IEEE P802.11
Wireless LANs

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| LB 200 Comment Resolution for TXOP Sharing |
| Date: 2014-04-27 |
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Abstract

This submission proposes resolutions for comments in clause 9.48 of TGah Draft 1.3 with the following CIDs:

1544, 1545, 1624, 1904, 1905, 1911, 1912, 2088, 2823, 2825, 2866, 2152

Revisions –

R0 – Initial version of the document.

R1 – Fixed inconcistency in D equation and added TXOP truncation language from Relay side. It also includes some minor editorial changes during the PhC.

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 TGah Draft. This introduction is not part of the adopted material.

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

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

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| **CID** | **P.L** | **Clause** | **Comment** | **Proposed Change** | **Resolution** |
| 1544 | 207.24 | 9.48.3 | Current TXOP sharing will not allow multiple sharing sessions in a single TXOP, it maybe useful for downlink delivery from AP to the Relay that has several STAs, in each seccion Relay forward the packet to one of the attached STAs | make the multiple sharing sessions enabled in the TXOP sharing | Revised–TGah Editor to make changes shown in 14/560r1 under the heading for CIDs from 1544 to 2152 |
| 1545 | 207.24 | 9.48.3 | It is not clear how RTS/CTS proedure works with TXOP sharing. | Clarify that the TXOP holder explicitly indicates in the RTS that the TXOP responder can use (and how) the TXOP in the RTS frame. | Revised – Agree in principle with the commenter. Proposed resolution is to use the Order field in the frame control field of the S1G RTS frame to signal to the Relay that the current TXOP can be shared for forwarding the frame.TGah Editor to make changes shown in 14/560r1 under the heading for CIDs from 1544 to 2152. |
| 1624 | 207.59 | 9.48.3 | 802.11ah allows relay TXOP sharing to reduce the overhead from contention. In case of TXOP sharing there is a mechanism to acknowledge an MPDU on the first hop by sending an MPDU on the second hop within aPHY-RX-START-delay. In 802.11ah has been designed for a large amount of hidden nodes and both hops should be protected by NAV protection e.g. by RTS - CTS. There is no RTS -CTS mechanism defined for a shared TXOP that covers both hops. A frame exchange may look like this RTS (STA) - CTS (Relay) - MPDU (STA) - RTS (Relay) - CTS (root AP) - MPDU transmission (relay) - ACK (root AP) - RTS (STA) - CTS (relay) - MPDU transmission (STA) - RTS (relay) - CTS (root AP) - MPDU transmission (relay) - ACK (root AP) ... | Define a CTS mechanism that allows the protection of both hops for the whole TXOP duration, e.g. by sending RTS (STA) - CTS (relay) - CTS (root AP) - MPDU (STA) - MPDU (relay) - ACK (root AP) - MPDU (STA) - MPDU (relay) - ACK (root AP) ... | Revised –Agree in principle with the commenter. Proposed resolution introduces a protection mechanism along the lines of the commenter’s suggestion in the comment. TGah Editor to make changes shown in 14/560r1 under the heading for CIDs from 1544 to 2152. |
| 1904 | 229.26 | 9.48.3 | "An S1G STA indicates support of Implicit ACK in TXOP Sharing feature using the TXOP Sharing Implicit ACK Support subfield of the S1G Capabilities Info field in the S1G Capabilities element. An S1G STA shall set the TXOP Sharing Implicit ACK Support subfield to 1 in frames that it transmits containing the S1G Capabilities element if the dot11TXOPSharingImplicitACKSupportImplemented is true. Otherwise, the S1G STA shall set the TXOP Sharing Implicit ACK Support subfield to 0." '..in TXOP Sharing feature' indicates that it could be used elsewhere or is only for TXOP Sharing? But this section is about TXOP sharing and you jump in with Implicit ACK before describing anything about TXOP Sharing? Then you have a separate clause later for Implicit ACK, after Explicit ACK! The second para tells me how not to set for TXOP Sharing, surely the first para should tell me how to set it for TXOP sharing - but I get text on Implicit ACK? Needs rewriting. | Re-write sub section starting with "A S1G STA that supports TXOP sharing shall..." In addition the details of supporting Implicit ACK belong after P229L49. AND where is the similar text for Explicit ACK? Now let's look at the cited text, suggested it is rewritten as: "An S1G STA indicates support of Implicit ACK using the TXOP Sharing Implicit ACK Support subfield of the S1G Capabilities Info field in the S1G Capabilities element. If dot11TXOPSharingImplicitACKSupportImplemented is true, an S1G STA shall set the TXOP Sharing Implicit ACK Support subfield to 1 in transmitted frames containing the S1G Capabilities element. If dot11TXOPSharingImplicitACKSupportImplemented is false, the S1G STA shall set the TXOP Sharing Implicit ACK Support subfield to 0." | Revised –Agree in principle with the commenter. Certain paragraphs of the subclause are rewritten accounting for the commenters suggestions by describing first signalling used to indicate support of TXOP sharing, then support for implicit ack procedure. TGah Editor to make changes shown in 14/560r1 under the heading for CIDs from 1544 to 2152. |
| 1905 | 229.38 | 9.48.3 | "A non-S1G STA shall not perform TXOP sharing as described in this subclause." Can it perform TXOP sharing in another way? Why can it not perform TXOP Sharing? Would is not be good if nonS1G STAs could use this feature? I understand that the Short Frame Control field has the "Relayed Frame field in it but surely you could have used From DS To DS 11 or something? OR why cannot a standard STA use the Short Frame Control field? Could you not have invented a method that could be universally used? If you did not, then go back and reconsider and make the feature such that it could be universally used - It is a good feature (on the face of it). | Prove a case that these features, Relay Operation and TXOP sharing, should not be used by STAs in general or, better, make the necessary changes to make it a universal feature. | Revised –Note that proposed resolution in document 14/0312r1 deletes “as described in this Subclause” which addresses the first concern of the commenter. Regarding the other comments, partly addressed in the resolution of CID 1907 in 14/0312r1, the commenter fails to identify an issue and the suggested changes by the commenter are out of scope for the TGah amendment. TGah editor to make the changes proposed in 14/0312r1. |

