IEEE P802.11  
Wireless LANs

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| |  |  |  |  |  | | --- | --- | --- | --- | --- | | STA State Signaling | | | | | | Date: 2018-10-18 | | | | | | Author(s): | | | | | | Name | Affiliation | Address | Phone | email | | Matthew Fischer | Broadcom |  |  | [Matthew.fischer@broadcom.com](mailto:Matthew.fischer@broadcom.com) | |  |  |  |  |  | |  |  |  |  |  | |  |  |  |  |  | |  |  |  |  |  | |  |  |  |  |  | |  |  |  |  |  | |

Abstract

Proposed language to create a mechanism to signal STA State to be transmitted to a STA using the A-control field.

Changes are referenced to TGax D4.1.

**REVISION NOTES:**

**R0**:

initial

**R1**:

Change resolution of Maximum RX PPDU Duration field from 500 us to 512 us

10.14 PPDU duration constraint – see next change

27.5.3.2.3 Allowed settings of the Trigger frame fields and TRS Control subfield – the Maximum RX PPDU Duration language is moved out of this location and into 10.14 PPDU duration constraint – it was in the wrong place and the wording of the AP behaviour is corrected so that it applies to all transmissions to the STA

9.2.4.6a.7a - Change maximum doze duration resolution from 250 us to 256 us

Update doc references

**R2**:

9.2.4.6a.7a – added text to indicate that Minimum PSDU Allocation value of 0 = no constraint on the minimum allocation size

9.2.4.6a.7a – modified Maximum PSDU Allocation value and field encoding to include a scaling factor

11.2.3.19a – added text to indicate that a STA in doze can exit doze before the end of the doze duration and the remaining doze duration is cancelled

27.5.3.3 – add restriction that minimum PSDU has to be less than maximum PSDU allocation

Update doc references

**R3**:

9.2.4.6a.7a – change “will transition to doze state” to “might transition to doze state”

11.2.3.6 – change Doze Transition subfield to Maximum RX PPDU Duration subfield, added “immediacy” of transition to doze

11.2.3.7 – change DTS to SSS and change doze transition to maximum RX PPDU duration

11.2.3.12 – remove the first change as the STA is not allowed to transition to doze while waiting for the response

11.2.3.12 – move the second change to appear in a different paragraph, which discusses the TDLS peer PSM service period and its termination

Update doc references

**R4**:

Update to D3.3

Update doc references

**R5**:

Removed RX Maximum DDSU signaling – control field now only signals STA State

Update doc references

**R6**:

Change meaning of STA State value 0 from signalling transition to Awake state to indefinite STA State

Added text to state that any existing signalling that indicates a transition to Awake state cancels any remaining Doze time that was signalled using the STA State field

Update doc references

**R7**:

Include awake End Time signalling

Update doc references

**R8**:

Add text to discussion.

Update to D4.0

Update to use CID 21051 from D4.0 LB238

11.2.3.19a – added “any previously signalled STA State End Time value is cancelled”

Update doc references

**R9**:

Provide separate capabilities for the State signalling bit from the State End Time subfield

* Add another capability bit
* Add another MIB variable
* Split the behavioural language as appropriate

Update doc references

**R10**:

Update to D4.1

11.2.3.19a – add language that prohibits simultaneous mode and state changes, such that a transition into PS mode (e.g. first frame with PM==1) always leaves the STA in Doze State and a transition out of PM mode leaves the STA in Awake State (e.g. first frame with PM==0)

Update doc references

**R11**:

Change function of STA State subfield:

* a “1” indicates a transition into DOZE state
* a “0” indicates no information

Update doc references

**END OF REVISION NOTES**

Interpretation of a Motion to Adopt

A motion to approve this submission means that the editing instructions and any changed or added material are actioned in the TGax Draft. This introduction is not part of the adopted material.

***Editing instructions formatted like this are intended to be copied into the TGax Draft (i.e. they are instructions to the 802.11 editor on how to merge the text with the baseline documents).***

***TGax Editor: Editing instructions preceded by “TGax Editor” are instructions to the TGax editor to modify existing material in the TGax draft. As a result of adopting the changes, the TGax editor will execute the instructions rather than copy them to the TGax Draft.***

**CIDs**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 21051 | Matthew Fischer | 26.8.5 | 383.50 | The TWT Information frame is a management frame for which reception and parsing at the receiving STA can be incovenient but is currently the only effective means for a STA to cause an early termination of a TWT SP. There needs to be a more convenient mechanism for a STA to cause a TWT SP early termination. Suggest using an A control value to signal a STA state transition with timing information. | Include a mechanism for signaling STA state transition which can be used by a STA to create an early termination of a TWT SP, such as is described in 11-18-1821 | Revise - TGax editor to make changes as shown in 11-18/1821r11 that are marked with CID 21051 which create a mechanism to signal a transition to doze state. TWT information behavior is unaltered, and still may be used in the original context as another method for TWT SP termination in addition to the requested use of indicating suspend and resume. |

