

WiMedia Platform Test Specification



Making High-Speed Wireless a Reality...

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[B]2 MULTIBAND OFDM PHYSICAL LAYER SPECIFICATION, RELEASE CANDIDATE 1.2, MARCH 26,
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1. Introduction

This specification is used in conjunction with the WiMedia MAC specification [B]1.

This document provides the test descriptions for WiMedia Platform testing. It is relevant for anyone implementing the WiMedia MAC protocol. The test descriptions in the document focus on performing testing on end products (not discrete MAC implementations).

Clause 2 defines a set of terms used in the remaining clauses.

Clause 3 provides general test information and a high level description of each test.

Clause 4 describes the test requirements for each test case, unless otherwise noted in clause 5.

Clause 5 provides the reference step procedures for each test case and any test case specific requirements. Pass/fail requirements for test cases are completely specified in clauses 4 and 5.

2. Definitions

For the purposes of this specification, the following terms and definitions apply. The WiMedia MAC Specification [B]1 should be referenced for terms not defined in this clause.

2.1 Adjacent Channel Interference: RF interference caused by a nearby radio operating on a different TFC.

2.2 Device under test (DUT): The device that is being tested.

2.3 FYI test: An FYI test is mandatory to run, but passing the test is not a requirement for certification.

2.4 Interop device (INTD): A companion device provided by the DUT provider, with which the DUT will operate and exhibit normal functionality. For example, a DUT that is a Certified Wireless USB self beaconing device could provide a Certified Wireless USB host as its interop device.

2.5 Platform test system: A set of device(s) that transmit stimuli during test cases and monitor the channel used for a test in order to record the test results.

2.6 Test operator: An individual executing an implementation of the test software to test a DUT and/or INTD.

2.7 Test software: A software implementation that executes the platform tests using a platform test system.

2.8 TX only test system: Test system that is only capable of transmitting pre-defined frames at specified times and is not capable of receiving frames. In most of the test cases for a TX only test system the test system transmits beacons with a superframe interval of 65538 microseconds to ensure that it is the slowest device in the beacon group.

2.9 TX and RX test system: Test system that is capable of transmitting beacons in specific slots and is capable of synchronizing to other devices in the beacon group. The TX and RX test system always sends beacons with a superframe interval in the range allowed by the WiMedia MAC specification [B]1.

3. Test Descriptions

3.1 General Test Information

3.1.1 Channel Selection by DUT

Each test case is run on a specific PHY channel [B]2. The DUT must have a mode in which it will operate on the specified channel. The DUT must not leave the specified channel during a test case. The DUT must support one of the following methods to operate on a specified channel during test cases:

- DUT supports an optional test mode ASIE, and will operate exclusively on a channel specified if such an IE is received from a neighbor. The test mode IE is defined in Annex B of this specification.
- DUT supports a device specific mechanism to specify the channel for operation. This could be done through a GUI or control on the device. The mechanism must be supported by the shipping product without modification.
- DUT will operate on a specific channel if all other channels have no available beacon slots.

The DUT submitter must provide another device to demonstrate operation. This device is referred to as the interop device (INTD). In all test cases the DUT (and INTD) must begin to demonstrate operation on a specified channel when the test operator is prompted by the test software. The meaning of demonstrate operation is DUT specific and will normally involve transmitting beacons by the DUT and INTD and the exchange of data between DUT and INTD. The demonstrated operation must be consistent with the appropriate PICS for any feature(s) relevant to the specific test case. Each optional feature for which support is claimed in the PICS shall be used by the DUT during its demonstrated operation outside a reservation of type Private. It is the responsibility of the manufacturer to provide suitable operation to invoke the optional features. Any optional feature claimed to be supported in the PICS but not used in the required manner during the test event will be ruled invalid and will require the DUT to be re-submitted for testing with a corrected PICS.

3.1.2 Test System Initialization

During each test case the test system is configured to monitor all traffic on the channel specified for the test. If the DUT requires all channels except the test channel to be blocked, the test system transmits a beacon on each channel except the channel under test with a BPOIE indicating that all beacon slots are occupied. The test system continues to transmit a beacon in each superframe on all channels except the channel under test throughout the test case. The test system uses the MAC address for the DUT and INTD to record the device associated with any observed failure.

3.1.3 Test System and DUT/INTD locations

The DUT and INTD shall be placed at least 2 meters from the test system. The DUT and INTD may be placed anywhere relative to each other, as long as they are each 2 meters from the test system. All of the devices shall have line of sight connections during test operation. During setup, the DUT and INTD may be aligned/rotated to maximize the successful reception of DUT/INTD beacons by the test system.

For the ACI tests, an adjacent channel interferer test system is required. The interferer is placed N meters from the DUT and INTD and N+2 meters from the test system (N is listed in the test case description). See Figure 1 for an example configuration.

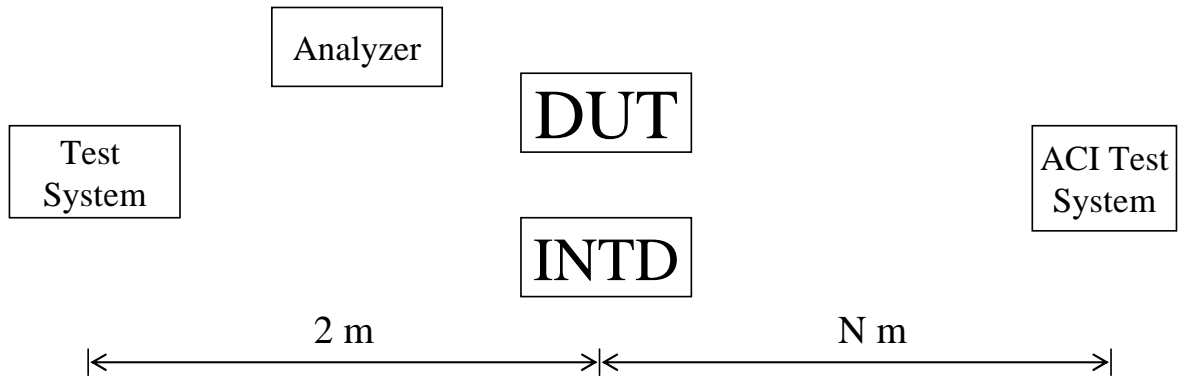


Figure 1 — ACI test setup

3.1.4 Standard Test Start-up Sequence

The following test sequence is executed during each test case. Any exceptions or departures from this sequence are noted in individual test descriptions.

- For the TX and RX test system, in many cases, the DUT and INTD may continue operation from one test to the next. For the TX only test system, the DUT and INTD must be disabled at the start of each test.
- The test system monitors all traffic on the test channel.
- The test system blocks all channels except the test channel as described in 3.1.2 (if required by DUT).
- The test software prompts for DUT and INTD to begin operation on specified channel.
- The test operator provides necessary stimuli for DUT and INTD to begin operation.
- The following conditions cause the DUT to fail the test case:
 - The DUT transmits any non-beacon frame before it begins transmitting beacons (except as noted in clause 4).
 - The DUT does not begin transmitting beacons on the specified channel.
 - The DUT transmits any frame on a channel other than the channel specified for test.

3.1.5 Required Response Time to Stimulus in Beacon Protocol Tests

When the test system provides a stimulus that requires a response by the DUT, it will continue to provide the stimulus until the response is observed or a timeout period is exceeded. The test software will record how long it took for the DUT to respond. Exceptions to this behavior are specifically called out in individual test cases.

3.1.6 Test System Handling of Lost or Skipped Beacons

The test system must account for the fact that the DUT will skip beacon transmission during the tests and that the test system may fail to correctly receive beacons from the DUT or INTD and vice versa. If the test system ever fails to receive a beacon from the DUT or INTD for $m\text{MaxLostBeacons}+1$ consecutive superframes (except for cases where the DUT or INTD hibernates or where test case collisions may cause different neighborhoods to be reported) then the test system treats the test as a failure. If the DUT fails to receive a beacon from the INTD or vice versa for $m\text{MaxLostBeacons}+1$ consecutive superframes the test system treats the test as a failure. In all cases where the test system does not successfully receive the DUT or INTD beacon the test system continues to provide the stimulus for the test case. As long as the next beacon received from the DUT or INTD has the expected information the test case is considered passed. If the DUT or INTD fails to receive a beacon from the test system for $m\text{MaxLostBeacons}+1$ consecutive superframes (except for cases where the DUT hibernates) the test system treats the test as a failure. In all cases where the DUT does not successfully receive the test system beacon

(and the test system can determine this through the BPOIE info) the test system continues to provide the stimulus for the test case. As long as the DUT responds correctly once it receives the test system beacon the test case is considered passed.

Note that the test system must allow for cases where it hears the DUT beacon but the INTD does not, or it hears the INTD beacon but the DUT does not. The test system must also allow for cases where it does not hear the DUT beacon but the INTD does, or it does not hear the INTD beacon but the DUT does. Such mismatches must not occur more than 8% of the time or the test is considered a failure.

3.1.7 Repeat Execution of Test Cases

The vendor presenting the DUT and INTD for testing may, for whatever reason, request to repeat the execution of a given test case provided that not more than 3 test cases are repeated in any given test run of all the test cases.

If a test case is repeated, it shall be repeated at least 3 times. The test system treats the test result as a failure, if more than 25% of the test runs fail (initial test run plus all repeated test runs).

Notes:

A test case might be re-started by the test operator due to an operator error or failure of the test system. In such a case, the test operator shall discard any captured information, and the previous rules on repetition do not apply to that attempt.

At the vendor's request, the test operator shall confirm after each test case that the DUT and INTD started synchronized based on the test system's logs, to permit the vendor to request repeat execution if desired.

3.1.8 Background Information on DUT Operation

The following information must be gathered and provided to the test system/test software before the tests described in this document are executed.

- Does the DUT require the INTD to begin transmitting beacons before it will begin beacon transmission?
- Method used by DUT to operate on a specific channel.
- EUI-48 of DUT and INTD. The EUI-48 of the DUT and INTD must not be the same. If either EUI-48 will change during test suite execution this must be explained by the test submitter.
- Whether DUT or INTD uses PCA.
- Which (if any) reservation types are used by the DUT and INTD.

3.2 Beacon Tests

3.2.1 Beacon Slot Info Test (Test Case 1.2)

This test verifies that the DUT sets the slot states correctly in the Beacon Slot Info bitmap.

The test system repeats the following pattern in consecutive superframes for at least 100 iterations: transmit a beacon with the moveable bit set to 0, transmit a beacon with the moveable bit set to 1, transmit a beacon which has an FCS error, skip beacon transmission and transmit a data frame.

In response to this test, a device

- shall correctly report the test system beacons it receives.

3.2.2 Generated DevAddr Conflict Test (Test Case 1.6)

This test verifies that a DUT changes its DevAddr when it receives a beacon that indicates a device with the same DevAddr is using a different beacon slot.

The test system transmits a beacon with the same DevAddr as the DUT. The test system transmits a beacon with a BPOIE that reports a beacon with the same DevAddr as the DUT, but in a different beacon slot.

In response to this test, a device

- shall use a new DevAddr in the superframe after receiving the test system's beacon with the DUT's DevAddr.
- shall use a new DevAddr in the superframe after receiving the test system's beacon with the BPOIE that reports the DUT's DevAddr in a beacon slot different from the DUT.

3.2.3 BP Length Expansion (Test Case 1.1)

This test verifies that the DUT will extend the Beacon Period length using a signaling slot when it receives a neighbor's beacon whose BP length does not cover the DUT's beacon slot.

The test system transmits a beacon with a BP Length that is less than the DUT's beacon slot.

In response to this test, a device

- shall transmit a beacon in a randomly selected signaling slot for $mMaxLostBeacons + 1$ superframes as well as the DUT's regular beacon in the corresponding beacon slot.
- shall start signaling slot usage in the superframe after receiving the test system's beacon in which the DUT's beacon slot is beyond the test system's BP length.
- shall not transmit a beacon in a signaling slot for at least $mMaxLostBeacons + 1$ superframes after transmitting a beacon in a signaling slot for $mMaxLostBeacons + 1$ consecutive superframes.
- shall cease signaling slot usage in the superframe after receiving the test system's beacon in which its beacon slot is within the test system's BP length.

3.2.4 Beacon Join with BP Length Expansion (Test Case 3.1)

This test verifies that the DUT will extend the Beacon Period length using a signaling slot when it joins an existing BP.

The test system transmits a beacon with a BP Length that is equal to its beacon slot number + 1. The DUT is required to join the test system's beacon group.

In response to this test, a device

- shall, upon joining the test system's beacon group, transmit a beacon in a randomly selected signaling slot for $mMaxLostBeacons + 1$ superframes as well as its regular beacon in the corresponding beacon slot.

3.2.5 Beacon Period Length Extension by Test System (Test Case 1.3)

This test verifies that the DUT will respond correctly when the Beacon Period length is increased by a device joining the beacon period.

The test system transmits a beacon in a signaling slot and in the identified beacon slot that requires the DUT to extend its BP Length.

In response to this test, a device

- shall extend its BP length in the superframe after receiving the signaling slot beacon.
- shall report the signaling slot beacon in its BPOIE.

3.2.6 Listen For Required Portion of a Slot Test (Test Case 1.4)

This test verifies that the DUT listens for the required portion of a beacon slot.

The test system transmits a beacon whose transmission start time varies from mGuardtime before the beacon slot start time to mGuardtime after the beacon slot start time.

In response to this test, a device

- shall correctly report the test system beacons in its BPOIE.

3.2.7 DevAddr Beacon Slot Collision (Test Case 1.5)

This test verifies that the DUT responds correctly when it receives a beacon that indicates a device with a different DevAddr is using its beacon slot.

The test system transmits a beacon with a BPOIE that reports a DevAddr different from the DUT's in the DUT's beacon slot.

In response to this test, a device,

- shall relocate its beacon slot in the superframe after the collision is detected.

3.2.8 BcstAddr Beacon Slot Collision (Test Case 1.8)

This test verifies that the DUT responds correctly when it receives a beacon with a BPOIE with BcstAddr in its beacon slot.

The test system transmits a beacon with a BPOIE that reports BcstAddr in the DUT's beacon slot.

In response to this test, a device:

- shall perform 1 of the following actions within mMaxBeaconSlotCollisionDetectionLatency + 1 superframes:
 - relocate its beacon slot,
 - skip beacon transmission,
 - or, transmit a beacon in a signaling slot.

3.2.9 Beacon Slot Collision after Skipped Transmission (Test Case 1.7)

This test verifies that the DUT responds correctly when it receives a beacon in its beacon slot after it skipped beacon transmission.

The test system transmits a beacon in the DUT's beacon slot.

In response to this test, a device:

- shall relocate its beacon slot after it receives a beacon in its beacon slot when it skips beacon transmission. It shall relocate its beacon slot within 30 seconds.

3.2.10 Beacon Period Contraction in Move Cases (Test Case 1.9)

This test verifies that the DUT will relocate its beacon to a lower slot when required by the beacon protocol.

With at least 1 available beacon slot between the signaling slots and the DUT's beacon slot, the test system transmits a beacon in a slot higher than the DUT's beacon slot with its moveable bit set to 0.

In response to this test, a device:

- shall contract its beacon slot to the lowest available beacon slot.

3.2.11 Beacon Period Contraction in Cases Where Move Is Not Allowed (Test Case 1.10)

This test verifies that the DUT will not relocate its beacon to a lower slot when a beacon in a higher indexed slot is movable.

With at least 1 available beacon slot between the signaling slots and the DUT's beacon slot, the test system transmits a beacon in a beacon slot higher than the DUT's beacon slot with its moveable bit set to 1.

In response to this test, a device:

- shall not contract to the lower available beacon slot while the test system is transmitting the moveable beacon.

3.2.12 Information Elements and Reserved Fields (Test Case 3.8)

This test verifies that the DUT maintains beacon synchronization when it receives a neighbor beacon containing multiple different IE types and Beacon reserved bits set.

The test system sends 1 or more beacons which contain the following IEs: Regulatory Domain, PCA Availability, DRP Availability, Probe, TIM, MAC Capabilities, PHY Capabilities, Identification, Link Feedback, Application Specific, Application Specific Probe, MKID, MAB, Test, Local cycle change Request and Link Indication IE. The test system also sends a beacon with the following reserved bits set to 1: Frame Control[15:14], Sequence Control[15] and Beacon Parameters.Device Control[5:2].

In response to this test, a device:

- shall continue normal operation on the channel.

3.2.13 Reporting Unaligned Beacon frame in BPOIE (Test Case 1.14)

This test verifies that the DUT reports an unaligned beacon frame in its BPOIE with 0x2 in the bit map and 0xFFFF for the corresponding DevAddr.

The test system sends an unaligned beacon frame in a beacon slot in which the DUT is required to listen. The unaligned beacon frame's BPST falls within the BP of the DUT, so that the DUT is not required to relocate its BPST.

In response to this test, a device:

- shall report the unaligned beacon frame in its BPOIE with a Beacon Slot Info bitmap value of 2 and a DevAddr = 0xFFFF.

3.2.14 BP Length with BcstAddr reports (Test Case 1.15)

This test verifies that the DUT does not extend its BP Length due to a neighbor beacon reporting BcstAddr in a slot beyond the highest monitored beacon slot.

The test system reports reception of 1 or more HCS error frames in beacon slots that are beyond the DUT's highest monitored beacon slot.

In response to this test, a device:

- shall not extend its BP length mBPExtension beacon slots beyond its highest monitored beacon slot.

3.2.15 Signaling Slot Beacon Slot Collision (Test Case 1.16)

This test verifies that the DUT responds correctly when it receives a beacon in a signaling slot that indicates a device with a different DevAddr is using its beacon slot.

The test system sends a beacon frame in a signaling slot that has a different DevAddr but has the same beacon slot as the DUT.

In response to this test, a device:

- shall relocate its beacon slot in the superframe after the collision is detected.

3.2.16 Hibernation Mode IE Test (Test Case 3.10)

This test verifies that the DUT sets the slot states correctly in the Beacon Slot Info bitmap in the presence of a hibernating neighbor. It also ensures the DUT includes a MAC Capabilities IE when requested, and if the device supports hibernation anchor functionality, tests that the IE is included and formatted correctly.

Under normal operation, the test system sends beacon frames that simulate a hibernating device. The simulated device always sends at least 4 beacons counting down to hibernation. The test runs for at least 5 hibernation cycles. The hibernating device must use a beacon slot lower than those of the DUT and INTD. The test includes simulation of a device that ceases operation while hibernating, to test compliance to the mMaxHibernationProtection requirement. The test also sends a few beacons simulated to come from an alternate device during the hibernation interval.

In response to this test, a device:

- shall mark the beacon slot for the hibernating device as occupied and non-movable in the BPOIE in its beacon, with DevAddr set to the DevAddr of the hibernating device, during the hibernation interval indicated.
- shall not mark the beacon slot for the hibernating device as occupied in the BPOIE in its beacon after a hibernation interval has ended, except in response to actual beacons received.
- shall consider the hibernating device's beacon slot as occupied in superframes up to mMaxHibernationProtection after the last received beacon from the test system, and shall contract only after that time has expired.
- shall include a MAC Capabilities IE in its beacon in every superframe following transmission of a test system beacon containing a Probe IE that requests the MAC Capabilities IE, unless it does not indicate reception of the test system beacon in its BPOIE.
- should, if the included MAC Capabilities IE has the Hibernation anchor bit set to one, include a Hibernation Anchor IE. If it does, the fields must be set correctly. If the device indicates Hibernation Anchor support but does not include a Hibernation Anchor IE, a warning is generated, but this is not a cause for test failure.

3.2.17 Scan and Join When Receiving Intermittent Beacons (Test Case 3.11)

This test verifies that the DUT will scan for at least 2 superframes when it receives no beacon frames or valid frame headers after scanning for 1 superframe.

The test system transmits at least 4 beacons every other superframe.

In response to this test, a device

- shall join the test system's beacon group.

3.2.18 Scan and Join When Receiving Intermittent Beacons and Data Frames (Test Case 3.12)

This test verifies that the DUT will scan for at least 3 superframes when it receives no beacon frames after scanning for 2 superframes, but does receive 1 or more valid frame headers.

The test system transmits at least 4 beacons every third superframe. During every superframe, the test system transmits at least 4 data frames.

In response to this test, a device

- should join the test system's beacon group.

3.3 Beacon Merge Tests

3.3.1 Overlapping Alien BP Requires BPST Realignment (Test Case 1.11)

This test verifies that the DUT will realign its BPST when it overlaps with an alien BPST.

The test system transmits a beacon during the DUT's beacon period which requires the DUT to realign its BPST with the test system's BPST.

In response to this test, a device

- shall adjust its BPST to align with the test system beacon's BPST and relocate its beacon slot.

3.3.2 Updating BP Switch IE (Test Case 1.12)

This test verifies that the DUT will update a BP Switch IE correctly when changes are required to the existing values in a BP Switch IE it is transmitting. This test verifies that the DUT will perform beacon relocation.

The test system will perform a normal BP switch countdown. At least once during the BP relocation, the test system will force the DUT to reset its BP Move Countdown field to mInitialMoveCountdown.

In response to this test, a device

- shall include a valid BP Switch IE in its beacon.
- shall set its BP Move Countdown value to the test system's BP Move Countdown value.
- shall decrement its BP Move Countdown field each superframe.
- upon its BP Move Countdown reaching 0, shall relocate its beacon per its Beacon Slot Offset and BPST Offset.

3.3.3 BP Switch IE with No Switching Neighbor (Test Case 1.17)

This test verifies that the DUT sets the fields of a BP Switch IE correctly, and changes BPST correctly, in the event a neighbor cancels a BP merge, and in the event the neighbor that initiated the BP merge disappears.

In the first part of the test, the test system includes a BP Switch IE indicating a BP Merge. After 4 superframes, the test system modifies the BP Switch IE consistent with halting the relocation process as described in the MAC Specification sub clause 8.2.6.3. The test system then counts down to zero and adjusts one microsecond as described.

In response to this part of the test, a device

- shall modify its BP Switch IE and count down consistent with MAC rules.

