IEEE P802.11  
Wireless LANs

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| Comment Resolution for Subclause 4.12 | | | | |
| Date: 2014-03-15 | | | | |
| Author(s): | | | | |
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Abstract

This submission proposes resolutions for comments in clause 4.12 of TGah Draft 1.0 with the following CIDs:

1008, 1009, 1010, 1011, 1559, 1573, 1574, 1575, 1576, 1582, 1661, 1664, 1665, 1799, 1800, 1808, 1809, 1810, 1811, 1813, 1814, 1815, 1816, 1817, 2080, 2081, 2153, 2154, 2156, 2319, 2320, 2321, 2322, 2347, 2348, 2349, 2350, 2351, 2352, 2353, 2354, 2355, 2356, 2499, 2500, 2517, 2609, 2699, 2798, 2799, 2800, 2801, 2833, 2876, 2877, 2930, 2931, 2971, 2972

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** | **Page.Line** | **Subclause** | **Comment** | **Propose Change** | **Resolution** |
| 1008 | 3.08 | 4.12 | I didn't see anywhere a description of how mesh and relay interact. | Please add a statement that Relay is not supported when mesh is supported. Or more formally, constrain dot11MeshActivated to be false when either of the dot11Relay variables are true. | Reject:  Comment failed to identify a real issue.  Reply to commentor:  Relay will operate as a STA when connects to an AP and operates as an AP when an STA wants to connect to it. The coexistence of STAs, Aps with mesh network exists in the currents standard |
| 1009 | 3.11 | 4.12 | A hanging subclause is one that occurs following text in the parent subclause. IEEE-SA style disallows these. 4.12.2 is a hanging subclause. | Review all subclauses. Those subclauses containing both direct text and child subclauses need to be adjusted. Adjust by adding a new ".1" child containing the offending text. This is usually called "Introduction" or "General". | Agree with the commenter  Revised:  TGah editor to make changes shown in 11-14-0314r1 |
| 1010 | 3.26 | 4.12 | "is called Root AP." – grammar | "is called a Root AP" | Agree with the commenter  Revised:  TGah editor to make changes shown in 11-14-0314r1 |
| 1011 | 4.01 | 4.12.1 | "The introduction of a relay enables non-AP STAs to use higher MCSs and reduce the time non-AP STAs will stay in Active mode". The use of "will" creates all kinds of problems in a standard, because it can be viewed as an assertion or guarantee of behaviour. Unless you mean to provide such a guarantee, don't use "will". | Review all uses of "will" (excluding frontmatter) and, except where describing future behaviour necessarily guaranteed by the normative statements in the standard, reword into the present tense. For example, the cited sentence becomes: "The introduction of a relay enables non-AP STAs to use higher MCSs and reduce the time non-AP STAs stay in Active mode". | Agree with the commenter  Revised:  TGah editor to make changes shown in 11-14-0314r1 |
| 1559 | 4.24 | 4.12.3 | Text states, "A Relay transmits a frame received from a non-AP STA to the AP with which it is associated ..". Which entity is "it"? | Clarify | Agree with the commenter  Revised:  TGah editor to make changes shown in 11-14-0314r1 |
| 1573 | 3.16 | 4.12 | Association should be Association Response | change 'Association' to 'Association Responses' | Agree with the commenter  Revised:  TGah editor to make changes shown in 11-14-0314r1 |
| 1574 | 3.63 | 4.12.1 | The term "relay", "Relay", "relay function" and "relaying function" should be unified. | As the comment suggests. | Agree with the commenter. “relay” is replaced with “Relay”, relaying is used as a verb, so it is left untouched.  Revised:  TGah editor to make changes shown in 11-14-0314r1 |
| 1575 | 4.01 | 4.12.1 | Relay STAs are the Relay or the Relay STAs of the Relay? | change 'Relay STAs' to 'Relays' | Agree with the commenter  Revised:  TGah editor to make changes shown in 11-14-0314r1 |
| 1576 | 4.12 | 4.12.2 | what is the meaning of A relay STA? | change 'a relay STA' to 'A Relay' | Agree with the commenter  Revised:  TGah editor to make changes shown in 11-14-0314r1 |