**Discussion:**

Several features within the TGax draft and the baseline 802.11 standard use mechanisms which incorporate some aspect of time scheduling. For example, OFDMA operation, TWT, Power Save and others, either include by definition or are often deployed with some periodic time behaviour in their operation. Additional functions beyond 802.11 but that affect the operation of an 802.11 STA frequently also incorporate schedule-like behaviour. Examples of such functions include those that are defined to operate on an 802.11 STA and functions that are operating within non-802.11 devices, but operate within the same channels as 802.11 STAs. As these many functions operate, they can create windows of time during which the ability of an 802.11 STA to perform 802.11 frame exchanges is reduced, impaired or impossible. Given that there are various features competing for the use of each of the possible time slots of operation for a given 802.11 STA, it is useful to have some ability within 802.11 to signal the existence of known timing constraints among devices so that common periods of operation can be identified and any periods where communication is impaired or impossible can be avoided.

There is a suggestion that a valid mechanism for early termination of a TWT SP is for the non-AP STA to transmit an MPDU with PM==1, but this is explicitly disallowed in the TGax draft, see **26.8.5 Power save operation during TWT SPs**.

In order to accommodate this desire, this document inclues a set of proposed changes to TGax D3.2 which create a new mechanism for signaling a constraint on the duration of a PPDU that may be transmitted to the constrained STA and to signal a duration of a doze state. The new signaling is included in the A-control field.

In addition, a receiving STA might have constraints on UL and DL transmissions and the proposal includes a mechanism for the STA to express those constraints while adding *recommendations* for an AP to obey those constraints.

**Proposed Changes to TGax D4.1:**

***TGax editor: within TGax D4.1, add the following new definition in the appropriate location within 3.2 Definitions specific to IEEE 802.11:***

**3.2 Definitions specific to IEEE 802.11**

**STA State Signaling (SSS) STA**: A STA with dot11STAStateSignalingActivated equal to true that is associated with an AP from which it has received an Extended Capability element that indicates support for STA State signaling. **(#21051)**

***TGax editor: within TGax D4.1, add the following new abbreviation in the appropriate location within 3.4 Abbreviations and acronyms:***

**3.4 Abbreviations and acronyms**

SSS STA State Signaling **(#21051)**

**9.4.2.26 Extended Capabilities element**

***TGax editor: within TGax D4.1, add another row to Table 9-153 – Extended Capabilities field as shown:***

**Table 9-153—Extended Capabilities field**

|  |  |  |
| --- | --- | --- |
| **Bit** | **Information** | **Notes** |
| 77 | TWT Requester Support | A STA sets the TWT Requester Support field to 1 when dot11TWTOptionActivated is true, dot11HEOptionImplemented is true and TWT requester functionality is supported. Otherwise, the STA sets the TWT Requester Support field to 0. See 10.48 (Target wake time (TWT)). |
| 78 | TWT Responder Support | A STA sets the TWT Responder Support field to 1 when dot11TWTOptionActivated is true, dot11HEOptionImplemented is true and TWT responder functionality is supported. Otherwise, the STA sets the TWT Responder Support field to 0. See 10.48 (Target wake time (TWT)). |
| 79 | OBSS Narrow Bandwidth RU In OFDMA Tolerance Support | An AP STA sets the OBSS Narrow Bandwidth RU In OFDMA Toler-ance Support field to 1 if dot11OBSSNarrowBWRUinOFDMAToler-ated is true, and sets it to 0 otherwise.  A non-AP STA sets the OBSS Narrow Bandwidth RU In OFDMA Tolerance Support field to 0. |
| 83 | Enhanced Multi- BSSID Adver-tisement Support | This field is reserved for a non-AP STA or when the AP has dot11Mul-tiBSSIDActivated set to false.  Set to 1 to indicate that the AP supports enhancements related to dis-covery and advertisement of nontransmitted BSSIDs.  Set to 0, other-wise. Also see 11.1.3.8 (Multiple BSSID procedure). |
| <ANA> | STA State Signaling Support | A STA sets the STA State Signaling Support field to 1 when dot11STAStateSignalingActivated is true and dot11HEOptionImplemented is true and sets it to 0 otherwise. **(#21051)** |
| <ANA> | STA State Transition Time Support | A STA sets the STA State Signaling Support field to 1 when dot11STAStateTransitionTimeActivated is true and dot11STAStateSignalingActivated is true and dot11HEOptionImplemented is true and sets it to 0 otherwise. **(#21051)** |

