IEEE P802.11  
Wireless LANs

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| 11bn CR MAC Seamless Roaming | | | | |
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Abstract

This document contains Proposed Draft Text (PDT) for the Seamless Roaming feature of the proposed TGbn (UHR, Ultra High Reliability) amendment to the 802.11 standard.

This submission also proposes resolutions for the following 141 CIDs received for TGbn CC50:

757, 1470, 1765, 2430, 1455, 3757, 3759, 3890, 485, 881, 1828, 1998, 3000, 2354, 2355, 2526, 2529, 2532, 2535, 2540, 3117, 3118, 3917, 3916, 3919, 1440, 1764, 1810, 2530, 3316, 231, 239, 491, 492, 494, 1829, 1869, 2015, 2531, 2714, 3923, 3928, 3936, 232, 234, 419, 497, 498, 506, 534, 1797, 1800, 1813, 2020, 2024, 2025, 2228, 3007, 3008, 3009, 3182, 3368, 532, 1327, 3469, 486, 529, 2011, 2027, 2028, 2079, 3462, 3761, 3925, 3463, 3864, 3926, 487, 495, 496, 3197, 3198, 535, 1812, 2022, 2392, 3465, 3467, 3468, 3471, 3591, 3932, 3934, 3938, 1323, 1766, 1784, 1801, 3588, 3807, 3893, 503, 536, 1325, 1441, 1787, 1798, 2029, 2030, 2031, 2032, 3010, 3937, 157, 3586, 156, 165, 204, 222, 228, 235, 238, 868, 1799, 2033, 3119, 3808

**Editorial**: 757, 1470, 1614, 1765, 1796, 2430,

**General:** 1455, 3757, 3759, 3890

**Introduction:** 485, 881, 1828, 1998, 3000

**Architecture:** 155, 513, 3819, 3820, 3821, 3822, 3823, 3865

**Discovery:** 2354, 2355, 2526, 2529, 2532, 2535, 2540, 3117, 3118, 3916, 3917, 3919

**Association/Candidate Recommendation:** 1440, 1764, 1810, 2530, 3316, 3891

**Preparation:** 231, 239, 491, 492, 494, 1829, 1869, 2015, 2531, 2714, 3923, 3928, 3936,

**Execution:** 232, 234, 419, 497, 498, 534, 1797, 1800, 1813, 2020, 2024, 2025, 2228, 3007, 3008, 3009, 3182, 3368

**DS Mapping:** 532, 1327, 3469,

**Context:** 486, 529, 2011, 2027, 2028, 2079, 3461, 3462, 3761, 3925,

**BA Agreement:** 3463, 3864, 3926, 1441

**Renegotiation:** 487, 495, 496, 3197, 3198

**DL Data transmission:** 535, 1812, 2022, 2392, 3465, 3467, 3468, 3471, 3591, 3932, 3934, 3935, 3938

**UL Data transmission:** 531, 506, 1323, 1766, 1784, 1801, 3588, 3807, 3893,

**Data forwarding**: 503, 536, 1325, 1787, 1798, 2029, 2030, 2031, 2032, 3010, 3937,

**QoS:** 3586, 3587, 3924

**Misc:** 156, 165, 204, 222, 228, 235, 238, 868, 1799, 2033, 3119, 3808

**Revision information**

The following is a summary of the important changes that occurred within each revision of this document:

|  |  |
| --- | --- |
| **Revision** | **Major changes** |
| 0 |  |
|  |  |

**Introduction**

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 TGbn Draft. The abstract, revision information, introduction, explanation of the proposed changes and references sections are not part of the adopted material.