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| 2866 | 207.26 | 9.48.3 | If an implicit TXOP sharing support bit is in the capability element, then when a relay receives a frame, the relay needs to do a search through a long list of STAs, and find out if this STA has this capability. If it has this capability, then relay has to be prepare the next data frame for transmission. All of this has to be done within SIFS time. And repeated for every data frame received.As described in TGah SFD (R.4.5.B.3), the capability bit for indicating an implicit TXOP sharing support shall be in the per-frame header (such as a Relayed Frame field in the Frame Control field). | As described in TGah SFD, please use a Relayed Frame field in the Frame Control field for indicating an implicit TXOP sharing support. | Rejected -- TXOP sharing enables the Relay to forward the received data using the TXOP that the TXOP initiator has obtained via EDCA. The way the mechanism is defined, the Relayed Frame field in the Short Data frame allows the TXOP initiator to give permission to the Relay to use its TXOP. Also note that SIFS for 11ah is 160 us that is enough to check STAs capabililty to support implicit acknowledgement. |

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| 1911 | 230.05 | 9.48.3.1 | "The Relay AP (Relay STA), that intends to use Explicit ACK procedure, shall set the Duration Indication field to 1 and Duration field to 0 in the NDP ACK frame that is transmitted to the non-AP STA (AP)..." Either AP or STA can use Explicit ACK? Also will the AP understand an NDP ACK, presumably only if a S1G AP, do you need to make that distinction? Again I ask why make the Relay function so S1G specific? What has Long Response got to do with it (what is Long Response?). | Replace cited text with "A Relay AP or Relay STA that intends to use the Explicit ACK procedure shall set the Duration Indication field to 1 and Duration field to 0 in the NDP ACK frame." | Revised–Added a note at the end of Subclause 9.48.3.1: “NOTE—The description above applies to both uplink and downlink procedures with the non-AP STA (AP), i.e., either the non-AP STA or the AP, is the TXOP initiator for the TXOP sharing exchange.” which clarifies the intent. Also NDP ACK frames are generated only by S1G STAs and also Long Response is related to Response Indication Deferral mechanism which is applicable to S1G STAs as well.TGah Editor to make changes shown in 14/560r1 under the heading for CIDs from 1544 to 2152 |
| 1912 | 229.63 | 9.48 3.1 | "Throughout this subclause, a Response Indication of Long Response is signaled by setting the Duration Indication field to 1 and the Duration field to 0 for NDP ACK." What has this to do with Explicit ACK? Why start with something else and furthermore I have no idea what Long Response is as I can't find it defined anywhere (seperate comment). Setting the Duration Indication and hte Duration filelds to 0 in the NDP ACK does what with respect to Explicit ACK? | I have no alternative suggestions because I do not understand what this trying to tell me. Please clarify why you start a section on Explicit ACK with something else? | Revised – This comment was partly addressed in 14/0312r1 where, among other changes, a reference to clause 9.3.2.12 (Response Indicaiton procedure) was added to aid the reader identify the purpose of the Long Response. When using TXOP sharing with explicit ack the Relay sets the Response indication to long response in the NDP Ack frame to protect the forwarded frame (as the Long Response sets the RID of receiving STAs to an amount of time during which they defer accessing the mediumTGah editor to make the changes proposed in 14/0312r1. |