In the second part of the test, the test system needs to be in beacon slots 2 and 3. It includes a BP Switch IE indicating a BP Merge in its beacon in slot 2, and does not indicate reception of that beacon in its beacon in slot 3. After 4 superframes, the test system ceases sending the beacon in slot 2, which included the BP Switch IE.

In response to this part of the test, a device

- shall continue to count down its existing BP Switch IEs and change BPST at the correct time, despite the presence of the beacon in beacon slot 3. It is expected to become Movable, but not permitted to contract into beacon slot 2. Once the merge is complete, it is possible the DUT and INTD will merge back to align with the test system beacon in slot 3, but not without a proper BP Switch IE and countdown or a drop and rejoin.

3.4 Reservation Tests

3.4.1 Device Honors Reservations When It Receives Reservations with Conflicting Types For The Same MAS (Test Cases 2.1, 2.2, 2.3 and 2.4)

These tests verify that a DUT will not transmit in reservations advertised by other devices when it receives beacons indicating reservations with conflicting types for the same MAS.

The test system generates a reservation conflict with the DUT's reservation using Hard DRPs and Alien BP DRPs. The reservation conflicts will force the DUT to stop transmitting in the conflicting MAS slots and, if possible, relocate its reservation.

In response to this test, a device

- shall stop transmitting in a conflicting MAS by the start of the superframe following the superframe in which the conflict is discovered.
- which is the reservation owner shall remove the conflicting MAS from its reservation.
- which is the reservation target shall either remove the conflicting MAS from its reservation or mark the reservation as Conflict.

3.5 Synchronization Tests

3.5.1 Clock Accuracy (Test Case 5.1)

This test verifies that a DUT beacon interval indicates the minimum required clock accuracy.

In response to this test, a device

- when transmitting beacons by itself,
 - shall transmit beacons with a beacon interval between 65536-1.4 to 65536+1.4 microseconds.
- when transmitting beacons with the INTD,
 - shall have an average beacon interval of 65536 +/- 1.4 microseconds.
 - shall have a beacon interval of between 65536-1.4 to 65536+2.4 microseconds for superframes in which the DUT heard the INTD beacon in the previous ten superframes.
 - shall have a beacon interval between 65536-1.4 and 65536+5.4 microseconds between every superframe.

Note: These values are assuming a perfect test system. A test implementation needs to factor in test system resolution.

3.5.2 Start-up Beacon Period Synchronization (all Test Cases with Tx only test system)

This test verifies that DUT synchronizes to the slowest beacon in the superframe on startup.

The test system starts a beacon group with a beacon interval of 65538 microseconds.

In response to this test, a device

- shall join the test system's beacon group.
- shall maintain beacon period synchronization with the test system.
- for each beacon transmitted shall transmit it no later than and no earlier than 13 microseconds before the beacon slot boundary defined by the test system beacons.

- shall have an average error (difference between test system's slot boundary and where the beacon is received) in beacons transmitted of less than 4 microseconds over 100 beacons.

3.5.3 Synchronization with Multiple Beacons (Test Cases 3.3 and 3.4)

This test verifies that DUT synchronizes correctly in the presence of multiple beacons.

The test system transmits 9 beacons with nominal intervals of 65538 microseconds, with each beacon sent a random number of microseconds from 0 to 4 earlier than the scheduled location based on the nominal interval.

In response to this test, a device

- shall maintain beacon period synchronization with the test system.

3.5.4 Bad Link BPST Synchronization (Test case 3.9)

This test verifies that DUT synchronizes correctly when it does not receive a beacon every superframe.

The test system transmits beacons with the following pattern - transmits a beacon in superframe N and skips beacon transmission in superframe N+1 and N+2.

In response to this test, a device

- shall maintain beacon period synchronization with the test system.

3.6 Reservation Policy Tests

3.6.1 Reservation Size and Location Rules While Operating On An Empty Channel (Test Case 5.1)

This test verifies that the DUT follows reservation size and location rules when it operates on an empty channel.

3.6.2 Row Reservations Are Taken As Low As Possible In Superframe (Test Case 2.5)

This test verifies that the DUT follows reservation size and location rules when it operates on a channel with existing row reservation(s).

The test system transmits a beacon with a reservation that occupies the lowest N rows of the superframe.

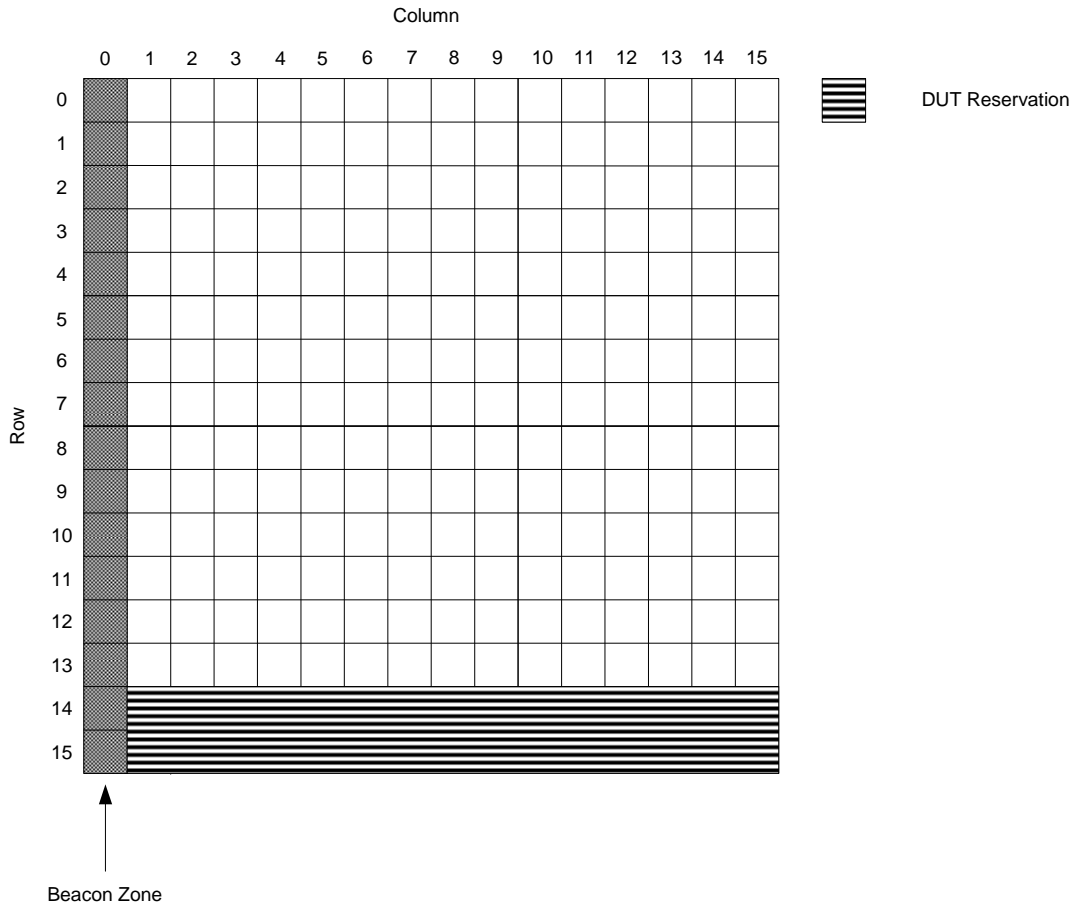


Figure 2 — DUT Row Reservation on Empty Channel

Figure 2 shows an example DUT reservation on an empty channel. For this DUT the test system would take an initial reservation of 1 row (as show in Figure 2) and check that the DUT took the lowest available block of two rows.

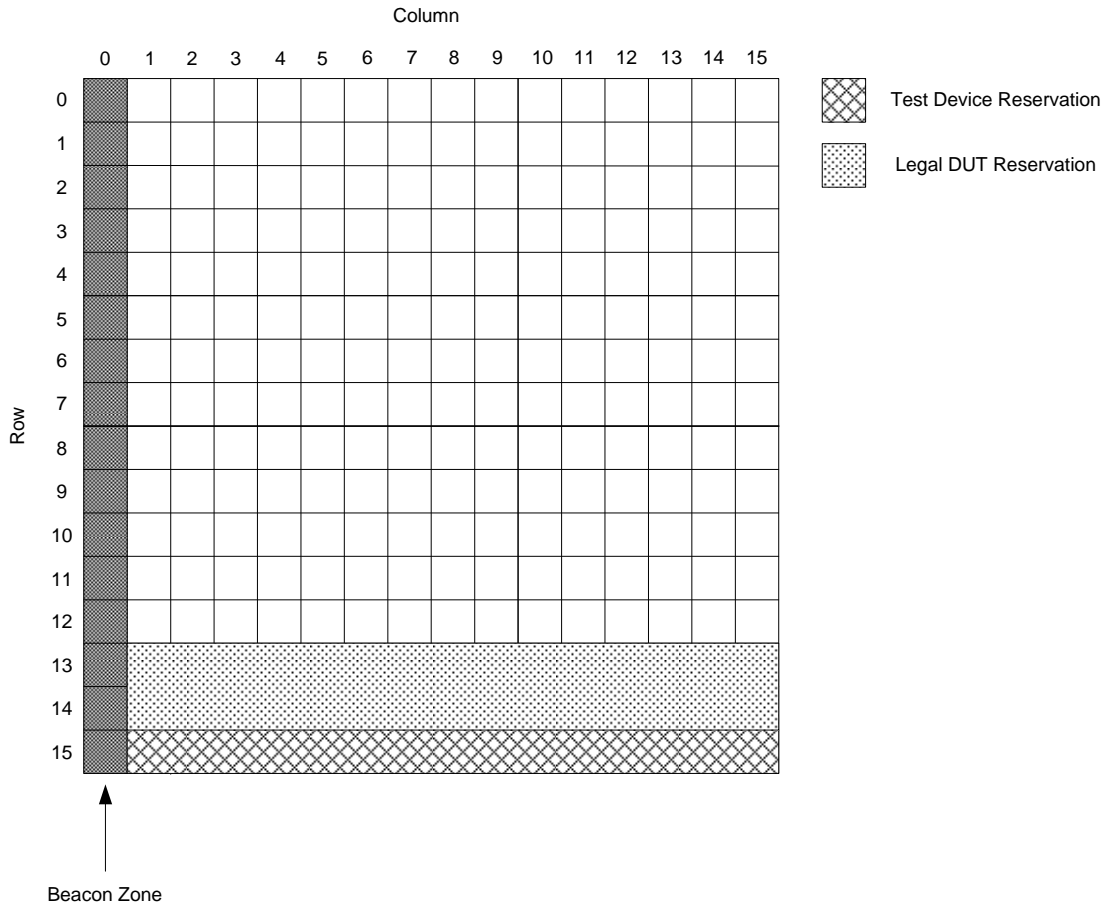


Figure 3 — Legal DUT Reservation with One Row Reserved

In response to this test, a device

- shall establish its row reservations as low as possible in the superframe.

3.6.3 DUT Row Reservation Blocks Move Lower In Superframe When Possible (Test Case 2.5)

This test verifies that the DUT follows reservation size and location rules when it operates on a channel with existing row reservation(s). The test specifically tests that the DUT will move reservations lower in the superframe when other device reservations are removed.

The test system transmits a beacon with a reservation that occupies the lowest N rows of the superframe. After the DUT establishes its row reservation, the test system removes its reservation.

In response to this test, a device

- shall lower its reservation as much as possible within mCompaction Limit superframes.

3.6.4 DUT Column Reservation Blocks Located As High As Possible (Test Case 2.5)

This test verifies that the DUT follows reservation size and location rules when it operates on a channel with existing column reservation(s). The test specifically tests that the DUT still locates its reservation correctly when it joins a channel with existing column reservations.

The test system transmits a beacon with a reservation that occupies the top N rows of the superframe.

Note: If the DUT reservation contains blocks of more than 4 contiguous MAS, the reservation may be required to change to smaller blocks or mark part of the reservation unsafe when it must locate lower in the superframe.

Example Test Behavior

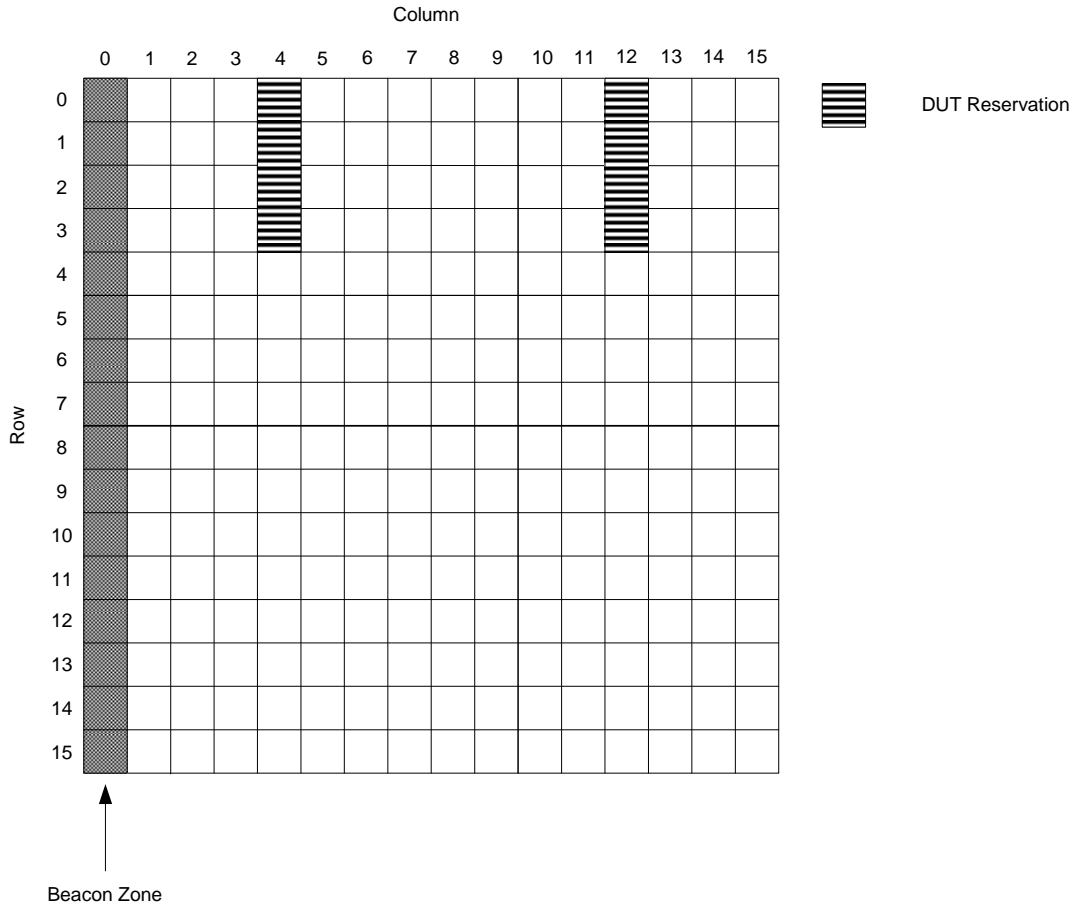


Figure 4 — Initial DUT Column Reservation on Empty Channel

Figure 4 shows the initial reservation of a DUT on an empty channel. The reservation consists of two evenly spaced blocks of 4 MAS. Figure 5 shows the expected DUT reservation when it joins a channel with the top row reserved. The test software assumes that the DUT will keep its preferred reservation pattern if possible.

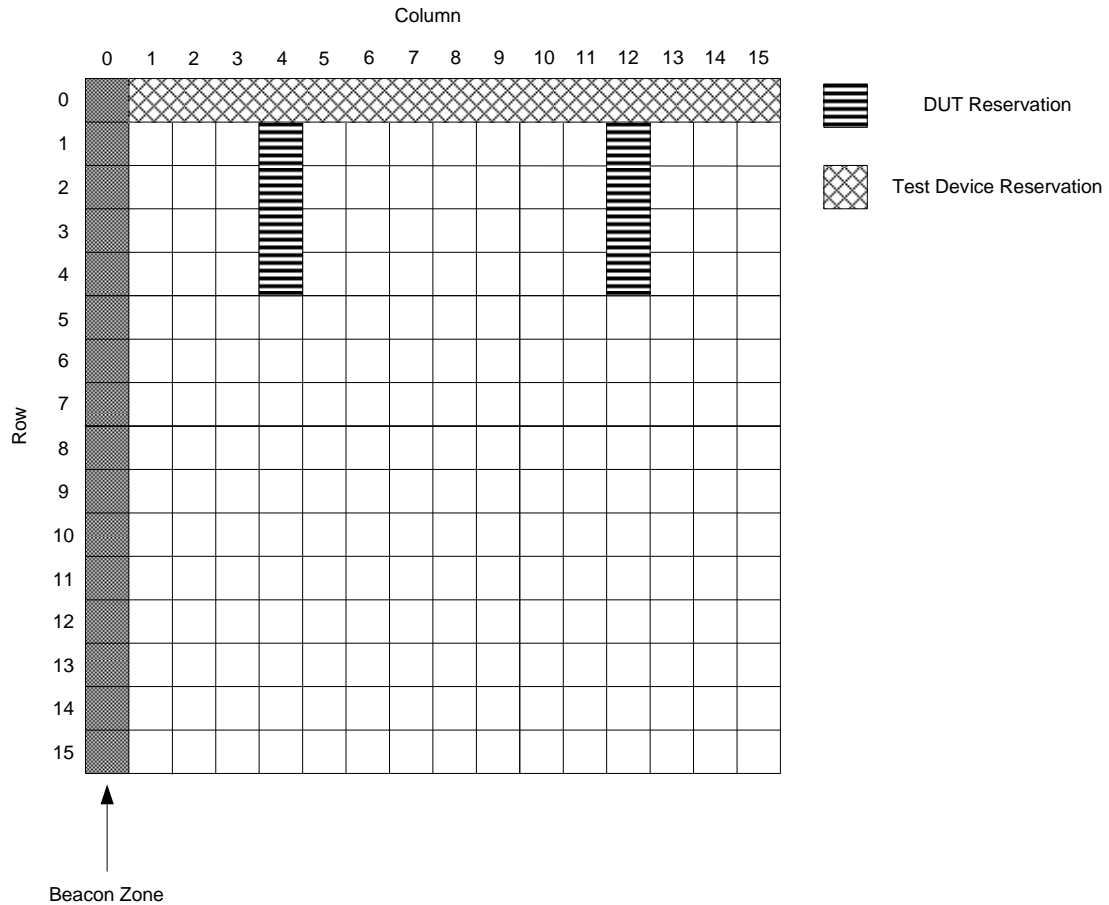


Figure 5 — Legal DUT Reservation with Top Row Reserved

In response to this test, a device

- shall establish its column reservations as high as possible in the superframe.

3.6.5 DUT Column Reservation Blocks Move Up In Superframe When Possible (Test Case 2.5)

This test verifies that the DUT follows reservation size and location rules when it operates on a channel with existing column reservation(s). The test specifically tests that the DUT will move blocks in a column reservation component higher in the current column when possible.

The test system transmits a beacon with a reservation that occupies the top N rows of the superframe. After the DUT establishes its column reservation, the test system removes its reservation.

In response to this test, a device

- shall move its reservation as high as possible in the superframe within mCompactionLimit superframes.

3.6.6 DUT Row Reservation Policy (Test Case 2.6)

This test verifies that the DUT follows reservation size and location rules when it operates on a channel with existing row reservation(s). This test specifically verifies that the DUT will move its row reservation down in the superframe and over an existing reservation when possible.

The test system transmits a beacon with a reservation that occupies the bottom 8 rows of the superframe. Once the DUT establishes its row reservation, the test system frees 1 row at a time from its reservation until it frees its entire reservation.

In response to this test, a device

- shall lower its reservation as much as possible within mCompactionLimit superframes.

3.6.7 DUT Column Reservation Policy (Test Case 2.7)

This test verifies that the DUT follows column reservation size and location policy rules when it operates on a channel with existing column reservation(s). The test specifically tests that the DUT will move blocks in a column reservation component laterally and/or higher in the current column when possible.

The test system transmits a beacon that reserves the top 8 rows of the superframe. Once the DUT establishes its column reservation, the test system frees 1 column at a time from its reservation.

In response to this test, a device

- shall adjust its reservation (as necessary) per the Annex B rules for column reservations within mCompactionLimit superframes.

3.6.8 Response to a Relinquish Request (Owner and Target) (Test Case 2.8 – 2.11)

These tests verify that the DUT properly responds as an owner and/or target to receiving a Relinquish Response IE. These tests are only required if the DUT supports use of unsafe reservations.

The test system transmits a beacon which includes a Relinquish Response IE targeted at the DUT.

In response to this test, a device

- shall adjust its reservation to either release the identified unsafe MASs or make the identified MASs safe.
- shall, if it is the reservation target, forward the Relinquish Request to its reservation owner.

3.6.9 Issue Relinquish Request (Test Case 2.12)

This test verifies that the DUT will issue a Relinquish Request. This test is only required if the DUT supports issuing Relinquish Requests.

The test system reserves the entire superframe with the bottom 7 rows marked as safe and the upper 9 rows marked as unsafe.

In response to this test, a device

- shall include a Relinquish Request IE in its beacon.

3.7 PCA Tests

3.7.1 PCA Honors Reservation Boundaries (Test Case 7.1)

This test verifies that the DUT PCA traffic honors Hard, Soft and Private reservation boundaries. The test specifically verifies that the DUT PCA traffic is not transmitted in a Hard or Private reservation waits the proper backoff at the start of each Soft reservation and does not transmit in a Soft reservation in which it only receives the DRP IE for the reservation from the target.

The test system transmits a beacon with Hard, Private and Soft reservations, including a soft reservation as an owner and a target. The test system also transmits RTS frames at the start of Soft reservations (Owner) with a 10% probability.

In response to this test, a device

- shall not transmit frames in the Hard, Private and Soft (target) reservations.
- shall only transmit a frame in the Soft (owner) reservations after at least an AIFS microseconds from the start of the reservation.
- shall only transmit a frame in the Soft (owner) reservations after completing a PCA backoff.