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

Details of the CIDs and proposed resolution:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **CID** | **Commenter** | **Clause** | **Pg/Ln** | **Comment** | **Proposed Change** | **Resolution** |
| **Editorial** | | | | | | |
| 757 | Junbin Chen | 37.8.2.5 | 0.00 | In 37.8.2.5.3, the roaming execution procedure is started with a sequence {TBD req + context transfer + TBD resp}. However, the context transfer is a part of roaming preparation procedure, which is performed before the roaming execution procedure as stated in 37.8.2.5.2. That makes the description of "context transfer" confusing. Basically, these two "context transfer" shall be differentiated. | please clarify it | **Revised**  The intention is to allow some context transfer during ST preparation and the rest in ST execution. In D0.3, preparation is mandatory and this sentence in 37.1.4.6 also makes the intention clear “The current AP MLD shall transfer any context that is required per 37.14.8 (Context) and has not already been transferred to the target AP MLD (if any).  No actions needed for the editor. |
| 1470 | Akira Kishida | 37.8.2.5 Seamless Roaming | 75.42 | The expression "minimizes" has difficulty estimating what value is the minimum. | Change expression "minimizes" to "reduces." | **Accepted** |
| 1614 | Jian Yu | 37.8.2.5 | 75.36 | Make 37.8.2.5 Seamless Roaming a second level subclause | as in comment | **Revised**  Already updated in D0.3.  No actions needed for the editor. |
| 1765 | Chaoming Luo | 37.8.2.5.1 | 75.60 | P75L56 has stated "The context that can be transferred or renegotiated in this procedure is defined in 37.8.2.5.4 (Context).", so this TBD is not needed anymore. | Remove the sentence. | **Revised**  The TBD is no longer in D0.3.  No actions needed for the editor. |
| 1796 | Ryuichi Hirata | 37.8.2.5 | 75.36 | Seamless Roaming is not part of Multi-AP Coordination. | Separate Seamless Roaming subclause from 37.8 Multi-AP coordination framework. | **Revised**  Already updated in D0.3.  No actions needed for the editor. |
| 2430 | Manasi Ekkundi | 37.8.2.5.2 | 75.53 | The description of Transfer and Renegotiation of Context can be reworded and simplifed | "Context (see 37.8.2.5.4 (Context)) of the non-AP MLD can be transferred from current AP MLD to the target AP MLD. What context can be transferred or negotiated in this procedure is defined in 37.8.5.5.4(Context). | **Revised**  Already simplified in D0.3.  No actions needed for the editor. |
| **General** | | | | | | |
| 1455 | Akira Kishida | 37.8.2.5 Seamless Roaming | 75.36 | The term "Seamless roaming" is too general. | Consider to redifine the term, such as "Seamless MLD roaming." | **Revised**  The term has been redefined to SMD BSS transition in D0.3.  No actions needed for the editor. |
| 3757 | Liuming Lu | 37.8.2.5.3 Roaming execution procedure | 75.06 | The start time of the time period for the current AP MLD to transmit the individually addressed DL Data frames to the non-AP MLD after receiving the TBD Request frame is unclear. The period of TBD time should start from the time the TBD request frame is successfully received by the current AP MLD. | As in the comment. Please clarify. | **Revised**  That section has been updated in D0.3 and a lot of more requirements are there to describe the DLDrainTime so these issues should no longer be there in D0.3.  No actions needed for the editor. |
| 3759 | Liuming Lu | 37.8.2.5.1 General | 75.43 | The description of "the non-AP MLD remains in State 4 of association during the transition" is unclear. Need to clariy the entity with which the non-AP MLD remains association in State 4. | As in the comment. Please clarify. | **Revised**  That sentence was clarified in D0.3 as follows: “…State 4 of association with a seamless mobility domain management entity (SMD-ME)…”.  No actions needed for the editor. |
| 3890 | Abhishek Patil | 37.8.2.5 | 75.36 | Seamless Roaming operation is performed at the MLD level while MAPC is a per-link (channel-level) operation. Seamless Roaming section needs to be moved out of MAPC and be a section on its own. | Move Seamless roaming to a subclause under 37. | **Accepted**  Already done in D0.3.  No actions needed for the editor. |
| **Introduction** | | | | | | |
| 485 | Peshal Nayak | 37.8.2.5.1 | 75.44 | The term seamless experience is very vague | Either define the term seamless experience or remove it. | **Rejected** |
| 881 | John Wullert | 37.8.2.5.1 | 75.41 | The text indicates that seamless roaming "minimizes the time during which connectivity between the non-AP MLD and the DS is lost." Seamless roaming, as envisioned, is doing more than that. In particular, context transfer (e.g., block-ack parameters and sequence numbers) and multi-link setup will provide continuity of communications over the wireless medium | Revise sentence as "Seamless roaming is a mechanism for a non-AP MLD to transition from its current AP MLD to a target AP MLD that minimizes the time during which connectivity between the non-AP MLD and the DS is lost and maximizes the continuity of data exchange over the wireless medium. | **Revised**  That sentence was updated and simplified in D0.3 to something similar to the suggestion by the commenter.  No actions needed for the editor. |
| 1828 | Juseong Moon | 37.8.2.5 | 76.28 | A typical handover procedure (For example, procedure of 3GPP, etc.,) consists of preparation, execution, and completion phases. D0.1 lacks the necessary Roaming Completion phase. | As in comment. | **Revised**  There is not a stand-alone section for completion but there are mentioning of roaming completion in the body of ST execution that addresses the concern of the commenter.  No actions needed for the editor. |
| 1998 | Yelin Yoon | 37.8.2.5.1 | 75.45 | After the explanation of Seamless Roaming, a general explanation of each step would be helpful to follow through the rest of the subclauses. | "Add the following sentence after the first paragraph:  Seamless Roaming is composed of four steps which are Discovery, Recommendation, Roaming Preparation Phase, Roaming Execution Phase. | **Revised**  Text is added at the end of D0.3 section 37.14.1 to show all those steps and sections.  No actions needed for the editor. |
| 3000 | Mark RISON | 37.8.2.5.1 | 75.41 | "Seamless roaming is a mechanism for a non-AP MLD to transition from its current AP MLD to a target AP MLD that minimizes the time during which connectivity between the non-AP MLD and the DS is lost. By using this mechanism, the non-AP MLD remains in State 4 of association during the transition while preserving the context for data transmission for a seamless experience." -- if it remains in State 4 then you'd expect to have no "time during which connectivity between the non-AP MLD and the DS is lost" | Change to say (a) that this is State 4 with respect to one of the AP MLDs in the ESS and (b) that there might still be a loss of connectivity due to reasons xyz | **Revised**  That sentence was clarified in D0.3 as follows: “…State 4 of association with a seamless mobility domain management entity (SMD-ME)…”.  No actions needed for the editor. |
| **Architecture (6 unresolved)** | | | | | | |
| 155 | Jay Yang | 37.8.2.5 | 75.38 | The framework if Seamless Roaming is missing, please add it | as the comments | Arch |
| 513 | Peshal Nayak | 37.8.2.5 | 75.38 | A framework and some high level signaling for message exchange between current AP MLD and target AP MLD or generally between AP MLDs in a seamless roaming domain should be defined. | As in comment | Arch |
| 3819 | Abhishek Patil | 4.3 | 23.04 | TGbn introduces the concept of seamless roaming whereby a client device can transition from one AP MLD to another AP MLD without requiring reassociation. This feature will require defining and describing the behavior of new (logical) components within the 802.11 architecture and explaining how these components interact with other 802.11 components. Please update the relevant sub-clauses under 4.3 (such as 4.3.5.2, 4.3.8 etc) to explain the seamless roaming architecture. | As in comment | **Revised**  Agreed in principle with the commenter. Updated the sections.  **TGbn editor, please incorporate the changes tagged as #3819 in document 11-25-1131-00.** |
| 3820 | Abhishek Patil | 4.3 | 23.14 | Please update the subclauses under clause 4.5 to account for the architectural and behavioral changes needed to support seamless roaming feature. | As in comment | **Revised**  Agreed in principle with the commenter. Updated the sections.  **TGbn editor, please incorporate the changes tagged as #3820 in document 11-25-1131-00.** |
| 3821 | Abhishek Patil | 4.3 | 23.15 | Insert a new subclause under clause 4.9 to describe the reference model for seamless roaming. | As in comment | Arch |
| 3822 | Abhishek Patil | 4.3 | 23.16 | Update the subclauses under 5.1.5 to describe the architectural aspects of seamless roaming. | As in comment | Arch |
| 3823 | Abhishek Patil | 7.1 | 34.01 | Update the content under 7.1 (including figure 7.1 & 7.2) to describe the architectural aspects of seamless roaming. | As in comment | Arch |
| 3865 | Abhishek Patil | 11.3 | 66.01 | Please update the subclauses under clause 11.3 to account for the architectural and behavioral changes needed to support seamless roaming feature. | As in comment | Arch |
| **Discovery** | | | | | | |
| 2354 | Ahmadreza Hedayat | 37.8.2.5 | 75.36 | 11bn Seamless Roaming feature lacks an efficient mechanism where a non-AP STA can discover neighboring APs with desired capabilities (eg BSSes with light load, APs with co-located 6GHz link etc.) among its neighboring APs. Without such mechanism, a non-AP STA would end spending time and power to scan all the channels in search of APs with desired capabilities. | Enhance exsting discovery mechanism for UHR seamless roaming feature so that a non-AP STA can query its associated AP for neighboring APs with desired capabilities. | **Revised**  D0.3 already allows a non-AP MLD to discover the target AP MLDs using BTM, Probe Response, etc. See 37.14.2 SMD SS transition discover procedure.  No actions needed for the editor. |
| 2355 | Ahmadreza Hedayat | 37.8.2.5 | 75.36 | Baseline discovery mechanisms lack a mechanism where a non-AP STA can discover APs that belong to a specified SSID. Such mechanims helps a roaming non-AP STA to filter out many neghoboring APs that belong to different SSID. E.g. during roaming in a public venue with multiple operators, a roaming STA wuould need to stick with the same SSID and avoid unnecessarily probing APs that belong to other SSIDs. | Enhance existing discovery mechanisms so that a non-AP STA can query its associated AP for neighboring APs that belong to a specifed SSID. | **Revised**  D0.3 already allows a non-AP MLD to discover the target AP MLDs using BTM, Probe Response, etc. See 37.14.2 SMD SS transition discover procedure.  No actions needed for the editor. |
| 2526 | Jarkko Kneckt | 37.8.2.5.1 | 75.42 | A scanning STA needs AP transmission power information, so that STAs can estimate UL RSSI by using the measured DL RSSI. The UL and DL RSSI help to estimate AP link performance. AP transmission power also helps to estimate multiple links performance and avoid possible nasty UL RSSI surprises in the 6 GHz band. | Please include the AP transmission power information to the discovery information as specified in the submission 24/2118. | **Rejected**  The commenter fails to identify a technical problem. |
| 2529 | Jarkko Kneckt | 37.8.2.5.1 | 75.42 | "A non-AP STA scanning algorithms avoid unnecessary scans, because this consumes STA power. The STA typically scans only when it needs to roam. In this situation, STA does not have a luxury to wait for scanning responses, the STA needs to get the scanning information fast. | The serving AP shall provide neighbor APs information at least with a delay similar to active scanning (e.g. 20ms). If complete set of neighbor AP information is not possible to share fast, then the scanning STA needs to get fast at least the minimum set of neighbor AP parameters. | **Rejected**  The commenter fails to identify a technical problem. |
| 2532 | Jarkko Kneckt | 37.8.2.5.1 | 75.42 | Currently, an associated STA has no mechanism to obtain a complete set of parameters of all affiliated APs of one or more requested AP MLDs through the serving AP. This operation will replace the OTA ML Probe Request queries that will keep radio busy for a long time and avoid low latency data transmissions. | Please allow the serving AP to provide complete set of requested AP MLD parameters for each affiliated AP to the associated STA by using protected management frames. | **Rejected**  The commenter fails to identify a technical problem. |
| 2535 | Jarkko Kneckt | 37.8.2.5.1 | 75.42 | The seamless roaming should consider all the related roaming target AP selection procedures for the duration when connectivity and data transmissions are not possible. For instance, passive OTA scanning limits the data transmissions for over 100ms per scan operation in a link. Active scanning limits data transmissions for 30 - 50ms per scanned channel. given the number of available operatig channels, scanning causes much longer time when the connectivity is lost between the non-AP MLD and the DS. | The time when connectivity is lost between the non-AP MLD and DS shall include also scanning and discovery time. | **Rejected**  The commenter fails to identify a technical problem. |
| 2540 | Jarkko Kneckt | 37.8.2.5 | 75.36 | The Beacon frames are getting bloated. 802.11 should be active to reduce Beacon bloat. One possibiltiy to reduce Beacon bloat is to not add non-colocated neighbor AP infomration in RNR elemetn to beacon frames. The non-colocated neighbor AP infomration should be available for non-associated STAs only through probe responses. | Please allow non-colocated neighbor AP information to be requested by probe request frame and carried in probe response frames. | **Revised**  The SMD Information element is already provided in the Probe Response frame in D0.3  No actions are needed for the editor. |
| 3117 | Mark RISON | 37 | 0.00 | It would be helpful to have a signal that a BSS is the only one in an ESS. This would allow clients to skip performing roaming scans, and hence save power | As it says in the comment | **Rejected**  The commenter fails to identify a technical problem. |
| 3118 | Mark RISON | 37 | 0.00 | It would be helpful to have a signal that all BSSes in an ESS (or a complete set of contiguous BSSes within an ESS) can be identified. This would allow clients to only perform roaming scans on the channels those BSSes are on, and hence save power | As it says in the comment | **Rejected**  The commenter fails to identify a technical problem. |
| 3917 | Binita Gupta | 37.8.2.5 | 75.36 | After a non-AP MLD associates with the SMD, it can discover neighboring candidate target AP MLDs for seamless roaming through RNR. Hence, it is desired to enhance RNR to report SMD related information including 'Same SMD' indication and an SMD ID short identifier for reported APs that belong to another SMD. | Enhance RNR to carry SMD level information as in the comment. | **Rejected**  The commenter fails to identify a technical problem. |