| 1582 | 4.30 | 4.12.3 | Some typo error, e.g. "To avoid a buffer overflow condition, for example, when adequate buffer space is available, a Relay can use flow control signaling to request that non-AP STAs stop sending frames to the Relay until a later time." | Change ot  "To avoid a buffer overflow condition, for example, when  adequate buffer space is unavailable, a Relay can use flow control signaling to request that non-AP STAs stop sending frames to the Relay until a later time." | Agree with the commenter  Revised:  TGah editor to make changes shown in 11-14-0314r1 |
| 1661 | 3.08 | 4.12 | Clause 4 is an introduction, not a location for definitions that are not found in the main text of this standard. | All of the current material seems to be repeated in 9.48, so just summarize those concepts in 4.12. | Reject:  Comment failed to identify a real issue.  Response to the commentor:  Clause 9 uses normative language to properly define the behaviors, in this subclause, no normative text is used and it is only for the purpose of describing features |
| 1664 | 3.22 | 4.12 | This statement is unclear about whether a relay STA forwards to a relay AP, vice versa, or neither. Also "associated to" and "AP that Relay STA" are both broken English. | Delete this sentence. | The sentence is changed to clarify.  Revised:  TGah editor to make changes shown in 11-14-0314r1 |
| 1665 | 3.27 | 4.12 | Per the Style Guide "set to" is used only when the value of a field is being set, not when the field simply holds the relevant value or is being read. | Replace "set to" with "value" here and with appropriate words everyplace else in the draft in which it does not explicitly refer to the process of setting the relevant value. | The sentence is changed to clarify.  Revised:  TGah editor to make changes shown in 11-14-0314r1 |
| 1799 | 3.23 | 4.12 | It is not clear if the Releay-AP and Relay-STA from the same Relay can/may operate in different frequency channels. | Please add clarification to the text | Reject:  The comment does not identify a real issue.  Response to the commentor:  This is an implementation choice and may not need be defined in the standard |
| 1800 | 4.19 | 4.12.2 | It is not clear if the text refers to forwarding of the frame from the first hop to the second hop in the same relay or multiple relays | Please add text to clarify TXOP sharing by relays | The sentence is changed to clarify.  Revised:  TGah editor to make changes shown in 11-14-0314r1 |
| 1808 | 25.19 | 4.12 | "that resides inside a Relay "? should agree with the description for Relay AP and have "entity" included. In addition "that successfully completes ..." is not correct. It is a STA that "can successfully complete." | Replace:  "The Relay STA is a non-AP STA with additional functionalities for the relaying of frames (see 9.48 (Relay operation)), that resides inside a Relay and that successfully completes association and authentication with a parent AP, and receives a Relay element in the association response"  With: "The Relay STA is a non-AP STA with additional functionalities for the relaying of frames (see 9.48 (Relay operation)). A Relay STA can successfully complete association and authentication with a parent AP, and receive a Relay element in the association response." | Reject:  Comment failed to identify a real issue.  Response to the commentor:  Completing the association “as a relay” which means receiving a Relay element in the association response is a condition that differs Relay STA and a regular non-AP STA |
| 1809 | 25.23 | 4.12 | "The Relay forwards frames from (to) STAs associated to the Relay AP to (from) the AP that Relay STA is associated to." This is very clumsy. I think the Figure explains it better. I would suggest deleting this. | Delete "The Relay forwards frames from (to) STAs associated to the Relay AP to (from) the AP that Relay STA is associated to." | The sentence is changed to clarify.  Revised:  TGah editor to make changes shown in 11-14-0314r1 |