3.7.2 PCA Use of Duration (Test Case 7.2)

This test verifies that the DUT respects the Duration field while transmitting frames via PCA.

The test system sets up PCA reservations of 4 MASs in columns 4, 8, and 12, and a Private reservation in row 15. The test system transmits RTS frames with random Duration values at the start of the PCA reservations to leave portions of the superframe off-limits to PCA traffic.

In response to this test, a device

- shall operate normally.
- shall not transmit a PCA frame that overlaps a claimed Duration from a test system RTS frame, with an 8 percent allowance for the DUT or INTD missing the test system frame header.

(Note that because of the private row reservation at the bottom of the chart, a test system frame sent at the start of a PCA reservation block will always beat out a DUT or INTD PCA frame.)

3.8 ACI Tests

3.8.1 ACI Present During Join (Test Case 8.1)

This test verifies that the DUT will correctly join and operate in a beacon group while in the presence of adjacent channel interference.

In this test, the adjacent channel interference is started before the DUT is enabled. For TFI-to-TFI and TFI-to-FFI interference, the interferer is the same distance from the DUT as the test system. For FFI-to-FFI interference, the interferer is one half the distance from the DUT as the test system.

In response to this test, a device

- shall join the test system's beacon group.
- shall operate normally.

3.8.2 ACI Present After Join (Test Case 8.2)

This test verifies that the DUT will correctly operate in a beacon group while in the presence of adjacent channel interference.

In this test, the adjacent channel interference is started after the DUT has joined the test system's beacon group. For TFI-to-TFI and TFI-to-FFI interference, the interferer is the same distance from the DUT as the test system. For FFI-to-FFI interference, the interferer is one half the distance from the DUT as the test system.

In response to this test, a device

- shall operate normally.

3.9 Power Management Mechanism Tests

3.9.1 Global Cycle Establishment – Single GCST (Test Case 9.1)

This test verifies that DUT can establish a global cycle when it creates a beacon group or when it joins a beacon group where no other device has a GCSC field. In either case the DUT should choose a GCST. This test also verifies that INTD can also establish a global cycle when joining a beacon group where other devices have an existing (single) GCSC.

In response to this test, a device

- shall join the test system's beacon group.
- shall establish a global cycle by choosing a GCST value if no GCST is received (first device joining) or using a value one less than the value of the received GCST (second device joining).

3.9.2 Global Cycle Establishment – Multiple GCST (Test Case 9.2)

This test verifies that DUT can establish a global cycle when it joins a beacon group where at least two devices have a different GCST.

In response to this test, a device

- shall join the test system's beacon group.
- shall establish a global cycle by using a GCSC value one less than the smaller GCST value received.

3.9.3 Global Cycle Process – Single Unaligned GCST (Test Case 9.3)

This test verifies that DUT can align its GCST when it receives one or more beacons indicating a single unaligned GCSC value.

In response to this test, a device

- shall set its GCSC field to a random integer drawn from a uniform distribution over the interval $[0, wMaxGCSC]$ when the difference between its GCST and the unaligned GCST is equal to $(wMaxGCSC+1)/2$.
- shall set its GCSC field to one less than the unaligned GCSC value in the previous superframe when the unaligned GCST falls within the second half of the device's global cycle.
- Shall decrement its GCSC by one in when none of previous conditions are present.

3.9.4 Global Cycle Process – Multiple Unaligned GCST (Test Case 9.4)

This test verifies that DUT can align its GCST when it receives beacons indicating multiple unaligned GCSC values.

In response to this test, a device

- shall set its GCSC field to one less than smallest received GCSC value.

3.9.5 Local Cycle (Test Case 9.5)

This test verifies that DUT and INTD set the Local Cycle Index field in their Anchor Selection IE to a value larger than or equal to 0 and smaller than or equal to $wMaxLocalCycleIndex (=8)$. The test also verifies that the DUT and INTD are in active mode in the first superframe of their local cycles.

In response to this test, a device

- shall join the test system's beacon group.
- shall start its local cycle at a BPST, and shall determine its local cycle as follows: Local cycle = $2n$ superframes, where n is its local cycle index; $0 \leq n \leq wMaxLocalCycleIndex$
- Shall be in active mode in the first superframe of its local cycle.
- Shall set the Local Cycle Index in the Cycle Parameters field in its Anchor Selection IE to its current local cycle index.

3.9.6 Anchor Selection – Selecting Neighbor (Test Case 9.6)

This test verifies that the DUT shall select its hibernation anchor once every anchor cycle at the beginning (within the first few superframes) of that anchor cycle.

In response to this test, a device

- shall start a new anchor cycle every $2wMaxLocalCycleIndex$ superframes relative to its GCST.

3.9.7 Anchor Selection – Selecting Self (Test Case 9.7)

This test verifies that the DUT shall select itself as a hibernation anchor if it has not selected a neighbor as its hibernation anchor as described in rule C within $wMaxCycleWait$ superframes after the start of an anchor cycle, where $wMaxCycleWait$ is randomly selected between $[wMaxCycleWaitMin, wMaxCycleWaitMax]$.

3.9.8 Anchor Selection – Selecting Rule D (Test Case 9.8)

This test verifies that the DUT selects itself as a hibernation anchor, when in the previous superframe,

- It has received an ACW or AnchorAddr from all of its neighbors and
- All neighbors that have an ACW value higher than its own have indicated selection of a hibernation anchor and
- All neighbors that have the same ACW value as its own and have higher beacon slot numbers than its own have indicated selection of a hibernation anchor.

4. Continuously Monitored Background Tests

The tests described in this sub clause are checked continuously in the background during all other test cases unless exceptions are specifically noted.

Frames sent within a private reservation established by the DUT or INTD are only tested for standard frame formats and frame type and frame sub-type field values.

4.1 Additional Conditions Key

Additional common conditions that are applied to a background check, as required:

- [DADDR] Applies only if the DestAddr of the immediately previous frame is the same as the DevAddr of the device.
- [STRM] Applies only to sequences of frames with the same Delivery ID and DestAddr field values.
- [8%] Subject to an 8% frame loss limit. A device must pass this test in at least 92% of the frames in which the check is made. To avoid statistical anomalies, no errors are reported when the background check is applied to less than 100 DUT or 100 INTD frames in a testcase.
- [50%] Subject to a 50% frame loss limit. A device must pass this test in at least 50% of the frames in which the check is made. To avoid statistical anomalies, no errors are reported when the background check is applied to less than 100 DUT or 100 INTD frames in a testcase.

4.2 Beacon Format Background Tests

This test verifies that a variety of beacon format rules are not violated by the DUT or INTD for a beacon received without an HCS error. At least 92% of the DUT beacons must be received by the test system with the expected FCS value. Header checks are performed for beacon frames received with FCS errors, but payload checks are ignored.

Beacon Format Checks

- BFC-01 The Frame_Control.Reserved field must be zero.
- BFC-02 The Frame_Control.Protocol_Version field must be zero.
- BFC-03 The Frame_Control.Secure field must be zero.
- BFC-04 The Frame_Control.Ack_Policy field must be No-ACK.
- BFC-05 The Frame_Control.Retry field must be zero.
- BFC-06 The Frame_Control.Frame_Type field must be zero (Beacon frame).
- BFC-07 The Frame_Control.Frame_Type field must be zero in any frame transmitted in a beacon period.
- BFC-08 The Frame_Control.Frame_Subtype field must be zero.
- BFC-09 The DestAddr field must be 0xFFFF (BcstAddr).
- BFC-10 The Sequence_Control.More_Fragments field must be zero.
- BFC-11 The Sequence_Control.Fragment_Number field must be zero.
- BFC-12 The Sequence_Control.Sequence_Number field must be zero or increment by one each superframe (not each beacon).
- BFC-13 The Access_Information.Access_Method field must be zero.
- BFC-14 The Access_Information.More_Frames field must be zero.
- BFC-15 The Access_Information.Duration field must be zero, the transmission time of the frame body of the beacon frame, or the time remaining in the BP measured from the end of the PLCP header of the beacon frame, as determined by the largest BP Length announced by neighbors of the device in the previous superframe.

- BFC-16 Information Elements must appear in ascending order by Element ID (except for Application-specific Information Elements).
- BFC-17 Application-specific Information Elements must not appear before any Information Element with an Element ID from 0-7.
- BFC-18 DRP IEs that have the same Target ID and Stream Index must be adjacent to each other.
- BFC-19 The Beacon_Parameters.Device_Identifier field must be set to an EUI-48 as indicated by the test submitter.
- BFC-20 The Beacon_Parameters.Device_Identifier field must not be zero.
- BFC-21 The Beacon_Parameters.Device_Identifier field must not have the group bit (i.e. the least significant bit of the left most octet) set unless it is all 1's.
- BFC-22 The Beacon_Parameters.Beacon_Slot_Number field must be set to the slot number the beacon is received in, unless the beacon is received in a signaling slot. In the case where a beacon is received in a signaling slot the field must be set to the non-signaling slot for the beacon.
- BFC-23 The Beacon_Parameters.Device_Control.Reserved field must be zero.
- BFC-25 The Beacon_Parameters.Device_Control.Movable bit must be set to one if and only if there was one or more available beacon slot between the DUT's beacon slot and the signaling slots in the prior superframe.
- BFC-26 The Element ID for an information element must not be a reserved value (3-7 or 25-249).
- BFC-27 The value of the length field of an Information Element must not extend past the end of the beacon payload.
- BFC-28 The ASIE specifier ID field in an Application-specific Information Element must be in the WiMedia list of assigned IDs [B]3.
- BFC-29 The Target_DevAddr field in an Application-specific Probe IE must be the DevAddr for a device in the beacon period of the DUT.
- BFC-30 The ASIE specifier ID field in an Application-specific Probe IE must be in the WiMedia list of assigned IDs [B]3.
- BFC-31 A device must always include a single BPOIE in its beacon.
- BFC-32 The Beacon Slot Info Bitmap field for a beacon slot in the DUT beacon must be set as follows:

Condition in the previous superframe within the device's BP Length		Value in current superframe
Test system hears nothing		Must be 0 except: <ul style="list-style-type: none"> – The value may be 1, 2, or 3 up to 8% of the time.
Test system gets HCS error		No check
Test system gets a beacon frame with an FCS error	From DUT/INTD or not intentionally generated by test system	Must be 1 or 3 except: <ul style="list-style-type: none"> – The value may be 0 or 2 up to 8% of the time.
	Intentionally generated by the test system	Must be 2 except: <ul style="list-style-type: none"> – The value may be 0 up to 8% of the time.
Test system gets a non-aligned beacon frame		Must be 2 except: <ul style="list-style-type: none"> – The value may be 0 up to 8% of the time.
Test system gets a non-beacon frame		Must be 0 or 2
Test system gets a valid beacon with:	Movable bit 0	Must be 1 except: <ul style="list-style-type: none"> – The value may be 0 or 2 up to 8% of the time.
	Movable bit 1	Must be 3 except: <ul style="list-style-type: none"> – The value may be 0 or 2 up to 8% of the time.
Test system recognizes hibernation period of a device and DUT/IND had previously indicated that it had received that device's beacon that announced the hibernation period.		Must be 1.

Each condition is tracked and checked individually. To avoid statistical anomalies, a failure to report the expected value in excess of 8% of the time, as indicated in column two, is not considered an error for a particular test unless the condition in column one occurs at least 25 times during that test. It can still be reported as a warning.

- BFC-33 A BPOIE must have the length field set to $1 + \text{Ceiling}(\text{Bp Length}/4) + 2 \times (\text{NumOccupiedSlots})$ bytes.
- BFC-34 A BP Switch IE must not be included in the beacon (except in specific test cases where this is expected behavior).
- BFC-35 A Channel Change IE must not be included in the beacon.
- BFC-36 If an element in the Beacon Slot Info Bitmap is set to 1 or 3, the corresponding DevAddr must be set to the SrcAddr of the beacon received in the corresponding beacon slot in the previous superframe. However, if the Beacon Slot Info Bitmap is set to 1 and that slot corresponds to that of a hibernating device in the previous superframe, the corresponding DevAddr must instead be set to the SrcAddr of the hibernating device.
- BFC-37 If an element in the Beacon Slot Info Bitmap is set to 2, the corresponding DevAddr must be set to BcstAddr or the SrcAddr of the beacon received in the corresponding beacon slot in the previous superframe.

- BFC-38 The SrcAddr field must be in the generated DevAddr range (0x0100-0xFEFF).
- BFC-39 The Beacon frame must be long enough to contain the required Beacon Parameters and BPOIE fields. The minimum size is 12 bytes.
- BFC-40 Each Information Element in a beacon must contain at least an Element ID and a length field.
- BFC-41 The Sequence_Control.Reserved field must be zero.
- BFC-42 In a MAC Capabilities IE, the MAC_Capability_Bitmap.Reserved fields must be zero.
- BFC-43 In a PHY Capabilities IE, the PHY_Capability_Bitmap.Reserved fields must be zero.
- BFC-44 DRP-C (DRP context IE) must immediately precede the first DRP describing this reservation.

4.3 Data and Control Frames Background Tests

This test verifies that a variety of rules for control, command and data frames are not violated by the DUT or INTD.

Control, Command and Data Frame Checks

- CCD-01 If a device sends an immediate acknowledgement frame, the transmission must begin SIFS from the end of the previous data frame. [DADDR], [8%]
- CCD-02 If a device sends a CTS frame, the transmission must begin SIFS from the end of the previous RTS frame. [DADDR], [8%]
- CCD-03 Outside of a private reservation, for frames with the access method set to one and more frames set to zero, the device must not transmit another frame to the same recipient in the current reservation block.
- CCD-04 If a device sets the More Frames bit to zero in a frame sent with Access Method set to zero, it must not transmit additional frames using PCA to the same recipient(s) within the current superframe unless the recipient did not include a PCA Availability IE in its beacon or included a PCA Availability IE in its beacon with the TIM IE Required bit set to zero.
- CCD-05 The frame payload of a secure frame must be at least 20 bytes in length.
- CCD-06 A duration value for a frame sent with access method zero must at least cover that frame.
- CCD-07 A device must not transmit past the time indicated in the latest non-zero Duration field in RTS, command, data, or aggregated data frames.
- CCD-08 A device must not transmit past the time indicated in the latest non-zero Duration field minus SIFS minus the transmission time for an immediate ack for a data frame sent with the immediate ack policy.
- CCD-09 A device must not set a value in a Duration field in an RTS, command, data or aggregated frame that exceeds the end of the reservation block. (if the transmission occurs in a reservation block).
- CCD-10 A device must not send a frame with the access method set to one in a hard or private reservation that has been released (UDA/UDR).
- CCD-11 A device must not send a frame in a hard reservation with access method set to zero unless the reservation has been released (UDA/UDR).
- CCD-12 A device must not transmit a frame that completes less than pSIFS before the end of the reservation block (from the test system perspective).
- CCD-13 A device must not transmit frames during an alien BP reservation (except to possibly send a beacon in the alien BP).

- CCD-14 A device other than the reservation owner or target must not transmit frames during an unreleased hard reservation.
- CCD-15 Devices other than the reservation owner must not initiate frame transactions in an unreleased hard reservation.
- CCD-16 A device must not transmit a data frame in an unreleased hard reservation unless the Delivery ID field is set to a Stream Index that is the same as the Stream Index for the reservation and the DestAddr of the frame is the same as the Target DevAddr for the reservation or the DestAddr of the frame matches the DevAddr of any target of an established multicast reservation.
- CCD-17 A device must not transmit a non-beacon frame during its beacon period or any of its neighbors' beacon periods.
- CCD-18 Outside of a private reservation, a device must not transmit consecutive data or command frames with the same sequence number, fragment number, Delivery ID and DestAddr unless the retry bit is set in second frame.
- CCD-19 A device must not send a frame with the access method set to one outside any of the device's established hard or private reservations, except for a frame transmitted within a soft reservation by the owner of the soft reservation to the target(s) of the soft reservation.
- CCD-20 The second octet in the Aggregation Header of an Aggregated Data frame must be 0.
- CCD-21 The sum of the length fields in the Aggregation Header of an Aggregated Data frame must be less than or equal to 4095 if the Secure bit in the Frame Control field is set to 0 and 4075 if the Secure bit in the Frame Control field is set to 1.
- CCD-22 The Aggregation_Header.MSDU_Count field in an Aggregated Data frame must be less than or equal to mAggregationLimit (63).
- CCD-23 The payload length of an Aggregated Data frame shall be equal to the sum of: (1) 0 if an non-secure frame or 20 if a secure frame, (2) the length of the Aggregation Header ($2 + N \cdot 2 + \text{pad to 4-octet boundary}$) where N is the value of the MSDU Count field and (3) The sum of the N MSDU lengths each rounded up to a 4-octet boundary (except for the last).
- CCD-24 A device shall not fragment any MSDU/MCDU to more than mMaxFragmentCount (8) fragments. The More Fragments bit shall not be set to 1 in a frame where the Fragment Number field = 7.
- CCD-25 Once a device transmits a frame containing a whole MSDU/MCDU or fragment thereof, the device shall not fragment or re-fragment the frame. The payload length of a frame with the Retry bit set to 1 must be the same as the payload length of the last frame transmitted with the same Sequence Number and Fragment Number field values. [STRM]
- CCD-26 A device shall not create frame fragments smaller than mMinFragmentSize (1) octets. The payload length of a frame with Fragment Number = 0 and More Fragments = 1, OR with Fragment Number > 0 shall be > 0.
- CCD-27 A device shall set the Fragment Number field in the first fragment to zero. If the Retry bit of a frame is set to 0 and the More Fragments bit of the previous frame was set to 0, the Fragment Number shall equal 0. [STRM], [8%]
- CCD-28 The device shall set the Fragment Number in each subsequent fragment to the Fragment Number of the previous fragment plus 1. If the More Fragments bit of the previous frame is set to 1 and the Retry bit of the current frame is set to 0, the Fragment Number of the current frame shall equal the value of the Fragment Number field in the previous frame plus 1. [STRM], [8%]
- CCD-29 The device shall not increment the Fragment Number field when a fragment is re-transmitted. If the More Fragments bit of the previous frame is set to 1 and the Retry bit of the current frame is set to 1, the Fragment Number of the current frame

- shall equal the value of the Fragment Number field in the previous frame. [STRM], [8%]
- CCD-30 A device shall assign the same Sequence Number to all fragments of an MSDU/MCDU. If the value of the Fragment Number field of a frame is not equal to 0, the value of the Sequence Number field shall equal the Sequence Number of the last frame transmitted with the Retry bit set to 0 and the More Fragments bit set to 1. [STRM], [8%]
- CCD-31 A B-ACK frame must have the format indicated in Figure 18 of [B]1. The 4th octet of the B-ACK frame payload must be zero and the Sequence Control.Reserved field of the B-ACK frame payload must be zero.
- CCD-32 If a device sends a B-ACK frame, the transmission must begin SIFS from the end of the previous frame. [DADDR], [8%]
- CCD-33 If a device sends a B-ACK frame, the ACK policy of the immediately previous frame must be B-ACK Request. [DADDR], [8%]
- CCD-34 A device must transmit a B-ACK frame if the ACK policy of the immediately previous frame was set to B-ACK Request. [DADDR], [8%]
- CCD-35 If a device sends an Imm-ACK frame, the ACK policy of the immediately previous frame must be Imm-ACK. [DADDR], [8%]
- CCD-36 A device must transmit an Imm-ACK frame if the ACK policy of the immediately previous frame was set to Imm-ACK and the previous frame was received with a correct FCS. [DADDR], [50%]
- CCD-37 (Notification) To demonstrate support for fragmentation, a device must transmit at least 1000 fragments during at least one testcase. This code is reported if the minimum frame requirement is met.
- CCD-38 (Notification) To demonstrate support for aggregation, a device must transmit at least 100 Aggregated Data frames in at least one testcase. This code is reported if the minimum frame requirement is met.

4.4 Reservation Policy Background Tests

This test verifies that a variety of reservation policy requirements are not violated by the DUT or INTD.

Reservation Policy Checks

- RPC-01 A device must not transmit a DRP IE with status 0 or 1 which includes a MAS defined in a DRP IE within an existing status one reservation (as defined by the beacons received by the device over the last $mMaxLostBeacons+1$ superframes).
- RPC-02 A device must not identify more than $mTotalMASLimit$ MASs in DRP IEs with the Unsafe bit set to zero.
- RPC-03 A device must not identify more than Y consecutive MAS in the same zone within a column component in DRP IEs with the Unsafe bit set to zero, where Y is a function of the MAS number within the zone (counting from zero) of the earliest reserved MAS within the set of consecutive MASs, as shown in Table 76 in the WiMedia MAC specification [B]1.
- RPC-04 A device must not set the Unsafe bit to one in DRP IEs except to comply with the two Unsafe bit requirements listed above.
- RPC-05 A device must not include MASs in zone zero in the column component of a reservation.
- RPC-06 In the row component of a reservation, the reservation owner must select reservation blocks such that the lowest MAS number selected within a zone is maximized, except that the reservation owner is not required to use more than one reservation block per zone.