| 3916 | Binita Gupta | 37.8.2.5 | 75.36 | After a non-AP MLD associates with the SMD, it needs to discover neighboring candidate target AP MLDs for seamless roaming. It is desired to enhance BTM Query and BTM Request to query neighbor discovery information for seamless roaming. BTM Query can indicate a new reason for Neighbor Discovery and BTM Request send in response provides desired information for neighbors in RNR and Neighbor Report elements. Client can use (Extended) Request elements in the BTM Query to request for specific elements for neighboring APs to be returned in the NR elements. | Add a clause on Neighbor Discovery for seamless roaming. Define BTM Query enhancements to query for 'neighbor discovery 'and for specific elements desired using (Extended) Request elements in the BTM Query. Define BTM Request enhancements to provide RNR and extend NR element to provide elements of interest such as RSNE and RSNXE in the optional subelements. Commenter will bring a contribution. | **Rejected**  The commenter fails to identify a technical problem. |
| 3919 | Binita Gupta | 37.8.2.5 | 75.36 | To optimize roaming scan time for seamless roaming, 11bn should define ways for a non-AP MLD to discover probe response information for neighboring AP MLDs of the serving AP MLD, through the serving AP MLD. This way, the non-AP MLD does not need to perform off channel scan to receive probe response info for neighboring AP MLDs. A simple approach is to enhance the multi-link probe request/response for probing neighboring AP MLDs. | Enhance the Probe Request ML element to indicate a probe for a Neighbor AP MLD. Allow neighbor ML Probe Request to include one or more neighbor Probe Request ML elements. Allow returning one or more Basic ML elements in the neighbor Probe Response. For efficiency can apply inheritance across Basic ML elements in the response frame. | **Rejected**  The commenter fails to identify a technical problem. |
| **Association/Candidate Recommendation** | | | | | | |
| 1440 | Akira Kishida | 37.8.2.5.2 Roaming preparation procedure | 75.46 | The state of association of an MLD in seamless roaming procedure is unclear. At least one of the MLD links should be associated with the roaming source node until the roaming process is completed because connection interruption will occur if all the MLD links switch their association state at a time. | Please consider to specify. | **Revised**  That sentence was clarified in D0.3 as follows: “…State 4 of association with a seamless mobility domain management entity (SMD-ME)…”.  No actions needed for the editor. |
| 1764 | Chaoming Luo | 37.8.2.5.1 | 75.42 | There are two AP MLDs: current AP MLD to a target AP MLD. Which one is the peer entity of the "State 4 of association" for the non-AP MLD? | Add text to clarify it. | **Revised**  That sentence was clarified in D0.3 as follows: “…State 4 of association with a seamless mobility domain management entity (SMD-ME)…”.  No actions needed for the editor. |
| 1810 | Guogang Huang | 37.8.2.5.1 | 75.43 | Should clarify which the non-AP MLD remains in State 4 with. There are two cases. If the non-AP MLD associates with the SMD-ME, then the non-AP MLD should remain state 4 with SMD-ME. If the non-AP MLD associates with the current AP MLD, then the non-AP MLD remains in state 4 with the current AP MLD before DS mapping change and with the target AP MLD after the DS mapping change. | as in comment | **Revised**  That sentence was clarified in D0.3 as follows: “…State 4 of association with a seamless mobility domain management entity (SMD-ME)…”.  No actions needed for the editor. |
| 2530 | Jarkko Kneckt | 37.8.2.5.1 | 75.42 | A roaming STA is likely at the edge of the serving AP coverage. The most relevant roaming target AP may not be a neighbor of the serving AP. The roaming STA should be reducing the number of roamings and obtain the most relevant candidate AP information, even if the candidate roaming target AP is not immediate neighbor of the serving AP. | Please allow a scanning STA to request information of the APs that may not be 1-hop neighbors of the serving AP. The scanning STA would benefit from having a pointer to available APs BSSIDs, channels and operating channels, if the serving AP is not able to send complete or dynamic information. | **Rejected**  The commenter fails to identify a technical problem. |
| 3316 | Prabodh Varshney | 37.8.2.5.1 | 75.41 | How Target MLD is selected is not clear. | Define how Target MLD is selected. | **Revised**  D0.3 has a new section to describe target MLD selection. Please see 37.14.4 (Target AP MLD selection recommendation).  No actions are needed for the editor. |
| 3891 | Abhishek Patil | 37.8.2.5.1 | 75.43 | Clarify in the sentence that the client doesn't perform reassociation when moving from one AP MLD to another. Add ' without requiring reassociation and' after 'MLD' and delete 'that'. | The updated sentence would read: "... to a target AP MLD without requiring reassociation and minimizing the time .... | **Revised**  That paragraph has been updated in D0.3 to reflect the same.  No actions are needed for the editor. |
| **Preparation** | | | | | | |
| 231 | Pei Zhou | 37.8.2.5.2 | 75.52 | Before roam to a specific target AP MLD, non-AP MLD shall obtain at least the RSSI (or SNR) between itself and the target AP MLD. In addition to passively monitor the Beacon from target AP MLD, non-AP MLD can actively send a request frame (e.g., Probe Request frame) and get the response frame from the target AP MLD to evalute the link quality. | During roaming preparation procedure, before transfer context and set up the link(s) with the target AP MLD, the non-AP MLD can use request/reponse frame to actively monitor the RSSI (link quality) between itself and a target AP MLD. | **Rejected**  Currently the standard does not prohibit a non-AP MLD to send Probes to any AP to check the RSSI. |
| 239 | Pei Zhou | 37.8.2.5.2 | 75.47 | In order to avoid ping-ping and achieve a more reliable roaming, roaming configuration process may be performed during or before Roaming preparation procedure. The roaming configuration process allows the negotiation of accurate roaming triggering conditions and (theshold)parameters between non-AP MLD, current AP MLD, and target AP MLD. | As in comment. The commenter will bring a contribution to address this comment and provide more detailed solutions. | **Rejected**  Roaming is typically initiated by the STA (when the STA is moving across multiple APs coverage) and it's not controlled by any threshold parameters parameters set by the APs. |
| 491 | Peshal Nayak | 37.8.2.5.2 | 75.53 | Does the target AP MLD have to accept all the context during preparation phase? Sometimes it may not be possible for the target AP MLD to accept all the context as setup at the current AP MLD. In this case, the target AP MLD should have the flexibility to reject the context that it cannot accept. | The response frame of roaming preparation procedure should indicate to the non-AP MLD what context cannot be transferred from the current AP MLD to the target AP MLD. This can enable the non-AP MLD to resetup those at the target AP MLD after roaming. Otherwise, non-AP MLD does not know what is transferred and what is not transferred. | **Rejected**  Current design is all the context listed are transferred but we allow a non-AP MLD to request some of the context NOT to be transferred (please see 37.14.8).  There is no concept of a target AP MLD not able to accept some context. |
| 492 | Peshal Nayak | 37.8.2.5.2 | 75.53 | Does the current AP MLD intiate a transfer of all the context corresponding to the non-AP MLD when the non-AP MLD initiates a roaming procedure? | The non-AP MLD should be allowed to indicate in the request frame for the preparation procedure which context it wants to be transferred to the target AP MLD. | **Revised**  Current design is all the context listed are transferred but we allow a non-AP MLD to request some of the context NOT to be transferred (please see 37.14.8).  No actions needed for the editor. |
| 494 | Peshal Nayak | 37.8.2.5.2 | 75.53 | How does the non-AP MLD convey to the current AP MLD what context it wants to have transferred and which ones it wants to renegotiate with the target AP MLD. | The non-AP MLD should be allowed to indicate which context it wants to transfer and which context it wants to renegotiate with the target AP MLD | **Revised**  Current design is all the context listed are transferred but we allow a non-AP MLD to request some of the context NOT to be transferred (please see 37.14.8).  No actions needed for the editor. |
| 1829 | Juseong Moon | 37.8.2.5.2 | 75.58 | In 'Setting up the link(s) with the target AP MLD', clarification is needed on how a non-AP MLD performing EMLSR sets up EMLSR links. | As in comment. | **Rejected**  The link preparation at the target AP MLD should be agnostic to EMLSR mode. Note the preparation is performed between the non-AP MLD and its current AP MLD so it is not affected by EMLSR or not. |
| 1869 | Sanghyun Kim | 37.8.2.5.2 | 75.58 | When a roaming non-AP STA adds a link with the Target AP MLD, does the STA operating on the newly added link continue to use the AID assigned by the serving AP MLD, or does it need to obtain a new AID from the Target AP MLD? If a new AID is used for the setup link with the Target AP MLD, the non-AP MLD would need to operate using two different AIDs during the roaming process." | Please clarify the AID management method for a roaming non-AP MLD. Additionally, if a roaming non-AP MLD is required to operate using two different AIDs, it is necessary to review whether any modifications are needed in the defined multi-link operation(such as ML-TIM) to accommodate this scenario." | **Revised**  AID is assigned by the target AP MLD as described in D0.3 section 37.14.5.2 Target links preparation.  No actions are needed for the editor. |
| 2015 | Yelin Yoon | 37.8.2.5.1 | 75.60 | In the Roaming Preparation phase, after the non-AP MLD requests for what context is to be transferred, the current AP MLD needs to indicate what context has been transferred. | In the Roaming Preparation phase, as a response to the non-AP MLD's request on context transfer, the serving AP MLD indicates what context has been transferred in the Link Reconfiguration Response frame. The response does not include the contexts that have to be transferred mandatorily and indicates whether the requested context transfer of each context is accepted or rejected. If all requested contexts are accepted, the response does not need to be sent | **Revised**  Current design is all the context listed are transferred but we allow a non-AP MLD to request some of the context NOT to be transferred (please see 37.14.8).  No actions needed for the editor. |
| 2531 | Jarkko Kneckt | 37.8.2.5.1 | 75.42 | A scanning STA may not need a complete set of roaming target AP MLD parameters before roaming. The required information for roaming includes AP MLD identification, number of links, load of the links and operating channels of the links. | Please allow a non-AP MLD to setup a link with knowing only a partial set of the roaming target AP MLD capabilities and operation parameters values. Instruct that the link setup provides complete set of information to the STA and additional query-response signaling of complete discovery parameters just before roaming adds delays and non-AP STA power consumption. | **Rejected**  The commenter fails to identify a technical problem. |
| 2714 | Chittabrata Ghosh | 37.8.2.5.2 | 75.47 | Prior to roaming, non-AP MLD should obtain assurance of QoS levels and number of links that could be supproted by a Candidate AP MLD in case it roams to the AP MLD; having this assurance prior to roaming preparation will improve the success of roaming - please include details of assuring QoS and number of links | As in the comment | **Revised**  Roaming preparation already allows a non-AP MLD to prepare the target links and needed QoS (e.g., SCS, MSCS) with one or more target AP MLDs. Please see 37.14.5)  No actions are needed for the editor. |
| 3923 | Binita Gupta | 37.8.2.5.2 | 75.47 | When setting up links on a target AP MLD, some links may be accepted and some may be rejected by the target AP MLD, like in 11be. A client may prefer to prepare a target AP MLD only if all requested links can be setup. If not, it may prefer to prepare another target AP MLD indicated either in the same request or subsequently via another request. | In roaming preparation request, allow a client to signal its preference for preparing a target AP MLD only if all requested links are accepted. Client can use this to prepare the best AP which can provide all requested links. | **Rejected**  The commenter fails to identify a technical problem. |
| 3928 | Binita Gupta | 37.8.2.5.4 | 76.29 | Other static context such as operating modes that are enabled (DPS, NPCA, DSO, DUO, PUO etc.) and related operating parameters may be desired to transfer to target AP MLD links or renegotiate for the links of the target AP MLD. Note that it is important to setup OM modes on the target as part of roaming, so that client can continue to operate with desired modes w/o added delay of OM updates. | Define procedure for transferring/negotiating operating modes and operation parameters for target AP MLD links as part of roaming prep procedure. | **Rejected**  The commenter fails to identify a technical problem. |
| 3936 | Binita Gupta | 37.8.2.5.2 | 75.47 | Assuming a client can prepare multiple target AP MLDs for roaming, it can signal to prepare another AP MLD after it has prepared a first AP MLD because its RSSI conditions have changed. In these cases, client may not be interested In keeping prep with the previous target AP MLD because it does not intend to roam there. Then client should indicate its intention to not use any previous roaming prep so that resources (links, SCS resources etc.) can be released as soon as possible. | Define signaling where client can signal to cancel any previous roaming prep to the serving AP MLD. | **Revised**  There is a timeout defined in the spec (in the SMD Information element) between the ST preparation response and ST execution request (to the same target AP MLD). if a prepared target AP MLD does not receive an ST execution request after the timeout, all the corresponding prepared links, keys, context, etc will be deleted.  No actions are needed for the editor. |
| **Execution** | | | | | | |
| 232 | Pei Zhou | 37.8.2.5.2 | 75.60 | To better assist the roaming execution procedure, non-AP MLD and target AP MLD may exchange their power save status, roaming (execution) availability time/window, BSS Load, etc. | As in comment. Such procedure can be added in or before roaming preparation procedure. | **Rejected**  A non-AP MLD can already Query the current AP MLD for target AP MLD candidate recommendations (please see 37.14.2). |
| 234 | Pei Zhou | 37.8.2.5.3 | 76.17 | There are context transfer and data transfer between TBD Request frame and TBD Response frame. Context and data transfer may not be done within SIFS time. | A new timer can be defined to indicate the gap between TBD Request frame and TBD Response frame. For example, when sending the TBD Request frame, if the non-AP MLD doesn't receive TBD Response frame after the timer, the non-AP MLD can suspend or stop roaming. | **Revised**  The current PDT already allows the non-AP MLD to try another prepared target AP MLD for roaming (please see 37.14.5).  No actions are needed for the editor. |