**9.2.4.6.3a HE variant**

***TGax editor: within TGax D4.1, add another row to Table 9-22a – Control ID subfield values, and modify the reserved value, as shown:***

**Table 9-22a—Control ID subfield values**

|  |  |  |  |
| --- | --- | --- | --- |
| **Control ID Value** | **Meaning** | **Length of the Control Information subfield (bits)** | **Content of the Control Information subfield** |
| 0 | Triggered response scheduling (TRS) | 26 | See 9.2.4.6a.1 (TRS Control) |
| 1 | Operating mode (OM) | 12 | See 9.2.4.6a.2 (OM Control) |
| 2 | HE link adaptation (HLA) | 26 | See 9.2.4.6a.3 (HLA Control) |
| 3 | Buffer status report (BSR) | 26 | See 9.2.4.6a.4 (BSR Control) |
| 4 | UL power headroom (UPH) | 8 | See 9.2.4.6a.5 (UPH Control) |
| 5 | Bandwidth query report (BQR) | 10 | See 9.2.4.6a.6 (BQR Control) |
| 6 | Command and status (CAS) | 8 | See 9.2.4.6a.7 (CAS Control) |
| 7 | STA State Signaling (SSS) **(#21051)** | 26 | See 9.2.4.6a.7a (SSS Control) |
| 8-15 | Reserved |  |  |

***TGax editor: within TGax D4.1, insert the following new subclause:***

**9.2.4.6a.7a SSS Control** **(#21051)**

If the Control ID subfield in a Control subfield of an A-Control subfield is 7, then the Control Information subfield of the Control subfield is defined as shown in Figure 9-15jk (Control Information subfield for SSS Control).

|  |  |  |  |
| --- | --- | --- | --- |
|  | B0 | B1 B14 | B15 B18 |
|  | STA State | STA State Transition Time | Reserved |
| Bits: | 1 | 14 | 4 |

**Figure 9-15jk—Control Information subfield for SSS Control**

The STA State subfield signals a transition of STA Power Save state at the transmitting STA that occurs after receipt of acknowledgement to the MPDU containing the subfield, or immediately when no acknowledgement is expected. A value of 1 in the STA State subfield indicates that the transmitting PS STA is transitioning to the doze state and indicates that a non-PS STA is transitioning to the unavailable state. A value of 0 provides no information regarding PS STA or non-PS STA state. **(#21051)**

The STA State Transition Time is an unsigned integer that indicates the value that the 14 MSbits of the 24 LSbits of the TSF will have when the transmitting PS STA will transition from the awake state to the doze state when the STA State subfield has the value of 1, except that a value of 0 in the subfield indicates a transition to the doze state following the acknowledgement of the frame. The STA State Transition Time indicates the value that the 14 MSbits of the 24 LSbits of the TSF will have when the transmitting non-PS STA will transition from the available state to the unavailable state when the STA State subfield has the value of 1, except that a value of 0 in the subfield indicates a transition to the unavailable state following the acknowledgement of the frame. The STA State Transition Time subfield is reserved when the STA State subfield has the value 0. **(#21051)**

***TGax editor: within TGax D4.1, add the following heading, editing instruction and text:***

**11.2.3.5.1 Power management with APSD procedures**

***Change the 13th paragraph as follows:***

When the GCR-A delivery method is used, the scheduled Service Interval field is 0. If a STA has a GCR agreement with an AP for a group address using the GCR-A delivery method, there is no defined end of the scheduled SP. The STA in PS mode shall enter the awake state and shall remain awake in order to receive the buffered group addressed BUs until the AP changes the delivery method of the stream to a method other than GCR-A or until the GCR agreement is canceled or until the STA transitions to the doze state or unavailable state following the transmission of an MPDU with the STA State subfield equal to 1. **(#21051)**

***TGax editor: within TGax D4.1, add the following heading, editing instruction and text:***

**11.2.3.6 AP operation**

***Insert the following item at the end of the 2nd paragraph, immediately following item l):***

m) If an MPDU that contains a STA State subfield with a value of 1 is received from a STA then at the time indicated in the accompanying STA State Transition Time subfield, or after acknowledgement of the MPDU if the STA State Transition Time subfield value is 0, the AP should assume that the PS STA is in doze state or the non-PS STA is in the unavailable state and shall cease delivery of any frames to the STA **(#21051)**

