# Wireless LAN Consortium

## 802.11 Base AP MAC Conformance Test Suite v3.4 Report

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January 3, 2013
Report Rev. 1.1

Joe Vendor
Magic Wireless Company
52 OFDM Drive
Mimo, NH 010111

Mr. Vendor,

Enclosed are the results from the Wireless MAC AP Test Suite testing performed on the:

Magic Device Name MD-360 802.11a/b/g Access Point

This testing pertains to a set of standard requirements, put forth in the IEEE Std. 802.11-2007 Edition. The tests performed are part of the 802.11 Base AP MAC Conformance Test Suite, which is available on the UNH-IOL's website:

ftp://ftp.iol.unh.edu/pub/wireless/TestSuites/mac/802.11_Base_AP_MAC_Test_Suite_v3.4.pdf

| Issues Observed While Testing |
|---|
| *1.1.4: Open System Authentication Processing* - The DUT was observed to not transmit an Authentication Response upon reception of an Authentication Request. |
| *1.1.13: Duplicate Detection and Recovery*- The DUT was observed to incorrectly filter duplicate frames. |
| *1.3.2: Aging Function* - The DUT was observed to discard buffered traffic for an associated station prior to the expiration of the station's Listen Interval. |
| *1.3.3: PS-Poll Processing* - The DUT was observed to not transmit a data or null data frame upon reception of an unsolicited PS-Poll. |

As always, we welcome any comments regarding this Test Suite. If you have any questions about the test procedures or results, please contact me via e-mail at TJ.Tester@iol.unh.edu or by phone at +1-603-862-2263.

Regards,

TJ MCTester

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MD5 Fingerprint: **EEE1 7A82 7806 EB21 AF94 F189 E4BE 361B**
SHA-1 Fingerprint: **ECFB 7FAF AB4A 0832 2408 E965 9F5C E3F2 D784 AAAB**

Table 1 - Result Key - The following table contains possible results and their meanings

| Result | Interpretation |
|---|---|
| **PASS** | The DUT was observed to exhibit conformant behavior. |
| **FAIL** | The DUT was observed to exhibit non-compliant behavior. |
| **PASS with Comments** | The DUT was observed to exhibit conformant behavior, however, additional explanation of the situation is included. |
| **Warning** | The DUT was observed to exhibit behavior that is not recommended. |
| **Informative** | Results are for informative purposes only and are not judged on a pass or fail basis. |
| **Refer to Comments** | From the observations, a valid pass or fail could not be determined. An additional explanation of the situation is included. |
| **Not Applicable** | The DUT does not support the technology required to perform these tests. |
| **Not Available** | Due to testing station or time limitations, the tests could not be performed, or were performed in a limited capacity. |
| **Not Tested** | Not tested due to time constraint of the test period. |
| **Borderline** | The observed values of the specified parameter are valid at one extreme, and invalid at the other. |

Table 2 - Setup and Configuration Information

| **Product** | |
|---|---|
| Manufacturer | Magic Device Machine |
| Model | MD-360 |
| Serial Number | FTH25489FE |
| MAC Address | 00:0M:0A:0C:00:00 |
| Hardware Version | 3AGE3584 |
| Firmware Version | 8.4.2453 |
| IOL Label | VN-DUTT-00000123456 |
| **Test System Hardware** | |
| RF Isolated Environment | USC-26 RF/EMI Isolation Chamber 16'x 8' x 8' @ 100dB |
| Sniffer | Atheros DK4 Sniffer Station |
| Test Station | Atheros DK4 Testing Station |
| Ethernet Station (STA-E) | Atheros DK4 Testing Station |

In many traces, identification frames were used to simplify result collecting. These frames are identified by their source MAC address (00:00:01:ba:bb:1e). Below is an example of an identification frame found in a trace:

| No. | Info | Protocol | Source | Destination |
|---|---|---|---|---|
| 1 | Beacon frame, BI=100, SSID=MAC"" | IEEE 802.11 | Xerox_00:00:11 | Broadcast |
| 2 | Part a: Non-Acknowledged Frames | Babble Frame | 0.0.0.0 | 255.255.255.255 |
| 3 | MSDU1 => ICMP Echo Request with Protocol Version > 0 | Babble Frame | 0.0.0.0 | 255.255.255.255 |
| 4 | Echo (ping) request | ICMP | 192.168.0.102 | aa:bb:cc:dd:ee |
| 5 | Acknowledgement | IEEE 802.11 | | Xerox_00:00:11 |
| 6 | Clear-to-send | IEEE 802.11 | | aa:bb:cc:dd:ee |
| 7 | Data | IEEE 802.11 | Xerox_00:00:11 | aa:bb:cc:dd:ee |

Rows highlighted in green are Management Frames.
Rows highlighted in blue are Control Frames.
Rows highlighted in white are Data Frames.
Rows highlighted in violet are ICMP Echo Requests/Responses

Fields or Frame excerpts highlighted in this reports are important and directly related to the issue being shown in the trace excerpt.

**GROUP 1: DEFAULT CONFIGURATION**

| Test # and Label | Part(s) | Result(s) |
|---|---|---|
| **1.1.1: Frame Processing** | **a** | **PASS** |
| | **b** | **PASS** |
| | **c** | **PASS** |

**Comments on Test Procedure**

*Purpose*: To verify that the DUT processes the reception of MAC frames properly.

This test verifies that the DUT correctly formats MAC layer frames that it receives, while properly processing the received frame by continuing the frame exchange sequence. It also verifies that the DUT can operate upon reception of an unexpected or incorrectly formatted frame, testing the robustness of the DUT. It is assumed that the data transmission rate is not a factor in this test other than in the calculation of the duration field.

The DUT should:

a. not transmit an ACK for MSDU1-MSDU2b, but it should receive the frame without any system failures.
b. transmit an ACK for MSDU3-MSDU11 and receive the frame without any system failures.
c. receive MSDU12a-l without any system failures. The DUT may or may not transmit an ACK upon reception.

**Comments on Test Results**

a-c. There were no issues uncovered during the testing process.

| Test # and Label | Part(s) | Result(s) |
|---|---|---|
| **1.1.2: Null Data Processing** | **a** | **PASS** |
| | **b** | **PASS** |

**Comments on Test Procedure**

*Purpose***:** To verify that the DUT operates properly upon reception of Null Data frames.

APs and STAs must have the ability to operate properly upon reception of null frames with specific bits set in the Frame Control field, which consists of the following subfields: Protocol Version, Type, Subtype, To DS, From DS, More Fragments, Retry, Power Management, More Data, WEP, and Order.

The DUT should:

a. not transmit an ACK in response to MSDU1-MSDU3, but should transmit an ACK followed by an ICMP Echo Response following every valid ICMP Echo Request.
b. transmit an ACK in response to MSDU4-MSDU12, and also should transmit an ACK followed by an ICMP Echo Response following every valid ICMP Echo Request.

**Comments on Test Results**

a-b. There were no issues uncovered during the testing process.

| Test # and Label | Part(s) | Result(s) |
|---|---|---|
| **1.1.3: Deauthentication Processing** | **a** | **PASS** |
| | **b** | **Informative** |
| | **c** | **PASS** |

**Comments on Test Procedure**

*Purpose*: To verify that the DUT processes deauthentication frames properly.

