IEEE P802.11
Wireless LANs

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| Combined Text for Active Scanning |
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Abstract

The submission provides normative text for active scanning clause 10.1.4.3 as a response to the active scanning related comments. In current 802.11ai D0.2 a lot of comments were given for the poor instructions to the editor and modifications that are done to the active scanning by other groups, like 802.11ad.

The submission combines the active scanning clauses of the 802.11ad and 802.11ai standards to the normative text. The additions from 802.11ad are implemented to clauses 10.1.4.3.2, 10.1.4.3.4 and 10.1.4.3.6. The clause 10.1.4.3.4 is copied from the 802.11ad standard and only its title is renumbered. In this version of the submission, the changes due to 802.11ad are shown with track changes.

Otherwise, the submission uses the default notation of the 802.11 amendments.

To clean up the instructions to the editor, the submission deletes the content of the 10.1.4.3.2 and

10.1.4.3.3. In the 802.11ai D0.2 it is shown to the group that essentially the same content is written to the new subclauses.

The submission contains only editorial changes.

References:

802.11ai D0.2

802.11ad D 9.0

802.11-2012

**10.1.4.3.2 Active scanning procedure of the scanning STA**

*Instructions to Editor: Change title of subclause 10.1.4.3.2 (new number) as shown.*

*Change text (mainly from old clause 10.1.4.3.3) as shown.*

*Delete the existing figure 10-3. Add two new figures and add figure 10.3a from the 802.11ad. Number the captions of the figure accordingly.*

Upon receipt of the MLME-SCAN.request primitive with ScanType indicating an active scan, a STA shall use the following procedure:

For each channel to be scanned:

a) Wait until the ProbeDelay time has expired or a PHYRxStart.indication primitive has been received;

b) Perform the Basic Access procedure as defined in 9.3.4.2 if the STA is a non-DMG STA;

c) DMG STAs only:

1. Start generation of DMG Beacon frames according to the rules described in 10.1.3.2b DMG Beacon generation before network initialization, if the STA intends to transmit DMG Beacon frames with the Discovery Mode field set to 1.
2. Otherwise, proceed to step (e);

d) If a DMG Beacon frame is received, perform beamforming training with the peer DMG STA as defined in 9.35.5;

e) Perform the Basic Access procedure as defined in 9.3.4.2 if the STA is a DMG STA;

f) When the criteria defined in the 10.1.4.3.3 are met, send a probe request to the broadcast or individual destination address. Or, in the case of a DMG STA only,

a) following the transmission of an SSW-Feedback frame send a Probe Request to the MAC address of the DMG STA addressed by the SSW-Feedback frame

b) or optionally, following the reception of an SSW-Feedback frame send a Probe Request to the MAC address of the DMG STA that transmitted the SSW-Feedback frame

In all these cases the Probe Request is sent with the SSID and BSSID from the MLME-SCAN.request primitive. When transmitted by a DMG STA, the transmitted Probe Request frame includes the DMG Capabilities element. When the SSID List is present in the MLME-SCAN.request primitive, send one or more Probe Request frames, each with an SSID indicated in the SSID List and the BSSID from the MLME-SCAN.request primitive.

g) Set a ProbeTimer to 0 and start the ProbeTimer.

h) If PHY-CCA.indication (busy) primitive has not been detected before the ProbeTimer reaches MinChannelTime and the STA is a non-DMG STA, then go to step i), else when ProbeTimer reaches MaxChannelTime, process all received probe responses. process the received probe responses or Beacon, and when ReportingOption is set to IMMEDIATE and new AP or new information of the AP is detected, issue MLME-SCAN.confirm primitive with the ResultCode equal to INTERMEDIATE\_SCAN\_RESULT and the BSSDescriptionSet containing information of the AP.

i)set NAV to 0 and scan the next channel.If the Reportingoption is set to ChannelSpecific an MLME-SCAN Confirm primitive is issued with all information of all APs that were discovered from the scanned channel.