- RPC-07 In the column component of a reservation, the reservation owner must select reservation blocks that meet its requirements such that each block is located within the first eight MASs of its zone, if possible. If not possible, the reservation owner must select reservation blocks that meet its requirements and that minimize the highest MAS number selected in any zone.
- If multiple potential zone locations meet the previous requirements, the reservation owner must select reservation blocks in zones such that the latest used set in the following ordered list of sets is as early as possible:
- [{8}, {4 or 12}, {2, 6, 10, or 14}, {1, 3, 5, 7, 9, 11, 13, or 15}].
- If there are multiple possible zone locations that use the same latest set, the reservation owner should minimize the highest MAS number selected within the zones. The reservation owner must place each reservation block at the earliest available location within its zone.
- Note: A reservation owner may disregard the reservation location rules for MASs identified in DRP IEs with the Unsafe bit set to one according to the Y limit stated in B.2.
- RPC-08 In all DRP IEs identifying the same reservation, the conflict Tie-breaker bit must be set to the same value.
- RPC-09 The Stream Index field in a DRP IE must be zero in Alien BP or PCA reservations.
- RPC-10 The Target/Owner DevAddr field in a DRP IE must be zero in Alien BP or PCA reservations.
- RPC-11 The Reason Code field in a DRP IE must be zero in Alien BP or PCA reservations.
- RPC-12 Once set, the Conflict Tie-breaker Bit field in a DRP IE must not change.
- RPC-13 The owner bit field in a DRP IE must be zero in Alien BP reservations.
- RPC-14 A given MAS may only be referenced once in a beacon's DRP IEs.
- RPC-15 A reservation owner shall not include a MAS in a Status 1 reservation unless it was asserted as Status 0 in the previous superframe (including skipped beacon transmission), except in the case of BPST realignment where certain exceptions to this rule may apply.
- RPC-16 If, due to a MAS becoming available, a reservation is out of compliance with the siting rules (see RPC-05 and RPC-06), the reservation owner must relocate the reservation to meet the siting rules within mCompactionLimit superframes.
- RPC-17 In each DRP IE a device transmits for an established reservation (where the reservation owner and target have the DRP IE status bit set to 1), the reservation owner and target shall ensure that the Target/Owner DevAddr field is set to the current DevAddr (as determined from the latest received beacon from that device) corresponding to the EUI-48 of the target and owner respectively.
- RPC-18 A reservation target shall not include MASs in its DRP IE(s) that were not included in the reservation owner's DRP IE(s) in the last beacon received from the reservation owner.
- RPC-19 For unicast reservations only, the target of a reservation must respond to a new reservation or changes to an existing reservation in the superframe following the reception of a DRP IE(s) from the owner.
- RPC-20 The DRP_Control.Reserved field must be zero.
- RPC-21 The DRP_Control.Reservation_Type field must not be a reserved value (5-7).
- RPC-22 The DRP_Control.Reason_Code field must not be a reserved value (6-7).

- RPC-23 A device shall not identify more than $mTotalMASLimit$ MASs in DRP IEs with the Unsafe bit set to zero.
- RPC-24 A device shall not identify more than Y consecutive MAS in the same zone within a column component in DRP IEs with the Unsafe bit set to zero, where Y is specified in Table 76 of [B]1.
- RPC-25 If a device requests a neighbor to release MASs in an unsafe DRP IE, the device shall not include a new unsafe DRP IE in its beacon or change a DRP IE to set the Unsafe bit to one until $mOwnerUnsafeHoldoff$ superframes have passed.
- RPC-26 If a device includes an unsafe DRP IE in its beacon and it receives a Relinquish Request IE that identifies MASs included in the unsafe DRP IE, it shall not include a new unsafe DRP IE in its beacon or change a DRP IE to set the Unsafe bit to one until the neighbor requesting release establishes a new DRP IE or $mTargetUnsafeHoldoff$ superframes have passed.
- RPC-27 The Relinquish_Request_Control.Reserved field in a Relinquish Request IE must be zero.
- RPC-28 The Target DevAddr field in a Relinquish Request IE shall identify a device with one or more unsafe DRP IEs in its beacon, except when a Reservation Target is forwarding a Relinquish Request IE to its Reservation Owner.
- RPC-29 If a reservation target receives a request to relinquish certain MASs included in a reservation, it shall include in its beacon a DRP Availability IE and a Relinquish Request IE identifying those MASs with the Target DevAddr set to the DevAddr of the reservation owner. The device shall include the IEs in its beacon for $mMaxLostBeacons+1$ superframes following the superframe in which it received the relinquish request, unless the reservation owner changes the reservation such that it does not contain the requested MASs.
- RPC-30 If a device (owner or target) receives a beacon that contains a Relinquish Request IE with Target DevAddr set to its own DevAddr that identifies MASs it includes in an unsafe DRP IE, it shall either modify its DRP IEs to remove the identified MASs or modify its DRP IEs such that the Unsafe bit in any DRP IE that includes one or more identified MASs is set to zero, within $mUnsafeReleaseLimit$ superframes after first receiving the Relinquish Request IE.

4.5 Beacon Protocol Observation Background Tests

This test verifies that a variety of beacon protocol rules are not violated by the DUT when it demonstrates operation with an INTD.

Beacon Protocol Checks

- BPC-01 A device must not transmit a beacon in a slot higher than or with a slot number higher than $mMaxBPLength/2-1$ except in specific test cases that are exercising BP merge or beacon slot collisions.
- BPC-02 A device must transmit beacons at $pBeaconTransmitRate$ (53.3 Mbps).
- BPC-03 The transmission time of a beacon must not exceed $mMaxBeaconLength$.
- BPC-04 The beacon payload must not contain more than 320 bytes (not including the FCS).
- BPC-05 An announced BP Length must not include more than $mBPExtension$ slots after the last unavailable beacon slot in the BP of the prior superframe (from the DUT perspective) or the DUT beacon slot in the current superframe, or a slot indicated in a signaling slot beacon in the prior superframe (whichever is greater), except in tests that specifically allow exceptions during the BP merge protocol.

- BPC-06 A device transmitting in a beacon slot must start the transmission at the beginning of the beacon slot (within - mGuardTime to + mGuardTime from the perspective of the test system).
- BPC-07 A device's transmitted BP Length must include at least the device's own beacon slot, all monitored beacon slots (from the DUT perspective) in the BP of the prior superframe and the beacon slot indicated in any beacon received in a signaling slot in the prior superframe.
- BPC-08 If a device transmits a beacon in a beacon slot that is higher than the BP Length of any of its neighbors, the device must transmit the same beacon (except for the signaling slot field) in a randomly chosen signaling slot until its neighbors extend their BP Lengths to include the device's beacon slot or it has transmitted the beacon in the signaling slot for mMaxLostBeacons+1 superframes.
- BPC-09 If a device transmits a beacon in a signaling slot for mMaxLostBeacons+1 superframes it must not transmit another beacon in a signaling slot for at least the next mMaxLostBeacons+1 superframes.
- BPC-11 An active mode device must skip beacon transmission at least every mMaxNeighborDetectionInterval superframes while still listening to beacons for its BP Length.
- BPC-12 If and only if in the latest mMaxLostBeacons+1 superframes the device's beacon has been movable and any beacons after the devices have been non-movable the device must shift its beacon into the first available slot after the signaling slots.
- BPC-13 The Beacon Slot Number field must be set to the device's non-signaling beacon slot for a beacon sent in a signaling slot.
- BPC-14 The signaling slot bit must be set to one if the beacon is sent in a signaling slot and zero otherwise.
- BPC-15 A device that switches its BPST to an alien BPST must not send a beacon in its old beacon group after changing its BPST.
- BPC-16 An announced BP Length must never be greater than 96.
- BPC-17 A device must begin using a new DevAddr in the superframe after it first receives a BPOIE indicating the DUT's DevAddr in a different slot.
- BPC-18 A device must begin using a new DevAddr in the superframe after it first receives a beacon with the same DevAddr.
- BPC-19 The device must relocate its beacon slot in the next superframe if its beacon slot is reported as occupied in the BPOIE of any beacon it receives in the current superframe, but the corresponding DevAddr is neither BcstAddr nor its own DevAddr used in the previous superframe.
- BPC-21 The device must not delay its BPST by more than 4 microseconds per superframe.
- BPC-23 The device must relocate its beacon slot in the next superframe if it receives a beacon in a signaling slot with the Beacon Slot Number field set to its own beacon slot.
- BPC-24 If a device does not receive a beacon from a neighbor at the end of the neighbor's hibernation duration, it shall treat the neighbor's beacon slot as occupied, but shall not mark it as occupied in its BPOIE, for up to mMaxHibernationProtection after the neighbor entered hibernation or until any beacon is received in the neighbor's beacon slot.
- BPC-25 A device's beacon transmission skip interval must not be constant. Note: Only valid for test cases 3.3, 3.4, 3.6 and 3.7 after both the DUT and INTD have started transmitting beacons.

4.6 PCA Background Tests

These checks run in the background during all tests for a PCA capable device.

PCA Background Checks

- PCA-01 A device must not transmit an initial frame earlier than pSIFS + pSlotTime from any point where the medium becomes available for PCA unless it is in a Soft DRP reservation where the device is the owner.
- PCA-02 A frame transmitted via PCA must end at least pSIFS before the medium becomes unavailable for PCA.
- PCA-04 A device must not send a PCA frame to a device with the TIM IE Required bit set to one in a PCA Availability IE in the previous superframe unless the device included a TIM IE in its beacon including the DevAddr of the recipient in the current superframe.
- PCA-05 A device must not transmit a PCA frame within the duration of a previous PCA frame unless an acknowledgement has been transmitted by the target of the previous PCA frame.
- PCA-06 A device must not violate the maximum time allowed for a TXOP except when:
 - The frame is a retry.
 - The frame is the sole frame transmitted by the device in the current TXOP.

4.7 B-ACK Background Tests

This section defines a list of error codes related to use of the Block ACK mechanism. References to the transmitter mean the device that is sending data frames, and to the recipient mean the device that is sending B-ACK frames. References to a stream indicate a sequence of frames from a transmitter to a recipient with the same Delivery ID field value. Most requirements are in the context of a stream – if the devices in question participate in multiple streams or send other frames not part of a stream, the error check is done independently for the set of frames within each stream.

Accurate detection of these errors is possible only when the test system successfully receives multiple sequential Block ACK frames, and (for some errors) at least the frame headers for all data frames in the block. The errors are reported as warnings, and failures are indicated if the error rate exceeds a threshold, to account for frames missed by the test system.

B-ACK Checks

- BAK-01 The Sequence_Control.Sequence Number field of a B-ACK frame must be consistent with the previous B-ACK frame. The Sequence Number for a B-ACK frame must fall within the range [Sequence Number from last B-ACK frame, {(Highest Sequence Number Observed in a data frame or indicated in the last B-ACK frame) + 1}], inclusive. The Sequence Number for a B-ACK frame must be equal to or greater than the earliest Sequence Number reported as not received in the Frame Bitmap of the previous B-ACK frame. [STRM], [8%]
- BAK-02 The Frame Bitmap of a B-ACK frame must contain bit values equal to 1 for each data frame transmitted since the last B-ACK frame, with a tolerance for missed frames. It must contain bit values equal to zero in other bitmap locations, except that bits at the beginning of the bitmap (for frames transmitted prior to the last B-ACK frame) may be set to one at the discretion of the recipient. [STRM], [50%]
- BAK-03 A device shall not send a frame with ACK Policy set to B-ACK before it receives a B-ACK frame with a value greater than one in the Frame Count field. [STRM], [8%]
- BAK-04 After receiving a B-ACK frame with zero length payload, a device shall not send a data frame with ACK Policy set to B-ACK until it receives a B-ACK frame with a Frame Count field greater than one. [STRM], [8%]

- BAK-05 The Sequence Number field in data frames from the transmitter must fall in the range [Sequence Number, {Highest indicated Sequence Number in Frame Bitmap + Frame Count - 1}], from the last B-ACK frame, inclusive. [STRM], [8%]
- BAK-06 After receiving a B-ACK frame with the Frame Count field equal to N, a device shall send at most N minus 1 data frames with ACK policy set to B-ACK before sending a frame with the ACK policy set to B-ACK Request. [STRM], [8%]
- BAK-07 After receiving a B-ACK frame, the total of all frame payloads transmitted in the B-ACK sequence (as indicated in their PLCP Header Length fields) up to and including the next frame transmitted with ACK Policy set to B-ACK Request, shall not exceed the value indicated in the received B-ACK frame's Buffer Size field. [STRM], [8%]
- BAK-08 The sequence numbers of frames transmitted between received B-ACK frames must be in increasing order of Sequence Number/Fragment Number. [STRM], [8%]
- BAK-09 Any frames indicated as missing in a B-ACK frame must be transmitted in the set of frames prior to the next B-ACK frame, or in the set of frames prior to the second B-ACK frame. [STRM], [8%]
- BAK-10 After reception of a B-ACK frame, a device shall not transmit any frames with a Sequence Number/Fragment Number equal to a frame that was acknowledged in the Frame Bitmap. Note: Retransmission of just the frame that requested the B-ACK is legitimate if the transmitter missed the B-ACK frame. [STRM], [8%]
- BAK-11 If a B-ACK control frame is received with Frame Count or Buffer Size set to zero, the next frame the transmitter sends for that stream must be the same frame it sent requesting the B-ACK frame. (If the B-ACK frame indicated successful reception of the requesting frame, the frame can be sent with zero-length payload, but the Sequence Number and Fragment Number in the header must be the same.) [STRM], [8%]
- BAK-12 (Notification) To demonstrate support for B-ACK, the DUT and INTD must transmit at least 10000 frames with an ACK policy of B-ACK or B-ACK Request frames in at least one testcase. This code is reported if the minimum frame requirement is met.

4.8 Power Management Background Tests

- PMT-01 A device shall be in active mode in the first superframe of its local cycle.
- PMT-02 A device shall start its local cycle at a BPST, and shall determine its local cycle as follows: Local cycle = 2n superframes, where n is its local cycle index; $0 \leq n \leq wMaxLocalCycleIndex$.
- PMT-03 A device shall set the Local Cycle Index in the Cycle Parameters field in its Anchor Selection IE to its current local cycle index.
- PMT-04 A device shall set the Global Cycle Start Countdown (GCSC) field in its Anchor Selection IE to the number of superframes before the start of the next global cycle, not including the current superframe
- PMT-05 The device shall set the GCSC value to wMaxGCSC in the first superframe of every global cycle and decrement it by one in each subsequent superframe, except as noted below. [[same requirement as "In all other cases, the device shall decrement its GCSC by one in each superframe."]]
- PMT-06 Before a device includes a Anchor Selection IE in its beacon, it shall establish a GCST. To establish a GCST, the device shall set its GCSC field in the current superframe to one less than the value of the GCSC fields contained in beacons it received in the previous superframe.
- PMT-07 If the device received beacons containing two or more different GCSC values in the previous superframe, it shall set its GCSC field to one less than the smallest received GCSC value.

- PMT-08 If the device did not receive any beacon with a GCSC field, and it has not previously established a GCST, it may choose any GCS.
- PMT-09 Devices using two or more unaligned GCSTs may come into range. To address this situation, a device shall follow these rules:
- If the GCSC fields in one or more beacons the device received in the previous superframe indicate a single GCST that is not aligned with the device's own GCST, the device shall check the difference between its GCST and the unaligned GCST. If that difference is equal to $(wMaxGCSC+1)/2$ superframes, the device shall set its GCSC field for the current superframe to a random integer drawn from a uniform distribution over the interval $[0, wMaxGCSC]$. Otherwise, if the unaligned GCST falls within the second half of the device's global cycle, the device shall set its GCSC for the current superframe to one less than the unaligned GCSC value in the previous superframe, to align GCSTs.
 - If the GCSC fields in beacons the device received in the previous superframe indicate two or more distinct GCSTs that are not aligned with the device's own GCST, the device shall set its GCSC field for the current superframe to one less than the smallest received GCSC value, to align with the next GCST.
- PMT-10 In all other cases, the device shall decrement its GCSC by one in each superframe.
- PMT-11 A device that changes its GCST shall include the new GCSC value in the GCSC field of subsequently transmitted beacons
- PMT-12 The device shall be in active mode at the start of its local cycles based on its new GCST. The device shall also be in active mode at the start of its local cycles based on its previous GCST for at least $2wMaxLocalCycleIndex$ superframes.
- PMT-13 A device that receives one or more GCSC values that are different from its own shall stay in active mode for at least $mMaxLostBeacons$ additional superframes.
- PMT-14 A device shall not increase its local cycle index except when all its neighbors are in active mode, since this is the time when all neighbors can receive the updated local cycle index.
- PMT-15 A device shall start a new anchor cycle every $2wMaxLocalCycleIndex$ superframes relative to its GCST.
- PMT-16 A device shall determine its anchor cycle weight (ACW) as the smaller of $wMaxACW$ or the number of anchor cycles when the device has not been a hibernation anchor.
- PMT-17 A device shall set the Anchor Cycle Weight (ACW) field in its Anchor Selection IE to its anchor cycle weight in the first superframe of an anchor cycle and successive superframes until it selects a hibernation anchor. Once a device selects a hibernation anchor, it shall announce its selected hibernation anchor by replacing its ACW with its AnchorAddr in all subsequent beacons transmitted in the anchor cycle.
- PMT-18 If the device is mains-powered, it shall select itself as a hibernation anchor and shall announce that selection in every superframe, including the first superframe, of every anchor cycle.
- PMT-19 Let X be the set of the device's neighbors that have selected themselves as hibernation anchors, and let Y be the set of the device's neighbors that have not selected a hibernation anchor.
- The device shall select any device from set X as its hibernation anchor in the next superframe if:
- the neighbor graph of set X is a connected graph (according to graph theory);

AND

- each device in set Y has a neighbor in set X.

The neighbor graph of set X is a graph with vertices corresponding to devices in set X, and edges that connect a pair of vertices if the corresponding devices are neighbors. For purposes of this test, devices are considered neighbors if each reports the other's DevAddr in the appropriate beacon slot in its BPOIE in any of the latest $mMaxLostBeacons+1$ superframes.

- PMT-20 The device shall select itself as a hibernation anchor in the next superframe if in the current superframe all of the following conditions are satisfied:
- It has received an ACW or AnchorAddr from all of its neighbors.
 - All neighbors that have an ACW value higher than its own have indicated selection of a hibernation anchor.
 - All neighbors that have the same ACW value as its own and have higher beacon slot numbers than its own have indicated selection of a hibernation anchor.
 - It does not select a neighbor to be its hibernation anchor as described in rule C
- PMT-21 The device shall select itself as a hibernation anchor if it has not selected a neighbor as its hibernation anchor as described in rule C within $wMaxCycleWait$ superframes after the start of an anchor cycle, where $wMaxCycleWait$ is randomly selected between [$wMaxCycleWaitMin$, $wMaxCycleWaitMax$].
- PMT-22 If a device selects itself as a hibernation anchor, it shall remain in active mode for the rest of the anchor cycle, and shall include a Hibernation Anchor IE in its beacon in each superframe. In the Hibernation Anchor IE it shall include hibernation information about each of its hibernating neighbors, as defined in the WiMedia MAC specification.
- PMT-23 Once a device selects a hibernation anchor in an anchor cycle, it shall not change that selection for the rest of the anchor cycle.
- PMT-24 A device shall stay in active mode until all neighbors of the device have selected a hibernation anchor.

5. Reference Test Procedure

This clause describes a reference test procedure with test cases that cover all the test descriptions provided in this test specification. For many test cases multiple procedures are provided that can be carried out by test systems with different capabilities. The types of test systems that are targeted are a TX only test system and a TX and RX test system.

To cover the requirements of this test specification, the following is required:

- Each test case in this clause must be implemented in at least one type of test system.
- A device must be tested against all implemented test cases by both types of test systems.

For all test cases in this clause (unless otherwise noted in the test case procedure), the test fails if the DUT or INTD violate any checks listed in the background checks defined in 4 during any part of any analyzer trace (regardless of whether the test system is beaconing or not). If there is any inconsistency between this clause and the test descriptions in this specification, this clause takes precedence.

The test case descriptions address the fact that both the INTD and DUT may be tested at the same time.

All test system beacons have a unique EUI-48 and DevAddr and do not have the movable bit set unless otherwise indicated.

Unless otherwise noted, the test system transmits all beacons with a compliant BP Length and a correctly formatted BPOIE.

When testing with the TX and RX test system, the DUT and INTD can continue operating between many of the test cases. Only test cases 2.5, 3.1, 3.6, 3.7, 5.1 and 5.2 require the DUT and INTD to be stopped at the start of the test.

The test cases are split into the following categories:

- 1 – Beacon Period Management,
- 2 – Reservation Management,
- 3 – Scan and Synchronization,
- 4 – Stress Test,
- 5 – Miscellaneous Operation,
- 6 – Interop,
- 7 – PCA,
- 8 – ACI,
- 9 – Power Management Mechanism

In cases where the DUT and INTD are allowed to cease demonstrating operation, but are required to automatically re-start, operation must resume before the test system stops transmitting beacons.

Test case 3.12 is an FYI test. It is mandatory to run this test, but it is not a requirement to pass.

The DUT or INTD are allowed to cease demonstrating operation and/or beacon transmission at any point after a beacon slot relocation would place them in a beacon slot higher than slot 20 or a BP Length extension would require a BP Length greater than 28. If beacon slot 13 is occupied, it is possible for the DUT or INTD to select a slot higher than 20 after a beacon slot relocation, which would permit it to cease operation.

Test Setup: Test system calibration

This calibration procedure is run for the TX only test system before all other test cases. The calibrated beacon interval of 65538 microseconds is used in all test cases unless otherwise specified.

TX only test system:

1. Start analyzer capture.
2. Start test system beacon in slot 2 with a beacon interval of 65538 microseconds.
3. Stop analyzer capture. Check that analyzer interval is 65538 microseconds. If not – adjust test system settings so the reported analyzer interval is 65538 microseconds.

Test Case 1.1: BP Length Expansion

TX only test system:

1. Start analyzer capture.
2. Test system starts the beacon period and sends a beacon in slot 2 with a BP Length of 12.
3. Standard test start-up sequence.
4. Test system decreases its BP Length to 4.
5. After 4 seconds, the test system increases its BP Length to 12.
6. After 1 second, the test system starts sending its beacon with a BPOIE indicating that a device with a DevAddr of 0xAA is occupying slot 3.
7. After 2 seconds, the test system decreases its BP Length to 5.
8. After 4 seconds, test system stops transmitting beacons.
9. After at least 2 seconds, stop analyzer capture.