Deauthentication is a class 1 management service that invalidates an authentication relationship with a peer MAC entity. This service may be invoked by any authenticated party (STA or AP), and is a notification rather than a request; therefore deauthentication can not be refused by either party. It is possible for a STA to transmit a deauthentication notification to a group address, terminating authentication to all APs at once. Within a BSS, the reception of a deauthentication frame also invalidates an association relationship.

a. The DUT should not transmit any class 2 or 3 traffic to the TS upon reception of MSDU1.
b. INFORMATIVE: Upon reception of MSDU2, [1] is unclear whether or not the frame should be processed. If the DUT processes the frame, then all traffic from the DUT to the TS should cease.
c. The DUT should not transmit an ACK upon reception of MSDU3, nor process the frame.

**Comments on Test Results**

a. There were no issues uncovered during the testing process.
b. The DUT was observed to not process a deauthentication frame transmitted to a broadcast address.
c. There were no issues uncovered during the testing process.

| Test # and Label | Part(s) | Result(s) |
|---|---|---|
| **1.1.4: Open System Authentication Processing** | **a** | **FAIL** |
| | **b** | **PASS** |
| | **c** | **PASS** |
| | **d** | **PASS** |

**Comments on Test Procedure**

*Purpose:* To verify that the DUT properly handles received authentication request frames and generates authentication response frames properly.

Open System Authentication is a mandatory algorithm for 802.11 networks. The authentication service allows class 2 traffic to be transferred from one peer MAC entity to another; it is also the first step in becoming part of a BSS network. If and only if a STA has successfully authenticated may it request association, the second step in joining of a BSS network. This test is designed to ensure that an AP can properly process received authentication requests, and respond with appropriate authentication responses.

The DUT should:

a. respond to MSDU2 with an Authentication Response containing an unsuccessful status code, and not associate successfully.
b. respond to MSDU3 with an Authentication Response containing an unsuccessful status code, and not associate successfully.
c. respond to MSDU4 with an Authentication Response containing a successful status code, and also successfully associate.
d. not respond to MSDU5 with an ACK nor process the frame.

**Comments on Test Results**

a. The DUT was observed to not respond with an Authentication Response containing an unsuccessful status code upon reception of an Authentication Request containing an invalid transaction sequence number; however The DUT did not successfully associate. The DUT should respond to an Authentication Request with an Authentication Response containing an appropriate status code. See IEEE Std. 802.11-2007 subclause 8.2.2.2. Please refer to Table 3 for more information regarding this result.

b-d. There were no issues uncovered during the testing process.

| Test # and Label | Part(s) | Result(s) |
|---|---|---|
| **1.1.5: Association Processing** | **a** | **PASS** |
| | **b** | **PASS** |
| | **c** | **PASS** |
| | **d** | **PASS** |
| | **e** | **PASS** |
| | **f** | **PASS** |

**Comments on Test Procedure**

*Purpose:* To verify that the DUT properly handles received association request frames and generates association response frames properly.

Association is a service that allows class 3 traffic to be transferred from one peer MAC entity to another. Transmitting an association request is the second and final step in becoming part of a non-secure BSS network. There are many fields within an association request, an AP must be able to properly interpret the contents of these fields, and react appropriately upon reception of such a frame. This test is designed to ensure that an AP can properly process received association requests, and respond with appropriate association responses.

The DUT should:

a. respond to MSDU3-6 with an association response. If successful, the DUT should forward the ICMP Echo Requests from STA-E to the TS. If unsuccessful, the DUT should not forward any class 3 traffic to the TS.
b. respond to MSDU7 with an association response. If successful, the DUT should forward the ICMP Echo Requests from STA-E to the TS. If unsuccessful, the DUT should not forward any class 3 traffic to the TS.
c. respond to MSDU8 with an association response. If successful, the DUT should forward the ICMP Echo Requests from STA-E to the TS. If unsuccessful, the DUT should not forward any class 3 traffic to the TS.
d. respond to MSDU9 with an association response containing a successful status code. Furthermore, the DUT should forward the ICMP Echo Requests from STA-E to the TS.
e. not respond to MSDU10 with an ACK nor process the frame.
f. respond to MSDU11 with an association response containing an unsuccessful status code.

**Comments on Test Results**

a-f. There were no issues uncovered during the testing process.

| Test # and Label | Part(s) | Result(s) |
|---|---|---|
| **1.1.6: Disassociation Processing** | **a** | **PASS** |
| | **b** | **Informative** |
| | **c** | **PASS** |

**Comments on Test Procedure**

*Purpose:* To verify that the DUT properly handles received disassociation frames.

Disassociation is a class 2 management service that invalidates strictly an association relationship with a peer MAC entity. This service may be invoked by any authenticated party (STA or AP), and is a notification rather than a request; therefore disassociation can not be refused by either party. It is possible for a STA to transmit a disassociation notice to a group address, terminating association to all APs at once. Reception of a disassociation frame invalidates specifically as association relationship and does not affect the underlying authentication relationship.

a. The DUT should not transmit any class 3 traffic to the TS upon reception of MSDU1.
b. INFORMATIVE: Upon reception of MSDU2, [1] is unclear whether or not the frame should be processed. If the DUT processes the frame, then all class 3 traffic from the DUT to the TS should cease.
c. The DUT should not respond to MSDU3 with an ACK nor process the frame.

**Comments on Test Results**

a. There were no issues uncovered during the testing process.
b. The DUT was observed to NOT process Disassociation frames transmitted to the broadcast address.
c. There were no issues uncovered during the testing process.

| Test # and Label | Part(s) | Result(s) |
|---|---|---|
| **1.1.7: Reassociation Processing** | **a** | **Not Applicable** |
| | **b** | **Not Applicable** |
| | **c** | **Not Applicable** |
| | **d** | **Not Applicable** |
| | **e** | **Not Applicable** |
| | **f** | **Not Applicable** |

**Comments on Test Procedure**

*Purpose:* To verify that the DUT properly handles received reassociation request frames, and generates reassociation response frames properly.

Reassociation is a class 2 management service within a BSS that allows a STA to become associated with an AP, typically an AP that it has previously held a valid association. There are many fields within a reassociation request. An AP must be able to properly interpret the contents of these fields, and react appropriately upon reception of such a frame. This test is designed to ensure that an AP can properly process received reassociation request frames, and respond with appropriate reassociation responses.

a. The DUT should
   - respond to MSDU6 with a reassociation response with a successful status code.
   - include the non-zero AID assigned to the TS in the reassociation response.
   - set the two MSB of the AID field in the reassociation response.
   - forward the response from STA-E of MSDU5 to the TS.

b. The DUT should
   - respond to MSDU7 with a reassociation response with an unsuccessful status code.
   - not transmit any class 3 frames to the TS after receiving MSDU4.

c. The DUT should
   - respond to MSDU8 with a reassociation response with an unsuccessful status code.
   - not transmit any class 3 frames to the TS after receiving MSDU4.

d. The DUT should
   - respond to MSDU9 with a reassociation response with an unsuccessful status code.
   - not transmit any class 3 frames to the TS after receiving MSDU4.

e. The DUT should not transmit an ACK upon reception of MSDU12 nor process the frame.

f. The DUT should respond to MSDU10 and MSDU11 with a reassociation response with a successful status code.