| 1810 | 25.26 | 4.12 | "A non-Relay AP that has Relay STAs associated to it is called Root AP." Should be "..a Root AP". Also not sure if "called" is the correct term, would suggest " is referred to as a Root AP" or even "I termed a Root AP. Also the capitalisation of Root is not consistent, see P135L14, P179L38, P231L58, P231L61 and P238L39. | Replace "A non-Relay AP that has Relay STAs associated to it is called Root AP." With "A non-Relay AP that has Relay STAs associated to it is known as a Root AP. Correct "root AP" to be "Root AP" at P135L14, P179L38, P231L58, P231L61 and P238L39 | Agree with the commenter  Revised:  TGah editor to make changes shown in 11-14-0314r1 |
| 1811 | 25.26 | 4.12 | "The Root AP..." should be "A Root AP..." | Replace "The Root AP..." with "A Root AP..." | Agree with the commenter  Revised:  TGah editor to make changes shown in 11-14-0314r1 |
| 1813 | 25.42 | 4.12 | Figure 4-31. If "AP" is a "Root AP" then label it so | Label "AP" as "Root AP" in Fig 4-31 | Accept:  TGah editor to make changes as suggested by CID 1813 |
| 1814 | 25.32 | 4.12 | Add a sentence at P25L32 to explain the flow of packets. This would be better than trying to do this at P25L23. | Insert after "...inside Relay 2." the following sentence "Frames from STA 1 and STA 2 are forwarded via the Relay AP in Relay 1 to the Relay STA in Relay 1 to the Root AP. Similarly frames from the Root AP are forwarded to STA 1 and STA 2 via the Relay STA and Relay AP in Relay 1." | Agree with the commenter. This makes the text more clear.  Revised:  TGah editor to make changes shown in 11-14-0314r1 |
| 1815 | 25.63 | 4.12.1 | Should 'relay" be Relay" here? | Replace "The introduction of a relay..." with "The introduction of a Relay..." | Agree with the commenter.  Revised:  TGah editor to make changes shown in 11-14-0314r1 |
| 1816 | 26.11 | 4.12.2 | Be consistent with Relay. Also not sure you need all this explanation in Section 4. The place for description is Clause 9. The first para could be deleted. | Delete first para but if not , then use capital "R" for relay(s) on L11 and L12 and L17. Further suggest that this | Agree with the commenter on capital R. the changes reflected in the provided resolution.  Revised:  TGah editor to make changes shown in 11-14-0314r1 |
| 1817 | 26.21 | 4.12.3 | This is too much for Clause 4. Suggest delete. All this should be in Clause 9, make sure Clause 9 stands on its own. | Delete. Make sure is covered in Clause 9. Cla | Reject:  Comment failed to identify a real issue.  Response to the commentor:  More description is provided to clarify the difference of Relay with existing features in the standard |
| 2080 | 25.60 | 4.12.1 | The function of the relay as defined here seems to be somewhat restrictive, limiting the relay of frames to and from a root AP (which is a mechanism already present with the 4 MAC address frames of 802.11, but relay adds the speed frame exchange). The relay should be able to relay to relay 2 as well. Additionnally, in a network where sensors have little memory and must limit uptime, the relay could be usable to relay traffic also from STA1 to STA2, using relay 1 ability to expedite the exchanges between STA1 and STA2 with the speed frame exchange system. | Expand the function of relay to allow relaying beyond its root AP, but also to other STAs or APs out of reach of the non-AP STA sender. | Reject:  The functionality is allowed in the existing document. Standard only describes two hops Relay while it does not prevent more than two hops. |
| 2081 | 26.24 | 4.12.3 | First sentence is unclear: "to the AP with which it is associated", who is "it"? The relay of the non-AP STA? In other words, does the relay also relay association exchanged to the root AP? | "A Relay transmits a frame received from a non-AP STA to the AP with which the Relay is associated" | Agree with the commenter  Revised:  TGah editor to make changes shown in 11-14-0314r1 |