TX and RX test system:

1. Start analyzer capture.
2. Standard test start-up sequence (if necessary).
3. Test system joins the beacon period and sends a beacon in slot 4 with a BP Length of 13. When the test system joins it sends the beacon for slot 4 with the signaling bit set in a signaling slot 4 times.
4. Test system modifies its BPOIE to indicate that a device with a DevAddr of 0xAA occupies slot 2.
5. After 2 seconds, the test system modifies its BPOIE to indicate that a device with a DevAddr of 0xBB occupies slot 3.
6. After 2 seconds, test system stops sending the beacon in slot 4 and adds a beacon in slot 2 with an empty BPOIE.
7. After 2 seconds, test system decreases its BP Length to 4.
8. After 4 seconds, the test system increases its BP Length to 13.
9. After 1 second, the test system starts sending its beacon with a BPOIE indicating that a device with a DevAddr of 0xAA is occupying slot 3.
10. After 2 seconds, the test system decreases its BP Length to 5.
11. After 4 seconds, test system stops transmitting beacons.
12. After at least 2 seconds, stop analyzer capture.

Test Case 1.2: Beacon Slot Info

TX only test system:

1. Start analyzer capture.

2. The test system creates the beacon group and transmits a beacon in slots 2 and 3. The BP Length is set to 13.
3. In superframe X, the test system sets the moveable bit to 1 for the beacon in slot 2 and sets the moveable bit to 0 for the beacon in slot 3.
4. In superframe X+1, the test system sets the moveable bit to 0 for the beacon in slot 2 and sets the moveable bit to 1 for the beacon in slot 3.
5. In superframe X+2, the test system skips beacon transmission for the beacon in slot 2 and sets the movable bit to 0 for the beacon in slot 3.
6. In superframe X+3, the test system sends a beacon with an invalid FCS in slot 3 and sets the moveable bit to 0 for the beacon in slot 2.
7. In superframe X+4, the test system sends a data frame in slot 3 (with a DestAddr = the test system's DevAddr, a PHY rate = 53.3 Mbps and a payload length = 20 B) and sets the moveable bit to 0 for the beacon in slot 2.
8. The test system repeats this cycle until the end of the test.
9. Standard test start-up sequence.
10. After at least 400 superframes, test system stops transmitting beacons.
11. After at least 2 seconds, stop analyzer capture.

TX and RX test system:

1. Start analyzer capture.
2. Standard test start-up sequence (if necessary).
3. The test system joins the beacon group in slots 4 and 5. When the test system joins it sends the beacon for slot 5 with the signaling bit set in a signaling slot 4 times.
4. In superframe X, the test system sets the movable bit to 1 for the beacon in slot 4 and sets the movable bit to 0 for the beacon in slot 5.
5. In superframe X+1, the test system sets the movable bit to 0 for the beacon in slot 4 and sets the movable bit to 1 for the beacon in slot 5.
6. In superframe X+2, the test system skips beacon transmission for the beacon in slot 5 and sets the movable bit to 0 for the beacon in slot 4.
7. In superframe X+3, the test system sends a beacon with an invalid FCS in slot 5 and sets the moveable bit to 0 for the beacon in slot 4.
8. In superframe X+4, the test system sends a data frame in slot 5 (with a DestAddr = the test system's DevAddr, a PHY rate = 53.3 Mbps and a payload length = 20 B) and sets the moveable bit to 0 for the beacon in slot 4.
9. The test system repeats this cycle (steps 4–8) until the end of the test.
10. After at least 400 superframes, test system stops transmitting beacons.
11. After at least 2 seconds, stop analyzer capture.

Note: The ability to generate a data frame is optional for all test systems. If a test system does not support data frame generation the corresponding step in the test procedure is skipped.

Test Case 1.3: Beacon Period Length Extension By Test System**TX only test system:**

1. Start analyzer capture.
2. Test system starts the beacon period and sends a beacon in slot 2 with a BP Length of 12.
3. Standard test start-up sequence.
4. The test system starts sending additional beacons in a signaling slot and slot 15. The signaling slot beacon is transmitted for only 4 superframes.

5. 2 seconds after step 4 the test system sends a beacon in a signaling slot with slot number 25, a beacon in slot 25, and continues to send beacons in slots 2 and 15. The signaling slot beacon is transmitted for only 4 superframes.
6. The beacons in slots 2, 15 and 25 are transmitted for 2 seconds and then the test system stops sending the beacons in slots 15 and 25.
7. After 1 second, test system stops transmitting beacons.
8. After at least 2 seconds, stop analyzer capture.

TX and RX test system:

1. Start analyzer capture.
2. Standard test start-up sequence (if necessary).
3. Test system starts sending beacons in both signaling slots and slots 13 and 15.
4. The beacons in step 3 are transmitted for 2 seconds and then the test system stops transmitting beacons.
5. After at least 2 seconds, stop analyzer capture.

Test Case 1.4.: Listen For Required Portion Of A Slot**TX only test system:**

1. Start analyzer capture.
2. Test system starts the beacon period and sends a beacon in slot 2 with a beacon interval of 65538 microseconds. The BP Length is set to 12.
3. Standard test start-up sequence.
4. The test system starts sending an additional beacon in slot 5 which is always 12 microseconds early.
5. Every 6th superframe, the test system sends the beacon in slot 2 8 microseconds late..
6. Repeat for 250 superframes.
7. Test system stops transmitting beacons.
8. After at least 2 seconds, stop analyzer capture.

TX and RX test system:

1. Start analyzer capture.
2. Standard test start-up sequence (if necessary).
3. The test system joins the beacon group in slots 4 and 5. When the test system joins it sends the beacon for slot 5 with the signaling bit set in a signaling slot 4 times. The beacon in slot 5 is always transmitted 8 microseconds early.
4. Every 6th superframe, the test system sends the beacon in slot 4 8 microseconds late..
5. Repeat for 250 superframes.
6. Test system stops transmitting beacons.
7. After at least 2 seconds, stop analyzer capture.

Note: The BPC-06 background check is not valid with respect to the test system beacon in slot 5 for each test system.

Test Case 1.5: DevAddr Beacon Slot Collision**TX only test system:**

1. Start analyzer capture.
2. Test system starts the beacon period and sends a beacon in slot 2. The BP Length is set to 12.
3. Standard test start-up sequence.

4. The test system starts sending its beacons with a BPOIE indicating a device with a DevAddr of 3 is occupying slot 3.
5. One second after step 4, the test system starts sending its beacons with a BPOIE indicating that a device with a DevAddr of 3 is occupying slot 3 and a device with a DevAddr of 4 is occupying slot 4.
6. One second after step 5, the test system stops indicating that devices occupy slot 3 and slot 4.
7. Wait 1 second.
8. Repeat steps 4-7 9 additional times.
9. After 1 second, test system stops transmitting beacons.
10. After at least 2 seconds, stop analyzer capture.

TX and RX test system:

1. Start analyzer capture.
2. Standard test start-up sequence (if necessary).
3. Test system joins the beacon period in slot 4. When the test system joins it sends the beacon for slot 4 with the signaling bit set in a signaling slot 4 times.
4. Test system modifies BPOIE to indicate that a device with a DevAddr of 0xAA is using slot 2.
5. One second after step 4, the test system starts sending its beacons with a BPOIE indicating that a device with a DevAddr of 0xAA is using slot 2 and a device with a DevAddr of 0xBB is using slot 3.
6. One second after step 5, the test system stops indicating that devices occupy slot 2 and slot 3.
7. Wait 1 second.
8. Repeat steps 4-7 9 additional times.
9. After 1 second, test system stops transmitting beacons.
10. After at least 2 seconds, stop analyzer capture.

Test Case 1.6: Generated DevAddr Conflict**TX only test system:**

1. Start analyzer capture.
2. Test system starts the beacon period and sends a beacon in slot 2. The BP Length is set to 12.
3. Standard test start-up sequence.
4. Find DevAddr for DUT and INTD.
5. The test system adds beacons in slot 5 and slot 6 with the beacon in slot 5 using the DUT DevAddr and the beacon in slot 6 using the INTD DevAddr. When the test system joins, it sends the beacon for slot 6 with the signaling slot bit set in a signaling slot 4 times.
6. Find the new DevAddr for the DUT and INTD.
7. The test system changes its BPOIE in the beacon in slot 5 to indicate that a device with the DUT DevAddr is in slot 6. The test system also changes its BPOIE in the beacon in slot 6 to indicate that a device with the INTD DevAddr is in slot 5.
8. After 2 seconds, test system stops transmitting beacons.
9. After at least 2 seconds, stop analyzer capture.

TX and RX test system:

1. Start analyzer capture.
2. Standard test start-up sequence (if necessary).

3. Find DevAddr for DUT and INTD.
4. The test system joins the beacon group in slot 4 and slot 5 with the beacon in slot 4 using the DUT DevAddr and the beacon in slot 5 using the INTD DevAddr.
5. Find the new DevAddr for the DUT and INTD.
6. The test system changes its BPOIE in the beacon in slot 4 to indicate that a device with the DUT DevAddr is in slot 5. The test system also changes its BPOIE in the beacon in slot 5 to indicate that a device with the INTD DevAddr is in slot 4.
7. After 2 seconds, test system stops transmitting beacons.
8. After at least 2 seconds, stop analyzer capture.

Note: The DUT or INTD must change its DevAddr in the superframe after it receives a beacon indicating a DevAddr conflict.

Test Case 1.7: Beacon Slot Collision After Skipped Transmission

TX only test system:

1. Start analyzer capture.
2. Test system starts the beacon period and sends a beacon in slot 2. The BP Length is set to 12.
3. Standard test start-up sequence.
4. The test system starts transmitting an additional beacon in slot 3.
5. Wait 30 seconds or until the DUT/INTD has moved into beacon slot 5, whichever occurs first.
6. The test system starts transmitting additional beacons in slots 4 and 6. The beacon in slot 6 has its moveable bit set.
7. Wait 30 seconds or until the INTD/DUT has moved into beacon slot 7, whichever occurs first.
8. Test system stops transmitting beacons.
9. After at least 2 seconds, stop analyzer capture.

TX and RX test system:

1. Start analyzer capture.
2. Standard test start-up sequence (if necessary).
3. Test system joins the beacon period and sends a beacon in slots 4. When the test system joins it sends the beacon for slot 4 with the signaling bit set in a signaling slot 4 times.
4. Test system slows its beacon interval to 65538 microseconds.
5. Test system starts transmitting an additional beacon in slot 2.
6. Wait 30 seconds or until the DUT/INTD has moved into beacon slot 5, whichever occurs first.
7. The test system starts transmitting an additional beacon in slots 3 and 6. The beacon in slot 6 has its moveable bit set.
8. Wait 30 seconds or until the INTD/DUT has moved into beacon slot 7, whichever occurs first.
9. Test system stops transmitting beacons.
10. After at least 2 seconds, stop analyzer capture.

Note: The DUT and INTD fail the test, if either the DUT or INTD is not in slot 5, when the test system beacon is added in slot 6.

Test Case 1.8: BcstAddr Beacon Slot Collision

TX only test system:

1. Start analyzer capture.
2. Test system starts the beacon period and sends a beacon in slot 2. The BP Length is set to 12.
3. Standard test start-up sequence.
4. The test system starts sending its beacons with a BPOIE indicating a device with a DevAddr of BcstAddr is occupying slot 3.
5. One second after step 4, the test system starts sending beacons with a BPOIE indicating devices with a DevAddr of BcstAddr are occupying slots 3 and 4.
6. After 2 seconds, test system stops transmitting beacons.
7. After at least 2 seconds, stop analyzer capture.

TX and RX test system:

1. Start analyzer capture.
2. Standard test start-up sequence (if necessary).
3. Test system joins the beacon period in slot 4. When the test system joins it sends the beacon for slot 4 with the signaling bit set in a signaling slot 4 times.
4. Test system starts sending beacons with a BPOIE to indicate a device with a DevAddr of BcstAddr is occupying slot 2.
5. One second after step 4, the test system starts sending beacons with a BPOIE indicating devices with a DevAddr of BcstAddr are occupying slots 2 and 3.
6. After 2 seconds, test system stops transmitting beacons.
7. After at least 2 seconds, stop analyzer capture.

Test Case 1.9: Beacon Period Contraction In Move Cases

TX only test system:

1. Start analyzer capture.
2. Test system starts the beacon period and sends a beacon in slots 2 and 3. The BP Length is set to 13.
3. Standard test start-up sequence.
4. The test system starts transmitting an additional beacon in slot 6 and a signaling slot beacon without the movable bit set. The signaling slot beacon is transmitted for only 4 superframes.
5. The test system stops sending the beacons in slot 2 and 3.
6. After 2 seconds, test system stops transmitting beacons.
7. After at least 2 seconds, stop analyzer capture.

TX and RX test system:

1. Start analyzer capture.
2. Standard test start-up sequence (if necessary).
3. Test system joins the beacon period and sends a beacon in slot 4. When the test system joins it sends the beacon for slot 4 with the signaling bit set in a signaling slot 4 times.
4. Test system modifies its BPOIE to indicate that a device with a DevAddr of 0xAA occupies slot 2.
5. After 2 seconds, the test system modifies its BPOIE to indicate that a device with a DevAddr of 0xBB occupies slot 3.

6. After 2 seconds, test system stops sending the beacon in slot 4 and adds beacons in slots 2 and 3 with empty BPOIEs.
7. After 2 seconds, test system starts transmitting an additional beacon in slot 6 without the movable bit set. When the test system joins, it sends the beacon for slot 6 with the signaling bit set in a signaling slot 4 times.
8. The test system stops sending a beacon in slots 2 and 3.
9. After 2 seconds, test system stops transmitting beacons.
10. After at least 2 seconds, stop analyzer capture.

Test Case 1.10: Beacon Period Contraction Where Move Is Not Allowed

TX only test system:

1. Start analyzer capture.
2. Test system starts the beacon period and sends a beacon in slots 2 and 3. The BP Length is set to 13.
3. Standard test start-up sequence.
4. The test system starts transmitting an additional beacon in slot 6 and a signaling slot without the movable bit set. The signaling slot beacon is transmitted for only 4 superframes.
5. The test system stops sending the beacon in slot 2 and simultaneously starts sending the beacon in slot 6 with the movable bit set.
6. After 2 seconds, test system stops transmitting beacons.
7. After at least 2 seconds, stop analyzer capture.

TX and RX test system:

1. Start analyzer capture.
2. Standard test start-up sequence (if necessary).
3. Test system joins the beacon period and sends a beacon in slot 4. When the test system joins it sends the beacon for slot 4 with the signaling bit set in a signaling slot 4 times.
4. Test system modifies its BPOIE to indicate that a device with a DevAddr of 0xAA is using slot 2.
5. After 2 seconds, the test system modifies its BPOIE to indicate that a device with a DevAddr of 0xBB is using slot 3.
6. After 2 seconds, test system stops sending the beacon in slot 4 and adds beacons in slots 2 and 3 with empty BPOIEs.
7. After 2 seconds, test system starts transmitting an additional beacon in slot 6 without the movable bit set. When the test system joins it sends the beacon for slot 6 with the signaling bit set in a signaling slot 4 times.
8. The test system stops sending beacons in slots 2 and 3 and simultaneously starts sending the beacon in slot 6 with the movable bit set.
9. After 2 seconds, test system stops transmitting beacons.
10. After at least 2 seconds, stop analyzer capture.

Test Case 1.11: Overlapping Alien BP Requires BPST Realignment

TX only test system:

1. Start analyzer capture.
2. Test system starts the beacon period and sends a beacon in slots 2 and 3. The BP Length is set to 13.
3. Standard test start-up sequence.

4. The test system changes the slot number in its beacon in slot 3 to 10, but continues to send it in slot 3.
5. In the following superframe, the test system stops transmitting the beacon in slot 2 and starts sending a beacon in the beacon slot immediately following the 'slot 10' beacon with the slot number set to 11.
6. After 10 seconds, test system stops transmitting beacons.
7. After DUT and INTD are transmitting beacons in slots 2 and 3 or at least 10 seconds (whichever occurs first), stop analyzer capture.

TX and RX test system:

1. Start analyzer capture.
2. Standard test start-up sequence (if necessary).
3. Test system joins the beacon period and sends a beacon in slot 4. When the test system joins it sends the beacon for slot 4 with the signaling bit set in a signaling slot 4 times.
4. Test system modifies its BPOIE to indicate that a device with a DevAddr of 0xAA is using slot 2.
5. After 2 seconds, the test system modifies its BPOIE to indicate that a device with a DevAddr of 0xBB is using slot 3.
6. After 2 seconds, test system stops sending the beacon in slot 4 and adds beacons in slots 2 and 3 with an empty BPOIE.
7. After 2 seconds, the test system changes the slot number in its beacon in slot 3 to 10, but continues to send it in slot 3.
8. In the following superframe, the test system stops transmitting the beacon in slot 2 and starts sending a beacon in the beacon slot immediately following the 'slot 10' beacon with the slot number set to 11.
9. After 10 seconds, test system stops transmitting beacons.
10. After DUT and INTD are transmitting beacons in slots 2 and 3 or at least 10 seconds (whichever occurs first), stop analyzer capture.

Note: The DUT and INTD are allowed to cease demonstrating operation and/or beacon transmission during this test case once the alien beacon is detected. Beacon transmission must automatically restart without manual intervention if it ceases.

Test Case 1.12: Updating BP Switch IE**TX only test system:**

1. Start analyzer capture.
2. Test system starts the beacon period and sends beacons in slots 2 and 3. The BP Length is set to 13.
3. Standard test start-up sequence.
4. The test system adds a BP Switch IE to the beacon in slot 2 and starts the countdown value at 9 with a beacon slot offset value of 8.
5. When the countdown values in the BP Switch IE of the beacon in slot 2 reaches 5 the test system also sends a BP Switch IE in slot 3 with a countdown value of 9 and a beacon slot offset of 12.
6. The superframe following step 5, the BP Switch IE of the beacon in slot 2 is sent with a countdown value of 9 and a beacon slot offset value of 12. The BP Switch IE of the beacon in slot 3 begins to countdown normally.
7. When the countdown value in the BP Switch IE for each test system beacon reaches 0, adjust its BPST and beacon slot number per the BPST Offset and beacon slot offset fields of the BP Switch IE.

8. After 10 seconds, test system stops transmitting beacons.
9. After DUT and INTD are transmitting beacons in slots 2 and 3 or at least 10 seconds (whichever occurs first), stop analyzer capture.

TX and RX test system:

1. Start analyzer capture.
2. Standard test start-up sequence (if necessary).
3. Test system joins the beacon period in slots 4 and 5. When the test system joins, it sends the beacon for slot 5 with the signaling bit set in a signaling slot 4 times.
4. Test system adds a BP Switch IE to the beacon in slot 4 and starts the countdown value at 9 with a beacon slot offset of 8.
5. When the countdown values in the BP Switch IE of the beacon in slot 4 reaches 5 the test system also sends a BP Switch IE in slot 5 with a countdown value of 9 and a beacon slot offset of 12.
6. The superframe following step 5, the BP Switch IE of the beacon in slot 4 is sent with a countdown value of 9 and a beacon slot offset value of 12. The BP Switch IE of the beacon in slot 5 begins to countdown normally.
7. When the countdown value in the BP Switch IE for each test system beacon reaches 0, adjust its BPST and beacon slot number per the BPST Offset and beacon slot offset fields of the BP Switch IE.
8. After 10 seconds, test system stops transmitting beacons.
9. After DUT and INTD are transmitting beacons in slots 2 and 3 or at least 10 seconds (whichever occurs first), stop analyzer capture.

Note: The DUT and INTD are allowed to cease demonstrating operation and/or beacon transmission during this test case once the BP Switch IE appears. Beacon transmission and demonstrated operation must automatically restart without manual intervention if either ceases.

Test Case 1.13: Maximum Beacon Slot Usage**TX only test system:**

1. Start analyzer capture
2. Test system starts transmitting a beacon in slot 2. The BP Length is set to 12.
3. Standard test start-up sequence.
4. The test system modifies its beacon in slot 2 with a BPOIE indicating a device with a DevAddr of 3 is occupying slot 3 and modifies the BP Length to 13.
5. One second after step 4, the test system modifies its beacon in slot 2 with a BPOIE indicating that device with a DevAddr of 3 is occupying slot 3 and a device with a DevAddr of 4 is occupying slot 4 and modifies the BP Length to 14.
6. Each second, the test system adds another device to its BPOIE (DevAddr X occupying slot X, where X is the lowest unoccupied slot above the signaling slots), and it increases its BP Length by 1, up to a maximum BP Length of 96. This continues until slots 3-95 are marked as occupied in the test system BPOIE.
7. After 1 second, test system stops transmitting beacons.
8. After at least 2 seconds, stop the analyzer capture.

TX and RX test system:

1. Start analyzer capture.
2. Standard test start-up sequence (if necessary).
3. Test system joins the beacon period in slot 4. When the test system joins it sends the beacon for slot 4 with the signaling bit set in a signaling slot 4 times.

4. Test system modifies the BPOIE to indicate that a device with a DevAddr of 0xAA is using slot 2.
5. One second after step 4, the test system starts sending its beacons with a BPOIE indicating that a device with a DevAddr of 0xAA is using slot 2 and a device with a DevAddr of 0xBB is using slot 3.
6. One second after step 5, the test system modifies its BPOIE, indicating that an additional device with a DevAddr of 5 is occupying slot 5.
7. One second after step 6, the test system modifies its BPOIE, indicating that an additional device with a DevAddr of 6 is occupying slot 6.
8. Each second, the test system adds another device to its BPOIE (DevAddr X occupying slot X, where X is the lowest unoccupied slot above the signaling slots), and it increases its BP Length by 1, up to a maximum BP Length of 96. This continues until slots 2-3 and 5-95 are marked as occupied in the test system BPOIE.
9. After 1 second, test system stops transmitting beacons.
10. After at least 2 seconds, stop the analyzer capture.

Test Case 1.14: Reporting Unaligned Beacon Frame In BPOIE

TX only test system:

1. Start analyzer capture.
2. Test system starts the beacon period and sends a beacon in slot 2. The BP Length is set to 12.
3. Standard test start-up sequence.
4. The test system modifies the BPOIE for the beacon in slot 2 to indicate a device with address 0xAA is in slot 6.
5. After 1 second, the test system adds a beacon that is transmitted in slot 5, but with a Beacon Parameters.Beacon Slot Number = 2.
6. After 2 seconds, test system stops transmitting beacons.
7. After at least 2 seconds, stop analyzer capture.