**Comments on Test Results**

a-f. The DUT was observed to not support Reassociation; therefore no results could be collected for this section.

| Test # and Label | Part(s) | Result(s) |
|---|---|---|
| **1.1.8: State Variables and Services** | **a** | **PASS** |
| | **b** | **PASS** |
| | **c** | **PASS** |
| | **d** | **PASS** |

**Comments on Test Procedure**

*Purpose:* To verify that

- The DUT maintains which stations are authenticated and which stations are associated.
- The DUT does not process class 2 frames from unauthenticated stations, and responds appropriately.
- The DUT does not process class 3 frames from unassociated stations, and responds appropriately.
- The DUT is able to respond to Probe Requests in all states.

For devices to engage in higher-level communication, such as IP layer, they must be part of the same BSS. The first part of becoming part of a BSS is authenticating with the AP. After a device has been successfully authenticated the next step to join the BSS is association. In order for the AP to keep track of what class frames it may transmit to a particular STA each station is given a state variable. The values for this variable are unauthenticated, authenticated but unassociated, and authenticated and associated. Each value of this variable determines a different state that the station is in for communication with the AP. These three different states determine which class of frames the AP and STA may exchange. If an AP receives a frame that is not allowed by the state relationship, the AP must respond appropriately. This test is designed to ensure that an AP responds appropriately upon reception of such frames.

The DUT should:

a. respond to MSDU4 and MSDU5 with a deauthentication.
b. respond to MSDU6-7, and MSDU9-16 with a deauthentication.
c. respond to MSDU6-7, and MSDU9-16 with a deauthentication or disassociation.
d. respond to MSDU8 with a Probe Response for all transmissions of MSDU8.

**Comments on Test Results**

a-d. There were no issues uncovered during the testing process.

| Test # and Label | Part(s) | Result(s) |
|---|---|---|
| **1.1.9: Acknowledgement and Duration Field Validation** | **a** | **PASS** |
| | **b** | **PASS** |
| | **c** | **PASS** |
| | **d** | **PASS** |
| | **e** | **PASS** |
| | **f** | **PASS** |

**Comments on Test Procedure**

*Purpose*: To verify that the DUT can properly calculate the duration field, and does not transmit an ACK upon reception of frames which do not contain a valid FCS field.

When a directed frame is successfully transmitted from one MAC entity to another, a CRC value is calculated by the receiving station to verify the integrity of the frame, and an acknowledgement frame is transmitted to indicate successful reception to the source station. In the event that the acknowledgement frame is lost, the transmitter should attempt to re-transmit the frame. If a directed frame is fragmented each fragment should have a calculated duration field, with the exception of the last fragment which should have a duration field of 0.

The DUT should:

a. transmit an ACK, for MSDU1, with a duration field of 0 µs.
b. transmit an ACK, for the first fragment of MSDU2, with an appropriate duration field; transmit an ACK, for the second fragment, of MSDU2 with a duration field of 0 µs.
c. transmit ACKs for all transmissions by the TS of MSDU3, not transmit ACKs for all transmissions by the TS of MSDU4.
d. transmit an ACK, for the first fragment of MPDU8, with an appropriate duration field.
e. transmit an ACK for MSDU7.
f. transmit all data frames with appropriate duration fields.

**Comments on Test Results**

a-e. There were no issues uncovered during the testing process.

| Test # and Label | Part(s) | Result(s) |
|---|---|---|
| **1.1.10: Defragmentation** | **a** | **PASS** |

**Comments on Test Procedure**

*Purpose:* To verify that the DUT is capable of receiving fragments of an arbitrary length, and is able to reassemble them.

Defragmentation is the process of assembling successfully received fragments back into the original MSDU or MMPDU. Since it is possible for the source STAs to transmit fragments of an arbitrary length, destination STAs must be capable of defragmenting fragments of arbitrary length. This test is designed to ensure that an AP can properly reassemble arbitrarily fragmented MSDUs.

a. The DUT should defragment MPDU1 for all the fragmentation thresholds, forward MPDU1 to STA-E, and forward the ICMP Echo Response to the TS.

**Comments on Test Results**

a. There were no issues uncovered during the testing process.

| Test # and Label | Part(s) | Result(s) |
|---|---|---|
| **1.1.11: Information Element Formatting** | **a** | **PASS** |
| | **b** | **PASS** |
| | **c** | **PASS** |
| | **d** | **PASS** |

**Comments on Test Procedure**

*Purpose:* To verify that the DUT includes and properly formats Information Elements within beacons, probes and association frames.

Information Elements (IEs) are subfields contained within beacons, probe requests, probe responses, association requests and association responses. Each IE is assigned a unique Element Identifier (EID) to distinguish it from the others. Also each IE must follow the format specified within the standard for which it is defined. This test is designed to ensure that a device properly formats IEs defined within IEEE Std. 802.11-2007 Edition.

The DUT should:

a-d. properly format any and all supported Information Elements within beacons and Probe Response frames.

**Comments on Test Results**

a-d. There were no issues uncovered during the testing process.

| Test # and Label | Part(s) | Result(s) |
|---|---|---|
| **1.1.12: CTS-to-self Recognition** | **a** | **PASS** |
| **Comments on Test Procedure** | | |

*Purpose:* To verify that the DUT will delay transmission of any non-ACK frame for the time period specified in a CTS-to-self frame.

With the addition of the 802.11g specifications to the base standard, ERP STAs are allowed to transmit CTS frames with a RA matching its own MAC address as a protection mechanism for legacy stations. Legacy stations and ERP stations must update their NAV counters with the duration field specified in the CTS frame. Since CTS frames are class 1 frames, a STA does not need to be authenticated or associated in order for the STA to update it's NAV with the duration field.

a. The DUT should not transmit any frames during the CTS flood.

**Comments on Test Results**

a. There were no issues uncovered during the testing process.

| Test # and Label | Part(s) | Result(s) |
|---|---|---|
| **1.1.13: Duplicate Detection and Recovery** | **a** | **PASS** |
| | **b** | **FAIL** |

**Comments on Test Procedure**

*Purpose*: To verify that the DUT properly detects and filters duplicate frames.

Due to the design of the MAC layer protocol, it is possible for a STA to successfully receive the same frame or fragment of a frame more than once. Accordingly, duplicate detection and recovery is built into the MAC layer. The primary mechanism to detect duplicates is the sequence and fragment numbers contained in each frame. STAs generate sequence numbers as an incrementing sequence of integers. All STAs should maintain a cache of recently received sequence and fragment numbers from each STA. Whenever a STA receives a frame with a matching source address, sequence number, and fragment number, with the retry bit set, it should discard the frame as a duplicate (but still transmit an ACK). Due to the sequence number field being a modulo 4096 counter, it is possible for a frame to be improperly discarded as a duplicate, although it is highly unlikely.