| 419 | Shuang Fan | 37.8.2.5.3 | 76.13 | The context transfer or renegotiation operation exists in both the roaming preparation and roaming execution procedures. It is unclear what the difference is between the context transfer operations in these two procedures. Please add a note to clarify it. | Add a note to clarify the difference about the context transfer or renegotiation operations between roaming preparation and roaming execution procedures. | **Revised**  In D0.3, the context transfer section lists out all the context. The renegotiation part is about the SCS.  No actions are needed for the editor. |
| 497 | Peshal Nayak | 37.8.2.5.3 | 76.21 | What is the reason to prevent the non-AP MLD from transmitting class 3 frames only? | Provide necessary explaination | **Revised**  This is because we do not want the non-AP MLD to send Class 3 frames to the target AP MLD before the target AP MLD is ready to receive those frames.  Class 1 and Class 2 frames to the target AP MLD should not be restricted (e.g., Probe Request).  No actions are needed for the editor. |
| 498 | Peshal Nayak | 37.8.2.5.3 | 76.21 | Its is little inefficient to disallow transmission of class 3 frames to target AP MLD until response frame is received from the current AP MLD. When the non-AP MLD is at execution phase, its link quality to the current AP MLD is likely to be very bad. This means that it can miss out frames transmtited by the current AP MLD. What happens if preparation and execution procedures are completed but due to bad link quality, the non-AP MLD does not receive response frame successfully from the current AP MLD? Does the non-AP MLD have to do a baseline roam with the current AP MLD? | The non-AP MLD should be allowed to communicate with the target AP MLD even if it does not receive a response frame sent by the current AP MLD. | **Revised**  In this case described by the commenter, the non-AP MLD can send an ST execution request to one of the target AP MLDs that it has prepared.  No actions are needed for the editor. |
| 534 | Po-Kai Huang | 37.8.2.5.1 | 75.44 | It is clear that non-AP MLD remains in state 4, but it is critical to define the relevent state on AP MLD because obviously it is not every AP MLD can be in state 4 with non-AP MLD, which implies that non-AP MLD can send data frame to any AP MLD. As a result, we need to define corresponding state on current AP MLD and target AP MLD through the roaming procedure. Clearly, before roaming execution request/response is completed, non-AP MLD is in state 4 and only current AP MLD is in state 4 with respect to the non-AP MLD. After the end of the TBD period to receive DL data from the current AP MLD, only target AP MLD is in state 4 with respect to the non-AP MLD. As a result, we only need to define the state durint the TBD period for current AP MLD and target AP MLD. | For current AP MLD in the TBD period, define a specific state 4a to highlight that only DL data frame and UL acknowledgement is allowed for class 3 frames. For target AP MLD in the TBD peirod, simply say that target AP MLD is in state 4. | **Revised**  Agreed in principle with the commenter. However, the UL data transmission restriction is still TBD so only made these clarifications:   * Current AP MLD transitions from State 3 to State 3 at the end of ST * Target AP MLD starts at State 3 during ST preparation and transitions to State 4 during ST execution   **TGbn editor, please incorporate the changes tagged as #534 in document 11-25-1131-00.** |
| 1797 | Ryuichi Hirata | 37.8.2.5.3 | 76.21 | The current text prohibits a non-AP MLD from transmitting Class 3 frames to the target AP MLD before it receives a TBD Response frame sent by the current AP MLD. However, UL transmission before receiving the TBD Response frame will help reduce packet drops at the non-AP MLD due to lifetime expiration. The target AP MLD may hold UL traffic before the DS mapping change and context transfer are completed and retrieve UL after the completion of the DS mapping change and context transfer. | Allow a non-AP MLD to transmit Class 3 frames before it receives TBD Response frame. | **Rejected**  Before the target AP MLD may not be ready to receive uplinks because the target AP MLD will need to be notified by the current AP MLD that the non-AP MLD wants to execute roaming. If the target AP MLD is not ready (so not expecting the non-AP MLD), the UL frames from the non-AP MLD will be dropped. |
| 1800 | Ryuichi Hirata | 37.8.2.5.3 | 76.21 | The current text does not desccribe the transmission of Class 1 and Class 2 frames before a non-AP MLD receives a TBD Response frame sent by a current AP MLD. | Add description about transmission of Class 1 and Class 2 frames before non-AP MLD receives the TBD Response frame sent by the current AP MLD. | **Revised**  There is no explicit description of that, which means the non-AP MLD and AP MLD just follows the baseline. |
| 1813 | Guogang Huang | 37.8.2.5.3 | 76.21 | If the non-AP MLD associates with the SMD-ME and remains in state 4 with the SMD-ME during the roaming. Then there is a need to clarify what's the relationship between SMD-ME and AP MLDs within this SMD. These is no state transition between AP MLD and non-AP MLD to control the frame filtering. From this point of view, this sentence doesn't make sense.  If the non-AP MLD associates with the current AP MLD considering that we already allow the non-AP MLD to retrieve buffer BUs with the current AP MLD after the DS mapping change, this sentence also doesn't make sense. | please remove or reword this sentence | **Revised**  That sentence has been updated in D0.3 to address the same concern.  No actions are needed for the editor. |
| 2020 | Yelin Yoon | 37.8.2.5.3 | 76.06 | We need to define what happens after the TBD (Transition) time | Once the Transition time expires, the non-AP MLD transitions to the Target AP MLD. If the Transition time expires before the end of the transmission of the buffered DL data, the remaining data can be transferred to the target AP MLD (Data Transfer) or discarded. If the buffered DL data transmission terminates before the Transition timer expiration, the non-AP MLD can transition to the target AP MLD. | **Revised**  D0.3 has a lot of details added to handle this (please see 37.14.9).  No actions needed for the editor. |
| 2024 | Yelin Yoon | 37.8.2.5.3 | 76.60 | In the Roaming Execution phase, the target AP MLD needs to indicate what context has been transferred | In the Roaming Execution phase, as a response to the non-AP MLD's request on context transfer, the serving AP MLD indicates what context has been transferred in the Link Reconfiguration Response frame. The response does not include the contexts that have to be transferred mandatorily and indicates whether the requested context transfer of each context is accepted or rejected. If all requested contexts are accepted, the response does not need to be sent | **Revised**  Current design is all the context listed are transferred but we allow a non-AP MLD to request some of the context NOT to be transferred (please see 37.14.8).  No actions needed for the editor. |
| 2025 | Yelin Yoon | 37.8.2.5.3 | 76.03 | A general explanation of the Roaming Execution phase is required that includes the general process and the purpose of this phase. | As in comment | **Rejected**  The commenter fails to identify a technical problem. |
| 2228 | Dana Ciochina | 37.8.2.5.3 | 0.00 | The current and target AP should be able to support each other in performing channel access to speed up the data transmission during the roaming execution phase. However there are no specific mechanisms defined for this. | define mechanisms to enable a coordinated channel access for speeding up the data transmission during the roaming phase and/or respecting QoS agreements for a defined time interval. | **Rejected**  The commenter fails to identify a technical problem. |
| 3007 | Mark RISON | 37.8.2.5.3 | 76.11 | "After receiving the TBD Request frame: -- The current AP MLD shall transfer the context (see 37.8.2.5.4 (Context)) that is required for enabling operations with the target AP MLD." -- but if it's already been transferred in the roaming preparation procedure (see 75.53) why transfer it again? | As it says in the comment | **Revised**  In D0.3, it is clarified that “The current AP MLD shall transfer any context that is required per 37.14.8 (Context) and has not already been transferred to the target AP MLD (if any).”  No actions needed for the editor. |
| 3008 | Mark RISON | 37.8.2.5.3 | 76.20 | "The non-AP MLD shall not transmit Class 3 frames to the target AP MLD until it has received the TBD Response frame sent by the current AP MLD." -- I think this should be expressed in terms of the state of the non-AP MLD w.r.t. the current and target MLDs, i.e. when the state becomes 4 (or 3 if security is not mandatory) | As it says in the comment | **Revised**  The target AP MLD is already in State 4 where Class 3 is allowed hence the restriction here.  No actions needed for the editor. |
| 3009 | Mark RISON | 37.8.2.5.3 | 76.24 | "After the TBD Request and Response frame exchange, if necessary and if the DS is not already notified about the update of the destination mapping for the non-AP MLD, the DS is notified about the update of the destination mapping for the non-AP MLD." -- how would the DS have been already notified? And "shall" should be used here | As it says in the comment | **Revised**  The corresponding sentences in D0.3 have been updated in section 37.14.6 and 37.14.7 to clarify these points raised by the commenter.  No actions needed for the editor. |
| 3182 | Yunbo Li | 37.8.2.5.3 | 76.13 | change to "The current AP MLD shall transfer the context (see 37.8.2.5.4 (Context)) that is required for enabling operations with the target AP MLD if it hasn't" | as in comment. | **Revised**  The corresponding sentences in D0.3 have been updated in section 37.14.6 and 37.14.7 to clarify these points raised by the commenter.  No actions needed for the editor. |
| 3368 | Giovanni Chisci | 37.8.2.5.3 | 76.13 | The bulleted list is unnecessary and the text can be moved to mainline | As in comment | **Revised**  The sentence has been improved and expanded to different sections in D0.3.  No actions needed for the editor. |
| **DS Mapping** | | | | | | |
| 532 | Po-Kai Huang | 37.8.2.5.3 | 76.24 | Clarify that no more UL data is passed up after DS mapping is changed. | Add "The current AP MLD shall not pass up any user data in the received reorder buffer to the next MAC process after the roaming execution response frame is sent. " | **Revised**  Agreed in principle with the commenter. Added the requirement to address the concern.  **TGbn editor, please incorporate the changes tagged as #532 in document 11-25-1131-00.** |
| 1327 | Renlong Zhou | 37.8.2.5.3 | 76.24 | Define the conditions for DS mapping change operation | The condition for performing the DS mapping change operation should take into account whether the uplink buffer and context on the current AP have been transferred to target AP MLD | **Revised**  The corresponding sentences in D0.3 have been updated in section 37.14.6 and 37.14.7 to clarify these points raised by the commenter.  No actions needed for the editor. |
| 3469 | Pooya Monajemi | 37.8.2.5.3 | 76.03 | At the time of initiating the roaming execution, the origin AP may have some data in the UL receive reorder buffers (in case there are holes in the bitmap). Spec needs to clarify what happens to this data. Furthermore, forwarding any remaining UL data must not interfere with the DS mapping update procedure. | Indicate that the origin AP shall forward all successfully received MSDUs in its reoder buffer to the upper layers prior to the initiation of DS mapping update. | **Revised**  Agreed in principle with the commenter. Added the requirement to address the concern.  **TGbn editor, please incorporate the changes tagged as #532 in document 11-25-1131-00.** |
| **Context (1 unresolved)** | | | | | | |
| 486 | Peshal Nayak | 37.8.2.5.2 | 75.53 | The definition of the term context is unclear. | Provide a clear definition for the term context. | **Rejected**  The commenter fails to identify a technical problem. |
| 529 | Po-Kai Huang | 37.8.2.5.4 | 76.31 | Context transfer of SN is useful for general cases. However, some AP vendors argue for difficulty to transfer next SN. If AP vendors has capabilty constriants, then one approach is to introduce a capability bit for AP to transfer SN. If AP can not transfer SN, then client will simply do not go to target AP MLD to receive DL data during the TBD period to receive DL data from current AP MLD. | If it is an issue for AP MLD to transfer next SN, add "AP MLD indicates capability to transfer the Next SN to be assigned for DL individually addressed data frame of each TID to enable DL data delivery of the target AP MLD during the TBD period to receive DL data from the current AP MLD" | **Revised**  The PDT already requires all AP MLDs in the same SMD be able to transfer and accept the context defined in 37.14.8. There were no proposals that suggest any exceptions in this round of comments so no actions are needed at this time.  No actions are needed for the editor. |
| 2011 | Yelin Yoon | 37.8.2.5.2 | 75.58 | Non-AP MLD needs to be able to request what context to be transferred during the Roaming Preparation phase. | As in comment | **Revised**  Current design is all the context listed are transferred but we allow a non-AP MLD to request some of the context NOT to be transferred (please see 37.14.8). |
| 2027 | Yelin Yoon | 37.8.2.5.4 | 76.31 | The context transfer should be done per TID. The format of the context transfer should be defined. | The format of the Context transfer: - TID - SN - PN - Block Ack Agreement Parameters - TBD The TID field indicates which TID value that the context contents belong to and the context contents come accordingly. If the static context has been transferred in the Roaming Preparation phase, the dynamic context is included in the context transfer. Otherwise, the context transfer format includes all the context that needs to be transferred. | **Revised**  Most are listed per TID in section 37.14.8  No actions are needed for the editor. |
| 2028 | Yelin Yoon | 37.8.2.5.4 | 76.31 | How the context is transferred need to be mentioned. | The context is transferred over the DS. | **Rejected**  The context transfer is highly implementation and deployment dependent so it’s outside the scope of 802.11bn. |
| 2079 | Liangxiao Xin | 37.8.2.5.2 | 75.60 | APs should negotiate what context can be transferred | same as comment | **Revised**  Current design is all the context listed are transferred but we allow a non-AP MLD to request some of the context NOT to be transferred (please see 37.14.8).  No actions are needed for the editor. |