See Figures10-ai8, and 10-3 for non-DMG STAs.See Figure 10-3a for DMG STAs that generate DMG Beacon frames with the Discovery Mode field set to 1.



**Figure 10-3c—Example of active scanning process when Probe Request frame is addressed to individual address.**



**Figure 10-3d—Example of active scanning process when Probe Request frame is addressed to broadcast address.**



**Figure 10-3a – Active scanning for DMG STAs.**

When all channels in the ChannelList have been scanned, the MLME shall issue an MLME-SCAN.confirm primitive with Resultcode set to SCAN\_SUCCESSand the BSSDescriptionSet containing all of the information gathered during the scan.

If the MLME receives an MLME-SCAN-STOP.request primitive, the STA shall complete the ongoing active scanning process at the scanned channel, and shall not initiate scanning at any new channel. The MLME shall issue an MLME-SCAN.confirm primitive with the ResultCode set to SCAN\_SUCCESS and BSSDescriptionSet containing all of the information gathered during the scan.

~~STAs, subject to the criteria below, receiving Probe Request frames shall respond with a probe response only if:~~

~~a) The Address 1 field in the probe request is the broadcast address or the specific MAC address of the STA, and either item b) or item c) below.~~

~~b) The STA is a mesh STA and the Mesh ID in the probe request is the wildcard Mesh ID or the specific Mesh ID of the STA.~~

~~c) The STA is not a mesh STA and~~

~~1) The SSID in the probe request is the wildcard SSID, the SSID in the probe request is the specific SSID of the STA, or the specific SSID of the STA is included in the SSID List element, and~~

~~2) The Address 3 field in the probe request is the wildcard BSSID or the BSSID of the STA.~~

~~Additionally, STAs with dot11InterworkingServiceActivated equal to true, receiving Probe Request frames containing an Interworking field in the Extended Capabilities element set to 1 shall examine the Interworking element in the received Probe Request frame and respond with a probe response only if~~

~~— The HESSID field, if present in the Interworking element, is the wildcard HESSID or the HESSID of the STA, and~~

~~— The Access Network Type field in the Interworking element is the wildcard Access Network Type or the Access Network Type of the STA.~~

~~Only APs and STAs in an IBSS or in an MBSS respond to probe requests. A result of the procedures defined in this subclause is that in each infrastructure BSS and IBSS there is at least one STA that is awake at any given time to receive and respond to probe requests. In an MBSS, STAs might not be awake at any given time to respond to probe requests. In an infrastructure BSS or in an IBSS, a STA that sent a Beacon frame shall remain in the Awake state and shall respond to probe requests, subject to criteria in the next paragraph, until a Beacon frame with the current BSSID is received. If the STA is contained within an AP, it shall remain in the Awake state and always respond to probe requests, subject to criteria in the next paragraph.~~

~~There may be more than one STA in an IBSS that responds to any given probe request, particularly in cases where more than one STA transmitted a Beacon frame following the most recent TBTT, either due to not receiving successfully a previous Beacon frame or due to collisions between beacon transmissions.~~

~~In an infrastructure BSS or in an IBSS, STAs receiving Probe Request frames shall respond with a probe response when the SSID in the probe request is the wildcard SSID or matches the specific SSID of the STA or when the specific SSID of the STA is included in the SSID List element. Furthermore, a STA with dot11RadioMeasurementActivated true receiving a probe request with a DSSS Parameter Set element containing a Current Channel field value that is not the same as the value of dot11CurrentChannel shall not respond with a probe response. An AP shall respond to all probe requests meeting the above criteria. In an IBSS a STA that transmitted a Beacon frame since the last TBTT shall respond to group addressed Probe Request frames. A STA in an IBSS shall respond to Probe Request frames sent to the individual address of the STA.~~

~~An associated mesh STA that receives a Probe Request frame shall not respond with a Probe Response frame when dot11RadioMeasurementActivated is true and the Probe Request frame contains a DSSS Parameter Set element with its Current Channel field value different from the value of dot11CurrentChannelNumber.~~