The DUT should:

a. The DUT should:
   - use the same sequence number in the sequence control for all MPDUs that make up the same MSDU.
   - use an incrementing sequence number for all transmitted frames.
   - acknowledge and forward MSDU1 to STA-E and forward the ICMP Echo Response to the TS.
   - acknowledge but not forward MSDU1r to STA-E nor forward an ICMP Echo Response to the TS.
   - acknowledge MPDU3a, MPDU3b, MPDU3c and forward the frame composed of MPDU3a and MPDU3b to STA-E and the ICMP Echo Response to the TS.

b. The DUT should:
   - use the same sequence number in the sequence control for all MPDUs that make up the same MSDU.
   - use an incrementing sequence number for all transmitted frames.
   - acknowledge and forward each MSDU to STA-E and forward the ICMP Echo Response to the TS.

**Comments on Test Results**

a. There were no issues uncovered during the testing process.
b. The DUT was observed to not transmit an ICMP Echo reply upon reception of an ICMP Echo request containing a previously received sequence number with retry bit unset. The DUT should acknowledge and forward the ICMP Echo Response to the TS. See IEEE Std. 802.11-2007 subclause 9.2.9. Please refer to Table 4 for more information regarding this result

**GROUP 2: RTS AND FRAGMENTATION**

| Test # and Label | Part(s) | Result(s) |
|---|---|---|
| **1.2.1: Recovery Procedure and Retransmit Limits** | **a** | **Not Available** |
| | **b** | **Not Available** |
| | **c** | **Not Available** |
| | **d** | **Not Available** |
| | **e** | **Not Available** |

**Comments on Test Procedure**

*Purpose*: To verify that

- the DUT properly increments and resets the appropriate retries.
- the DUT sets the Retry Bit in all resent MPDUs.
- the DUT uses consistent vales for the SRC and LRC

Each MSDU should have its own short retry counter (SRC) and long retry counter (LRC), and the station must also keep a separate station short retry counter (SSRC) and station long retry counter (SLRC). When the DUT does not successfully transmit a frame, it should increment the SSRC or SLRC and the SRC or LRC for the MSDU. The counter used is dependent on whether the frame exceeds dot11RTSThreshold. Whenever a directed frame is successfully transmitted, the SSRC or SLRC and either the SRC or LRC is reset to 0. Whenever a group frame is successfully transmitted, both the SSRC and SLRC should be reset to 0. A DUT should stop retrying a frame once the MPDU's SRC has reached dot11ShortRetryLimit, or the MSDU's LRC has reached aLongRetryLimit. A station shall also keep a Transmit MSDU Timer for each MSDU. It shall be started on the first attempt to transmit the first fragment of the MSDU. If the transmit MSDU timer reaches aMaxTransmitMSDULifetime, then the entire MSDU should be discarded.

The DUT should:

a. transmit a RTS in response to MSDU1 exactly dot11ShortRetryLimit times, each RTS with the retry bit set to 0.
b. transmit the ICMP Echo Response in response to MSDU1 exactly dot11LongRetryLimit times.
c. transmit the ICMP Echo Response to MSDU1 exactly dot11ShortRetryLimit times.
d. transmit the ICMP Echo Response to MSDU2 exactly dot11ShortRetryLimit times.
e. transmit the first fragment of the ICMP Echo Response dot11ShortRetryLimit times.

**Comments on Test Results**

a-e. The DUT does not support RTS Thresholds; therefore no results could be collected for this section.

| Test # and Label | Part(s) | Result(s) |
|---|---|---|
| **1.2.2: RTS/CTS and Directed MPDU Transfer** | **a** | **Not Available** |
| | **b** | **Not Available** |
| | **c** | **Not Available** |
| | **d** | **Not Available** |

**Comments on Test Procedure**

**Purpose:** To verify that

- The DUT successfully completes a RTS/CTS exchange only when both NAVs indicate the medium to be idle.
- The DUT properly receives frames from devices with a different RTS threshold than its own.
- The DUT initiates an RTS/CTS exchange for directed frames when the length of the MPDU is greater than the dot11RTSThreshold.
- The DUT does not initiate an RTS/CTS exchange for all MPDUs if the value of the dot11RTSThreshold is larger than the maximum MSDU length.
- An asynchronous data frame is transmitted using the basic access procedure when a RTS/CTS exchange is not used.
- An asynchronous data frame is transmitted after the CTS frame and a SIFS period when a RTS/CTS exchange is used.

For virtual carrier sense to work properly, RTS and CTS frames must include a properly calculated duration field to indicate to other stations how long the medium will be occupied. The device transmitting an RTS should reserve the medium up until the first ACK of the frame exchange. A CTS frame should be calculated by subtracting (aSIFSTime + aCTSTime) from the RTS frame's duration field. Neither frame should be transmitted if a device's NAV indicates the medium is busy. Additionally, both RTS and CTS frames must be transmitted at one of the basic rates so that all stations are aware that the medium will be busy. Consequently, stations must support receiving data frames at a different rate than the rate of the RTS/CTS frames. In order to allow the transmitting station to calculate the duration field for the RTS frame, a receiving station must respond with a CTS at the same rate as the RTS. Since dot11RTSThreshold can be set on a per-station basis, STAs must also be capable of receiving frames larger than their dot11RTSThreshold without a RTS/CTS exchange. Should a receiving station respond to a RTS with a CTS but not receive a subsequent frame after aCTSTimeout, it shall begin its backoff at the end of aCTSTimeout. A device should process received frames that are longer than its RTS threshold that are not preceded by a RTS/CTS exchange.

a. The DUT should :
   - not use RTS/CTS preceding the ICMP Echo Response to MSDU1.
   - not use RTS/CTS preceding the ICMP Echo Response to MSDU2.
   - use RTS/CTS preceding the ICMP Echo Response to MSDU3.

b. The DUT should:
   - use RTS/CTS preceding the first fragment of the ICMP Echo Response to MSDU4.
   - use RTS/CTS only preceding the first fragment.

c. The DUT should:
   - use RTS/CTS preceding the first fragment of the ICMP Echo Response to MSDU8.
   - use RTS/CTS only preceding the first fragment.

d. The DUT should:
   - not use RTS/CTS preceding the ICMP Echo Response to MSDU5.
   - not use RTS/CTS preceding the ICMP Echo Response to MSDU6.
   - use RTS/CTS preceding the ICMP Echo Response to MSDU7.

**Comments on Test Results**

a-d. The DUT was observed to not support this technology; therefore no results could be collected for this section.

| Test # and Label | Part(s) | Result(s) |
|---|---|---|
| **1.2.3: Broadcast and Multicast MPDU Transfer** | **a** | **Not Available** |
| | **b** | **Not Available** |
| | **c** | **Not Available** |

**Comments on Test Procedure**

*Purpose:* To verify that

- The DUT does not use RTS/CTS with broadcast and multicast frames.
- The DUT transmits broadcast and multicast frames with a duration of 0.
- The DUT transmits broadcast and multicast frames without fragmentation.

When an AP receives a broadcast frame, it should relay it at a rate in the BSSBasicRateSet and as a single MPDU. It must not transmit a RTS, nor may it fragment the frame since it will not receive any ACKs in response to the frame.

a. For all MSDUs transmitted without using RTS/CTS or Fragmentation, the DUT should:
   - not use fragmentation when forwarding the frames to the BSS.
   - not use RTS/CTS when forwarding the frames to the BSS.

b. For all MSDUs transmitted using RTS/CTS and Fragmentation, the DUT should:
   - not use fragmentation when forwarding the frames to the BSS.
   - not use RTS/CTS when forwarding the frames to the BSS.

c. The DUT should
   - buffer broadcast and multicast frames when there are PS-STAs present (at least the Listen Interval of the TS).
   - set the More Data bit when transmitting all buffered broadcast and multicast frames except for the last one.
   - be able to properly handle receiving data frames with the ToDS and FromDS bits both set to 1.