| 3461 | Pooya Monajemi | 37.8.2.5.4 | 76.32 | A UHR non-AP MLD can indicate what context is (not) to be transferred during a seamless roam. The procedure for signaling this configuration needs to be defined, as well as default context transfer behavior in absence of such configuration. | Define what context is transferred by default. Define how the non-AP MLD can indicate exceptions to this default and clarify the AP MLD behavior when such exceptions are indicated. Context that may not be transferred includes latest Sequence Numbers for either direction. | **Revised**  Current design is all the context listed are transferred but we allow a non-AP MLD to request some of the context NOT to be transferred (please see 37.14.8).  No actions are needed for the editor. |
| 3462 | Pooya Monajemi | 37.8.2.5.4 | 76.32 | It is not clear what happens to context that has been transferred during the roam preparation phase but changes during the time between roam preparation and roam execution | Clarify if certain context is allowed to be changed after roam preparation. If so, clarify the update procedure (if any) with the target AP MLD for this changed context. | Need more details |
| 3761 | Liuming Lu | 37.8.2.5.4 Context | 76.29 | The procedure for context transfer is unclear. After the the BA context for the non-AP MLD is transferred from the current AP MLD to the target AP MLD, the AP MLD need to response to the non-AP MLD with the status of the context transer and the successfully tranferred context. | As in the comment. | **Revised**  These are backhaul details that are outside the scope of 802.11bn. Since there are many different network deployments (e.g., enterprise, home, etc) the backhaul signaling is left for implementation.  No actions needed for the editor. |
| 3925 | Binita Gupta | 37.8.2.5.4 | 76.29 | Need to define the set of near-static/static context that get transferred during the roaming preparation phase, with the goal to transfer most (if not all) static context to minimize delays due to context negotiation during or right after roaming. | Define details on near-static/static context transfer during roaming preparation phase, e.g. security context, Block Ack agreements, SCS context etc. | **Revised**  We specify the listed context can be transferred during preparation (37.14.5) and any remaining ones shall be transferred during execution (37.14.6 and 37.14.7). This gives more flexibility to implementations.  No actions needed for the editor. |
| **BA Agreement (4 unresolved)** | | | | | | |
| 3463 | Pooya Monajemi | 37.8.2.5.4 | 76.32 | Block Ack is expected to be part of the context that is transferred. Spec needs to clarify how the BA sessions are transferred in case supported window sizes are different between the origin and the target AP | Indicate if/how the BA sessions are transferred if supported window sizes are different between the origin and the target AP | BA |
| 3864 | Abhishek Patil | 10.25 | 66.01 | The seamless roaming feature will involve special considerations for blockack maintanence (e.g., BA context transfer, special handling during transition phase etc). Please investigate and update relevant section under 10.25. | As in comment | BA |
| 3926 | Binita Gupta | 37.8.2.5.4 | 76.29 | During the roaming preparation BA static context such as UL or DL Block Ack agreements may can be renegotiated e.g. for the case when target AP MLD supports a different buffer size or client wants to reset the BA window SSN at the target AP. These cases should be supported. | Define procedure for negotiating Block Ack agreements as part of roaming prep procedure. | BA |
| 1441 | Akira Kishida | 37.8.2.5.6 Data forwarding | 76.39 | If the roaming MLD fails to confirm data reception from the destination node correctly, the BlockAck window cannot be shifted. The reception rule for Seamless roaming should be updated. | As in the comment. | BA |
| **Renegotiation** | | | | | | |
| 487 | Peshal Nayak | 37.8.2.5.2 | 75.55 | Is the prepartion procedure a single step procedure or it can be performed in multiple steps. Single step meaning exchange of one request and response frame and multi-step meaning multiple request and response frames are exchanged. If it's a single step, how does renegotiation occur and what is the behavior when a renegotiation request is rejected by the target AP MLD? Does the non-AP MLD fall back to baseline mechanism of setting up the context after roaming? | Details on how renegotiation can be performed along with context transfer in the preparation procedure need to be provided | **Revised**  SCS has been added in D0.3 because SCS is MLD-level. Please see 37.14.5 and 37.14.8.  No actions needed for the editor. |
| 495 | Peshal Nayak | 37.8.2.5.2 | 75.55 | What happens if renegotiation fails for a particular context? How does the non-AP MLD know about the failure? | The non-AP MLD should receive an indication of which contexts have been successfully renegotiated with the target AP MLD and which ones were not renegotiated. | **Revised**  The current design does not allow the target to reject any context. However, the target may reject some SCS a non-AP MLD is requesting. Please see 37.14.5 and 37.14.8.  No actions are needed for the editor. |
| 496 | Peshal Nayak | 37.8.2.5.2 | 75.49 | If preparation procedure is completed, is the target AP MLD considered to be indefinitely preparaed? This can be a little inefficient if the non-AP MLD never roams to the target AP MLD. There should be a deadline for the non-AP MLD to roam to the target AP MLD after preparation and preparation should be considered as void/invalid after the deadline if non-AP MLD fails to roam within that deadline | There should be a deadline to roam for the non-AP MLD after preparation is completed | **Revised**  Agreed in principle with the commenter and such timeout is added in D0.3 (see 37.14.5.2).  No actions are need for the editor. |
| 3197 | Javier Perez | 37.8.2.5.2 | 75.60 | Renegotiation of R-TWT agreements during roaming procedure can benefit QoS of R-TWT members. However, renegotiations should happen when the link between the non-AP MLD and the target AP MLD has been set up sucessfully. | Include in the text that R-TWT renegotiations may happen after link has been successfully set up between non-AP MLD and target AP MLD. | **Revised**  The suggestion is already allowed in D0.3 because it is baseline behavior. As soon as roaming finished, the non-AP MLD may renegotiate any rTWT with the target AP MLD. |
| 3198 | Javier Perez | 37.8.2.5.4 | 76.32 | Renegotiation of R-TWT agreements after roaming procedure may cause a degradation of QoS of R-TWT members. Renegotation during roaming procedure may reduce the time R-TWT members do not have a new R-TWT agreement in place in the target AP, thus maintaining their QoS. | Text does not include R-TWT as a context that can be renegotiated. Include R-TWT context as one of the contexts that can be renegotiated during the roaming preparation and/or execution phase | **Rejected**  The current design is only the MLD-level context is transferred. Any link-specific feature should be re-established with the target AP MLD. For rTWT, it will be quite challenging and complex due to different TSF and clocks between the two non-colocated AP MLDs. |
| **DL Data transmission (1 unreolsved)** | | | | | | |
| 535 | Po-Kai Huang | 37.8.2.5.5 | 76.36 | It will be useful for non-AP MLD to detemrine which TID is needed for DL data reception from the current AP MLD during the TBD period after the roaming execution request/response exchange. Only receiveing the necessary DL data helps the non-AP MLD to finish the transient period and goes to target AP MLD as soon as possible. | Have indication in the roaming execution request frame to indicate the TID that non-AP MLD wants to receive DL data during the TBD period. Current AP MLD then does not need to buffer the TID that is not indicated anymore. | New |
| 1812 | Guogang Huang | 37.8.2.5.3 | 76.06 | For the retrieval buffer BUs with the current AP MLD, we should update the state transition diagram and introduce a new state accordingly. | as in comment | **Revised**  Agreed in principle with the commenter. However, the UL data transmission restriction is still TBD so only made these clarifications:   * Current AP MLD transitions from State 3 to State 3 at the end of ST * Target AP MLD starts at State 3 during ST preparation and transitions to State 4 during ST execution   **TGbn editor, please incorporate the changes tagged as #534 in document 11-25-1131-00.** |
| 2022 | Yelin Yoon | 37.8.2.5.3 | 76.08 | The non-AP MLD needs information on the last buffered DL data to know when it has received all the buffered data from the current AP MLD so that it can transition to the target AP MLD even before the TBD time has not been reached yet. | The last SN value of the buffered data is included in a TBD (Roaming) Response frame. | **Revised**  In D0.3, we allow the current AP MLD to indicate to the non-AP MLD when a subset of TIDs are finished with DL data. Please see 37.14.9.  “- The current AP MLD should provide information that allows the non-AP MLD to identify the completion of downlink retrieval for a partial set of traffic categories (TID or AC) if requested by the non-AP MLD in the execution request.”  No actions are needed for the editor. |
| 2392 | Renlong Zhou | 37.8.2.5.3 | 76.09 | When the current AP MLD completes the individually addressed DL data transmission to the non-AP MLD before the TBD period time, there should be a mechanism to notify the non-AP MLD in advance. | Define the signaling by which the current AP MLD notifies the non-AP MLD of its DL buffer status. | **Revised**  In D0.3, we allow the current AP MLD to indicate to the non-AP MLD when a subset of TIDs are finished with DL data. Please see 37.14.9.  “- The current AP MLD should provide information that allows the non-AP MLD to identify the completion of downlink retrieval for a partial set of traffic categories (TID or AC) if requested by the non-AP MLD in the execution request.”  No actions are needed for the editor. |
| 3465 | Pooya Monajemi | 37.8.2.5.5 | 76.36 | The non-AP MLD needs to be notified when the retrieval of downlink data from the origin AP MLD is complete. Relying solely on a pre-defined timer will either incur DL loss if too short or add unncessary latency if too long, and setting a proper value is impossible ahead of time. | Define a mechanism for the origin AP MLD to notify the roaming non-AP MLD of empty DL buffer status. This may be reported for all DL data or per-TID. | **Revised**  In D0.3, we allow the current AP MLD to indicate to the non-AP MLD when a subset of TIDs are finished with DL data. Please see 37.14.9.  “- The current AP MLD should provide information that allows the non-AP MLD to identify the completion of downlink retrieval for a partial set of traffic categories (TID or AC) if requested by the non-AP MLD in the execution request.”  No actions are needed for the editor. |
| 3467 | Pooya Monajemi | 37.8.2.5.5 | 76.36 | While retrieving downlink data from the origin AP during a roaming transition, queues may be emptied for one high-priority TID while large data may still remain for a low-priority TID. This can cause latency if the STA needs to wait until completion of all data before continuing operations with the target AP | Define a mechanism for the STA to indicate which TIDs it is ready to receive at the target AP | **Rejected**  The commenter fails to identify a technical problem. |
| 3468 | Pooya Monajemi | 37.8.2.5.5 | 76.36 | A STA may only be interested in retrieving high-priority downlink data remaining on the origin AP (and discarding any other) | Define a mechanism for the STA to indicate the downlink TIDs that it intends to receive from the origin AP during a roaming transition | **Rejected**  The commenter fails to identify a technical problem. |
| 3471 | Pooya Monajemi | 37.8.2.5.5 | 76.36 | It is important for the STA to know the amount of DL data that remains on the origin AP during a seamless roam. This information is also beneficial outside the roaming procedure. | Define a mechanism for the origin AP MLD to notify the non-AP MLD of DL buffer status. This may be reported for all DL data or per-TID. | **Revised**  In D0.3, we allow the current AP MLD to indicate to the non-AP MLD when a subset of TIDs are finished with DL data. Please see 37.14.9.  “- The current AP MLD should provide information that allows the non-AP MLD to identify the completion of downlink retrieval for a partial set of traffic categories (TID or AC) if requested by the non-AP MLD in the execution request.”  No actions are needed for the editor. |
| 3591 | Tuncer Baykas | 37.8.2.5.3 | 76.08 | The sentence " If the non-AP MLD chooses to receive the individually addressed buffered downlink Data frames from the current AP MLD, it may do so for a period of TBD time." is not valid. STA may turn on or off its receiver at any time. | Remove the sentence. The sentence "The current AP MLD may transmit individually addressed DL Data frames to the non-AP MLD for a period of TBD time." already provides the same information. | **Revised**  The TBD time is now called the DLDrainTime in D0.3. The corresponding sentence has been revised to “When the non-AP MLD receives an ST execution response to an ST execution request, the non-AP MLD may choose to receive individually addressed buffered Data frames from its current AP MLD for the DLDrainTime.”  It is still up to the non-AP MLD whether and when to retrieve the DL buffered frames within that DLDrainTime.  No actions are needed for the editor. |
| 3932 | Binita Gupta | 37.8.2.5.4 | 76.30 | To maintain SN continuity for DL Tx, the serving AP MLD would transfer the next SN to be used to the target AP MLD. There will be some extra SN space added to account for MSDUs still being tricked down from the DS. If entire extra SN space does not get used, then there will be some SNs for which no MPDUs are ever sent. Then client needs to be notified of this so that it can advance its Rx Reorder buffer window. | In the roaming signaling, define a way to provide next SN that was sent to the target AP MLD and SN of the last MPDU delivered to the non-AP MLD from the serving AP MLD. This way the client can advance its Rx Reorder buffer for any SN gap between Next SN and last SN. | **Rejected**  The commenter fails to identify a technical problem. |
| 3934 | Binita Gupta | 37.8.2.5.5 | 76.34 | For buffered DL data delivery, post roaming transition, it is desirable to drain data as fast as possible so client can transition to the target AP MLD. Hence, client should come out of PS on multiple links whenever possible during this period for DL BUs delivery, and AP should be able to request a client to come out of PS on other links e.g. in roaming response or A-Control. | Define client and AP behavior for expediting delivery of buffered DL data by requesting clients to use multiple links to retrieve/drain of the buffered Bus. | **Rejected**  The commenter fails to identify a technical problem. |