| 2823 | 208.00 | 9.48.3.1 | For uplink transmission, what if the transmission from non-AP STA to Relay AP fails? What will non-AP STA do? The same problem needs to be considered for downlink transmission. | Please add the text on error recovery for relay. | Revised–Agree in principle with the commenter. The proposed resolution is to add a statement that the TXOP owner may transmit its next PPDU after PIFS for error recovery purposes.TGah Editor to make changes shown in 14/560r1 under the heading for CIDs from 1544 to 2152 |

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| 2088 | 230.33 | 9.48.3.2 | The relay would transmit to the root AP only if the root AP is on thre same channel (there does not seem to be a strict requirement that the relay and the root AP should always stay on the same channel) and the medium between the relay and the root AP is free (the root may be busy sending/receiving to/from another station or relay). The relay client STA may not detect if the relay could forward the frame. Unless the relay spends its time sending updated NDP values to show implicit/explicit ACK, the station may not know know that the relay could not send the frame yet. If in that case the station goes into retry mode, we may be wasting airtime and time. | When the relay correctly received the frame from the non-AP sta, and when the relay is delayed in forwrding the frame to the root-AP, allow the relay to send an explicit ACK with a reason code showing that the relay is delayed but will transmit the frame to the root AP. | Rejected –The Relay already chooses whether to use Implicit Ack or Explicit Ack upon reception of the frame to be forwarded. In addition the Relay does not need to indicate that forwarding is delayed (for the reason that the commenter specifies or for many other unspecified reasons) but simply forward the frame when the conditions allow it to do so. |
| 2825 | 208.00 | 9.48.3.2 | For downlink implicit ACK procedure, an AP needs to know the power state of a target non-AP STA before starting implict ACK procedure. It is probable that a Relay can not forward the received MPDU to the target non-AP STA within SIFS time when the target non-AP STA is in Doze state.In that case, AP would retransmit the MPDU unnessesarily because AP can not see any frame after ACKTimeout interval. Futhermore if the AP protected medium time for the relayed frame by setting duration field or response indicatin field in advance, the air time would be wasted. | Add the mechanism to know the power state of the target non-AP STA or activate the target non-AP STA before starting downlink implicit ACK procedure in the draft.Details are TBD. | Rejected –In a TXOP shared session for downlink transmission it is the Relay’s decision whether to forward the DL BU immediately or wait in a second moment. The AP in this case simply indicates to the Relay that it is allowed to perform TXOP Sharing, but the Relay should choose not to do so if the non-AP STA is in Doze state. |
| 2152 | 107 | 8.4.2.170k.2 | TXOP Sharing Implicit ACK Support should indicates support of Implicit ACK in TXOP Sharing, not support ofTXOP Sharing | change "support of TXOP Sharing" to "support of Implicit ACK in TXOP Sharing" | Accepted –TGah editor to make the changes suggested by the commenter.  |

**Discussion:** *None.*

* **Procedures of TXOP sharing for relay operation**

**Instructions to TGah Editor: *Change this subclause as follows:***

An S1G STA that supports TXOP sharing procedure may set the Relayed Frame field in the Frame Control field of Short Data, the Relayed Frame field in NDP Ack frames, and the Order field in the Frame Control field of an S1G RTS frame to 1. Otherwise, it shall set the Relayed Frame field or Order field in any frame to 0 unless the frame is an NDP Ack frame used for flow control as described in 9.48.4 (Flow control).

