nei beacon

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

Funzionalità annunciate nei beacon:

```
● 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
    .... .... .... ..00.. 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):%000000000
    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
```

Funzionalità annunciate nei beacon:


```

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

```

Associazione simile all'aggiunta della configurazione del blocco ACK per 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	WLCCP	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

```

HT Capability Info
  Element ID: 45 HT Capability Info (00)
  Length: 26 (04)
  HT Capability Info: 0000100001101110 (00-06)
    0..... I-SDS TXOP Protection Support: Not Supported
    .0..... AP allows use of 4096u Transmissions In Neighboring BSS
    ..0..... Device/BSS does Not Support use of TXOP
    ...2..... BSS does Allow use of 802.11e Rates (4096u)
    ....1..... Maximal A-MPDU size: 7935 bytes
    .....0..... Does Not Support HT-Delayed BlockAck Operation
    .....0..... No Ex STBC Support
    .....0..... Transmitter does Not Support Ex 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 20Mbit/s and 40Mbit/s Operation is Supported
    .....0... LDPC coding capability: Not Supported
  A-MPDU Parameters: 00001011 (07)
    ...0... Reserved (87) Bit (0x0)
    ...10... Minimum MPDU Start Spacing: 7 used (87) Bit (0x1)
    .....11 Maximum Ex A-MPDU Size: 64K (87) Bit (0x0)
  Supported MCS Set
  
```

A-MPDU enabled and seen in the beacon

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

Supported MCS rates

The screenshot displays the 'Supported MCS Set' section of a packet capture analysis. It lists supported MCS indices and their corresponding coding rates and data rates. The supported MCS set includes MCS 0 through MCS 15, with coding rates ranging from 1/2 to 5/4 and data rates ranging from 6.0 Mbps to 54.0 Mbps. The highest supported rate is 54.0 Mbps.

```

Supported MCS Set
- MCS Index 0 Supported - QPSK, 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 1/2
- MCS Index 6 Supported - 64 QAM, Coding Rate 3/4
- MCS Index 7 Supported - 64 QAM, Coding Rate 5/4
- MCS Index 8 Supported - 64 QAM, Coding Rate 1/2
- MCS Index 9 Supported - 64 QAM, Coding Rate 3/4
- MCS Index 10 Supported - 64 QAM, Coding Rate 5/4
- MCS Index 11 Supported - 64 QAM, Coding Rate 1/2
- MCS Index 12 Supported - 64 QAM, Coding Rate 3/4
- MCS Index 13 Supported - 64 QAM, Coding Rate 5/4
- MCS Index 14 Supported - 64 QAM, Coding Rate 1/2
- MCS Index 15 Supported - 64 QAM, Coding Rate 3/4
- Highest Supported Rate=54.0 Mbps [96-96 Sub-Carriers]
- Tx Supported MCS Set: 00 Not Defined [100 Sub-Carriers]
    
```

802.11a with N rates Enabled

The screenshot displays a packet capture analysis of a beacon frame. The 'Supported MCS Set' section shows that MCS 0 through MCS 15 are supported, with coding rates ranging from 1/2 to 5/4 and data rates ranging from 6.0 Mbps to 54.0 Mbps. The highest supported rate is 54.0 Mbps. A green callout box highlights the text 'Beacon frame including A-MPDU and MCS rates supported'.

```

Supported MCS Set
- MCS Index 0 Supported - QPSK, 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 1/2
- MCS Index 6 Supported - 64 QAM, Coding Rate 3/4
- MCS Index 7 Supported - 64 QAM, Coding Rate 5/4
- MCS Index 8 Supported - 64 QAM, Coding Rate 1/2
- MCS Index 9 Supported - 64 QAM, Coding Rate 3/4
- MCS Index 10 Supported - 64 QAM, Coding Rate 5/4
- MCS Index 11 Supported - 64 QAM, Coding Rate 1/2
- MCS Index 12 Supported - 64 QAM, Coding Rate 3/4
- MCS Index 13 Supported - 64 QAM, Coding Rate 5/4
- MCS Index 14 Supported - 64 QAM, Coding Rate 1/2
- MCS Index 15 Supported - 64 QAM, Coding Rate 3/4
- Highest Supported Rate=54.0 Mbps [96-96 Sub-Carriers]
- Tx Supported MCS Set: 00 Not Defined [100 Sub-Carriers]
    
```

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 Mbps Chan: 36 SSID: [0-23] 802.11 MAC Header Version: 0 Type: 0x00 Management SubType: 0x0000 Beacon Duration: 0 Microseconds Destination: FF:FF:FF:FF:FF:FF Source: 00:14:97:8A:8A:8E BSSID: 00:14:97:8A:8A:8E 802.11 Management - Beacon Timestamp: 17048868 Microseconds [10-11] Beacon Interval: 100 [12-13] Capability Info: 0000000000000000 SSI: ID=0 SSID Len=2 SSID=FF Rates: ID=1 Rates Len=8 Rate=6.0 Mbps Rate=9.0 Mbps Rate=12.0 Mbps Rate=18.0 Mbps Rate=24.0 Mbps Rate=36.0 Mbps Rate=48.0 Mbps Rate=54.0 Mbps ID=5 Rates Len=4 BDR Count=0 BDR Period=1 Bitmap Control=00000000 Part Virt Swap=0x00 Country ID=7 Country Len=18 Country Code=00 Starting Channel=36 Number of Channels=4 Max Tx Power (dBm)=20 Start Power ID=11 (BSS) Len=5 Station Count=0 Channel Utilization=0x10 / Avail Admission Capacity=23407 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=221 Vendor Specific Len=4 MIB=00-40-94 Data=(3 bytes) Vendor Specific ID=221 Vendor Specific Len=4 MIB=00-40-94 Version=0 CCX Version=1 Vendor Specific ID=221 Vendor Specific Len=2 MIB=00-40-94 Data=(2 bytes) Vendor Specific ID=221 Vendor Specific Len=2 MIB=00-40-94 Data=(2 bytes) FCS - Frame Check Sequence FCS: 0x51420932 Calculated
```

Informazioni correlate

- [Documentazione e supporto tecnico – Cisco Systems](#)