~~Probe Response frames shall be sent as directed frames to the address of the STA that generated the probe request. The SSID List element shall not be included in a Probe Request frame in an IBSS.~~

~~Requested Element IDs in the Request element shall be included in the Probe Response if the responding~~

~~STA supports it. In an improperly formed Request element, a STA may ignore the first element requested that is not ordered properly and all subsequent elements requested. In the probe response frame, the STA shall return the requested elements in the same order as requested in the Request element.~~

~~If dot11RadioMeasurementActivated is true and if the Request element of the Probe Request includes the RCPI element ID, the STA shall include in the Probe Response an RCPI element containing the measured RCPI value of the received Probe Request frame. If no measurement result is available, the RCPI value shall be set to indicate that a measurement is not available.~~

**10.1.4.3.3 Sending a probe request**

*Instructions to Editor: Delete the existing clause 10.1.4.3.3. Add the text to the new Clause 10.1.4.3.3 as shown.*

When an MLME receives an MLME-SCAN.request primitive with ScanType indicating an active scan, a STA may not transmit a Probe Request frame to a channel at which the STA has received:

* A broadcast addressed Probe Request frame to which the clause 10.1.4.3.6(Criteria to respond to probe request) allows at least the same responses as the information indicated in the received MLME-SCAN.request primitive.
* A broadcast addressed Probe Response or a Beacon frame containing at least the same information as indicated in the received MLME-SCAN.request primitive.

A Probe Request frame may contain Probe Response Reception Time element. When present, the Max Channel Time field of the Probe Response Reception Time element of the Probe Request frame is set to the Max Channel Time of the MLME-SCAN.request.

The SSID List element shall not be included in a Probe Request frame in an IBSS.

~~Upon receipt of the MLME-SCAN.request primitive with ScanType indicating an active scan, a STA shall~~

~~use the following procedure:~~

~~For each channel to be scanned:~~

~~a) Wait until the ProbeDelay time has expired or a PHYRxStart.indication primitive has been received.~~

~~b) Perform the Basic Access procedure as defined in 9.3.4.2.~~

~~c) Send a probe request to the broadcast destination address, with the SSID and BSSID from the~~

~~MLME-SCAN.request primitive. When the SSID List is present in the MLME-SCAN.request~~

~~primitive, send one or more probe request frames, each with an SSID indicated in the SSID List and~~

~~the BSSID from the MLME-SCAN.request primitive.~~

~~d) Set to 0 and start a ProbeTimer.~~

~~e) If PHY-CCA.indication (busy) primitive has not been detected before the ProbeTimer reaches~~

~~MinChannelTime, then set NAV to 0 and scan the next channel, else when ProbeTimer reaches~~

~~MaxChannelTime, process all received probe responses.~~

~~f) Set NAV to 0 and scan the next channel.~~

~~See Figure 10-3.~~

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**~~Figure 10-3 – Probe response~~**

~~When all channels in the ChannelList have been scanned, the MLME shall issue an MLME-SCAN.confirm primitive with the BSSDescriptionSet containing all of the information gathered during the scan.~~

**10.1.4.3.4 PCP selection in a PBSS**

*Instructions to Editor: Renumber the clause from 802.11ad*

The PCP selection procedure is performed by the SME in the following cases:

* At the reception of an MLME-SCAN.confirm that was received in response to an MLME-SCAN.request with the value of the ScanType parameter equal to ACTIVE and BSSType parameter equal to PERSONAL
* As part of a PCP handover (see 10.28.2 PCP Handover).

The decision whether the STA performs in the role of PCP is done by comparing the value of the STA’s PCP Factor (self\_PCP\_factor) and the PCP Factor of the peer STA (peer\_PCP\_factor) that is indicated in the peer STA’s DMG Capabilities element.

 The PCP Factor of a STA is constructed by concatenating the value of select fields present in the STA’s DMG Capabilities element defined in 8.4.2.130. The PCP Factor is defined in Figure 10-3b.