Reception of a valid Short Data frame with the Relayed Frame field equal to 1 or of an S1G RTS frame with the Order field equal to 1 indicates a Relay-shared TXOP.

An S1G STA indicates support of TXOP sharing with Implicit ACK using the TXOP Sharing Implicit ACK Support subfield of the S1G Capabilities Info field in the S1G Capabilities element. If dot11TXOPSharingImplicitACKSupportImplemented is true, the S1G STA shall set the TXOP Sharing Implicit ACK Support subfield to 1 in transmitted frames containing the S1G Capabilities element. Otherwise, the S1G STA shall set the TXOP Sharing Implicit ACK Support subfield to 0. (#60)

A non-S1G STA shall not perform TXOP sharing.

A Relay entity shall not perform TXOP sharing if the Relay STA and Relay AP are operating in different primary channels for the duration of the TXOP.

The sequence of frames exchanged over the first hop and second hop depends on the acknowledgement procedure used by the Relay. A Relay can use either:

* Explicit ACK procedure
* Implicit ACK procedure

When a Relay (Relay STA or Relay AP) receives a valid Short Data frame with the Relayed Frame field in the Frame Control field set to 1, the Relay may acknowledge the received Short Data frame using the Implicit or Explicit ACK procedure. The Relay shall not acknowledge the received valid Short Data frame using either Implicit or Explicit ACK procedure if the Relayed Frame field in the Frame Control field is set to 0 in the received short Data frame.

NOTE- The frames transmitted over the first hop and second hop can be sent at two different MCSs.

For error recovery purposes, during a Relay-shared TXOP, the TXOP owner may transmit its next PPDU when the CS mechanism (see 9.3.2.1(CS mechanism)) indicates that the medium is idle at the TxPIFS slot boundary (defined in 9.3.7(DCF timing relations)) (this transmission is a continuation of the current TXOP or SP).

* **Explicit ACK procedure**

**Instructions to TGah Editor: *Change this subclause as follows:***

Throughout this subclause, a Response Indication of Long Response is signaled in an NDP ACK frame by setting the Duration Indication field to 1 and the Duration field to 0 and a Response Indication of No Response is signaled by setting the Duration Indication field to 0 and the Duration field to 0 (see 9.3.2.12 (Response Indication procedure)).

A non-AP STA (AP) that intends to start a Relay-shared TXOP starts it by sending a Short Data frame addressed to the Relay AP (Relay STA) with the Relayed Frame field set to 1. The Relay AP (Relay STA), addressed by an RTS frame that intends to use the explicit ACK procedure, shall respond with an NDP CTS frame with the Duration field set as described in 9.48.3.3 (Relay-shared TXOP proection mechanisms). (CID#749, 983, 750, 981, 57)

When using the Explicit ACK procedure, the Relay AP (Relay STA) shall signal a Response Indication of Long Response in the NDP ACK frame that is transmitted as an acknowledgement to the non-AP STA (AP). In addition it shall set the Relayed Frame field of the NDP ACK frame to 1. Otherwise, it shall signal a Response Indication of No Response in the NDP Ack frame and shall set the Relayed Frame field to 0. (CID#749, 983, 750, 981, 57)

When using the Explicit ACK procedure, the Relay STA (Relay AP) shall forward the previously received Short Data frame to the AP (non-AP STA), SIFS after the Relay AP (Relay STA) has sent the NDP ACK frame to the non-AP STA (AP). In addition, the Relay STA (Relay AP) may protect the forwarded frame with a protection mechanism such as RTS/CTS exchange. Upon successful receipt of the relayed Short Data frame, the AP (non-AP STA) shall transmit an NDP ACK frame to the Relay STA (Relay AP), which shall signal a Response Indication of No Response terminating this Relay-shared TXOP.(CID#984, 262, 263, 57)

NOTE— The description above applies to both uplink and downlink procedures with the non-AP STA (AP), i.e., either the non-AP STA or the AP, is the TXOP owner for the TXOP sharing session.