TX and RX test system:

1. Start analyzer capture.
2. Standard test start-up sequence (if necessary).
3. Test system joins the beacon period and sends a beacon in slot 4. When the test system joins it sends the beacon for slot 4 with the signaling bit set in a signaling slot 4 times.
4. After 1 second, the test system modifies the BPOIE for the beacon in slot 4 to indicate a device with address 0xAA is in slot 6.
5. After 1 second, the test system adds a beacon that is transmitted in slot 5, but with a Beacon Parameters.Beacon Slot Number = 2.
5. After 2 seconds, test system stops transmitting beacons.
6. After at least 2 seconds, stop analyzer capture.

Test Case 1.15: BP Length With BcstAddr Reports

TX only test system:

1. Start analyzer capture.
2. Test system starts the beacon period and sends a beacon in slot 2. The BP Length is set to 13.
3. Standard test start-up sequence.
4. The test system modifies the BPOIE for the beacon in slot 2 to report a bit map = 0x2 and DevAddr = 0xFFFF in slots 5, 9 and 12.

5. After 2 seconds, test system stops transmitting beacons.
6. After at least 2 seconds, stop analyzer capture.

TX and RX test system:

1. Start analyzer capture.
2. Standard test start-up sequence (if necessary).
3. Test system joins the beacon period and sends a beacon in slot 4. When the test system joins it sends the beacon for slot 4 with the signaling bit set in a signaling slot 4 times.
4. After 1 second, the test system modifies the BPOIE for the beacon in slot 4 to report a bit map = 0x2 and DevAddr = 0xFFFF in slots 5, 9 and 12.
5. After 2 seconds, test system stops transmitting beacons
6. After at least 2 seconds, stop analyzer capture.

Test Case 1.16: Signaling Slot Beacon Slot Collision**TX only test system:**

1. Start analyzer capture.
2. Test system starts the beacon period and sends a beacon in slot 2. The BP Length is set to 12.
3. Standard test start-up sequence.
4. The test system transmits an additional beacon in a signaling slot with a DevAddr of 0xAA, Signaling Slot bit = 1 and Beacon Slot Number = 4 for 4 superframes.
5. The test system stops sending the signaling slot beacon, but modifies the BPOIE of the slot 2 beacon to indicate a device with DevAddr = 0xAA is in slot 4.
6. One second after step 5, the test system transmits an additional beacon in a signaling slot with a DevAddr of 0xBB, Signaling Slot bit = 1 and Beacon Slot Number = 3 for 4 superframes.
7. The test system stops sending the signaling slot beacon, but modifies the BPOIE of the slot 2 beacon to add a device with DevAddr = 0xBB is in slot 3.
8. After 1 second, test system stops transmitting beacons.
9. After at least 2 seconds, stop analyzer capture.

TX and RX test system:

1. Start analyzer capture.
2. Standard test start-up sequence (if necessary).
3. Test system joins the beacon period in slot 4. When the test system joins it sends the beacon for slot 4 with the signaling bit set in a signaling slot 4 times.
4. The test system transmits an additional beacon in a signaling slot with a DevAddr of 0xAA, Signaling Slot bit = 1 and Beacon Slot Number = 3 for 4 superframes.
5. The test system stops sending the signaling slot beacon, but modifies the BPOIE of the slot 4 beacon to indicate a device with DevAddr = 0xAA is in slot 3.
6. One second after step 5, the test system transmits an additional beacon in a signaling slot with a DevAddr of 0xBB, Signaling Slot bit = 1 and Beacon Slot Number = 2 for 4 superframes.
7. The test system stops sending the signaling slot beacon, but modifies the BPOIE of the slot 2 beacon to add a device with DevAddr = 0xBB is in slot 2.
8. After 1 second, test system stops transmitting beacons.
9. After at least 2 seconds, stop analyzer capture.

Test Case 1.17: BP Switch IE With No Switching Neighbor

TX only test system:

1. Start analyzer capture.
2. Test system starts the beacon period and sends beacons in slots 2 and 3 with a BP Length of 13. The beacons indicate receiving each other in their BPOIEs.
3. Standard test start-up sequence.
4. Test system includes a BP Switch IE in its slot 2 beacon with Countdown set to 9, then 8, 7, and 6 for 4 superframes. BPST Offset is 10000. It also includes a BP Switch IE in its slot 3 beacon consistent with correct reception of the slot 2 beacon.
5. Test system modifies the BP Switch IE in its slot 3 beacon to set Countdown to 9 and BPST Offset to 65535, consistent with "merge cancel" rules, then counts down and adjusts BPST by -1 consistent with the MAC spec. It also modifies its slot 2 beacon consistent with correct reception of the slot 3 beacon.
6. Test system runs with no BP Switch IEs for at least ten seconds, and ceases to indicate reception of any beacons in the BPOIE in its beacon in slot 3.
7. Test system includes a BP Switch IE in its slot 2 beacon with Countdown set to 9, then 8, 7, and 6 for 4 superframes. BPST Offset is 10000.
8. The test system ceases to send the beacon in slot 2.
9. After 10 seconds, the test system ceases to send the beacon in slot 3.
10. After at least 2 seconds, stop analyzer capture.

TX and RX test system:

1. Start analyzer capture.
2. Standard test start-up sequence (if necessary).
3. Test system joins the beacon period and sends beacons in beacon slots 4 and 5 with a BP Length of 8 and BPOIEs that indicate reception of each other. When the test system joins it also sends the beacon for slot 5 with the signaling bit set in a signaling slot 4 times.
4. Test runs for at least one second.
5. Test system includes a BP Switch IE in its slot 4 beacon with Countdown set to 9, then 8, 7, and 6 for 4 superframes. BPST Offset is 10000. It also includes a BP Switch IE in its slot 5 beacon consistent with correct reception of the slot 4 beacon.
6. Test system modifies the BP Switch IE in its slot 5 beacon to set Countdown to 9 and BPST Offset to 65535, consistent with "merge cancel" rules, then counts down and adjusts BPST by -1 consistent with the MAC spec. It also modifies its slot 4 beacon consistent with correct reception of the slot 5 beacon.
7. Test system runs with no BP Switch IEs for at least 10 seconds and ceases to indicate reception of any beacons in the BPOIE in its beacon in slot 5.
8. Test system includes a BP Switch IE in its slot 4 beacon with Countdown set to 9, then 8, 7, and 6 for 4 superframes. BPST Offset is 10000.
9. The test system ceases to send the beacon in slot 4.
10. After 10 seconds, the test system ceases to send the beacon in slot 5.
11. After at least 4 seconds, stop analyzer capture.

Note: The DUT and INTD are allowed to cease demonstrating operation and/or beacon transmission during this test case once the BP Switch IE appears. Beacon transmission and demonstrated operation must automatically restart without manual intervention if either ceases.

Test Case 2.1: Conflicting Reservation – Whole Superframe – Alien BP DRP

TX only test system:

1. Start analyzer capture.

2. Test system starts the beacon period and sends a beacon in slot 2 with a BPOIE that indicates that slots 3, 4, 5, and 6 are occupied. The BP Length is set to 16.
3. Standard test start-up sequence.
4. The test system begins to transmit beacons in slots 3, 4, 5, and 6 that contain DRP IEs that reserve the whole superframe except the first 5 MAS with reservation type Alien BP.
5. After 2 seconds, test system stops transmitting beacons.
6. After at least 2 seconds, stop analyzer capture.

TX and RX test system:

1. Start analyzer capture.
2. Standard test start-up sequence (if necessary).
3. Test system joins the beacon period and sends a beacon in slots 4, 5, 6, and 7. When the test system joins it sends the beacon for slot 7 with the signaling bit set in a signaling slot 4 times.
4. The test system begins to transmit beacons that contain DRP IEs that reserve the whole superframe except the first 5 MAS with reservation type Alien BP.
5. After 2 seconds, test system stops transmitting beacons.
6. After at least 2 seconds, stop analyzer capture.

Note: The DUT and INTD are allowed to stop demonstrating operation and/or beacon transmission once the conflict is created.

Test Case 2.2: Conflicting Reservation – DUT Reservation Only – Alien BP DRP**TX only test system:**

1. Start analyzer capture.
2. Test system starts transmitting a beacon with no reservations in slot 2. The BP Length is set to 12.
3. Standard test start-up sequence.
4. The test system begins to transmit a beacon in slot 5 that contains DRP IEs that reserve the top and bottom rows in the superframe. The reservation is of type Alien DRP. When the test system joins, it sends the beacon for slot 5 with the signaling slot bit set in a signaling slot 4 times.
5. After 10 seconds, test system stops transmitting beacons.
6. After at least 2 seconds, stop analyzer capture.

TX and RX test system:

1. Start analyzer capture.
2. Standard test start-up sequence (if necessary).
3. Stop analyzer capture. Note DUT reservation.
4. Start analyzer capture.
5. The test system begins to transmit a beacon in slot 4 that contains DRP IEs that reserves the same reservation pattern used by the DUT. The reservation is of type Alien DRP. When the test system joins it sends the beacon for slot 4 with the signaling bit set in a signaling slot 4 times.
6. After 10 seconds, test system stops transmitting beacons.
7. After at least 2 seconds, stop analyzer capture.

Note: The DUT and INTD are allowed to temporarily cease data exchange during this test case. Exchange of data must automatically restart without manual intervention if it ceases and sufficient

bandwidth remains on the channel. If available bandwidth was insufficient to require automatic restart, data exchange is not required to automatically restart after the test system stops transmitting beacons.

Test Case 2.3: Conflicting Reservation – Whole Superframe – Hard DRP

TX only test system:

1. Start analyzer capture.
2. Test system starts the beacon period and sends a beacon in slot 2 with a BPOIE that indicates that slots 3, 4, 5, and 6 are occupied. The BP Length is set to 16.
3. Standard test start-up sequence.
4. The test system begins to transmit beacons in slots 3, 4, 5, and 6 that contain DRP IEs that reserve the whole superframe except the first 4 MAS with reservation type Hard DRP. The tiebreaker bit is set to one initially. After one second the tiebreaker bit is set to zero.
5. After 2 seconds, test system stops transmitting beacons.
6. After at least 2 seconds, stop analyzer capture.

TX and RX test system:

1. Start analyzer capture.
2. Standard test start-up sequence (if necessary).
3. Test system joins the beacon period in slots 4, 5, 6, and 7. When the test system joins, it sends the beacon for slot 7 with the signaling slot bit set in a signaling slot 4 times.
4. The test system adds DRP IEs to its beacons in slots 4, 5, 6, and 7 that reserve the whole superframe except for the first 4 MAS with reservation type Hard DRP. The tiebreaker bit is set to 1.
5. After 1 second, the test system changes the tiebreaker bit for all DRP IEs to 0.
6. After 2 seconds, test system stops transmitting beacons.
7. After at least 2 seconds, stop analyzer capture.

Note: The DUT and INTD are allowed to stop demonstrating operation and/or beacon transmission once the conflict is created.

Test Case 2.4: Conflicting Hard DRP Reservation – DUT/INTD Reservation Only

TX only test system:

1. Start analyzer capture.
2. Test system starts transmitting a beacon with no reservations in slot 2. The BP Length is set to 12.
3. Standard test start-up sequence.
4. The test system begins to transmit a beacon in slot 5 that contains DRP IEs that reserve the top and bottom rows in the superframe. The reservation is of type Hard DRP and the tiebreak bit is set to zero. When the test system joins, it sends the beacon for slot 5 with the signaling slot bit set in a signaling slot 4 times.
5. One second later the test system stops sending a beacon in slot 5.
6. After 5 seconds the test system begins to transmit a beacon in slot 5 that contains DRP IEs that reserve the top and bottom rows in the superframe. The reservation is of type Hard DRP and the tiebreak bit is set to one. When the test system joins, it sends the beacon for slot 5 with the signaling slot bit set in a signaling slot 4 times.
7. After 10 seconds, test system stops transmitting beacons.
8. After at least 2 seconds, stop analyzer capture.

TX and RX test system:

1. Start analyzer capture.
2. Standard test start-up sequence (if necessary).
3. Stop analyzer capture. Observe DUT reservations and tiebreaker bits.
4. Start analyzer capture.
5. The test system begins to transmit a beacon in slot 4 that contains DRP IEs that reserve the same reservation pattern used by the DUT. The reservation is of type Hard DRP and the tiebreak bit is set to the opposite of the tiebreak bit in the DUT reservation.
6. After 10 seconds, test system stops transmitting beacons.
7. After at least 2 seconds, stop analyzer capture.

Note: DUT is not required to keep its reservation in same location when it wins tiebreaker. (DUT may decide it is safe to move because of apparent asymmetric link.)

Note: The DUT and INTD are allowed to temporarily cease data exchange during this test case. Exchange of data must automatically restart without manual intervention if it ceases and sufficient bandwidth remains on the channel. If available bandwidth was insufficient to require automatic restart, data exchange is not required to automatically restart after the test system stops transmitting beacons.

Test Case 2.5: Existing Reservation**TX only test system:**

1. Start analyzer capture.
2. Test system starts the beacon period and sends a beacon in slot 2 with a DRP IE that reserves the top and bottom rows in the superframe with reservation type Hard DRP. The BP Length is set to 12.
3. Standard test start-up sequence.
4. The test system stops sending beacons.
5. After at least 3 seconds, stop analyzer capture.

TX and RX test system:

1. Start analyzer capture.
2. Test system starts the beacon period and sends a beacon in slot 2 with the same reservation the DUT took when the DUT demonstrated operation on an empty channel and a BP length of 12.
3. Standard test start-up sequence.
4. After 2 seconds, test system stops transmitting beacons.
5. After at least 3 seconds, stop analyzer capture.

Note: The DUT and INTD are not required to begin demonstrating operation during this test case if insufficient bandwidth remains on the channel.

Test Case 2.6: DUT Row Reservation Policy**TX only:**

1. Start analyzer capture.
2. Test system starts the beacon period and sends a beacon in slot 2 with a BP length of 12 and with a DRP IE that reserves the bottom 8 rows of the superframe.
3. Standard test start-up sequence.
4. After 3 seconds, test system contracts its reservation by 1 row in its DRP IE, starting at the bottom of the superframe (row 15).

5. Repeat step 4 with the test system contracting 1 row at a time until it frees its entire reservation. The rows shall be freed in the following order: {15, 14, 13, 12, 11, 10, 9, 8}.
6. After 10 seconds, test system stops transmitting beacons.
7. After at least 2 seconds, stop analyzer capture.

TX and RX test system:

1. Start analyzer capture.
2. Standard test start-up sequence (if necessary).
3. Test system joins the beacon period in slot 4. When the test system joins it sends the beacon for slot 4 with the signaling bit set in a signaling slot 4 times.
4. After 1 second, test system adds an Alien BP DRP IE that reserves the bottom 8 rows of the superframe.
5. After 1 second, test system changes replaces the Alien DRP IE with a Hard DRP IE that reserves the bottom 8 rows of the superframe.
6. After 3 seconds, test system contracts its reservation by 1 row in its DRP IE, starting at the bottom of the superframe (row 15).
7. Repeat step 6 with the test system contracting 1 row at a time until it frees its entire reservation. The rows shall be freed in the following order: {15, 14, 13, 12, 11, 10, 9, 8}.
8. After 10 seconds, test system stops transmitting beacons.
9. After at least 2 seconds, stop analyzer capture.

Note: For the TX and RX test system, the DUT and INTD are allowed to temporarily cease data exchange during this test case. Exchange of data must automatically restart without manual intervention if it ceases and sufficient bandwidth remains on the channel. If available bandwidth was insufficient to require automatic restart, data exchange is not required to automatically restart after the test system stops transmitting beacons. For the TX only test system, the DUT and INTD are not required to begin demonstrating operation if insufficient bandwidth remains on the channel.

Test Case 2.7: DUT Column Reservation Policy**TX only:**

1. Start analyzer capture.
2. Test system starts the beacon period and sends a beacon in slots 2 and 3 with a BP length of 13. The test system beacon in slot 2 includes a DRP IE that reserves MASs 0-7 in zones 1, 3, 5, 7, 9, 11, 13 and 15. The test system beacon in slot 3 includes a DRP IE that reserves MASs 0-7 in zones 2, 4, 6, 8, 10, 12 and 14.
3. Standard test start-up sequence.
4. After 3 seconds, test system removes 1 of the column reservations, starting in zone 1.
5. Repeat step 4 with the test system freeing each column reservation 1 at a time until it frees its entire reservation. The reservations shall be freed in the following column order: {1, 15, 2, 14, 3, 13, 4, 12, 5, 11, 6, 10, 7, 9, 8}.
6. After 10 seconds, test system stops transmitting beacons.
7. After at least 2 seconds, stop analyzer capture.

TX and RX test system:

1. Start analyzer capture.
2. Standard test start-up sequence (if necessary).
3. Test system joins the beacon period in slots 4 and 5. When the test system joins it sends the beacon for slot 5 with the signaling bit set in a signaling slot 4 times.
4. After 1 second, test system adds an Alien BP DRP IE to the beacon in slot 4 that reserves the top 8 rows of the superframe with 8 MAS column reservations.

5. After 1 second, test system removes the Alien BP DRP IE and adds a Hard DRP IE to the beacon in slot 4 that reserves MASs 0-7 in zones 1, 3, 5, 7, 9, 11, 13 and 15 and a Hard DRP IE to the beacon in slot 5 that reserves MASs 0-7 in zones 2, 4, 6, 8, 10, 12 and 14.
6. After 3 seconds, the test system removes 1 column reservation in its beacons, starting in column 1.
7. Repeat step 6 with the test system freeing each column reservation 1 at a time until it frees its entire reservation. The reservations shall be freed in the following column order: {1, 15, 2, 14, 3, 13, 4, 12, 5, 11, 6, 10, 7, 9, 8}.
8. After 10 seconds, test system stops transmitting beacons.
9. After at least 2 seconds, stop analyzer capture.

Note: For the TX and RX test system, the DUT and INTD are allowed to temporarily cease data exchange during this test case. Exchange of data must automatically restart without manual intervention if it ceases and sufficient bandwidth remains on the channel. If available bandwidth was insufficient to require automatic restart, data exchange is not required to automatically restart after the test system stops transmitting beacons. For the TX only test system, the DUT and INTD are not required to begin demonstrating operation if insufficient bandwidth remains on the channel.

Test Case 2.8: Reservation Owner Response To Relinquish Request (Unsafe MASs only)

Required if DUT indicates support for making Unsafe reservations in its PICS.

TX only:

1. Start analyzer capture.
2. Test system starts the beacon period and sends a beacon in slot 2 with a BP length of 12.
3. Standard test start-up sequence.
4. DUT or INTD makes an unsafe reservation.
5. Find the DevAddr for the DUT and INTD. In the DUT and INTD beacons, find the Allocation field(s) for at least one DRP IE with the Unsafe bit set to one, the Owner bit set to one and the Reservation Status bit set to one.
6. The test system adds a Relinquish Request IE to its beacon in slot 2 with the Target DevAddr set to the DRP owner's DevAddr and the Allocation field(s) set to that observed in step 5.
7. After $mMaxLostBeacons+1$ superframes, test system removes the Relinquish Request IE from its beacon in slot 2.
8. After 2 seconds, test system stops transmitting beacons.
9. After at least 2 seconds, stop analyzer capture.

TX and RX test system:

1. Start analyzer capture.
2. Standard test start-up sequence (if necessary).
3. DUT or INTD makes an unsafe reservation.
4. Test system joins the beacon period in slot 4. When the test system joins it sends the beacon for slot 4 with the signaling bit set in a signaling slot 4 times.
5. Find the DevAddr for the DUT and INTD. In the DUT and INTD beacons, find the Allocation field(s) for at least one DRP IE with the Unsafe bit set to one, the Owner bit set to one and the Reservation Status bit set to one.
6. The test system adds a Relinquish Request IE to its beacon in slot 4 with the Target DevAddr set to the DRP owner's DevAddr and the Allocation field(s) set to that observed in step 5.

7. After $mMaxLostBeacons+1$ superframes, test system removes the Relinquish Request IE from its beacon in slot 4.
8. After 2 seconds, test system stops transmitting beacons.
9. After at least 2 seconds, stop analyzer capture.

Test Case 2.9: Reservation Owner Response To Relinquish Request (Whole Superframe)

Required if DUT indicates support for making Unsafe reservations in its PICS.

TX only:

1. Start analyzer capture.
2. Test system starts the beacon period and sends a beacon in slot 2 with a BP length of 12.
3. Standard test start-up sequence.
4. DUT or INTD makes an unsafe reservation.
5. Find the DevAddr for the unsafe DRP owner (i.e. includes a DRP IE in its beacon with the Unsafe bit set to one, the Owner bit set to one and the Reservation Status bit set to one).
6. The test system adds a Relinquish Request IE to its beacon in slot 2 with the Target DevAddr set to the DRP owner's DevAddr observed in step 5 and the Allocation field set to cover the entire superframe.
7. After $mMaxLostBeacons+1$ superframes, test system removes the Relinquish Request IE from its beacon in slot 2.
8. After 2 seconds, test system stops transmitting beacons.
9. After at least 2 seconds, stop analyzer capture.

TX and RX test system:

1. Start analyzer capture.
2. Standard test start-up sequence (if necessary).
3. DUT or INTD makes an unsafe reservation.
4. Test system joins the beacon period in slot 4. When the test system joins it sends the beacon for slot 4 with the signaling bit set in a signaling slot 4 times.
5. Find the DevAddr for the unsafe DRP owner (i.e. includes a DRP IE in its beacon with the Unsafe bit set to one, the Owner bit set to one and the Reservation Status bit set to one).
6. The test system adds a Relinquish Request IE to its beacon in slot 4 with the Target DevAddr set to the DRP owner's DevAddr observed in step 5 and the Allocation field set to cover the entire superframe.
7. After $mMaxLostBeacons+1$ superframes, test system removes the Relinquish Request IE from its beacon in slot 4.
8. After 2 seconds, test system stops transmitting beacons.
9. After at least 2 seconds, stop analyzer capture.

Test Case 2.10: Reservation Target Response To Relinquish Request (Unsafe MASs only)

Required if DUT indicates support for making Unsafe reservations in its PICS.