| 2153 | 3.35 | 4.12 | Figure4-31 is confusing. Two dashed lines with arrows both ends expand the Relay2 to a relay-STA and a relay-AP. This figure should explain that the STA1 and STA2 both have relay STA and AP inside. | Revise Figure4-31. For example.  [Relay1(\*)] [Relay2(\*)] (\*) Relay-STA  |  Relay-STA | Agree with the commenter, edited the description of the figure to reflect the comment. The figure is not changed since it introduces duplication and makes the figure too crowded.  Revised:  TGah editor to make changes shown in 11-14-0314r1 |
| 2154 | 3.57 | 4.12 | It is hard to determine if Figure4-31 is one-hop or two-hop ? The title of 4.12.1 is "two-hop" so probably it is two-hop, but not sure. | If the Figure4-31 shows two-hop, the title should indicate it. For example, change Figure 4-31 title to "two hop Relay". If it is one-hop, two-hop figure should be added. | Agree with the commenter  Revised:  TGah editor to make changes shown in 11-14-0314r1 |
| 2156 | 3.42 | 4.12 | The name of "AP" in figure 4-13 should be replaced with "Root AP" to align with an explanation of line 31 of page 3. | Replace "AP" with "Root AP." | Revised:  TGah editor to make changes as suggested by CID 1813 |
| 2319 | 3.23 | 4.12 | "The Relay forwards frames from (to) STAs associated to the Relay AP to (from) the AP that Relay STA is associated to." and confusing and seems circular. | Change to, "The Relay forwards frames received from STAs associated to the Relay AP by transmitting those frames onward from the Relay STA to its associated AP." | This sentence is changed to clarify this sentence  Revised:  TGah editor to make changes shown in 11-14-0314r1 |
| 2320 | 3.11 | 4.12 | The Relay AP and Relay STA within a given Relay would be co-located to form the Relay entity. Making this clear would help understanding this concept. | Add "co-located" before "Relay AP". Same thing at page 205 line 15 (in 9.48). | Reject:  “co-located” was removed in the last comment resolution since it believed to add more confision. |
| 2321 | 3.32 | 4.12 | In the sentence "Relayed frames between a AP and its associated Relay STA use either the 4-address frame format or the A-MSDU format" I have no idea where in the architecture this is referencing. Is the "AP" here a Root AP? Or, does this apply to any AP (Root or another Relay) with associated Relay STAs? | Clarify this sentence | Reject:  The comment failed to identify a real issue.  Response to the commentor:  It applies for any AP, it can be Root AP or another Relay as mentioned in the comment. |
| 2322 | 3.20 | 4.12 | What is a "parent AP"? | Add a definition, or change this to descriptive wording instead of a single adjective. | Agree with the commenter. Parent is removed.  Revised:  TGah editor to make changes shown in 11-14-0314r1 |
| 2347 | 3.15 | 4.12 | "Association frame" is ambiguous | Change to "Association Response [frame]" | Agree with the commenter. Proposed resolution is adopted.  Revised:  TGah editor to make changes shown in 11-14-0314r1 |
| 2348 | 3.20 | 4.12 | "association response" should be uppercase, and perhaps have a "frame" or "MMPDU" afterwards | Change to "Association Response" and check current 802.11 style to see if "frame" or "MMPDU" should be added afterwards | Agree with the commenter. Proposed resolution is adopted.  Revised:  TGah editor to make changes shown in 11-14-0314r1 |
| 2349 | 3.14 | 4.12 | "Relay entity" seems to be a non-preferred term | Change to just "Relay" (also in 9.48.3 at 207.40) | Reject:  Comment failed to identify a real issue.  Response to the commentor:  It is used to described what is a Relay. It is an “entity” with some properties. |
| 2350 | 3.27 | 4.12 | "Association response" should be uppercase, and perhaps have a "frame" or "MMPDU" afterwards | Change to "Association Response" and check current 802.11 style to see if "frame" or "MMPDU" should be added afterwards | Agree with the commenter. Proposed resolution is adopted.  Revised:  TGah editor to make changes shown in 11-14-0314r1 |