NOTE–According to the convention, the least significant bit is the leftmost bit (B0).

For each peer STA reported as part of an MLME-SCAN.confirm or considered as part of a PCP handover, the STA proceeds as follows. If the STA’s value of self\_PCP\_factor is greater than the value of peer\_PCP\_factor or the values are equal and the MAC address of the STA is greater than the MAC address of the peer STA contained in the peer STA’s DMG Capabilities element, the STA becomes a candidate PCP. Otherwise, the STA does not become a candidate PCP. For the purpose of this MAC address comparison, the first transmitted octet shall be interpreted as the most significant octet (i.e., big 16 endian).

The rules the SME of a candidate PCP follows to initialize a PBSS are described in 10.1.4.4.2 Initializing a DMG BSS.

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**10.1.4.3.5 Selecting the response frame to probe request**

*Instructions to Editor: Add the new Clause 10.1.4.3.5*

STAs receiving Probe Request frames shall respond, if the criteria to response to probe request as described in 10.1.4.3.6(Criteria to respond to probe request), are met.The STA shall response:

* with a Probe Response or a Beacon frame when dot11FILSActivated equal to true. More details on selecting the Probe Response or Beacon frame are described in 10.1.4.3.7(Probe response collision avoidance).
* with Probe Response frame when dot11FILSActivated equal to false

**10.1.4.3.6 Criteria to respond to probe request**

*Instructions to Editor: Add the new subclause 10.1.4.3.6.*

Only DMG STAs that are not members of a PBSS but that have transmitted at least one DMG Beacon with the Discovery Mode field set to 1, multi-band capable non-AP STAs for which the last received probe request included a Multi-band element, Aps, PCPs, and STAs in an IBSS or in an MBSS respond to probe requests. The procedures defined in this subclause ensure that in each BSS, except in DMG BSSs, there is at least one STA that is awake at any given time to receive and respond to probe requests.

In an MBSS, STAs might not be awake at any given time to respond to probe requests. In an infrastructure BSS or in an IBSS, a STA that sent a Beacon frame shall remain in the Awake state and shall respond to probe requests, subject to criteria in the next paragraph, until a Beacon frame with the current BSSID is received. If the STA is contained within an AP, it shall remain in the Awake state and respond to probe requests, subject to criteria in the next paragraphs. There may be more than one STA in an IBSS that responds to any given probe request, particularly in cases where more than one STA transmitted a Beacon or a DMG Beacon frame following the most recent TBTT, either due to not receiving successfully a previous Beacon or DMG Beacon frame or due to collisions between beacon transmissions.

A STA in an IBSS shall respond to Probe Request frames sent to the individual address of the STA.

A DMG STA that is not member of a PBSS but that has transmitted at least one DMG Beacon with the Discovery Mode field set to 1, an AP, a PCP and a STA in IBSS that transmitted a Beacon or DMG Beacon frame since the last TBTT shall STAs receiving Probe Request frames shall respond only if the criteria below are met:

a) The Address 1 field in the probe request is the broadcast address or the specific MAC address of the STA, and either item b) or item c) below.

b) The STA is a mesh STA and

1) The Mesh ID in the probe request is the wildcard Mesh ID or the specific Mesh ID of the STA.

c) The STA is not a mesh STA and

1) The SSID in the probe request is the wildcard SSID, or the SSID in the probe request is the specific SSID of the STA, or the specific SSID of the STA is included in the SSID List element, and

2) The Address 3 field in the probe request is the wildcard BSSID or the BSSID of the STA.

Additionally, STAs with dot11InterworkingServiceActivated equal to true receiving Probe Request frames containing an Interworking field in the Extended Capabilities element set to 1 shall examine the Interworking element in the received Probe Request frame and respond with a probe response only if:

— The HESSID field, if present in the Interworking element, is the wildcard HESSID or the HESSID of the STA, and

— The Access Network Type field in the Interworking element is the wildcard Access Network Type or the Access Network Type of the STA.