TX only:

1. Start analyzer capture.
2. Test system starts the beacon period and sends a beacon in slot 2 with a BP length of 12.
3. Standard test start-up sequence.
4. DUT or INTD makes an unsafe reservation.

5. Find the DevAddr for the DUT and INTD. In the DUT and INTD beacons, find the Allocation field(s) for at least one DRP IE with the Unsafe bit set to one, the Owner bit set to zero and the Reservation Status bit set to one.
6. The test system adds a Relinquish Request IE to its beacon in slot 2 with the Target DevAddr set to the DRP target's DevAddr and the Allocation field(s) set to that observed in step 5.
7. After $mMaxLostBeacons+1$ superframes, test system removes the Relinquish Request IE from its beacon in slot 2.
8. After 2 seconds, test system stops transmitting beacons.
9. After at least 2 seconds, stop analyzer capture.

TX and RX test system:

1. Start analyzer capture.
2. Standard test start-up sequence (if necessary).
3. DUT or INTD makes an unsafe reservation.
4. Test system joins the beacon period in slot 4. When the test system joins it sends the beacon for slot 4 with the signaling bit set in a signaling slot 4 times.
5. Find the DevAddr for the DUT and INTD. In the DUT and INTD beacons, find the Allocation field(s) for at least one DRP IE with the Unsafe bit set to one, the Owner bit set to zero and the Reservation Status bit set to one.
6. The test system adds a Relinquish Request IE to its beacon in slot 4 with the Target DevAddr set to the DRP target's DevAddr and the Allocation field(s) set to that observed in step 5.
7. After $mMaxLostBeacons+1$ superframes, test system removes the Relinquish Request IE from its beacon in slot 4.
8. After 2 seconds, test system stops transmitting beacons.
9. After at least 2 seconds, stop analyzer capture.

Test Case 2.11: Reservation Target Response To Relinquish Request (Whole Superframe)

Required if DUT indicates support for Unsafe reservations in its PICS.

TX only:

1. Start analyzer capture.
2. Test system starts the beacon period and sends a beacon in slot 2 with a BP length of 12.
3. Standard test start-up sequence.
4. DUT or INTD makes an unsafe reservation.
5. Find the DevAddr for the unsafe DRP target (i.e. includes a DRP IE in its beacon with the Unsafe bit set to one, the Owner bit set to zero and the Reservation Status bit set to one).
6. The test system adds a Relinquish Request IE to its beacon in slot 2 with the Target DevAddr set to the DRP target's DevAddr observed in step 5 and the Allocation field set to cover the entire superframe.
7. After $mMaxLostBeacons+1$ superframes, test system removes the Relinquish Request IE from its beacon in slot 2.
8. After 2 seconds, test system stops transmitting beacons.
9. After at least 2 seconds, stop analyzer capture.

TX and RX test system:

1. Start analyzer capture.
2. Standard test start-up sequence (if necessary).

3. DUT or INTD makes an unsafe reservation.
4. Test system joins the beacon period in slot 4. When the test system joins it sends the beacon for slot 4 with the signaling bit set in a signaling slot 4 times.
5. Find the DevAddr for the unsafe DRP target (i.e. includes a DRP IE in its beacon with the Unsafe bit set to one, the Owner bit set to zero and the Reservation Status bit set to one).
6. The test system adds a Relinquish Request IE to its beacon in slot 4 with the Target DevAddr set to the DRP target's DevAddr observed in step 5 and the Allocation field set to cover the entire superframe.
7. After $mMaxLostBeacons+1$ superframes, test system removes the Relinquish Request IE from its beacon in slot 4.
8. After 2 seconds, test system stops transmitting beacons.
9. After at least 2 seconds, stop analyzer capture.

Test Case 2.12: Issue Relinquish Request

Required if DUT indicates support for issuing Relinquish Requests in its PICS.

TX only test system and TX and RX test system:

1. Start analyzer capture.
2. Test system starts the beacon period and sends a beacon in slot 2 with a BP Length of 12, an unsafe DRP IE that reserves rows 0 through 8 and a safe DRP IE that reserves rows 9-15.
3. Standard test start-up sequence.
4. After 2 seconds, test system stops transmitting beacons.
5. After at least 2 seconds, stop analyzer capture.

Test Case 3.1: Beacon Join With BP Length Expansion

TX only test system and TX and RX test system:

1. Start analyzer capture.
2. Test system starts the beacon period and sends a beacon in slot 9 with the movable bit not set and with a BP Length of 10.
3. Standard test start-up sequence.
4. After 2 seconds, test system stops transmitting beacons.
5. After at least 2 seconds, stop analyzer capture.

Note: Initial DUT beacon can be marked movable – but not required. Must be marked movable by 5th beacon after join.

Test Case 3.2: BPST Adjustment Limit

TX only test system:

1. Start analyzer capture.
2. Test system starts the beacon period and sends a beacon in slot 2. The BP Length is set to 12.
3. Standard test start-up sequence.
4. The test system starts transmitting its beacons with an interval of 65544 microseconds.
5. After 2 seconds, test system stops transmitting beacons.
6. When DUT and INTD are transmitting beacons in slots 2 and 3 or after at least 10 seconds (whichever occurs first), stop analyzer capture.

TX and RX test system:

1. Start analyzer capture.
2. Standard test start-up sequence (if necessary).
3. Test system joins the beacon period in slot 4. When the test system joins it sends the beacon for slot 4 with the signaling bit set in a signaling slot 4 times.
4. Tests system changes its beacon period interval to 65544.
5. After 2 seconds, test system stops transmitting beacons.
6. When DUT and INTD are transmitting beacons in slots 2 and 3 or after at least 10 seconds (whichever occurs first), stop analyzer capture.

Note: The DUT fails if it is not transmitting beacons at least 12 microseconds earlier than the nominal beacon slot boundary defined by the test system beacons at any point within 20 superframes of the test system beacon interval increase. The DUT and INTD are allowed to cease demonstrating operation and/or beacon transmission during this test case once synchronization with the test system has been lost. Beacon transmission must automatically restart without manual intervention if it ceases. Automated trace analysis tools should synchronize to the DUT or INTD beacon instead of the test system beacon in this test case. This will minimize false error reports.

Test Case 3.3: Synchronization With 10 Long Beacons**TX only test system:**

1. Start analyzer capture.
2. Start test system transmitting beacons in slots 2–10 with nominal intervals of 65538 microseconds (as reported by the analyzer). Each beacon is sent a random number of microseconds from 0 to 4 earlier than the scheduled location based on the nominal interval. The BP Length is set to 21. Each test system beacon includes enough minimum length test mode IEs (with the subtype set to zero) to increase the beacon payload length to at least 290 bytes, but not more than 300 bytes.
3. Standard test start-up sequence.
4. After 5 minutes, test system stops transmitting beacons.
5. After at least 2 seconds, stop the analyzer capture.

TX and RX test system:

1. Start analyzer capture.
2. Standard test start-up sequence (if necessary).
3. The test system starts transmitting beacons in slots 4–12. When the test system joins, it sends the beacon for slot 12 in a signaling slot 4 times. Each test system beacon includes enough minimum length test mode IEs (with the subtype set to zero) to increase the beacon payload length to at least 290 bytes, but not more than 300 bytes.
4. The test system slows its beacon interval to 65538 microseconds.
5. For each superframe the test system changes which beacon is the slowest. All other beacons are transmitted from 1 to 4 microseconds early.
6. After 5 minutes, test system stops transmitting beacons.
7. After at least 2 seconds, stop analyzer capture.

Test Case 3.4: Synchronization With 10 Beacons With The NULL EUI-48 (FF-FF-FF-FF-FF-FF) And The Same DevAddr**TX only test system:**

1. Start analyzer capture.

2. Start test system transmitting beacons in slots 2–10 with nominal intervals of 65538 microseconds (as reported by the analyzer). Each beacon is sent a random number of microseconds from 0 to 4 earlier than the scheduled location based on the nominal interval. The BP Length is set to 21. The EUI-48 in all the test system beacons is set to NULL and the DevAddr is set to 2.
3. Standard test start-up sequence.
4. After 1 minute, test system stops transmitting beacons.
5. After at least 2 seconds, stop the analyzer capture.

TX and RX test system:

1. Start analyzer capture.
2. Standard test start-up sequence (if necessary).
3. The test system starts transmitting beacons in slots 4–12. When the test system joins, it sends the beacon for slot 12 in a signaling slot 4 times. The EUI-48 addresses of all the test system beacons are set to NULL and the DevAddr is set to 2.
4. The test system slows its beacon interval to 65538 microseconds.
5. For each superframe the test system changes which beacon is the slowest. All other beacons are transmitted from 1 to 4 microseconds early.
6. After 1 minute, test system stops transmitting beacons.
7. After at least 2 seconds, stop analyzer capture.

Test Case 3.5: Slowly Drifting Alien BP Requires Repeated BPST Realignment**TX only test system:**

1. Start analyzer capture.
2. Test system starts the beacon period and sends a beacon in slot 2 with calibrated intervals of 65538 microseconds. The BP Length is set to 12.
3. Standard test start-up sequence.
4. The test system changes its beacon period interval to 65533 microseconds.
5. After two minutes, the test system stops transmitting beacons.
6. Once the DUT and INTD are transmitting beacons in slots 2 and 3 or at least 10 seconds have elapsed (whichever occurs first), stop analyzer capture.

TX and RX test system:

1. Start analyzer capture.
2. Standard test start-up sequence (if necessary).
3. Test system joins the beacon period in slot 4. When the test system joins it sends the beacon for slot 4 with the signaling bit set in a signaling slot 4 times.
4. Test system modifies its BPOIE to indicate that a device with a DevAddr of 0xAA is using slot 2.
5. After 2 seconds, the test system modifies its BPOIE to indicate that a device with a DevAddr of 0xBB is using slot 3.
6. After 2 seconds, test system stops the beacon in slot 4 and adds a beacon in slot 2 with an empty BPOIE.
7. After 2 seconds, the test system changes its beacon period interval to 65533 microseconds.
8. After two minutes, the test system stops transmitting beacons.
9. Once the DUT and INTD are transmitting beacons in slots 2 and 3 or at least 10 seconds have elapsed (whichever occurs first), stop analyzer capture.

The normal background checks are not valid for this testcase. Only the following checks are valid:

1. The BPST of the DUT and INTD must be no greater than 12 microseconds earlier or 85 microseconds later than the test system's BPST.
2. The DUT and INTD are allowed to cease demonstrating operation and/or beacon transmission during this test case once synchronization with the test system has been lost. However, beacon transmission must automatically restart without manual intervention if it ceases. The DUT or INTD are allowed to cease beacon transmission if a BPST realignment would place them in a beacon slot higher than slot 20.

Test Case 3.6: Lots Of Small Traffic Join

TX only test system and TX and RX test system:

1. Start analyzer capture.
2. Test system starts the beacon period and sends a beacon in slot 2 with a DRP IE that reserves the lowest 7 rows in the superframe with Reservation Type set to Hard. The target of the reservation is the test system DevAddr. The BP Length is set to 12.
3. The test system begins to transmit data frames with a one byte payload at 200 Mbps with SIFS separation throughout the 7 row reservation. The destination address for the data frames is the test system DevAddr.
4. Standard test start-up sequence.
5. After 1 minute, test system stops transmitting beacons.
6. After at least 2 seconds, stop analyzer capture.

Test Case 3.7: Lots Of Large Traffic Join

TX only test system and TX and RX test system:

1. Start analyzer capture.
2. Test system starts the beacon period and sends a beacon in slot 2 with a DRP IE that reserves the lowest 7 rows in the superframe with reservation type Hard DRP. The target of the reservation is the test system DevAddr. The BP Length is set to 12.
3. The test system begins to transmit data frames with a 4095 byte payload at 200 Mbps with SIFS separation throughout the 7 row reservation. The destination address for the data frames is the test system DevAddr.
4. Standard test start-up sequence.
5. After 1 minute, test system stops transmitting beacons.
6. After at least 2 seconds, stop analyzer capture.

Test Case 3.8: Information Elements And Reserved Fields

TX only test system:

1. Start analyzer capture.
2. Test system starts the beacon period and sends a beacon in slot 2 and 3. The BP Length for each is set to 13.
3. The test system beacon in slot 2 has the following reserved bits set to 1 (as supported by the test system):
 - Frame Control [15:14].
 - Sequence Control [15].
 - Beacon Parameters.Device Control [5:2].
4. The test system beacon in slot 2 includes the following Information Elements:
 - TIM IE with DevAddr set to the slot 3 test system beacon

- BPOIE
 - PCA Availability IE marking the entire superframe (except for the Beacon Period) as available.
 - DRP Availability IE marking the entire superframe (except for the Beacon Period) as available.
 - MAC Capabilities IE
 - PHY Capabilities IE
 - Probe IE directed at the slot 3 test system beacon for its PHY Capabilities.
 - Application-specific Probe IE directed at the slot 3 test system beacon
 - Link Feedback IE directed at the slot 3 test system beacon.
 - Identification IE with the Device Information Type = Name String and the data portion set to "WiMedia".
 - MKID IE with a single MKID
 - MAB IE with a single Multicast Address Binding Block.
 - Regulatory Domain IE with Location Aware bit = 1, Regulatory Domain Number set to the current regulatory domain and the Mains Connection Status = 0.
 - Local Cycle Change Request
 - Link Indication IE
 - Test Mode IE
 - Application-specific IE
5. Standard test start-up sequence.
 6. After 5 seconds, test system stops transmitting beacons.
 7. After at least 2 seconds, stop analyzer capture.

TX and RX test system:

1. Start analyzer capture.
2. Standard test start-up sequence (if necessary).
3. Test system joins the beacon period and sends a beacon in slots 4 and 5. When the test system joins it sends the beacon for slot 5 with the signaling bit set in a signaling slot 4 times.
4. The test system beacon in slot 4 has the following reserved bits set to 1 (if supported by the test system):
 - Frame Control [15:14].
 - Sequence Control [15].
 - Beacon Parameters.Device Control [5:2].
5. The test system beacon in slot 4 includes the following Information Elements:
 - TIM IE with DevAddr set to the slot 3 test system beacon
 - BPOIE
 - PCA Availability IE marking the entire superframe (except for the Beacon Period) as available.
 - DRP Availability IE marking the entire superframe (except for the Beacon Period) as available.
 - MAC Capabilities IE
 - PHY Capabilities IE
 - Probe IE directed at the slot 3 test system beacon for its PHY Capabilities.
 - Application-specific Probe IE directed at the slot 3 test system beacon
 - Link Feedback IE directed at the slot 3 test system beacon.

- Identification IE with the Device Information Type = Name String and the data portion set to "WiMedia".
 - MKID IE with a single MKID
 - MAB IE with a single Multicast Address Binding Block.
 - Regulatory Domain IE with Location Aware bit = 1, Regulatory Domain Number set to the current regulatory domain and the Mains Connection Status = 0.
 - Test Mode IE
 - Application-specific IE
6. After 2 seconds, test system stops transmitting beacons.
 7. After at least 2 seconds, stop analyzer capture.

Test Case 3.9: Bad Link BPST Synchronization

Test system adjustment calculation:

1. Capture the BP Interval of the DUT and INTD independently averaged over at least 2 superframes, rounded to the nearest 0.1 microseconds. If the DUT requires the INTD to beacon before it will beacon (or vice versa), the dependent device's BP Interval can be captured by disabling or powering down the initial device. The dependent device should beacon for at least $mMaxLostBeacon + 1$ superframes after the initial device stops transmitting beacons.
2. Add 3 microseconds to the fastest BP Interval between the DUT and INTD (= $adjDUTBPInterval$).
3. Capture the free-running BP Interval of the test system averaged over at least 2 superframes, rounded to the nearest 0.1 microseconds (= $TSBPInterval$).
4. Calculate the difference between $adjDUTBPInterval$ and $TSBPInterval$ and round to the nearest microseconds ($TSadjustment$).
5. $TSadjustment$ is the number of microseconds that the test system's BP Interval must be slowed down by.

TX only test system:

1. Start analyzer capture.
2. Test system starts the beacon period and sends a beacon in slots 2, 3, 4 and 5 with calibrated intervals of 65538 microseconds. The BP Length is set to 15.
3. Standard test start-up sequence.
4. The test system slows its free-running beacon period interval by $TSadjustment$ microseconds.
5. Repeat the following pattern for at least 50 iterations:
 - In superframe N, test system sends a beacon in slots 2, 3, 4 and 5.
 - In superframe N+1 and N+2, test system skips beacon transmission.
6. Test system stops transmitting beacons.
7. After at least 2 seconds, stop analyzer capture.

TX and RX test system:

1. Start analyzer capture.
2. Standard test start-up sequence (if necessary).
3. Test system joins the beacon period in slots 4, 5, 6 and 7. When the test system joins it sends the beacon for slot 7 with the signaling bit set in a signaling slot 4 times.
4. The test system slows its free-running beacon period interval by $TSadjustment$ microseconds.
5. Repeat the following pattern for at least 50 iterations:

- In superframe N, test system sends a beacon in slots 4, 5, 6 and 7.
 - In superframe N+1 and N+2, test system skips beacon transmission.
6. Test system stops transmitting beacons.
 7. After at least 2 seconds, stop analyzer capture.

Test Case 3.10: Hibernation Mode IE

TX only test system:

1. Start analyzer capture.
2. Test system starts the beacon period and sends beacons in slots 2 and 3 with a BP Length of 13.
3. Standard test start-up sequence.
4. Obtain DUT and INTD DevAddrs using analyzer, provide to test software.
5. Test system adds to the beacon in slot 3: [in superframe N]
 - Hibernation Mode IE with Countdown set to 3 and Duration set to 12.
 - Probe IEs addressing the DUT and INTD requesting MAC Capabilities IE.
6. In following superframes, test system modifies its beacon in slot 3 as required by the MAC spec to count down to zero in the Hibernation Mode IE, then removes the second beacon for 12 superframes. [in superframes N+4 through N+15]. In superframes N+6 and N+8, the test system sends a beacon in slot 3 with a DevAddr and EUI-48 different than the one used in the hibernating beacon.
7. Repeat steps 5 and 6 four more times. [superframes N+16 through N+79]
8. Test system continues to send first beacon but not the second beacon for at least 15 seconds.
9. Test system stops sending beacons.
10. After at least 2 seconds, stop analyzer capture.

TX and RX test system:

1. Start analyzer capture.
2. Standard test start-up sequence (if necessary).
3. Test system joins the beacon period and sends a beacon in beacon slot 4 with a BP Length of 8. When the test system joins it sends the beacon for slot 4 with the signaling bit set in a signaling slot 4 times.
4. Test system modifies its BPOIE to indicate that a device with a DevAddr of 0xAA is using slot 2.
5. After 2 seconds, the test system modifies its BPOIE to indicate that a device with a DevAddr of 0xBB is using slot 3.
6. After 2 seconds, test system stops the beacon in slot 4 and adds a beacon in slots 2 and 3 with an empty BPOIE.
7. Obtain DUT and INTD DevAddrs using analyzer, provide to test software.
8. Test system adds to its beacon in slot 3: [in superframe N]
 - Hibernation Mode IE with Countdown set to 3 and Duration set to 12.
 - Probe IEs addressing the DUT and INTD requesting MAC Capabilities IE.
9. In following superframes, test system modifies its beacon in slot 3 as required by the MAC spec to count down to zero in the Hibernation Mode IE, then removes the slot 3 beacon for 12 superframes. [in superframes N+4 through N+15]. In superframes N+6 and N+8, the test system sends a beacon in slot 3 with a DevAddr and EUI-48 different than the one used in the hibernating beacon.
10. Repeat steps 8 and 9 four more times. [superframes N+16 through N+79]

11. Test system stops sending the slot 3 beacon, but test runs for at least 15 seconds.
12. Test system stops sending beacons.
12. After at least 2 seconds, stop analyzer capture.

Test Case 3.11: Scan And Join When Receiving Intermittent Beacons

TX only test system and TX and RX test system:

1. Start analyzer capture.
2. The test system creates the beacon group and transmits a beacon in slots 2, 3, 4 and 5 in superframe N. The BP Length is set to 15.
3. In superframe N+1, the test system skips all beacon transmission.
4. The test system repeats steps 2 and 3 for the duration of the test.
5. Standard test start-up sequence.
6. After 2 seconds, stop DUT and INTD operation.
7. Repeat steps 5 and 6 4 additional times.
8. Test system stops transmitting beacons.
9. Stop the analyzer capture.

Test Case 3.12: Scan And Join When Receiving Intermittent Beacons And Data Frames (FYI only)

TX only test system and TX and RX test system:

1. Start analyzer capture.
2. The test system creates the beacon group and transmits a beacon in slots 2, 3, 4 and 5 in superframe N. The BP Length is set to 15. The test system beacon in slot 2 includes a DRP IE reserving the bottom row of the superframe. The test system transmits at least 4 data frames with a 1 byte payload at 200 Mbps in the reservation. The destination address for the data frames is the test system DevAddr.
3. In superframe N+1 and N+2, the test system skips all beacon transmission, but still transmits at least 4 data frames in the reservation.
4. The test system repeats steps 2 and 3 for the duration of the test.
5. Standard test start-up sequence.
6. After 2 seconds, stop DUT and INTD operation.
7. Repeat steps 5 and 6 4 additional times.
8. Test system stops transmitting beacons.
9. Stop the analyzer capture.

Note: The initial beacon transmitted by the DUT or INTD (whichever joins first) should have a BPST that is no more than 12 microseconds earlier than the BPST of the test system.

Test Case 4.1: Bad Link

TX only test system:

1. Start analyzer capture.
2. Start test system transmitting beacons in slots 2-10 with nominal intervals of 65538 microseconds (as reported by the analyzer). Each beacon is sent a random number of microseconds from 0 to 4 earlier than the scheduled location based on the nominal interval. The BP Length is set to 21. The beacons each contain a BPOIE that properly indicates the presence of the other test system beacons. In addition: Each of the test system beacons has the following behavior.