| 3938 | Binita Gupta | 37.8.2.5.5 | 76.34 | Client may prefer to indicate its preference for buffered DL data handling during roaming transition, e.g. if clients has some high priority flows impacting user experience vs background traffic. To support such cases, client can provide its preference for DL data handling in the roaming request, e.g. at a high-level client can signal whether it prefers to - a) only drain, b) only forward, c) first drain as much then forward remaining, d) drain some and forward some in parallel. Client can also provide more granular preference for data draining or forwarding e.g. based on TIDs or ACs or SCS IDs | Define signaling for client to be able to indicate its preference for buffered DL data handling in the roaming request. Roaming response can signal AP side status on how buffered DL data will be handled by the serving AP (e.g. drain, forward, combination of the two, more granular status based on TIDs/ACs/SCS IDs etc. | **Rejected**  The commenter fails to identify a technical problem. |
| **UL Data transmission (9 unresolved)** | | | | | | |
| 531 | Po-Kai Huang | 37.8.2.5.3 | 76.03 | During the roaming execution request/response exchange, since there is a potential DS mapping change, it is not ideal to send any UL data. This is also true even when there is data forwarding. The reason is that sending the data directly to a better channel condition of target AP MLD is better than send the data frame firs to the current AP MLD thorugh a worse channel condition and go through another backhaul with unpredictable performance. | Add "The non-AP MLD shall not send any data during the request/response frame exchange" | UL data transmission TBD |
| 506 | Peshal Nayak | 37.8.2.5.3 | 76.01 | Behavior of non-AP MLD for handling UL data frames during the execution phase is unclear. | Provide a clarification on how UL data frames are handled during the execution phase. | UL data transmission TBD |
| 1323 | Renlong Zhou | 37.8.2.5 | 75.36 | During the roaming procedure, when a non-AP MLD has a large amount of data buffered on the link associated with the current AP, to avoid retransmissions after receiveing the roaming response, the non-AP MLD should be allowed to transmit data to the current AP. | Add a section for "UL data transmission" | UL data transmission TBD |
| 1766 | Chaoming Luo | 37.8.2.5.5 | 76.37 | A new subclause is needed to describe UL data transmission during the roaming procedure, because the UL buffered BU may be in retransmission state at the start of the roaming execution procedure. | Add a new subclause to describe UL data transmission. | UL data transmission TBD |
| 1784 | Chaoming Luo | 37.8.2.5.4 | 76.32 | UL BA context transfer should also be considered in case there are UL MPDUs not acked during the roaming preparation procecure. | As in comment. | UL data transmission TBD |
| 1801 | Ryuichi Hirata | 37.8.2.5.5 | 76.34 | Subclause for UL data transmission is missing. UL transmission during roaming procedure should be allowed. | Add subclause for UL data transmission. | UL data transmission TBD |
| 3588 | Tuncer Baykas | 37.8.2.5.3 | 75.48 | The draft only provides a section how DL data is transmitted during roaming process. The draft lacks the description until when non-AP MLD transmits buffered data to the serving AP during the roaming process. | Add the description until when non-AP MLD may transmit buffered data to the serving AP during the roaming process. The time when the non-AP MLD transmit data may consider the consider total size of the buffered data by the non-AP MLD. | UL data transmission TBD |
| 3807 | Yongho Seok | 37.8.2.5.5 | 76.34 | "37.8.2.5.5 DL data transmission" UL data transmission should be described. | As in the comment | UL data transmission TBD |
| 3893 | Abhishek Patil | 37.8.2.5.3 | 76.11 | Clarify that the non-AP MLD does not perform UL to the current AP MLD after it has received the response frame. | As in comment | UL data transmission TBD |
| **Data forwarding (10 unresolved)** | | | | | | |
| 503 | Peshal Nayak | 37.8.2.5.6 | 76.41 | The non-AP MLD should have a say in when and what type of data to forward. | As in comment | new |
| 536 | Po-Kai Huang | 37.8.2.5.6 | 76.41 | It is useful to define rules for the DL data forwarding. Specifically, AP MLD shall forward DL data of a TID starting from the end of data in the transmission window. As a result, once client receives all the DL data from the current AP MLD of a TID, then the client can just forward up all the DL data even if there is holes. | Define rules that AP MLD shall forward DL data of a TID starting from the end of data in the transmission window. | new |
| 1325 | Renlong Zhou | 37.8.2.5.6 | 76.39 | During the seamless roaming procedure, when the current AP has a large amount of uplink data buffered, how to switch the DS path to the target AP as quickly as possible should be considered. | Add UL data forwarding between current AP MLD and target AP MLD during seamless roaming | new |
| 1787 | Chaoming Luo | 37.8.2.5.6 | 76.42 | UL Data forwarding or retransmission should be considered in case there are UL MPDUs not acked during the roaming preparation procecure. | As in comment. | new |
| 1798 | Ryuichi Hirata | 37.8.2.5.6 | 76.41 | This section only mentions DL data forwarding. However, UL data forwarding is also useful for minimizing the duration of connectivity loss. | Add UL data forwarding to this subclause. | new |
| 2029 | Yelin Yoon | 37.8.2.5.6 | 76.42 | How to trigger data transfer needs to be defined. | The non-AP MLD can request for data transfer by sending a TBD Request frame. Although data transfer has not been requested by the non-AP MLD, the current AP MLD can transfer data to the target AP MLD. | new |
| 2030 | Yelin Yoon | 37.8.2.5.6 | 76.42 | When data is forwarded to the target AP MLD needs to be defined. | We have two options for choosing when to transfer data from the current AP MLD to the target AP MLD.  1. The data can be transferred while the current AP MLD transmits the queued DL data to the non-AP MLD. In this case, there may be a negotiation before the data transfer takes place.  2. The data can be transferred after the transmission of the queued DL data is terminated. The data transfer happens in the Roaming Execution phase. | new |
| 2031 | Yelin Yoon | 37.8.2.5.6 | 76.42 | What data is forwarded to the target AP MLD needs to be defined. | The higher priority data can be transmitted directly from the current AP MLD to the non-AP MLD while the current AP MLD transfers the rest of the data to the target AP MLD. The data that is left unsent at the current AP MLD can be transferred to the target AP MLD. | new |
| 2032 | Yelin Yoon | 37.8.2.5.6 | 76.42 | We need to decide whether the data transfer is mandatory or optional. | Data transfer is optional. | new |
| 3010 | Mark RISON | 37.8.2.5.6 | 76.41 | "forward DL data" is not clear. What is forwarding here? Is "DL data" the same as "Data frames"? | As it says in the comment | new |
| 3937 | Binita Gupta | 37.8.2.5.6 | 76.40 | To support data forwarding during roaming transition, the network needs to support high-throughput backhaul links between APs to forward data. It can't be expected that all networks deploying 11bn AP MLDs would support such high-throughput backhaul links. Hence, we strongly believe that data forwarding must be an optional capability that is advertised by the AP MLD. If supported the serving AP MLD can advertise its policy for data forwarding and can perform a combination of draining of DL data and forwarding some buffered DL data, e.g. based on policy, types of active flows (VO, VI, BE), amount of buffered data, RSSI/MCS of the client, backhaul link conditions etc. | Define AP MLD advertising its data forwarding capability and associated data forwarding policy - these could include e.g. all traffic supported for data forwarding, only certain ACs/TIDs/SCS stream level support, MSDUs/A-MSDUs only, limit on total data size that can be forwarded or duration for which data forwarding can be done. | **Revised**  “DL Data forwarding” is already included in the SMD Capabilities in D0.3.  No actions are needed for the editor. |
| **QoS** | | | | | | |
| 3586 | Tuncer Baykas | 37.8.2.5 | 75.48 | Informing QoS requirements of the before roaming would be beneficial for the network. Candidate AP may | Provide a method to indicate that the STA may negotiate the QoS requirements with the target AP. | **Revised**  To enhance QoS transition during ST, the SCS and MSCS renegotiation during roaming has been added to D0.3. Please see 37.14.5 and 37.14.8.  No actions are needed for the editor. |
| 3587 | Tuncer Baykas | 37.8.2.4 | 76.29 | QoS requirements should be included in context subsection. | as per comment | **Revised**  To enhance QoS transition during ST, the SCS and MSCS renegotiation during roaming has been added to D0.3. Please see 37.14.5 and 37.14.8.  No actions are needed for the editor. |
| 3924 | Binita Gupta | 37.8.2.5.2 | 75.47 | During roaming prep, by default target AP MLD can attempt to reserve resources for all the SCS streams. However, in some cases due to resource constraint, target AP may be able to only reserve resources for a subset of SCS streams. It may be desirable for a client to indicate its preference to prioritize reserving resources for some SCS streams. | Define a mechanism for client to signal the set of SCS streams it prefers to be prioritized for SCS resource reservation at the target AP MLD. Define a way for the response to signal for which SCS streams the resources are reserved at the target AP MLD. | **Revised**  To enhance QoS transition during ST, the SCS and MSCS renegotiation during roaming has been added to D0.3. Please see 37.14.5 and 37.14.8.  No actions are needed for the editor. |
| **Misc** | | | | | | |
| 156 | Jay Yang | 37.8.2.5 | 75.38 | The enhanced FT protocol is missing, please add it | as the comments | **Revised**  D0.3 captures the interaction of FT and ST in section 37.14.1 (page 139/line 63).  No actions are needed for the editor. |
| 165 | Jay Yang | 37.8.2.5 | 75.38 | If a NSTR/EMLSR non-AP MLD set up links with the APs affilicated with different AP MLDs during roaming, the two APs shall ensure there is no overlapping TXOP when exchange frames with the NSTR/EMLSR non-AP MLD | as the comments | **Rejected**  For such non-AP MLD, it could perform DL frame exchange with one AP MLD at a time. Besides, it will be extremely challenging to time-sync the two non-colocated AP MLDs. |
| 204 | Chunyu Hu | 37.8.2.5.1 | 76.40 | From the text, it seems that non-AP MLD may initiate the Seamless roaming. But can an AP MLD initiate this as well? This might be needed. | Add description or clarification on how an AP MLD initiates a Seamless roaming. | **Revised**  An AP MLD can use BTM Request to trigger ST in the non-AP MLD. However, it still has to be initiated by the non-AP MLD. This is no different than today’s case, where an AP can suggest a STA to perform BSS transition with disconnect imminent set to persuade the STA to move.  No actions are needed for the editor. |
| 222 | Pei Zhou | 37.8.2.5.3 | 76.04 | Current AP MLD can also initiate roaming request for non-AP MLD. | Please add the case that current AP MLD transmits TBD Request frame to non-AP MLD to initiate roaming. | **Revised**  An AP MLD can use BTM Request to trigger ST in the non-AP MLD. However, it still has to be initiated by the non-AP MLD. This is no different than today’s case, where an AP can suggest a STA to perform BSS transition with disassociation imminent set to persuade the STA to move.  No actions are needed for the editor. |
| 228 | Pei Zhou | 37.8.2.5.5 | 76.36 | During roaming, non-AP MLD may maintain multiple links (for example, UL and dual DL) between current AP MLD and target AP MLD. Considering the case non-AP MLD is NSTR MLD, PPDUs end time alignment should be designed in this clause. | Define or enhance the existing 802.11be PPDU end time alignment procedure during roaming. | **Revised**  NSTR non-AP MLD will likely perform sequential communication (as opposed to concurrent) with the current and the target due to the limitation pointed out by the commenter.  No actions are needed for the editor. |
| 235 | Pei Zhou | 37.8.2.5.4 | 76.31 | An EPCS enabled non-AP MLD needs its EPCS status continued after roaming to target AP MLD, in order to fast recover the EPCS services. Thus, EPCS related info can be defined as part of the context. | Add EPCS related info into context transfer. | **Rejected**  The commenter fails to identify a technical issue. The non-AP MLD can discover such capabilities in Beacon frames and Probe Response frames already. |
| 238 | Pei Zhou | 37.8.2.5.2 | 75.47 | If a target AP MLD is a mobile AP MLD with NSTR or the target AP MLD is operating in NPCA primary channel, it may not receive from or transmit to the roaming non-AP MLD at any time. Therefore, a roaming available time / window can be introduced to recommend suitable time for executing roaming procedures. | As in comment. | **Rejected**  The commenter fails to identify a technical issue. Note that seamless roaming is not designed to handle a target AP MLD that is mobile. |
| 868 | Tomoko Adachi | 37.8.2.5.3 | 0.00 | It seems better to also have the AP side to start the roaming procedure, as non-AP STAs tends to be sticky. | As in comment. | **Revised**  An AP MLD can use BTM Request to trigger ST in the non-AP MLD. However, it still has to be initiated by the non-AP MLD. This is no different than today’s case, where an AP can suggest a STA to perform BSS transition with disassociation imminent set to persuade the STA to move.  No actions are needed for the editor. |
| 1799 | Ryuichi Hirata | 37.8.2.5.3 | 76.05 | The current spec defines only non-AP MLD initiated seamless roaming. However, in some cases, AP MLD initiated seamless roaming is useful. | Allow AP MLD to initiate Seamless Roaming procedure. | **Revised**  An AP MLD can use BTM Request to trigger ST in the non-AP MLD. However, it still has to be initiated by the non-AP MLD. This is no different than today’s case, where an AP can suggest a STA to perform BSS transition with disassociation imminent set to persuade the STA to move.  No actions are needed for the editor. |
| 2033 | Eda Genc | 37.8.2.5 | 75.40 | The current seamless roaming decision relies solely on the non-AP STA. | Define a mechanism in seamless roaming so that the roaming decision does not solely rely on non-AP STA. | **Revised**  An AP MLD can use BTM Request to trigger ST in the non-AP MLD. However, it still has to be initiated by the non-AP MLD. This is no different than today’s case, where an AP can suggest a STA to perform BSS transition with disassociation imminent set to persuade the STA to move.  No actions are needed for the editor. |
| 3119 | Mark RISON | 37 | 0.00 | It would be helpful to have a signal that an AP commits to using BTM to steer a STA to another AP in the ESS where necessary. This would allow clients to skip performing roaming scans, and hence save power | As it says in the comment | **Revised**  An AP MLD can use BTM Request to trigger ST in the non-AP MLD. However, it still has to be initiated by the non-AP MLD. This is no different than today’s case, where an AP can suggest a STA to perform BSS transition with disassociation imminent set to persuade the STA to move.  No actions are needed for the editor. |
| 3808 | Yongho Seok | 37.8.2.5.3 | 76.01 | The roaming execution procedure should be more robust. Please define the recovery procedure. | As in the comment | **Rejected**  The commenter fails to identify a technical issue. Please provide more details to discuss any technical issues. |