***TGax editor: within TGax D4.1, add the following heading, editing instruction and text:***

**11.2.3.7 Receive operation for STAs in PS mode**

***Insert the following paragraph at the end of the subclause:***

An SSS STA may include an HE variant HT Control field containing the SSS Control subfield to signal a transition of STA state according to the rules described in 11.2.3.19a STA State Signaling. **(#21051)**

***TGax editor: within TGax D4.1, insert the following heading, editing instruction and text as shown:***

**11.2.3.8 Receive operation using APSD**

***Change item c) in the 1st paragraph as follows:***

c) The STA shall remain awake until it receives a QoS Data frame or QoS Null frame addressed to it, with the EOSP subfield equal to 1 or until the STA transitions to the doze state or unavailable state following the successful transmission of an MPDU with the STA State subfield equal to 1. **(#21051)**

***TGax editor: within TGax D4.1, insert the following heading, editing instruction and text as shown:***

**11.2.3.12 TDLS peer power save mode**

***Change the 14th paragraph as follows:***

A TDLS peer PSM service period is a period of time during which one or more individually addressed frames are transmitted between two TDLS peer STAs when at least one STA employs TDLS peer PSM. A TDLS peer PSM service period may be initiated during an Awake Window. A TDLS peer STA in power save mode may enter a doze state when it has successfully transmitted to and received from the corresponding TDLS peer STA in power save mode a QoS frame with the EOSP subfield equal to 1 or when the STA transitions to the doze state or unavailable state following the successful transmission of an MPDU with the STA State subfield equal to 1, ending the TDLS peer PSM service period. A TDLS peer STA in power save mode may enter a doze state when it has successfully received from the corresponding TDLS peer STA in active mode a QoS frame with the EOSP subfield equal to 1. **(#21051)**

***TGax editor: within TGax D4.1, insert the following editing instruction and new subclause:***

***Insert a new subclause at the end of 11.2.3.19:***

**11.2.3.19a STA State Signaling** **(#21051)**

An HE STA with dot11STAStateSignalingActivated equal to true supports STA State signaling using the STA State subfield of the SSS Control subfield and shall set the STA State Signaling Support subfield to 1 in transmitted Extended Capability elements and is called an SSS STA.

An HE STA with dot11STAStateSignalingActivated equal to true and dot11STAStateTransitionTimeActivated equal to true supports STA State Transition Time signaling using the STA State Transition Time subfield of the SSS Control subfield and shall set the STA State Transition Time Support subfield to 1 in transmitted Extended Capability elements.

An SSS STA may transmit SSS Control subfields in frames that it transmits to a STA from which it has received an Extended Capability element with the value 1 in the STA State Signaling Support subfield.

An SSS STA shall not transmit SSS Control subfields in frames that it transmits to a STA from which it has not received an Extended Capability element with the value 1 in the STA State Signaling Support subfield.

An SSS STA with dot11STAStateTransitionTimeActivated equal to false shall transmit the value 0 in the STA State Transition Time subfield of the SSS Control subfields that it transmits.

An SSS STA with dot11STAStateTransitionTimeActivated equal to true may transmit any value in the STA State Transition Time subfield of the SSS Control subfields that it transmits to a STA from which it has received an Extended Capability element with the value 1 in the STA State Transition Time Support subfield.

An SSS STA with dot11STAStateTransitionTimeActivated equal to true shall transmit the value 0 in the STA State Transition Time subfield of the SSS Control subfields that it transmits to a STA from which it has not received an Extended Capability element with the value 1 in the STA State Transition Time Support subfield.

An SSS STA shall not transmit a frame with the Power Management subfield of the Frame Control field set to 0 and the STA State subfield of the SSS Control field set to 1.

An SSS STA that transmits a frame with the STA State subfield of the SSS Control field set to 1 and the STA State Transition Time subfield not set to 0 may transition to doze state or may become unavailable when the 14 MSbits of the 24 LSbits of the TSF are equal to the value indicated in the STA State Transition Time subfield.

An SSS STA that transmits a frame with the STA State subfield of the SSS Control field set to 1 and the STA State Transition Time subfield set to 0 may transition to doze state or may become unavailable immediately following the receipt of the acknowledgement of the frame that contained the SSS Control field. A STA may indicate a transition to another state as described in 11.2 (Power management).

An SSS STA that receives a frame containing an SSS Control field with a non-zero value in the STA State Transition Time subfield should assume that the transmitting STA is transitioning to the doze state or the unavailable state when the 14 MSbits of the 24 LSbits of the TSF are equal to the value indicated in the STA State Transition Time subfield of the same frame unless the transmitting STA explicitly indicates that it has transitioned to another state at an earlier time, in which case the previously indicated STA State Transition Time is cancelled.