**Comments on Test Results**

a-c. The DUT was observed to not support this technology; therefore no results could be collected for this section.

| Test # and Label | Part(s) | Result(s) |
|---|---|---|
| **1.2.4: Directed MPDU Fragmentation** | **a** | **Not Available** |
| | **b** | **Not Available** |

**Comments on Test Procedure**

*Purpose:* To verify that the DUT properly fragments directed MSDUs and MMPDUs when the frame length exceeds the DUT's fragmentation threshold.

A STA's fragmentation threshold is the maximum transmission length that a directed MSDU or MMPDU can be before fragmentation will occur. To determine whether or not a MSDU or MMPDU should be fragmented, a transmitting STA must account for the length and type of frame (unicast, broadcast, or multicast) as well as the type of network that the frame is to be transmitted in (Ad-hoc or Infrastructure). For either type of network, if the MSDU or MMPDU is unicast and is larger than the transmitting STA's fragmentation threshold, it should be fragmented before transmission.

For a fragment transmission to be considered successful, the STA that transmitted the fragment must receive an ACK before proceeding to transmit the next frame. There are many errors that could occur with a fragment transmission. For example, the fragment could be determined invalid due to the FCS in which case the receiving STA would not transmit an ACK. Another possible instance for an unsuccessful transmission is if the STA that transmitted the fragment does not hear the receiving STA's ACK. The fragment would be retransmitted after the transmitting STA performs the backoff procedure.

Each fragment has specific information included by the transmitting STA. This includes the frame type, more fragments indicator bit, destination address, retry bit, sequence number, and fragment number. All of these values should be correctly set by the source STA before the fragment is transmitted. If they are not correctly set before transmission, they will not be received or assembled correctly.

a. The DUT should:
   - transmit the response to MSDU1 fragmented at 512-bytes.
   - correctly set the More Fragments Bit in all fragments.
   - correctly set the Destination Address in all fragments.
   - correctly maintain the same Sequence Number for all fragments belonging to the response to MSDU1.
   - begin the Fragment Number at 0 and increments it by 1 for each successive fragment belonging to the response to MSDU1.

b. The DUT should:
   - transmit the response to MSDU4 and MSDU5 fragmented at 300-bytes.
   - correctly set the More Fragments Bit in all fragments.
   - correctly set the Destination Address in all fragments.
   - correctly maintain the same Sequence Number for all fragments belonging to the response to MSDU4 and MSDU5.
   - begin the Fragment Number at 0 and increments it by 1 for each successive fragment belonging to the response to MSDU4 and MSDU5.

**Comments on Test Results**

a-b. The DUT was observed to not support this technology; therefore no results could be collected for this section.

| Test # and Label | Part(s) | Result(s) |
|---|---|---|
| **1.2.5: Multirate Support** | **a** | **Not Available** |
| | **b** | **Not Available** |
| | **c** | **Not Available** |
| | **d** | **Not Available** |
| | **e** | **Not Available** |
| | **f** | **Not Available** |

**Comments on Test Procedure**

*Purpose:* To verify that the DUT's dynamic rate-switching algorithm will properly interoperate and coexist with all supported physical layer data transmission rates.

One performance enhancer of the 802.11 specification is the dynamic rate-switching mechanism. Rate-switching allows a STA to determine a transmit rate that gives it the optimal throughput based on the number of retries per rate and the throughput per rate. Since dynamic rate-switching may be supported, a STA must also support successful reception and acknowledgement of frames at different transmit rate values. An example of successful reception and acknowledgement is having all frames with multicast and broadcast RA transmitted at one of the rates included in the BSSBasicRateSet, regardless of the underlying physical layer.

The intention for the stringent requirements for rate selection is to allow for multiple STAs in a network to use different rate configurations. In this scenario, it guarantees that an optimal amount of traffic be heard by every STA in the BSS. It also allows for a STA to properly set its NAV value to include any necessary control response frames needed to complete the frame exchange.

a-f. The DUT should
- transmit all control response (CTS and ACK) frames at one of the basic rates in the BSSBasicRateSet that is not only of the same modulation, but at a rate less than or equal to the rate that the previous frame was transmitted at.
- transmit all other control frames at one of the rates in the BSSBasicRateSet.
- transmit directed data and management frames at a rate that is known to be supported by the receiving STA.
- transmit all frames with multicast and broadcast address 1 field are transmitted at one of the rates included in the BSSBasicRateSet, regardless of their PHY type.
- Not initiate transmission of a data or management frame at a data rate higher than the greatest rate in the OperationalRateSet.

**Comments on Test Results**

a-b. The DUT was observed to not support this technology; therefore no results could be collected for this section.

| Test # and Label | Part(s) | Result(s) |
|---|---|---|
| **1.2.6: Defragmentation using RTS/CTS** | **a** | **Not Available** |

**Comments on Test Procedure**

*Purpose*: To verify that the DUT is capable of receiving fragments of an arbitrary length, and is able to reassemble them properly while using RTS/CTS.

Defragmentation is the process of assembling successfully received fragments back into the original MSDU or MMPDU. All STAs must be capable of defragmentation. Because it is possible for source STAs to transmit fragments of an arbitrary length, destination STAs must be capable of defragmenting fragments of arbitrary length.

Defragmentation can be a difficult process for the receiving STA, especially when receiving pieces of different MSDUs or MPDUs at a time. To aid the receiving STA in the assembly process, specific information is included in each fragment by the transmitting STA. Each fragment contains information in the header that is used to put a sequence of fragments together again after the entire sequence has been received. This information that the defragmenting STA must use includes the frame type, address of transmitter, sequence control field, and the More Fragments indicator.

A STA must also be able to handle received fragments from multiple MSDUs or MPDUs at once. Reference [1] specifies that a STA must be able to handle fragments from at least three different frames concurrently. A maximum number is not specified; however, when receiving more concurrent fragmented MSDUs or MPDUs, there is a greater chance that more errors will be experienced.

After receiving the first fragment any MSDU or MMPDU, a receive timer will be initiated. If the receive timer exceeds the MaxReceiveLifetime timer, which has a predetermined value of 512 kμs, all received fragments for that MSDU or MMPDU will be discarded. Any fragments that belong to a particular MSDU or MMPDU that are received after the timer has elapsed will be acknowledged by the receiving STA but should then be discarded.

The DUT should:

a. defragment MSDU1 for all the fragmentation thresholds used to fragment it, use the RTS/CTS procedure, forward MSDU1 to STA-E, and forward the ICMP Echo Response to the TS.

**Comments on Test Results**

a. The DUT was observed to not support this technology; therefore no results could be collected for this section.

**GROUP 3: WEP AND POWERSAVE**

| Test # and Label | Part(s) | Result(s) |
|---|---|---|
| **1.3.1: WEP Decryption Procedure** | **a** | **PASS** |
| | **b** | **PASS** |
| | **c** | **PASS** |
| | **d** | **PASS** |

**Comments on Test Procedure**

*Purpose:* To verify that

- The DUT properly decrypts data as specified by the 802.11 standard.
- The DUT does not process encrypted frames with an invalid ICV.