| 2351 | 3.23 | 4.12 | "The Relay forwards frames from (to) STAs associated to the Relay AP to (from) the AP that Relay STA is associated to." is confusing | Change to "The Relay forwards frames between STAs associated to the Relay AP and the AP that the Relay STA is associated to." | Agree with the commenter. The sentence is changed to clarify this.  Revised:  TGah editor to make changes shown in 11-14-0314r1 |
| 2352 | 3.33 | 4.12 | "Relayed frames between a AP and its associated Relay STA use either the 4-address frame format or the A-MSDU format." seems to be (a) important and (b) not part of the Figure | Move this sentence to a new para below the Figure | Agree with the commenter. Proposed resolution is adopted.  Revised:  TGah editor to make changes shown in 11-14-0314r1 |
| 2353 | 3.63 | 4.12.1 | "a relay" is probably referring to the entity, not the general concept | Change to "a Relay" (twice here; possibly also elsewhere) | Agree with the commenter. Proposed resolution is adopted.  Revised:  TGah editor to make changes shown in 11-14-0314r1 |
| 2354 | 3.59 | 4.12.1 | Relays contain a non-AP STA, but the benefits described here do not appear to apply to those non-AP STAs | Change to "non-Relay non-AP STA" | Reject:  Comment failed to identify a real issue.  Response to the commenter:  In fact it applies to both Relay STA and Relay AP. |
| 2355 | 4.05 | 4.12.1 | No actual description of what "two-hop Relay operation" means is given | If it means that a Relay STA is never associated with a Relay AP, then say so | Agree with the commenter. Proposed resolution is adopted.  Revised:  TGah editor to make changes shown in 11-14-0314r1 |
| 2356 | 4.25 | 4.12.3 | "A Relay transmits a frame received from a non-AP STA to the AP with which it is associated when the destination address of the frame is not the address of a STA which is associated to the Relay.": (a) the destination address of which frame (the one received or the one transmitted) and (b) surely the destination address of the frame transmitted by the non-AP STA is guaranteed not to be the address of that STA! | Perhaps "A Relay transmits a frame received from a non-AP STA to the AP with which it is associated when the destination address of the frame received is not the address of the Relay AP."? | Agree with the commenter. Proposed resolution is adopted.  Revised:  TGah editor to make changes shown in 11-14-0314r1 |
| 2499 | 4.13 | 4.12.2 | Incorrect wording. | Change "The additional channel access delay increases the number of the contention-based channel accesses in the network." to "The additional channel access increases the number of nodes competing for contention-based channel accesses in the network." | Agree with the commenter. Proposed resolution is adopted.  Revised:  TGah editor to make changes shown in 11-14-0314r1 |
| 2500 | 4.25 | 4.12.3 | Missing information. | Change "A Relay transmits a frame received from a non-AP STA to the AP with which it is associated when the destination address of the frame is not the address of a STA which is associated to the Relay." to "A Relay AP forwards a frame received from an associated non-AP STA to the Relay STA located within the same Relay for transmission to the AP with which the Relay STA is associated when the destination address of the frame is not the address of a STA which is associated to the Relay AP." And change "a Relay can use flow control signaling to request that non-AP STAs stop sending frames to the Relay until a later time" to "a Relay AP can use flow control signaling to request that non-AP STAs stop sending frames to the Relay AP until a later time" | Agree with the commenter. The sentence is changed to clarify.  Revised:  TGah editor to make changes shown in 11-14-0314r1 |