- Randomly transmit FCS errors 10% of the time.
 - Randomly do not transmit 10% of the time.
 - Randomly indicate that other test system beacons are received with an HCS error 10% of the time.
 - Randomly indicate that other test system beacons are not received 10% of the time.
 - Randomly indicate that the other test system beacons are received with FCS errors 10% of the time.
3. Standard test start-up sequence.
 4. Once step 3 is complete a test system beacon behaves as if there is a collision if its slot is reported with an HCS error three consecutive times by another test system beacon. This test system beacon is relocated to a random slot between slot 13 and 20 and then marks itself moveable and contracts back following normal protocol rules. If multiple collisions are detected at the same time – the test system chooses unique slots between 13 and 20 for relocation.
 5. After 3 minutes, the test system beacons stop relocating due to collisions. At this point each test system beacon randomly reports HCS errors for slot 11 and slot 12 50% of the time.
 6. After 2 minutes, test system stops transmitting beacons.
 7. After at least 2 seconds, stop the analyzer capture.

TX and RX test system:

1. Start analyzer capture.
2. Standard test start-up sequence (if necessary).
3. Start test system transmitting beacons in slots 4-12 with nominal intervals of 65538 microseconds (as reported by the analyzer). Each beacon is sent a random number of microseconds from 0 to 4 earlier than the scheduled location based on the nominal interval. The BP Length is set to 21. The beacons each contain a BPOIE that properly indicates the presence of the other test system beacons. In addition: Each of the test system beacons has the following behavior.
 - Randomly transmit FCS errors 10% of the time.
 - Randomly do not transmit 10% of the time.
 - Randomly indicate that other test system beacons are received with an HCS error 10% of the time.
 - Randomly indicate that other test system beacons are not received 10% of the time.
 - Randomly indicate that the other test system beacons are received with FCS errors 10% of the time.
4. Once step 3 is complete a test system beacon behaves as if there is a collision if its slot is reported with an HCS error three consecutive times by another test system beacon. This test system beacon is relocated to a random slot between slot 13 and 20 and then marks itself moveable and contracts back following normal protocol rules. If multiple collisions are detected at the same time – the test system chooses unique slots between 13 and 20 for relocation.
5. After 3 minutes, the test system beacons stop relocating due to collisions. At this point each test system beacon randomly reports HCS errors for slot 2 and slot 3 50% of the time.
6. After 2 minutes, test system stops transmitting beacons.
7. After at least 2 seconds, stop the analyzer capture.

Test Case 5.1: Clock Accuracy

TX only test system and TX and RX test system:

1. Start analyzer capture.
2. Standard test start-up sequence.
3. Stop analyzer capture.

Test Case 5.2: Standby/Hibernate

Test case is only run if DUT or INTD are connected to a controlling device (such as a PC).

TX only test system:

1. Start analyzer capture.
2. Start test system transmitting beacons in slots 2–10 with nominal intervals of 65538 microseconds (as reported by the analyzer). Each beacon is sent a random number of microseconds from 0 to 4 earlier than the scheduled location based on the nominal interval. The BP Length is set to 21. The EUI-48 in all the test system beacons is set to NULL and the DevAddr is set to 2.
3. Standard test start-up sequence.
4. After 5 seconds, the controlling device is placed into standby or hibernate.
5. Wait for controlling device to enter standby or hibernate. After 1 minute, test system stops transmitting beacons.
6. Stop the analyzer capture.

TX and RX test system:

1. Start analyzer capture.
2. Standard test start-up sequence (if necessary).
3. The test system starts transmitting beacons in slots 4–12. When the test system joins, it sends the beacon for slot 12 in a signaling slot 4 times. The EUI-48 addresses of all the test system beacons are set to NULL and the DevAddr is set to 2.
4. The test system slows its beacon interval to 65538 microseconds.
5. For each superframe the test system changes which beacon is the slowest. All other beacons are transmitted from 1 to 4 microseconds early.
6. After 5 seconds, the controlling device is placed into standby or hibernate.
7. Wait for controlling device to enter standby or hibernate. After 1 minute, test system stops transmitting beacons.
8. Stop the analyzer capture.

Test Case 5.3: Optional Feature Demonstration

A device must demonstrate operation of all optional features for which it claims support in its PICS. Run this testcase, as required, to demonstrate operation of each optional feature that is not demonstrated in another testcase. For this testcase, position the analyzer(s) as close to the DUT and INTD as is reasonable in order to maximize the reception of frames from the DUT and INTD.

TX only test system:

1. Start analyzer capture.
2. Start test system transmitting beacons in slots 2–10 with nominal intervals of 65538 microseconds (as reported by the analyzer). Each beacon is sent a random number of microseconds from 0 to 4 earlier than the scheduled location based on the nominal interval. The BP Length is set to 21. Each test system beacon includes enough minimum length test mode IEs (with the subtype set to zero) to increase the beacon payload length to at least 290 bytes, but not more than 300 bytes.

3. Standard test start-up sequence.
4. DUT and INTD demonstrate operation of optional features. Inform test operator when complete.
5. Test system stops beaconing.
6. After at least 2 seconds, stop the analyzer capture.

TX and RX test system:

1. Start analyzer capture.
2. Standard test start-up sequence (if necessary).
3. The test system starts transmitting beacons in slots 4–12. When the test system joins, it sends the beacon for slot 12 in a signaling slot 4 times. Each test system beacon includes enough minimum length test mode IEs (with the subtype set to zero) to increase the beacon payload length to at least 290 bytes, but not more than 300 bytes.
4. The test system slows its beacon interval to 65538 microseconds.
5. For each superframe the test system changes which beacon is the slowest. All other beacons are transmitted from 1 to 4 microseconds early.
6. DUT and INTD demonstrate operation of optional features. Inform test operator when complete.
7. Test system stops beaconing.
8. After at least 2 seconds, stop analyzer capture.

Test Case 6.1: Reference Platform Interoperability

The group interoperability test is performed with four pairs of reference platforms. The reference platform pairs are referred to as platform A, B, C, and D in this test description. The procedure for the selection of reference platforms is outside the scope of this specification. All of the platforms are positioned with line of sight paths to each other. The platforms are spaced approximately equally within a 5 meter diameter circular area.

Test Procedure:

1. Start analyzer capture.
2. Start platform A.
3. One minute later, start platform B.
4. One minute later, start platform C.
5. One minute later, start platform D.
6. One minute later, standard test start-up sequence.
7. After 5 minutes, shutdown platform A.
8. After 10 seconds, shutdown platform B.
9. After 10 seconds, shutdown platform C.
10. After 10 seconds, shutdown platform D.
11. After 10 seconds, shutdown DUT and INTD.
12. Stop analyzer capture.

The test is repeated using different orders for starting and shutting down the platforms. Each platform shall be started first and last at least once during the sequence.

Test Case 7.1: PCA Honors Reservation Boundaries**TX only test system:**

1. Start analyzer capture.

2. Test system starts the beacon period and sends a beacon in slot 2 with a BP length of 12 with the following DRP IEs:
 - Hard DRP that reserves the bottom 2 rows of the superframe.
 - Soft DRP as the reservation owner that reserves MASs 0-3 in columns 2, 6, 10 and 14 with a multicast target DevAddr.
 - Soft DRP as the reservation target that reserves MASs 0-3 in columns 1, 3, 5, 7, 9, 11, 13 and 15.
 - Private DRP that reserves MASs 0-3 in columns 4 and 12.
3. Standard test start-up sequence.
4. At the start of each Soft DRP (Owner) reservation block, with a 10% probability, the test system sends an RTS frame at the start of the Soft DRP (Owner) with a duration field of 1000 microseconds.
5. After 20 seconds, test system stops transmitting beacons and RTS frames.
6. After at least 2 seconds, stop analyzer capture.

TX and RX test system:

1. Start analyzer capture.
2. Standard test start-up sequence.
3. Test system starts transmitting a beacon in slot 4. When the test system joins it sends the beacon for slot 4 with the signaling bit set in a signaling slot 4 times.
4. The test system adds an Alien BP DRP IE which reserves MASs 0-3 in columns 1, 2, 3, 5, 6, 7, 9, 10, 11, 13, 14 and 15 and rows 14 and 15..
5. After 1 second, the test system removes the Alien DRP IE and replaces it with the following DRP IEs:
 - Hard DRP that reserves the bottom 2 rows of the superframe.
 - Soft DRP as the reservation owner that reserves MASs 0-3 in columns 2, 6, 10 and 14 with a multicast target DevAddr.
 - Soft DRP as the reservation target that reserves MASs 0-3 in columns 1, 3, 5, 7, 9, 11, 13 and 15.
 - Private DRP that reserves MASs 0-3 in columns 4 and 12.
6. At the start of each Soft DRP (Owner) reservation block, with a 10% probability, the test system sends an RTS frame at the start of the Soft DRP (Owner) with a duration field of 1000 microseconds.
7. After 20 seconds, test system stops transmitting beacons and RTS frames.
8. After at least 2 seconds, stop analyzer capture.

Note: For the TX and RX test system, the DUT and INTD are allowed to temporarily cease data exchange during this test case. Exchange of data must automatically restart without manual intervention if it ceases and sufficient bandwidth remains on the channel. If available bandwidth was insufficient to require automatic restart, data exchange is not required to automatically restart after the test system stops transmitting beacons. For the TX only test system, the DUT and INTD are not required to begin demonstrating operation if insufficient bandwidth remains on the channel.

Test Case 7.2: PCA Use Of Duration**TX only test system:**

1. Start analyzer capture.
2. Test system starts the beacon period and sends a beacon in slot 2 with a BP Length of 12. The beacon includes one reservation of type PCA, which reserves MASs 0-3 in columns 4, 8, and 12, and one reservation of type Private claiming row 15.

3. Standard test start-up sequence.
4. Find DevAddr for DUT and INTD.
5. With a probability of 50%, the test system sends an RTS frame at the start of each PCA reservation block. The SrcAddr of the RTS frame is the DevAddr of the test system beacon in slot 2. The DestAddr of the RTS frame alternates between the DevAddr of the DUT and the DevAddr of the INTD. The data frame sets Duration to a random value between 50 and 1024 microseconds.
6. Test runs for at least 30 seconds after device starts operation.
7. Test system ceases to send beacon and RTS frames.
8. After at least 2 seconds, stop analyzer capture.

TX and RX test system:

1. Start analyzer capture.
2. Standard test start-up sequence.
3. Find DevAddr for DUT and INTD.
4. Test system starts transmitting a beacon in slot 4. When the test system joins it sends the beacon for slot 4 with the signaling bit set in a signaling slot 4 times.
5. The test system adds an Alien BP DRP IE which reserves MASs 0-3 in columns 4, 8, and 12 and row 15.
6. After 1 second, the test system removes the Alien DRP IE and replaces it with one reservation of type PCA, which reserves MASs 0-3 in columns 4, 8, and 12, and one reservation of type Private claiming row 15.
7. With a probability of 50%, the test system sends an RTS frame at the start of each PCA reservation block. The SrcAddr of the RTS frame is the DevAddr of the test system beacon in slot 2. The DestAddr of the RTS frame alternates between the DevAddr of the DUT and the DevAddr of the INTD. The data frame sets Duration to a random value between 50 and 1024 (microseconds).
8. Test runs for at least 30 seconds after device starts operation.
9. Test system ceases to send beacon and RTS frames.
10. After at least 2 seconds, stop analyzer capture.

Note: For the TX and RX test system, the DUT and INTD are allowed to temporarily cease data exchange during this test case. Exchange of data must automatically restart without manual intervention if it ceases and sufficient bandwidth remains on the channel. If available bandwidth was insufficient to require automatic restart, data exchange is not required to automatically restart after the test system stops transmitting beacons. For the TX only test system, the DUT and INTD are not required to begin demonstrating operation if insufficient bandwidth remains on the channel.

Test Case 8.1: ACI Present During Join

TX only and TX and RX test systems:

1. Start analyzer capture.
2. The ACI test system starts running Test Case 3.6 on the ACI channel with the following modifications:
 - a. The ACI test system reservation is for all rows in the superframe.
 - b. The ACI test system stops activity only once the test case is complete.
3. Run Test Case 1.13.
4. Stop analyzer capture.
5. Start analyzer capture.
6. Run Test Case 3.4.

7. Stop analyzer capture.
8. The test is repeated for each of the following channel combinations:

DUT/INTD Channel	ACI Test System Channel	ACI Test System Distance N (m)
9	10	2
9	13	2
13	9	2
13	14	1
15	14	1

Test Case 8.2: ACI Present After Join

TX only and TX and RX test systems:

1. Start analyzer capture.
2. Run Test Case 3.4.
3. Immediately after step 3 of Test Case 3.4, start the ACI test system running Test Case 3.6 on the ACI channel with the following modifications:
 - a. The ACI test system reservation is for all rows in the superframe.
 - b. The ACI test system stops activity only once the test case is complete.
4. Stop analyzer capture.
5. The test is repeated for each of the following channel combinations:

DUT/INTD Channel	ACI Test System Channel	ACI Test System Distance N (m)
9	10	2
9	13	2
13	9	2
13	14	1
15	14	1

Test Case 9.1: Global Cycle Establishment – Single GCST

TX only and TX and RX test systems:

1. Start analyzer capture.
2. Test system starts the beacon period and sends a beacon in slot 2.
3. The test system beacon in slot 2 does not include an Anchor Selection IE.
4. Standard test start-up sequence.
5. Test runs for at least 2048 (i.e. $wMaxGCSC+1$) superframes after DUT and INTD have started operation.
6. Stop analyzer capture.

Test Case 9.2: Global Cycle Establishment – Multiple GCST

TX only and TX and RX test systems:

1. Start analyzer capture.

2. Test system starts the beacon period and sends a beacon in slot 2 and 3.
3. The test system beacon in slot 2 includes an Anchor Selection IE with a GCSC value of 2000.
4. The test system beacon in slot 3 includes an Anchor Selection IE with a GCSC value of 1000.
5. Standard test start-up sequence.
6. Test runs for at least 2048 (i.e. $wMaxGCSC+1$) superframes after DUT and INTD have started operation.
7. Stop analyzer capture.

Test Case 9.3: Global Cycle Process – Single Unaligned GCST

TX only and TX and RX test systems:

1. Start analyzer capture.
2. Test system starts the beacon period and sends a beacon in slot 2.
3. The test system beacon in slot 2 does not include an Anchor Selection IE.
4. Standard test start-up sequence.
5. When the Anchor Selection IE GCSC value of the DUT is 2047 the test system will change its GCSC value to 2047 in the next superframe.
6. When the Anchor Selection IE GCSC value of the DUT is 2040 the test system will change its GCSC value to 1024 in the next superframe.
7. When the Anchor Selection IE GCSC value of the DUT is 1 the test system will change its GCSC value to 1024 in the next superframe.
8. Test runs for at least 2048 (i.e. $wMaxGCSC+1$) superframes after DUT and INTD have started operation.
9. Stop analyzer capture.

Test Case 9.4: Global Cycle Process – Multiple Unaligned GCST

TX only and TX and RX test systems:

1. Start analyzer capture.
2. Test system starts the beacon period and sends a beacon in slot 2 and 3.
3. The test system beacon in slot 2 includes an Anchor Selection IE with a GCSC value of 2000.
4. The test system beacon in slot 3 includes an Anchor Selection IE with a GCSC value of 1000.
5. Standard test start-up sequence.
6. The test system changes the beacon slot 2 Anchor Selection IE GCSC value to any integer in the range [0 - 2047] less than its current value
7. The test system changes the beacon slot 3 Anchor Selection IE GCSC value to any integer in the range [0 - 2047] less than its current value
8. Test runs for at least 2048 (i.e. $wMaxGCSC+1$) superframes after DUT and INTD have started operation.
9. Stop analyzer capture.

Test Case 9.5: Local Cycle

TX only and TX and RX test systems:

1. Start analyzer capture.

2. Test system starts the beacon period and sends a beacon in slot 2.
3. Standard test start-up sequence.
4. Repeat step 2-4 16 additional times.
5. Stop analyzer capture.

Test Case 9.6: Anchor Selection - Selecting Neighbor

TX only and TX and RX test systems:

1. Start analyzer capture.
2. Test system starts the beacon period and sends a beacon in slot 2 and 3.
3. The test system beacon in slot 2 includes an Anchor Selection IE with the 'Selecting anchor' bit in the cycle parameters set to 0, GCSC set to 2047, Local cycle index set to 8, anchor DevAddr is 0x00AA
4. The test system beacon in slot 3 includes an Anchor Selection IE with the 'Selecting anchor' bit in the cycle parameters set to 0, GCSC set to 2047, Local cycle index set to 8, anchor DevAddr is 0x00AA
5. Standard test start-up sequence.
6. The test system beacon in slot 2 includes an Anchor Selection IE with the 'Selecting anchor' bit in the cycle parameters set to 0, GCSC maintains the countdown sequence, Local cycle index set to 8, anchor DevAddr is 0x00BB.
7. The test system beacon in slot 3 includes an Anchor Selection IE with the 'Selecting anchor' bit in the cycle parameters set to 0, GCSC maintains the countdown sequence, Local cycle index set to 8, anchor DevAddr is 0x00BB
8. Test runs for at least 2048 (i.e. $wMaxGCSC+1$) superframes after DUT and INTD have started operation.
9. Stop analyzer capture.

Test Case 9.7: Anchor Selection - Selecting Self

TX only and TX and RX test systems:

1. Start analyzer capture.
2. Test system starts the beacon period and sends a beacon in slot 2.
3. The test system beacon in slot 2 includes an Anchor Selection IE with the 'Selecting anchor' bit in the cycle parameters set to 1, GCSC set to any value in the range 0-2047, Local cycle index set to 8, anchor DevAddr is 0x00AA, ACW set to 0. The BPOIE indicates that slot 3 is occupied.
4. Standard test start-up sequence.
5. Test runs for at least 8 superframes after the DUT and INTD have started operation.
6. The test system beacon in slot 2 includes an Anchor Selection IE with the 'Selecting anchor' bit in the cycle parameters set to 1, GCSC maintains the countdown sequence, Local cycle index set to 8, anchor DevAddr is 0x00AA, ACW set to 0. The BPOIE indicates that slot 3 is empty.
7. Test runs for 16 superframes (to allow the INTD to move into slot 3
8. Test runs for 512 superframes to complete an Anchor cycle
9. At the next GCST the test system beacon in slot 2 includes an Anchor Selection IE with the 'Selecting anchor' bit in the cycle parameters set to 1, GCSC maintains the countdown sequence, Local cycle index set to 8, anchor DevAddr is that of the DUT, ACW set to 0. The BPOIE indicates that slot 3 is empty. The Hibernation Mode IE with countdown set to 10 and duration set to 12
10. Test runs for at least 2048 (i.e. $wMaxCycleWait$) superframes after DUT and INTD have started operation.

11. Stop analyzer capture.

Test Case 9.8: Anchor Selection – Rule D

TX only and TX and RX test systems:

1. Start analyzer capture.
2. Test system starts the beacon period and sends a beacon in slot 2.
3. The test system beacons in slot 4, 5, 6 with DevAddr 0x00AA, 0x00BB, 0x00CC respectively. Each beacon includes an Anchor Selection IE with the 'Selecting anchor' bit in the cycle parameters set to 1, GCSC set to any value in the range 0-2047, Local cycle index set to 8, ACW set to 255.
4. Test runs for at least 2048 (i.e. wMaxCycleWait) superframes after DUT and INTD have started operation.
5. Stop analyzer capture.

Annex A (normative) Test Mode IE

The MAC allows for the definition of MAC protocol Information Elements (IEs). The format of an IE is shown in Figure 34 of [B]1 and copied in Figure 6 below.

octets: 1	1	N
Element ID	Length (=N)	IE specific fields

Figure 6 — Information Element

WiMedia MAC IE Element ID 251 is assigned to the Test Mode IE.

The Test Mode IE is defined as shown in Figure 7.

octets: 1	1	1	N
Element ID (=251)	Length (=1+N)	Test Mode Sub-type	Sub-type-specific fields

Figure 7 — Test Mode IE

The Test Mode IE is defined to have an initial 'sub-type' field, to facilitate future additions of test functions. Table 1 contains the valid field values for the Test Mode Sub-type field.

Table 1 — Test Mode Sub-type field values

Value	Sub-type
0	Reserved
1	Channel Selection
2	Test System
3–255	Reserved

Only a legitimate Test System is permitted to include a Test Mode IE in its beacon.

A.1 Channel Selection Test Mode Sub-type

The Channel Selection Test Mode Sub-type, value 1, is defined where the next field is a single octet containing the value of the PHY Channel Number to be used for operation by any DUT receiving the IE in a test system beacon. The Test Mode IE for sub-type 1 is shown in Figure 8.

octets: 1	1	1	1
Element ID (=251)	Length (=2)	Test Mode Sub-Type (=1)	PHY Channel Number [B]2

Figure 8 — Test Mode IE for sub-type 1

A Test System should transmit beacons carrying Channel Selection Test Mode IEs on at least the desired operating channel and preferably on all available channels with the PHY Channel Number field set the desired PHY Channel Number.

A device receiving a beacon containing a Channel Selection Test Mode IE should immediately change its channel to the channel specified in the IE, or signal its intent to change by including the Channel Change IE in its beacon (as defined in 7.8.5 of [B]1) and executing the associated channel change procedure.

The format of PHY channel numbers is defined in [B]2.

A.2 Test System Test Mode Sub-type

The Test System Test Mode Sub-type, value 2, is defined here. The Test Mode IE for sub-type 2 is shown in Figure 9.

octets: 1	1	1
Element ID (=251)	Length (=1)	Test Mode Sub-Type (=2)

Figure 9 — Test Mode IE for sub-type 1

The Test System Test Mode Sub-type is included in all beacons sent by the test system and identifies these beacons as test system beacons.

Annex B Bibliography

[B]1 Distributed Medium Access Control (MAC) for Wireless Networks, Draft 1.5, October 5th, 2009

[B]2 Multiband OFDM Physical Layer Specification, Release Candidate 1.2, March 26, 2009

[B]3 WiMedia Assigned Numbers, Version 1.2.1, October 24th, 2008