Due to the inherent nature of the WLAN environment, the opportunity for eavesdropping is greatly increased. Therefore, the Wired Equivalent Privacy (WEP) algorithm was developed. WEP attempts to give 802.11 networks the same amount of security that would be provided on a regular wired network that was using no extra security functions. There are four parts that are essential to the performance of the WEP algorithm:

- The secret key: is the key that is entered into the "WEP key" value.
- The initialization vector (IV): extends the useful lifetime of a secret key and provides the self-synchronous property of the WEP algorithm.
- The pseudorandom number generator (PRNG): transforms a relatively short secret key into an arbitrary length key sequence.
- The integrity check value (ICV): protects against unauthorized data modification.

Given these components, it is imperative that a device have the ability to correctly decrypt received frames.

The DUT should:

a. transmit an ACK upon reception of MSDU1, however, not transmit an ICMP Echo Response.
b. transmit an ACK upon reception of MSDU2, however, not transmit an ICMP Echo Response.
c. not transmit an ACK upon reception of MSDU3, nor process the frame.
d. transmit an ACK for each transmission of MSDU4, and transmit an ICMP Echo Response.

**Comments on Test Results**

a-d. There were no issues uncovered during the testing process.

| Test # and Label | Part(s) | Result(s) |
|---|---|---|
| **1.3.2: Aging Function** | **a** | **Not Available** |
| | **b** | **FAIL** |
| | **c** | **Not Available** |
| | **d** | **Not Available** |
| | **e** | **PASS** |

**Comments on Test Procedure**

*Purpose:* To verify that

- The DUT discards any buffered traffic that has been queued for an excessive period of time.
- The DUT does not discard any buffered traffic after any period less than the Listen Interval of the STA for which the traffic is buffered.

As APs have a limited amount of memory reserved for buffering, and it is possible for stations to fail or go out of range without properly disassociating, an aging function must be designed into APs to discard old frames. The exact point at which frames should be discarded is not defined in the standard, but the period must not be shorter than a Listen Interval, otherwise frames could be discarded before a STA has a chance to poll for them.

The DUT should:

a-d. eventually discard traffic that has been buffered for a period of time longer than the listen interval of TS1. Additionally, the DUT should not discard traffic that has been buffered for TS1 for less than the listen interval of TS1.

e. eventually discard traffic that has been buffered for a period of time longer than the Listen Interval of each TS. Additionally, the DUT should not discard traffic that has been buffered for each TS for less than the Listen Interval of each TS.

**Comments on Test Results**

a, c, d. The DUT was observed to not support configuration of the Beacon Interval; therefore no results could be collected for this section.

b. The DUT was observed to discard buffered traffic for an associated station prior to the expiration of the station's Listen Interval. The TS was successfully associated with a Listen Interval of 1024, and the DUT was observed to buffer traffic for the TS for less than 500 Beacon Intervals. The DUT should buffer traffic for the TS for at least the Listen Interval of the TS. See IEEE Std. 802.11-2007 subclause 11.2.1.11. Please refer to

c. Table 5 for more information regarding this result.

e. There were no issues uncovered during the testing process.

| Test # and Label | Part(s) | Result(s) |
|---|---|---|
| **1.3.3: PS-Poll Processing** | **a** | **FAIL** |
| | **b** | **FAIL** |
| | **c** | **FAIL** |
| | **d** | **FAIL** |

**Comments on Test Procedure**

*Purpose:* To verify that the DUT has the ability to operate properly upon reception of PS-Poll frames.

A STA may be in two different power states, awake and doze. The two ways a STA changes from these states, determined by the STA's power management mode, are active mode and power save mode (PS). A STA that changes from doze to awake for frame transmission shall perform a clear channel assessment in order to set its NAV appropriately, or until a ProbeDelay period has occurred. All MSDUs or management frames destined for STAs in PS mode will be buffered at the AP, and all broadcast/multicast frames, if destined to any STA in PS mode, will also be buffered at the AP before distribution. After a DTIM, the AP shall transmit any buffered broadcast/multicast frames, with the More Data field set for each MSDU except the last, indicating the presence of more buffered broadcast/multicast frames at the AP. All buffered MSDUs and management frames shall be transmitted in the same manner as buffered broadcast/multicast frames, upon reception of a PS-Poll from the STA by the AP. Retried PS-Polls will not be treated as new requests to deliver any traffic that is buffered. When a STA changes back to Active mode, the AP shall transmit buffered MSDUs and management frames, if they exist, without waiting for a PS-Poll.

The DUT should:

a-d. either transmit a queued data frame, or transmit an ACK followed by either a queued data frame or a null data frame upon reception of each PS-Poll.

**Comments on Test Results**

a-d. The DUT was observed to not transmit a data or null data frame upon reception of an unsolicited PS-Poll. The DUT should transmit a data or null data frame to any station upon reception of a PS-Poll frame. See IEEE Std. 802.11-2007 subclause 11.2.1. Please refer to Table 6 for more information regarding this result.

| Test # and Label | Part(s) | Result(s) |
|---|---|---|
| **1.3.4: Defragmentation using WEP** | **a** | **Not Tested** |

**Comments on Test Procedure**

*Purpose:* To verify that the DUT is capable of receiving WEP encrypted fragments of an arbitrary length, is able to reassemble them, and properly encrypt the resulting MSDU.

Defragmentation is the process of assembling successfully received fragments back into the original MSDU or MMPDU. All STAs must be capable of defragmentation. Because it is possible for source STAs to transmit fragments of an arbitrary length, destination STAs must be capable of defragmenting fragments of arbitrary length.

Defragmentation can be a difficult process for the receiving STA, especially when receiving pieces of different MSDUs or MPDUs at a time. To aid the receiving STA in the assembly process, specific information is included in each fragment by the transmitting STA. Each fragment contains information in the header that is used to put a sequence of fragments together again after the entire sequence has been received. This information that the defragmenting STA must use includes the frame type, address of transmitter, sequence control field, and the More Fragments indicator.

A STA must also be able to handle received fragments from multiple MSDUs or MPDUs at once. Reference [1] specifies that a STA must be able to handle fragments from at least three different frames concurrently. A maximum number is not specified; however, when receiving more concurrent fragmented MSDUs or MPDUs, there is a greater chance that more errors will be experienced.

After receiving the first fragment any MSDU or MMPDU, a receive timer will be initiated. If the receive timer exceeds the MaxReceiveLifetime timer, which has a predetermined value of 512 kμs, all received fragments for that MSDU or MMPDU will be discarded. Any fragments that belong to a particular MSDU or MMPDU that are received after the timer has elapsed will be acknowledged by the receiving STA but should then be discarded.

The DUT should:

a. defragment MSDU1 for all the fragmentation thresholds used to fragment it, forward MSDU1 to STA-E, and forward the ICMP Echo Response to the TS.

**Comments on Test Results**

a. The DUT was observed to not support a 64-bit wep key, and there was not enough time remaining in the test week to implement a test using a 128-bit key.