| 2517 | 3.08 | 4.12 | Relay seems to descrbe a new mode, which really just seems to be a special case of single hop mesh. Relate the relay function to mesh and describe how its different. | Based on the description, Relay should be derived from Mesh behavior. Change the description to eiher differentiate from mesh, or use mesh. | Reject:  Comment failed to identify a real issue.  Response to the commentor:  Relay function is not mesh function. While there are similarities but it is greatly simplified to address a very simple architecture. |
| 2609 | 3.23 | 4.12 | The statements, "The Relay forwards frames from (to) STAs associated to the Relay AP....". This statement implies that there exist a construct of "Relay BSS" in the same way there is a Mesh BSS (MBSS). Need to explain what Relay BSS is and its characteristics. | as in comment | Agree with the commenter. The sentence is changed to clarify.  Revised:  TGah editor to make changes shown in 11-14-0314r1 |
| 2699 | 3.57 | 4.12 | Title of Figure 4-31 should be "Relaying Mechanism". Current title "Relay" implies a single entity, whereas the figure shows multiple entities connected in hierarchical fashion | Title should be "Example hierarchy of Relays and non-Relays" | Agree with the commenter. The title is changed to “Two hops Relay” clarify.  Revised:  TGah editor to make changes shown in 11-14-0314r1 |
| 2798 | 3.19 | 4.12 | Why not call it a Relay non-AP STA to avoid confusion? | Change text from "...that resides inside a Relay and that..." to "...that resides inside a Relay non-AP STAT and that..." | Reject:  Comment failed to identify a real isse  Response to the commentor:  “Relay” is defined in the draft and it is not equivalent of “Relay non-AP STA”. |
| 2799 | 3.35 | 4.12 | What is the difference between the network in Figure 4-31 and a MESH? | Some text should be added to explain the difference between a Relay and an MSTA | Reject:  Comment failed to identify a real issue.  Response to the commentor:  Relay function is not mesh function. While there are similarities but it is greatly simplified to address a very simple architecture. |
| 2800 | 3.35 | 4.12 | Within Figure 4-31, the top 'AP' box should be renamed 'root AP' | as per comment | Accept:  TGah editor to make changes as suggested by CID 1813 |
| 2801 | 4.35 | 4.12 | Figure 4-31 indicates that Relay STAs are associated with an AP, and not non-AP STAs. Should this be a Relay AP here? | as per comment | Reject:  Relay STAs should associate with an AP as indicated in the figure. Relay AP is also an AP which they can associate to |
| 2833 | 4.26 | 4.12.3 | change wording for better understanding | change "(SIFS)" to "(in SIFS time)" | Agree with the commenter. The resolution is adopted  Revised:  TGah editor to make changes shown in 11-14-0314r1 |
| 2876 | 3.33 | 4.12 | "a AP" should be "an AP" | Change "a AP" to "an AP" | Agree with the commenter. The sentence is changed  Revised:  TGah editor to make changes shown in 11-14-0314r1 |
| 2877 | 3.15 | 4.12 | There's no Association frame. | Modify the the last sentence of the second paragraph from "... includes the Relay element in its Beacon, Association, and Probe Response frames." to "... includes the Relay element in its Beacon, Association Response, and Probe Response frames.". | Agree with the commenter.  Revised:  TGah editor to make changes shown in 11-14-0314r1 |
| 2930 | 3.33 | 4.12 | "4-address frame format" is unclear. Does it mean a MAC frame without frame aggregation? | Please clarify. | Reject:  4-address frame format is defined appropriately in subcluase 9.48 |
| 2931 | 3.42 | 4.12 | In Figure 4-31, the caption of "AP" (at the top of the figure) should be replaced with "Root AP". | As in comment. | Accept  TGah editor to adopt the proposed resolution |
| 2971 | 3.19 | 4.12 | "entity" is missing | insert "entity" after "Relay" | Reject:  “Relay” is defined properly. There is no entitiy after it. |
| 2972 | 4.00 | 4.12.3 | the sentence needs to rephrase | phrase "when adequate buffer space is available" should be moved to the end of the sentence | Agree with the commenter.  Sentence is changed.  Revised:  TGah editor to make changes shown in 11-14-0314r1 |