**9.48.3.2 Implicit ACK procedure**

**Instructions to TGah Editor: *Change this subclause as follows:***

The implicit ACK procedure is available only when the PARTIAL AID information is included in the PLCP header of the PPDU that carries the frame (i.e., the PREAMBLE\_TYPE is either S1G\_SHORT\_PREAMBLE or S1G\_LONG\_PREAMBLE).

A STA that intends to share the TXOP with the Relay starts the TXOP by sending to the Relay an S1G RTS frame with the Order field set to 1 or a Short Data frame that has the Relayed Frame field set to 1. A Relay (Relay STA or Relay AP) that is the intended receiver of the S1G RTS frame which intends to use the implicit ACK shall respond with an NDP CTS frame with the Duration field set as described in 9.48.3.3.(Relay-shared TXOP protection mechanisms).

When a Relay receives a Short Data frameduring a Relay-shared TXOP, the Relay may directly forward the received frame without sending back an acknowledgement frame to the transmitter of the frame. If the Short Data frame was preceded by an RTS frame then the Relay should protect the forwarded frame by sending an RTS frame to the intended receiver as described in 9.48.3.3(Relay-shared TXOP protection mechanisms).

If the MPDU is transmitted by a non-AP STA, which is associated to a Relay AP, to the AP, then the Relay AP forwards the received MPDU to the AP to which it is associated, using SIFS. After transmitting the MPDU, the non-AP STA shall wait for an ACKTimeout interval, with a value of aSIFSTime + aSlotTime + aPHY-RX-START-Delay, starting at the PHY-TXEND.confirm primitive. If the non-AP STA receives a valid PLCP header within the ACKTimeout interval and the PARTIAL AID in the received PLCP header is identical to the PARTIAL AID corresponding to BSSID of the AP, the non-AP STA recognizes it as a successful acknowledgement, permitting the frame sequence to continue, or to end without retries, as appropriate for the particular frame sequence in progress.

If the MPDU is transmitted by an AP to a Relay STA, then the Relay STA forwards the received MPDU to the non-AP STA that is associated to the Relay AP, using SIFS. After transmitting the MPDU, the AP shall wait for an ACKTimeout interval, with a value of aSIFSTime + aSlotTime + aPHY-RX-START-Delay, starting at the PHY-TXEND.confirm primitive. If the AP receives a valid PLCP header within the ACKTimeout interval and the PARTIAL AID in the received PLCP header is identical to the PARTIAL AID corresponding to the DA of the transmitted MPDU, the AP recognizes it as successful acknowledgement, permitting the frame sequence to continue, or to end without retries, as appropriate for the particular frame sequence in progress. If the RA of the forwarded MPDU is different from the DA of the MPDU transmitted by the AP, then the Relay STA shall use the explicit ACK procedure.

An AP to which the Relay STA is associated may use the implicit ACK procedure to transmit a downlink frame to a non-AP STA only if it knows the partial AID of the non-AP STA associated to the Relay AP.(#715) For this purpose, the Relay STA may indicate an associated non-AP STA's AID to the AP by sending a STA Information Announcement frame including an AID Announcement element when the non-AP STA becomes associated or the non-AP STA's AID is changed. A non-AP STA associated to a Relay AP may use the implicit ACK procedure to transmit an uplink frame to an AP only if it knows the BSSID of the AP to which the Relay STA of the Relay is associated. For this purpose, the Relay AP may indicate the BSSID of the AP to newly associated non-AP STAs by using RootAP BSSID field in the Relay element in Beacon frame, Probe Response or Short Probe Response frame.

**Instructions to TGah Editor: *Insert a new Subclause after 9.48.3.2 as follows:***

**9.48.3.3 Relay-shared TXOP protection mechanism**

An S1G STA that supports TXOP sharing should initiate a Relay-Shared TXOP by sending an S1G RTS frame as the first frame in the exchange under EDCA.