**TRACE EVALUATION:**

**Table 3**

**Test #: 1.1.4: Open System Authentication Processing part a**
From: Apple\AirPort_Extreme_Base_Station\July09\MAC\AP\Base\Traces\1.1.4.cap

| No. | Info | Protocol | Source | Distination |
|---|---|---|---|---|
| 42 | Deauthentication, Unspecified reason | IEEE 802.11 | Xerox_00:00:01 | aa:bb:cc:dd:ee |
| 43 | Acknowledgement | IEEE 802.11 | | Xerox_00:00:01 (RA) |
| 44-54 | Beacon frames, BI=100, SSID=MAC"" | IEEE 802.11 | aa:bb:cc:dd:ee | Broadcast |
| 55 | Authentication, Successful | IEEE 802.11 | Xerox_00:00:01 | aa:bb:cc:dd:ee |
| 56 | Acknowledgement | IEEE 802.11 | | Xerox_00:00:01 (RA) |
| 57-67 | Beacon frames, BI=100, SSID=MAC"" | IEEE 802.11 | aa:bb:cc:dd:ee | Broadcast |
| 68 | Association Request, SSID=MAC"" | IEEE 802.11 | Xerox_00:00:01 | aa:bb:cc:dd:ee |
| 69 | Acknowledgement | IEEE 802.11 | | Xerox_00:00:01 (RA) |
| 70 | Deauthentication, Station requesting (re)association is not authenticated with responding station | IEEE 802.11 | aa:bb:cc:dd:ee | Xerox_00:00:01 |
| 71 | Acknowledgement | IEEE 802.11 | | aa:bb:cc:dd:ee |

```
Frame 55
IEEE 802.11 Authentication
    Type/Subtype: Authentication (0x0b)
    Frame Control: 0x00B0 (Normal)
    Duration: 258
    Destination address: aa:bb:cc:dd:ee
    Source address: Xerox_00:00:01 (00:00:01:00:00:01)
    BSS Id: aa:bb:cc:dd:ee
    Fragment number: 0
    Sequence number: 1
    Frame check sequence: 0xb0a3f749 [correct]
        [Good: True]
        [Bad: False]
IEEE 802.11 wireless LAN management frame
    Fixed parameters (6 bytes)
        Authentication Algorithm: Open System (0)
        Authentication SEQ: 0x000a
        Status code: Successful (0x0000)

0000  b0 00 02 01 00 1b 63 2d 00 fa 00 00 01 00 00 01
0010  00 1b 63 2d 00 fa 10 00 00 00 0a 00 00 00 b0 a3
0020  f7 49
```

**Table 4**

**Test # 1.1.13: Duplicate Detection and Recovery part b**
From: Apple\AirPort_Extreme_Base_Station\July09\MAC\AP\Base\Traces\1.1.13.cap

| No. | Info | Protocol | Source | Distination |
|---|---|---|---|---|
| 267 | Echo (ping) request | ICMP | 192.168.1.101 | 192.168.1.20 |
| 268 | Acknowledgement | IEEE 802.11 | | Xerox_00:00:01 (RA) |
| 269 | Echo (ping) reply | ICMP | 192.168.1.20 | 192.168.1.101 |
| 270 | Acknowledgement | IEEE 802.11 | | aa:bb:cc:dd:ee |
| 271-292 | Beacon frames, BI=100, SSID=MAC"" | IEEE 802.11 | aa:bb:cc:dd:ee | Broadcast |
| 293 | Echo (ping) request | ICMP | 192.168.1.102 | 192.168.1.20 |
| 294 | Acknowledgement | IEEE 802.11 | | Xerox_00:00:02 (RA) |
| 295 | Echo (ping) reply | ICMP | 192.168.1.20 | 192.168.1.102 |
| 296 | Acknowledgement | IEEE 802.11 | | aa:bb:cc:dd:ee |

```
Frame 267
IEEE 802.11 Data
    Type/Subtype: Data (0x20)
    Frame Control: 0x0108 (Normal)
    Duration: 44
    BSS Id: aa:bb:cc:dd:ee
    Source address: Xerox_00:00:01 (00:00:01:00:00:01)
    Destination address: DellComp_23:63:de (00:08:74:23:63:de)
    Fragment number: 0
    Sequence number: 15
    Frame check sequence: 0x5551ac8e [correct]
    Header checksum: 0x342f [correct]
    Source: 192.168.1.101 (192.168.1.101)
    Destination: 192.168.1.20 (192.168.1.20)
Internet Control Message Protocol
    Type: 8 (Echo (ping) request)
    Code: 0 ()
    Checksum: 0xe8c4 [correct]
    Identifier: 0x6ac1
    Sequence number: 4854 (0x12f6)
    Data (1000 bytes)
        Data: 000102030405060708090A0B0C0D0E0F1011121314151617...
        [Length: 1000]

Frame 293
IEEE 802.11 Data
    Type/Subtype: Data (0x20)
    Frame Control: 0x0908 (Normal)
    Duration: 44
    BSS Id: aa:bb:cc:dd:ee
    Source address: Xerox_00:00:02 (00:00:01:00:00:02)
    Destination address: DellComp_23:63:de (00:08:74:23:63:de)
    Fragment number: 0
    Sequence number: 15
    Frame check sequence: 0x0178d21b [correct]
    Total Length: 1028
    Identification: 0x0000 (0)
    Flags: 0x00
    Fragment offset: 0
    Time to live: 255
    Protocol: ICMP (0x01)
    Header checksum: 0x342e [correct]
        [Good: True]
```

```
        [Bad: False]
    Source: 192.168.1.102 (192.168.1.102)
    Destination: 192.168.1.20 (192.168.1.20)
Internet Control Message Protocol
    Type: 8 (Echo (ping) request)
    Code: 0 ()
    Checksum: 0xe8c4 [correct]
    Identifier: 0x6ac1
    Sequence number: 4854 (0x12f6)
    Data (1000 bytes)
        Data: 000102030405060708090A0B0C0D0E0F1011121314151617...
        [Length: 1000]
```