* Relay

4.12.1 General

A Relay is an entity that logically consists of a Relay AP and a Relay STA.

The Relay AP is an AP with additional functionalities for the relaying of frames (see 9.48 (Relay operation)) that resides inside a Relay entity. The Relay AP supports 4 address frame format and includes the Relay element in its Beacon, (Re-)Association Response, and Probe Response frames.

The Relay STA is a non-AP STA with additional functionalities for the relaying of frames (see 9.48 (Relay operation)), that resides inside a Relay and that successfully completes association and authentication with a AP, and receives a Relay element in the (Re-)Association Response.

The Relay STA forwards frames from STAs associated to the Relay AP of the same Relay entity to the AP to which it is associated. The Relay AP forwards frames to non-AP STAs associated to it that are received from the AP to which the Relay STA of the same Relay entity is associated.

A non-Relay AP that has Relay STAs associated to it is known as a Root AP. A Root AP includes a Relay element with the Control field value equal to 0 in Beacons, Probe Responses and (Re-)Association Responses.

An example of a Relay function is illustrated in Figure 4-31 (Relay), where Relay 1 and Relay 2 are Relays, both of which consisting of a Relay STA and a Relay AP, whose Relay STAs are associated with an AP that is a Root AP. STA 1 and STA 2 are non-AP STAs associated with the Relay AP of Relay 1. STA3 and STA4 are non-AP STAs associated with the Relay AP of Relay 2. Frames from STA 1 and STA 2 are forwarded via the Relay AP of Relay 1 to the Relay STA of Relay 1 and then to the Root AP. Similarly, frames from the Root AP are forwarded to STA 1 and to STA 2 via the Relay STA and the Relay AP of Relay 1.

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|  |
| * Two hop Relay |

Frames are relayed from the AP to its associated Relay STA using either the 4-address frame format or the A-MSDU format.

4.12.2 Two-hop Relay function

A Two-hop Relay provides connectivity when the Relay STA is associated to the Root AP as shown in Figure 4-31.

The Relay function allows an AP and non-AP STAs to exchange frames with one another by the way of a Relay. The introduction of a Relay enables non-AP STAs to use higher MCSs and reduce the time non-AP STAs stay in Active mode. This improves battery life of non-AP STAs. Relays may also provide connectivity for non-AP STAs located outside the coverage of the AP.

The relaying function is bi-directional, and this standard describes necessary rules and mechanisms to enable Two-hop Relay operation.

4.12.3 TXOP sharing operation for Relay

One source of additional overhead when Relays are used is due to a frame being transmitted over two hops through a Relay requiring two separate channel accesses. The additional channel access delay increases the number of nodes competing for contention-based channel accesses in the network. This increases the collision probability between multiple STAs trying to access the medium.

TXOP sharing by Relays reduces channel access delay and the number of contention-based channel accesses by allowing the frame transmission exchanged over the first hop and second hop to share a single TXOP. If TXOP sharing is used, frames transmitted over the first hop and second hop are separated by SIFS.

4.12.4 Flow control

A Relay STA transmits a frame received by the Relay AP from a non-AP STA to the AP towhich the Relay STA is associated when the destination address of the frame is not the address of any of the STAs which are associated to the Relay AP. The transmission occurs either immediately (in SIFS time) after the Relay receives the frame or after some delay. Immediate transfers can take place at the discretion of the Relay, but can also become delayed due to channel conditions or Relay buffer conditions. For example, if preceding transmissions experience failures, frames can fill the Relay's buffer space. To avoid a buffer overflow condition, for example, when adequate buffer space is unavailable, a Relay can use flow control signaling to request that non-AP STAs stop sending frames to the Relay until a later time.(#744)