**Text to be adopted begins here.**

*TGbn editor: the following is from 11be. Please modify 4.3.5.2, 4.5.3.3 as follows:*

4.3.5.2 Extended service set (ESS): the large coverage network

***Change the first paragraph as follows:***

The DS and infrastructure BSSs allow IEEE Std 802.11 to create a wireless network of arbitrary size and complexity. IEEE Std 802.11 refers to this type of network as the ESS. An ESS is the union of the infrastructure BSSs with the same SSID connected by a single DS. All BSSs in an ESS have the same SSID. All BSSs created by APs affiliated with an AP MLD have the same SSID and belong to the same ESS. An AP MLD is part of the same ESS as its affiliated APs. (#3819)If an SMD is present in a wireless network, all BSSs created by APs affiliated with an AP MLD that is under the same SMD have the same SSID and belong to the same ESS. The ESS does not include the DS.

4.5.3.3 Association

***Change the first three paragraphs as follows:***

To deliver an MSDU within an ESS via the DS, the DS needs to know which AP or AP MLD within the ESS

to deliver the MSDU to, so that the MSDU might ultimately be delivered to the addressed IEEE 802.11 non-

AP STA or non-AP MLD. This information is provided to the DS by the concept of association. Association

is necessary, but not sufficient, to support BSS-transition mobility. Association is sufficient to support no-transition mobility. Association is one of the services in the DSS.

Before a non-AP STA is allowed to deliver an MSDU via an AP, it first becomes associated with the AP. Before a non-AP MLD is allowed to deliver an MSDU via an AP MLD, it first becomes associated with the AP MLD. (#3820)If an AP MLD is part of an SMD, before a non-AP MLD is allowed to deliver an MSDU via the AP MLD, it first becomes associated with the SMD-ME.

For a non-GLK STA that is not affiliated with an MLD, the act of becoming associated with an AP invokes

the association service, which provides the STA to AP mapping to the DS. For a non-AP MLD, the act of becoming associated with an AP MLD invokes the association service (see 11.3 (STAauthenticationAuthentication and association)), which provides the non-AP MLD to AP MLD mapping to the DS. How the information provided by the association service is stored and managed within the DS is not specified by this standard.

## SMD BSS transition

### General

SMD BSS transition is a mechanism for a non-AP MLD to transition from its current AP MLD to a target AP MLD (#3891)without requiring reassociation. SMD BSS transition minimizes the time during which connectivity between the non-AP MLD and the DS is lost. The non-AP MLD remains in State 4 of association with a seamless mobility domain management entity (SMD-ME) during the SMD BSS transition while preserving the context for data transmission for a seamless experience. To support SMD BSS transition, an SMD is introduced in the IEEE 802.11 architecture. The SMD consists of multiple AP MLDs, where a non-AP MLD can use the SMD BSS transition procedure to transition between the AP MLDs within the SMD. An SMD-ME provides SMD-level authentication and association (see 11.3 (STA authentication and association)), IEEE 802.1X Authenticator functions and RSNA key management functions for non-AP MLDs across all AP MLDs within the SMD.

Two data path models between the non-AP MLD and the DS are supported by the SMD:

* One MAC SAP for the SMD.
* Separate MAC SAP per AP MLD of the SMD.

Only one of these data path models is used within an SMD.

(#154)In the case of a separate MAC SAP per AP MLD, the DS mapping is updated when the non-AP MLD transitions to another AP MLD within the SMD and the component of the 802.1X Authenticator in the SMD-ME interacts with an 802.1X Authenticator component in the AP MLD that manages the 802.1X Controlled Port for the non-AP MLD.

In the case of a single MAC SAP for the SMD, the 802.1X Authenticator in the SMD-ME manages the 802.1X Controlled Port for the non-AP MLD.

(#369)The SMD and the 802.1X Authenticator component in the corresponding SMD-ME are uniquely identified by an SMD identifier (see 9.4.2.xxx (SMD Information element)). The SMD identifier is used in establishing a single PMKSA and PTKSA for a non-AP MLD that associates with the SMD-ME.

If the SMD is part of an FT mobility domain, the single PMKSA to be used in the SMD is a PMK-R1 security association that is bound to the SMD-ME (through the SMD identifier (see 9.4.2.xxx (SMD Information element)), when the non-AP MLD initially associates with the SMD-ME using FT initial MD association. A non-AP MLD can transition from one SMD to another SMD that is part of the same mobility domain using fast BSS transition.

A non-AP MLD performs initial association with the SMD-ME through an AP MLD within the SMD that establishes an SMD-level security association across all AP MLDs in the SMD. The non-AP MLD transitions between AP MLDs within the SMD while maintaining its association and security association with the SMD-ME. This new mobility type is called SMD BSS transition. When a non-AP MLD is in the process of transitioning from its current AP MLD to a target AP MLD within the SMD, the same PMKSA and PTKSA created as part of RSNA security association established with the SMD-ME shall be used to protect the communications with its current AP MLD and the target AP MLD.

SMD BSS transition includes the following procedures:

* SMD BSS transition discovery (see 37.14.2 (SMD BSS transition discovery procedure (#188)(#507)(#2000)(#2352)))
* Initial association to the SMD-ME (see 37.14.3 (Initial association to the SMD-ME ))
* Target AP MLD selection recommendation (see 37.14.4 (Target AP MLD selection recommendation (#188)(#2000)(#2002)(#2003)(#2004)(#2353)(#2005)))
* SMD BSS transition preparation (see 37.14.5 (SMD BSS transition preparation procedure))
* SMD BSS transition execution
  + Through current AP MLD (see 37.14.6 (SMD BSS transition execution procedure via the current AP MLD))
  + Through target AP MLD (see 37.14.7 (SMD BSS transition execution procedure via the target AP MLD))

### SMD BSS transition discovery procedure (#188)(#507)(#2000)(#2352)

A non-AP MLD can use mechanisms such as active scanning (see 11.1.4.3.2 (Active scanning procedure for a non-DMG STA) and 35.3.4.2 (Use of multi-link probe request and response)), the BSS transition management framework (see 11.21.7 (BSS transition management) and 35.3.23 (BSS transition management for MLDs)) or the neighbor report framework (see 11.10.10 (Usage of the neighbor report)) for discovery of the neighboring AP MLDs and SMD BSS transition support by those AP MLDs.

NOTE 1 – A neighboring AP MLD might or might not be part of the same SMD.

NOTE 2 – An AP is not required to report non-collocated APs in the Reduced Neighbor Report element that is carried in its Beacon and FILS Discovery frames.

(#3912) An SMD Information element provides an SMD identifier and SMD capabilities for an SMD. (#1066)An AP MLD that is managed by an SMD shall include the SMD Information element in the Probe Response frames. The SMD Information element is provided as part of the Neighbor Report element in the BSS Transition Management Request frame and Neighbor Report Response frames for a reported AP that is part of a different SMD than the reporting AP.

A mechanism is defined to retrieve probe response content for neighboring AP MLD(s) of the current AP MLD, through the current AP MLD.

### Initial association to the SMD-ME

(#3912) To perform SMD-level association, a non-AP MLD shall initiate association and authentication with the SMD-ME. The SMD Information element shall be included in the Authentication frame when authenticating with the SMD-ME. The SMD Information element shall be included in the (Re)Association Request and Response frames when performing initial association with the SMD-ME.

As part of performing authentication of a non-AP MLD with the SMD-ME, a single PMKSA shall be established between the non-AP MLD and the SMD-ME using the SMD identifier. The PMKSA includes an SMD-level PMK.

As part of initial association of a non-AP MLD with the SMD-ME, an SMD-level PTKSA is derived between the non-AP MLD and the SMD-ME using the SMD identifier.

### Target AP MLD selection recommendation(#188) (#2000)(#2002)(#2003)(#2004)(#2353)(#2005)

The current AP MLD may use the BSS transition management procedure (see 11.21.7 (BSS transition management) and 35.3.23 (BSS transition management for MLDs)) [TBD updates if required] to recommend one or more candidate target AP MLDs within the same SMD (or a different neighboring SMD) to the non-AP MLD, as shown in Figure 37-6 (Candidate selection for target AP MLDs). (TBD detailed information to be carried in the BSS transition management frames).

A non-AP MLD may send a BSS Transition Management Query frame (see 11.21.7.2 (BSS transition management query)) to its current AP MLD to request recommendation for candidate target AP MLDs. The current AP MLD shall respond with a BSS Transition Management Request frame. In addition, the current AP MLD may send an unsolicited BSS Transition Management Request frame (see 11.21.7.4 (BSS transition management response)) to the non-AP MLD to indicate its recommendation for candidate target AP MLDs for SMD BSS transition. TBD – detailed information to be carried.



**Figure 37-6— Candidate selection for target AP MLDs**

### SMD BSS transition preparation procedure

#### General

When a non-AP MLD uses SMD BSS transition to transition from its current AP MLD to a target AP MLD within an SMD, an SMD BSS transition preparation procedure as shown in Figure 37-7 (SMD BSS transition preparation and execution procedures) (#3004)shall be performed before performing the SMD BSS transition execution procedure that is described in 37.14.6 (SMD BSS transition execution procedure via the current AP MLD) and 37.14.7 (SMD BSS transition execution procedure via the target AP MLD) to minimize the time during which connectivity between the non-AP MLD and the DS is lost. The SMD BSS transition preparation procedure consists of (#2006)the following:

* Transfer of the context (see 37.14.8 (Context)) related to the non-AP MLD from its current AP MLD to the target AP MLD or the renegotiation of the context with the target AP MLD. (#3003)
* Setting up the link(s) with the target AP MLD as described in 37.14.5.2 (Target links preparation).



**Figure 37-7— SMD BSS transition preparation and execution procedures**

(#3922)(#2010) A non-AP MLD prepares one or more candidate target AP MLDs within an SMD by sending a separate ST preparation request for each candidate target AP MLD. If a SMD BSS transition preparation was successful with one or more candidate target AP MLDs, then the non-AP MLD shall attempt SMD BSS transition execution with only one of those target AP MLDs at a time. If the attempted SMD BSS transition execution fails, the non-AP MLD may attempt SMD BSS transition execution with another prepared AP MLD. [TBD on policy indication from the AP on multiple target AP MLDs preparation].

#### Target links preparation

(#2715) When a non-AP MLD performs the SMD BSS transition preparation procedure to prepare a target AP MLD, the non-AP MLD shall send an ST preparation request(#493)(#2007)(#2009)(#2715)(#3457)(#3892)(#3921) to its current AP MLD.

The ST preparation request shall include the following:

* (#493)A target AP MLD MAC address.
* The Per-STA Profile subelement for each affiliated non-AP STA that the non-AP MLD is requesting to set up with the target AP MLD in the Reconfiguration Multi-link element (see 35.3.6.4 (Link reconfiguration to the setup links)) carried in the ST preparation request.
* (#517)The Listen Interval field.
* A list of SCS IDs, if the non-AP MLD requests that the target AP MLD prioritizes resource reservation for certain SCS streams.