A Relay that is the intended receiver of the S1G RTS frame with the Order field equal to 1 and intends to use the Relay-Shared TXOP responds with an NDP CTS frame with a value of the Duration field which depends on the acknowledgment procedure it shall use during this Relay-Shared TXOP:

* If explicit ack procedure (see 9.48.3.1 (Explicit Ack procedure) then the Duration field of the NDP CTS shall be set to a value D:
	+ D = *TRTS +TPENDING – TPPDU<= D <= TTXOP \_REMAINING-TPPDU,*

where *TRTS* is the value obtained from the Duration/ID field of the S1G RTS frame that elicited the response, *TPPDU* is the time, in microseconds, between the end of the PPDU carrying the RTS frame and the end of the of the NDP CTS, *TPENDING* is the estimated time required for the transmission of the frame to be forwarded, its response if required, protection frame exchanges if required, plus applicable IFS durations, and *TTXOP\_REMAINING* is equal to any *TTXOP* as defined in 8.2.5.2 (Setting for single and multiple protection under enhanced distributed channel access (EDCA)) minus *TRTS*.

* If implicit ack procedure (see 9.48.3.2 (Implicit Ack procedure)), then the Duration/ID field of the NDP CTS shall be set according to 8.2.5.7 (Setting for control response frames). When using the implicit ack procedure, upon successful reception of a Short Data frame that is preceded by the the transmission of an NDP CTS as described above, the Relay (Relay STA or Relay AP) should protect the Short Data frame transmission with an RTS/CTS protection mechanism. The Duration/ID field of the RTS frame shall be less than or equal to *TTXOP* for that AC, as defined in 8.2.5.2) minus the estimated time since the start of the reception of the RTS frame with the Order field equal to 1 that was sent by the Relay-shared TXOP owner.

A Relay (Relay STA or Relay AP) that uses the Relay-Shared TXOP may transmit an (NDP) CF-End frame after successfully forwarding the Short Data frame if the remaining duration is long enough to transmit this frame.

A Relay that is the intended receiver of the S1G RTS frame with the Order field equal to 0 responds with an NDP CTS frame as described in 9.3.2.7 (CTS and DMG CTS procedure).

**Instructions to TGah Editor: *Change subclause 8.2.4.1.10 as follows:***

**8.2.4.1.10 Order field**

The Order field is 1 bit in length. It is used for the following purposes:

— It is set to 1 in a non-QoS (#100)Data frame transmitted by a non-QoS STA to indicate that the

frame contains an MSDU, or fragment thereof, that is being transferred using the StrictlyOrdered

service class.

— It is set to 1 in a QoS data or (#100)Management frame transmitted with a value of HT\_GF,

HT\_MF, VHT(11ac) or S1G for the FORMAT parameter of the TXVECTOR to indicate that the frame

contains an HT Control field.

-- It is set to 1 in an S1G RTS frame to indicate that the intended recipient of the frame has permission to extend the TXOP as described in 9.48.3.3 (Relay-shared TXOP protection mechanism).

Otherwise, the Order field is set to 0.

NOTE—The Order field is always set to 0 for frames transmitted by a DMG STA. (11ad)

9.3.2.9 Ack procedure

***Change the following paragraph as follows:***

Additional exceptions exist for S1G STAs for accepting a valid frame as successful acknowledgment as described in the following three paragraphs:

Under TXOP sharing relay operation as described in 9.49.3 (Procedures of TXOP sharing for relay operation):

* If an MPDU is transmitted by a STA associated with a relay AP under TXOP sharing relay operation, and the PARTIAL\_AID in the PHY-RXSTART.indication primitive that occurs within RxPHYStartDelay(#2873) is identical to the PARTIAL\_AID corresponding to the BSSID of the root AP then the reception shall be accepted as a successful acknowledgment (#Ed) of the MPDU transmission. If the PARTIAL\_AID is equal to 0 then the STA shall consider the MPDU as successful acknowledgement only if it is an RTS frame with RA frame equal to the BSSID of the root AP.
* In addition, when an AP transmits an MPDU to a Relay STA under TXOP sharing relay operation and the PARTIAL\_AID in the PHY-RXSTART.indication primitive that occurs within aRxPHYStartDelay(#2873) is identical to the PARTIAL\_AID corresponding to the DA of the transmitted MPDU shall be accepted as a successful acknowledgment (#Ed) of the MPDU transmission. If the PARTIAL\_AID is equal to 0 then the STA shall consider the MPDU as successful acknowledgement only if it is an RTS frame with RA frame equal to the DA.