The requirement to be in the awake state at the start of each TWT SP associated with an unannounced TWT agreement is not an explicit indication of state transition and therefore, an SSS STA that had signalled a transition to the doze state before the start of such a TWT SP shall be assumed to remain in the doze state unless some other explicit state transition event occurs.

An SSS STA shall only use STA State and STA State Transition Time values from the most recently received SSS Control field from an SSS STA.

If a STA explicitly indicates a transition to the awake state or available state (see 11.2 (Power management)) any previously signaled STA State value and any previously signalled STA State Transition Time value is cancelled. **(#21051)**

***TGax editor: within TGax D4.1, insert the following heading, editing instruction and text as shown:***

**11.2.4.4 STA power state transitions**

***Change item c) in the 3rd paragraph as follows:***

c) If a STA receives at least one individually addressed ATIM frame containing the STA’s individual address in the RA field during the ATIM window then the STA shall remain in the awake state at least until the earlier of the completion of the successful transmission to and reception from the source STA of each received ATIM frame, a frame with the EOSP subfield equal to 1, or until the STA successfully transmits an MPDU with the STA State subfield equal to 1, and the end of the next ATIM window. **(#21051)**

**26.8.5 Power save operation during TWT SPs**

***TGax editor: within TGax D4.1, in subclause 26.8.5 Power save operation during TWT SPs, modify the text as shown:***

A TWT requesting STA or a TWT scheduled STA shall classify any of the following events as a TWT SP termination event:

1) The transmission by the TWT requesting STA or TWT scheduled STA of an acknowledgment in response to an individually addressed QoS Data or QoS Null frame sent by the TWT responding STA or TWT scheduling AP, respectively, that had the EOSP subfield equal to 1.

2) The transmission by the TWT requesting STA or TWT scheduled STA of an acknowledgment in response to an individually addressed frame that is neither a QoS Data frame nor a QoS Null frame, sent by the TWT responding STA or TWT scheduling AP, respectively, with the More Data field equal to 0.

3) The reception of an individually addressed or broadcast QoS Data or QoS Null frame sent by the TWT responding STA or TWT scheduling AP, that does not solicit an immediate response and with the EOSP subfield equal to 1.

4) The reception of an individually addressed frame that is neither a QoS Data frame nor a QoS Null frame, sent by the TWT responding STA or TWT scheduling AP, that does not solicit an immediate response and with the More Data field equal to 0.

5) The reception of a Trigger frame sent by the TWT responding STA or TWT scheduling AP that has the More TF field equal to 0 and is not addressed to the TWT requesting STA or TWT scheduled STA provided that the TWT requesting STA or TWT scheduled STA is either awake for an announced trigger-enabled TWT SP but did not transmit an indication that it is in the awake state to the TWT responding STA or TWT scheduling AP or is awake for an unannounced trigger-enabled TWT SP.

6) The occurrence of the TSF time corresponding to the non-zero value indicated in the STA State Transition Time subfield of an MPDU received from the TWT requesting STA when the STA State subfield of the MPDU is equal to 1. **(#21051)**

7) Immediately after the successful transmission of an MPDU transmitted by the TWT scheduled STA or the TWT requesting STA that contains an SSS Control field with a STA State equal to 1 and a value of zero in the STA State Transition Time subfield. **(#21051)**

**TGax Editor: *Add a new MIB variable in C.3 MIB SSSail within the dot11StationConfigEntry group as shown:***

**C.3 MIB Detail**

dot11STAStateSignalingActivated OBJECT-TYPE **(#21051)**

SYNTAX TruthValue

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"This is a capability variable. Its value is determined by device capabilities.

This attribute, when true, indicates that the STA implementation is capable of signaling its transition from awake to doze state and/or from available to unavailable state and is capable of interpreting the signalled transition from awake to doze state and available to unavailable state of other STAs. The capability is disabled, otherwise."

DEFVAL { false }

::= { dot11StationConfigEntry <XX>}

dot11STAStateTransitionTimeActivated OBJECT-TYPE **(#21051)**

SYNTAX TruthValue

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"This is a capability variable. Its value is determined by device capabilities.

This attribute, when true, indicates that the STA implementation is capable of signaling the Transition Time of a transition from the awake state to the doze state and/or from the available to the unavailable state and is capable of interpreting the signalled Transition Time of a doze or unavailable state. The capability is disabled, otherwise."

DEFVAL { false }

::= { dot11StationConfigEntry <XX>}

**End of proposed changes.**