**Table 5**

**Test # 1.3.2: Aging Function part b**
From: Apple\AirPort_Extreme_Base_Station\July09\MAC\AP\Base\Traces\1.3.2.cap

| No. | Info | Protocol | Source | Distination |
|---|---|---|---|---|
| 2155 | Authentication, Successful | IEEE 802.11 | Xerox_00:00:01 | aa:bb:cc:dd:ee |
| 2156 | Acknowledgement | IEEE 802.11 | | Xerox_00:00:01 (RA) |
| 2157 | Authentication, Successful | IEEE 802.11 | aa:bb:cc:dd:ee | Xerox_00:00:01 |
| 2158 | Acknowledgement | IEEE 802.11 | | aa:bb:cc:dd:ee |
| 2159-2168 | Beacon frames, BI=100, SSID=MAC"" | IEEE 802.11 | aa:bb:cc:dd:ee | Broadcast |
| 2169 | Association Request, SSID=MAC"" | IEEE 802.11 | Xerox_00:00:01 | aa:bb:cc:dd:ee |
| 2170 | Acknowledgement | IEEE 802.11 | | Xerox_00:00:01 (RA) |
| 2171 | Association Response, Successful | IEEE 802.11 | aa:bb:cc:dd:ee | Xerox_00:00:01 |
| 2172 | Acknowledgement | IEEE 802.11 | | aa:bb:cc:dd:ee |
| 2173-2217 | … | | | |
| 2218 | Null function (No data) | IEEE 802.11 | Xerox_00:00:01 | aa:bb:cc:dd:ee |
| 2219 | Acknowledgement | IEEE 802.11 | | Xerox_00:00:01 (RA) |
| 2221 | Echo (ping) request | ICMP | 192.168.1.102 | 192.168.1.101 |
| 2222 | Acknowledgement | IEEE 802.11 | | Xerox_00:00:02 (RA) |
| 2223-2612 | Beacon frames, BI=100, SSID=MAC"" | IEEE 802.11 | aa:bb:cc:dd:ee | Broadcast |
| 2613 | Beacon frame, BI=100, SSID=MAC"" | IEEE 802.11 | aa:bb:cc:dd:ee | Broadcast |

```
Frame 2169
IEEE 802.11 Association Request
    Type/Subtype: Association Request (0x00)
    Frame Control: 0x0000 (Normal)
    Duration: 258
    Destination address: aa:bb:cc:dd:ee
    Source address: Xerox_00:00:01 (00:00:01:00:00:01)
    BSS Id: aa:bb:cc:dd:ee
    Fragment number: 0
    Sequence number: 59
    Frame check sequence: 0x39f101e9 [correct]
IEEE 802.11 wireless LAN management frame
    Fixed parameters (4 bytes)
        Capability Information: 0x0001
        Listen Interval: 0x0400
    Tagged parameters (21 bytes)
        SSID parameter set: "MAC"
            Tag Number: 0 (SSID parameter set)
            Tag length: 3
            Tag interpretation: MAC

0000  00 00 02 01 00 1b 63 2d 00 fa 00 00 01 00 00 01
0010  00 1b 63 2d 00 fa b0 03 01 00 00 04 00 03 4d 41
0020  43 01 07 02 04 0b 16 0c 18 30 32 05 12 24 48 60
0030  6c 39 f1 01 e9
```

```
Frame 2171
IEEE 802.11 Association Response
    Type/Subtype: Association Response (0x01)
    Frame Control: 0x0010 (Normal)
    Duration: 0
    Destination address: Xerox_00:00:01 (00:00:01:00:00:01)
    Source address: aa:bb:cc:dd:ee
    BSS Id: aa:bb:cc:dd:ee
    Fragment number: 0
    Sequence number: 1
    Frame check sequence: 0x466bceea [correct]
IEEE 802.11 wireless LAN management frame
    Fixed parameters (6 bytes)
        Capability Information: 0x0021
        Status code: Successful (0x0000)
        Association ID: 0x0002

0000  10 00 00 00 00 00 01 00 00 01 00 1b 63 2d 00 fa
0010  00 1b 63 2d 00 fa 10 00 21 00 00 00 02 c0 01 08
0020  82 84 8b 0c 12 96 18 24 32 04 30 48 60 6c 2d 1a
0030  0c 10 1b 00 00 00 00 00 00 00 00 00 00 00 00 00
0040  00 00 00 00 00 00 00 00 00 00 3d 16 01 00 1b 00
0050  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0060  00 00 46 6b ce ea

Frame 2218
IEEE 802.11 Null function (No data)
    Type/Subtype: Null function (No data) (0x24)
    Frame Control: 0x1148 (Normal)
        Version: 0
        Type: Data frame (2)
        Subtype: 4
        Flags: 0x11
            .... ..01 = DS status: Frame from STA to DS via an AP
            .... .0.. = More Fragments: This is the last fragment
            .... 0... = Retry: Frame is not being retransmitted
            ...1 .... = PWR MGT: STA will go to sleep
            ..0. .... = More Data: No data buffered
            .0.. .... = Protected flag: Data is not protected
            0... .... = Order flag: Not strictly ordered
    Duration: 44
    BSS Id: aa:bb:cc:dd:ee
    Source address: Xerox_00:00:01 (00:00:01:00:00:01)
    Destination address: aa:bb:cc:dd:ee
    Fragment number: 0
    Sequence number: 62
    Frame check sequence: 0x84664f26 [correct]
        [Good: True]
        [Bad: False]

0000  48 11 2c 00 00 1b 63 2d 00 fa 00 00 01 00 00 01
0010  00 1b 63 2d 00 fa e0 03 84 66 4f 26
```

```
Frame 2613
IEEE 802.11 Beacon frame
    Type/Subtype: Beacon frame (0x08)
    Frame Control: 0x0080 (Normal)
        Version: 0
        Type: Management frame (0)
        Subtype: 8
        Flags: 0x0
    Duration: 0
    Destination address: Broadcast (ff:ff:ff:ff:ff:ff)
    Source address: aa:bb:cc:dd:ee
    BSS Id: aa:bb:cc:dd:ee
    Fragment number: 0
    Sequence number: 2566
    Frame check sequence: 0x7bf4917d [correct]
IEEE 802.11 wireless LAN management frame
    Fixed parameters (12 bytes)
        Timestamp: 0x000000000FA64180
        Beacon Interval: 0.102400 [Seconds]
        Capability Information: 0x0121
        Traffic Indication Map (TIM): DTIM 1 of 3 bitmap empty
            Tag Number: 5 (Traffic Indication Map (TIM))
            TIM length: 4
            DTIM count: 1
            DTIM period: 3
            Bitmap Control: 0x00 (mcast:0, bitmap offset 0)

0000  80 00 00 00 ff ff ff ff ff ff 00 1b 63 2d 00 fa
0010  00 1b 63 2d 00 fa 60 a0 80 41 a6 0f 00 00 00 00
0020  64 00 21 01 00 03 4d 41 43 01 08 82 84 8b 96 0c
0030  12 18 24 03 01 01 05 04 01 03 00 00 07 06 55 53
0040  20 01 0b 1b 20 01 00 2a 01 00 32 04 30 48 60 6c
0050  2d 1a 0c 10 1b ff ff 00 00 00 00 00 00 00 00 00
0060  00 00 00 00 00 00 00 00 00 00 00 00 3d 16 01 00
0070  1b 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0080  00 00 00 00 dd 18 00 50 f2 02 01 01 0a 00 03 a4
0090  00 00 27 a4 00 00 42 43 5e 00 62 32 2f 00 dd 07
00a0  00 03 93 01 69 01 20 7b f4 91 7d
```

**Table 6**

**Test #: 1.3.3: PS-Poll Processing**

From: Apple\AirPort_Extreme_Base_Station\July09\MAC\AP\Base\Traces\1.3.3.cap

| No. | Info | Protocol | Source | Distination |
|---|---|---|---|---|
| 148 | Power-Save poll | IEEE 802.11 | Xerox_00:00:01 (BSSID) | aa:bb:cc:dd:ee |
| 149 | Acknowledgement | IEEE 802.11 | | Xerox_00:00:01 (RA) |
| 150-160 | Beacon frames, BI=100, SSID=MAC"" | IEEE 802.11 | aa:bb:cc:dd:ee | Broadcast |
| 161 | Power-Save poll | IEEE 802.11 | Xerox_00:00:01 (BSSID) | aa:bb:cc:dd:ee |
| 162 | Acknowledgement | IEEE 802.11 | | Xerox_00:00:01 (RA) |