An associated mesh STAs with dot11RadioMeasurementActivated equal to true receiving a Probe Request frame with a DSSS Parameter Set element containing a Current Channel field value that different from the value of dot11CurrentChannel shall not respond to Probe Request frame.

STAs with dot11FILSActivated equal to true receiving a Probe Request frame with FILS Request Parameters element shall respond to Probe Request frame only if all the criteria below that are present in the corresponding Probe Request frame are met:

1. The access delay as indicated by the BSS Delay Criteria field of the FILS Criteria field of the FILS Request Parameters element is less than the value as specified in the Max Delay Limit field of the FILS Criteria field of the FILS Request Parameters element as explained in 8.4.2.178(FILS Request Parameters element)
2. The HT Support Criteria of the FILS Criteria field of the FILS Request Parameters element is set to 1 and the responding STA is HT STA.
3. The VHT Support Criteria of the FILS Criteria field of the FILS Request Parameters element is set to 1 and the responding STA is VHT STA.
4. The Minimum Data Rate field of the FILS Request Parameters element indicates lower data rate that can be provided over the MAC\_SAP.
5. The Received Signal Strength field of the FILS Request Parameters element indicates lower reception power limit than the reception power of the Probe Request frame as explained in 8.4.2.178(FILS Request Parameters element).
6. The STA knows the OUIs as specified by the OUI Response Criteria of the FILS Request Parameters element as explained in 8.4.2.178(FILS Request Parameters element).

**10.1.4.3.7 Probe response collision avoidance**

*Instructions to Editor: Add the new Clause 10.1.4.3.7*

If a STA with dot11FILSActivated equal to true receives two or more Probe Request frames that meet the criteria to respond as specified in 10.1.4.3.6(Criteria to respond to probe request) and the STA has dot11OmitReplicateProbeResponses true, the responding STA may respond by a single Beacon or Probe Response frameaddressed to broadcast address. The Beacon or the broadcasted Probe Response frame shall contain all the information requested by the responded Probe Request frames. More details on selecting the Probe Response or Beacon frame are described below.

STAs with dot11FILSActivated equal to true should respond to one or more Probe Request frames addressed to broadcast address with a Beacon frame if the criteria below are met:

* The responding STA that is about to transmit a probe response receives an acknowledged Probe Response addressed to the requesting STA containing information of the BSS of the responding STA.
* The next TBTT of the responding STA is within dot11BeaconResponseDuration and is no later than any deadline of Probe Response Reception Time, if the Probe Response Reception Time element is present in any Probe Request frame.

**10.1.4.3.8 Sending a response to probe request**

*Instructions to Editor: Add the new Clause 10.1.4.3.8*

Probe Response frames shall be transmitted as directed frames to the address of the STA that generated the probe request, or to the broadcast address.

Requested Element IDs in the Request element shall be included in the Probe Response frame if the responding STA supports it. In an improperly formed Request element, a STA may ignore the first element requested that is not ordered properly and all subsequent elements requested. In the Probe Response frame, the STA shall return the requested elements in the same order as requested in the Request element.

If dot11RadioMeasurementActivated is true and if the Request element of the Probe Request includes the RCPI element ID, the STA shall include in the Probe Response an RCPI element containing the measured RCPI value of the received Probe Request frame. If no measurement result is available, the RCPI value shall be set to indicate that a measurement is not available.

If the Probe Response Reception Time element is present in the Probe Request frame, the responder with dot11FILSActivated true shall discard the pending untransmitted Probe Response frame to the Probe Request frame when the elapsed time equals to the value of the Max Channel Time field of the Probe Response Reception Time element of the Probe Request frame has been exceeded.

If the Comprehensive Response field of the FILS Request Parameters element of the Probe Request, the Probe Response or Beacon frame may include information of other BSSs, if the criteria as defined in 10.1.4.3.6.(Criteria to respond to probe request) are met for the included BSS.The BSSs which information is included may have different primary channel as the responding STA. When information of other BSSs is included, one Neighbor Report element is added to Probe Response or Beacon frame per one reported BSS.