(#499) The non-AP MLD shall indicate in the ST preparation request whether the non-AP MLD requests part of the context not to be transferred as described in 37.14.8 (Context) (TBD actual signaling).After receiving the ST preparation request:

* If the target AP MLD accepts one or more links requested by the non-AP MLD in the ST preparation request:
  + The target AP MLD shall set up the accepted links at the target AP MLD according to the procedures defined in 35.3.6.4 (Link reconfiguration to the setup links).
  + If a separate MAC SAP per AP MLD is used as described in 37.9.1 (General), the target AP MLD shall keep the IEEE 802.1X Controlled Port blocked so that general data traffic cannot pass directly between the non-AP MLD and the target AP MLD.
  + The context for the non-AP MLD shall be transferred from the current AP MLD to the target AP MLD per 37.14.8 (Context).
  + (#3927)The current AP MLD shall transfer the SCS descriptors of all the currently established SCS of that non-AP MLD to the target AP MLD.
    - The target AP MLD may accept or reject an SCS stream (e.g. based on its resource availability) and indicate that to the current AP MLD.
  + (#3927)The current AP MLD shall transfer the MSCS Descriptor of the established MSCS with the non-AP MLD.
    - The target AP MLD may accept or reject the MSCS (e.g. based on its resource availability) in the ST preparation response and indicate that to the current AP MLD.
  + If the non-AP MLD requests that the target AP MLD prioritizes resource reservation for certain SCS streams by providing a list of SCS IDs, the AP MLD should consider applying the prioritization requested by the non-AP MLD amongst the SCS streams of the non-AP MLD when deciding whether to accept or reject an SCS.
* The current AP MLD shall send an ST preparation response(#493)(#2007)(#2009)(#2715) (#3457)(#3892)(#3921)to the non-AP MLD and the frame shall include the following:
  + The status (Accept/Reject) of each requested link setup at the target AP MLD.
  + If the status is Accept for at least one link, the frame shall include the following:
    - The AID assigned to the non-AP MLD by the target AP MLD
    - (#3927)A list of already established SCS streams that have been accepted by the target AP MLD. SCS streams that are not indicated as accepted are not setup at the target AP MLD
    - An indication of the status (accept or reject) of the transfer of MSCS context to the target AP MLD.
    - A list of SCS streams that have been requested by the non-AP MLD and accepted by the target AP MLD (if any).
* Group keys shall not be included in the ST preparation response.
* (#515) If an ST execution request from the non-AP MLD requesting SMD BSS transition to a target AP MLD is not received by the current AP MLD or the target AP MLD within the timeout(#515) value indicated in the SMD Information element, the following shall be deleted:
  + The setup links at the target AP MLD.
  + The transferred context at the target AP MLD.

TBD on whether/how the renegotiation of context is performed in these request/response frames.

When a non-AP MLD receives an ST preparation response from the current AP MLD indicating that the SMD BSS transition preparation was successfully completed with at least one setup link established at the target AP MLD:

* The Basic Multi-link element in the ST preparation response shall be processed by the non-AP MLD according to the procedures defined in 35.3.6.4 (Link reconfiguration to the setup links).
* (#514)The non-AP MLD shall be in power save mode for all the setup links with the target AP MLD as specified in 35.3.6.4 (Link reconfiguration to the setup links).
* (#515) The non-AP MLD may initiate the SMD BSS transition execution procedure by sending an ST execution request requesting SMD BSS transition to the same target AP MLD within the timeout value, either via the current AP MLD (see 37.14.6 (SMD BSS transition execution procedure via the current AP MLD)) or via the target AP MLD (see 37.14.7 (SMD BSS transition execution procedure via the target AP MLD)).
* (#534)The target AP MLD shall start at State 3 with the non-AP MLD (see 11.3 (STA authentication and association)).

NOTE 1 – The DS mapping update operation is not performed during the ST preparation procedure.

NOTE 2 – The SCS streams that were not indicated as accepted in the ST preparation response are not set up at the target AP MLD.

### SMD BSS transition execution procedure via the current AP MLD

When a non-AP MLD uses SMD BSS transition to transition from its current AP MLD to a target AP MLD within an SMD through its current AP MLD, the non-AP MLD shall send an (#511)(#2017)(#3260)(#3458)(#3929)ST execution request to its current AP MLD (#3893) (TBD if the non-AP MLD shall stop sending Data frames to its current AP MLD) The Per-STA Profile subelement in the Reconfiguration Multi-Link element shall not be present in the ST execution request.

(#515) If the current AP MLD receives an ST execution request within the timeout value(#515) described in 37.14.5.2 (Target links preparation) and the target AP MLD has been prepared for SMD BSS transition for the non-AP MLD as described in 37.14.5 (SMD BSS transition preparation procedure), then:

* The current AP MLD shall transfer any context that is required per 37.14.8 (Context) and has not already been transferred to the target AP MLD (if any).
* If a separate MAC SAP per AP MLD is used as described in 37.14.1(General), the target AP MLD may initiate the DS mapping update for the non-AP MLD and unblock the IEEE 802.1X Controlled Port for general data traffic to pass between the non-AP MLD and the target AP MLD.
* If the non-AP MLD had requested its current AP MLD not to transfer the next SN for existing DL block ack agreements of all TIDs (see 37.14.8 (Context)), the target AP MLD shall reset the SN to 0 for all the DL TIDs and the non-AP MLD shall initialize *WinStartB* to 0 for each DL TID with a block ack agreement, before DL traffic delivery from the target AP MLD to the non-AP MLD.
* If the non-AP MLD had requested its current AP MLD not to transfer the latest SN that has been passed up for existing UL block ack agreement of all TIDs (see 37.14.8 (Context)), the non-AP MLD shall reset the SN to 0 for all the UL TIDs and the target AP MLD shall initialize *WinStartB* to 0 for each UL TID with a block ack agreement, before UL traffic delivery from non-AP MLD to the target AP MLD.
* Once the DLDrainTime has expired or terminated as described in 37.14.9 (Downlink data transmission)), the target AP MLD considers the SMD BSS transition execution procedure complete (i.e., the non-AP MLD has fully transitioned to the target AP MLD).
* The current AP MLD shall send an (#511)(#2017)(#3260)(#3458)(#3929)ST execution response with the status value set to SUCCESS to the non-AP MLD after the transfer of the context is completed(#530) (if any). The current AP MLD shall include the following in the ST execution response:
  + (#522)(#3590)The DLDrainTime.
  + Group keys of the successfully setup links at the target AP MLD.
* (#532)The current AP MLD shall not pass any user data in its uplink reordering buffer to the next MAC process after the ST execution response is sent.
* (#154)If a separate MAC SAP per AP MLD is used as described in 37.14.8 (General) and the target AP MLD has not initiated the DS mapping update for the non-AP MLD, the target AP MLD shall initiate it for the non-AP MLD and unblock the IEEE 802.1X Controlled Port for general data traffic to pass between the non-AP MLD and the target AP MLD.
* The target AP MLD shall consider the SMD BSS transition execution procedure complete (i.e., the non-AP MLD has fully transitioned to the target AP MLD) if the non-AP MLD has indicated that the DLDrainTime has terminated.

NOTE 1 – The necessary contents of the ST execution response (e.g. security parameters) might have been provided by the target AP MLD to the current AP MLD during the SMD BSS transition preparation procedure.

NOTE 2 – The current AP MLD is expected to set the DLDrainTime to a value sufficiently large for the non-AP MLD to receive all the buffered data from the current AP MLD.

The non-AP MLD shall not transmit Class 3 frames to the target AP MLD until it has received the ST execution response with status value set to SUCCESS from the current AP MLD for at least one link.

(#534)If the DLDainTime has expired or was terminated by the non-AP MLD, the current AP MLD shall transition to State 3 with the non-AP MLD.

### SMD BSS transition execution procedure via the target AP MLD

When a non-AP MLD uses SMD BSS transition to transition from its current AP MLD to a target AP MLD within an SMD through the target AP MLD, the non-AP MLD shall send an ST execution request to the target AP MLD (#3893) (TBD if the non-AP MLD shall stop sending Data frames to its current AP MLD).

The Per-STA Profile subelement in the Reconfiguration Multi-Link element shall not be present in the ST execution request.

After the non-AP MLD transmits the ST execution request to the target AP MLD on one of the setup links with the target AP MLD, the non-AP STA corresponding to that link shall remain in awake state while the other non-AP STAs corresponding to the setup links remain in doze state as described in 35.3.6.4 (Link reconfiguration to the setup links).

The ST execution request and ST execution response for SMD BSS transition execution shall be transmitted on the same link between the non-AP MLD and the target AP MLD.

(#515) If the target AP MLD receives an ST execution request within the timeout value(#515) directly from the non-AP MLD described in 37.14.5.2 (Target links preparation) and the target AP MLD has been prepared for SMD BSS transition for that non-AP MLD, then:

* The target AP MLD shall transfer any context from the current AP MLD that is required per 37.14.8 (Context) and has not already been transferred to the target AP MLD (if any).
* If a separate MAC SAP per AP MLD is used as described in 37.9.1 (General), the target AP MLD may initiate the DS mapping update for the non-AP MLD and unblock the IEEE 802.1X Controlled Port for general data traffic to pass between the non-AP MLD and the target AP MLD.
* If the non-AP MLD had requested its current AP MLD not to transfer the next SN for existing DL block ack agreement of all TIDs (see 37.14.8 (Context)), the target AP MLD shall reset the SN to 0 for all the DL TIDs and the non-AP MLD shall initialize *WinStartB* to 0 for each DL TID with a block ack agreement, before DL traffic delivery from the target AP MLD to the non-AP MLD.
* If the non-AP MLD had requested its current AP MLD not to transfer the latest SN that has been passed up for existing UL block ack agreement of all TIDs (see 37.14.8 (Context)), the non-AP MLD shall reset the SN to 0 for all the UL TIDs and the target AP MLD shall initialize *WinStartB* to 0 for each UL TID with a block ack agreement, before UL traffic delivery from non-AP MLD to the target AP MLD.
* The target AP MLD shall send an ST execution response to the non-AP MLD after the transfer of the context is completed(#530) (if any). The target AP MLD shall include the following in the ST execution response:
  + (#522)(#3590)The DLDrainTime (TBD if the value of the DLDrainTime can be set to 0).
  + Group keys of the successfully setup links at the target AP MLD.
* (#532)The current AP MLD shall not pass any user data in its uplink reordering buffer to the next MAC process after the ST execution response is sent.
* (#534)If the current AP MLD shall transition to State 3 with the non-AP MLD.
* (#154)If a separate MAC SAP per AP MLD is used as described in 37.14.1 (General) and the target AP MLD has not initiated the DS mapping update for the non-AP MLD, the target AP MLD shall initiate it for the non-AP MLD and unblock the IEEE 802.1X Controlled Port for general data traffic to pass between the non-AP MLD and the target AP MLD.
* The target AP MLD shall consider the SMD BSS transition execution procedure complete (i.e., the non-AP MLD has fully transitioned to the target AP MLD) if the non-AP MLD has indicated that the DLDrainTime has terminated.

NOTE – The necessary contents of the ST execution response (e.g. security parameters) might have been provided by the target AP MLD to the current AP MLD during the SMD BSS transition preparation procedure.

The non-AP MLD shall not transmit Class 3 frames (other than the ST execution request to the target AP MLD) until it has received the ST execution response frame with the status value set to SUCCESS from the target AP MLD for at least one link.

### Context

The following context can be transferred to the target AP MLD with the exceptions described in the next paragraph:

* The block ack parameters and block ack timeout value for any block ack agreement on each TID.
* The next SN to be assigned for DL individually addressed Data frame of each TID.
* The latest duplicate receiver cache for each TID without block ack agreement.
* The latest SN that has been passed up to the DS for each TID with UL block ack agreement.
* The starting PN to be assigned for DL individually addressed frame by the target AP MLD.
* The initial value to be used by each replay counter of the target AP MLD for UL individually addressed frame.
* *WinStartO* of each existing DL block ack agreement.
* (#3927)Information of SCS Descriptor elements of established SCS streams with the current AP MLD.
* (#3927)Information of MSCS Descriptor element of established MSCS and the corresponding UP{tuple} with the current AP MLD.

NOTE 1 – The *WinStartO* of each existing DL block ack agreement ensures the target AP MLD does not exceed the reordering buffer window of the non-AP MLD.

NOTE 2 – TBD on the agreed buffer size with the target AP MLD.

A non-AP MLD may request the following part of the context not to be transferred from its current AP MLD to the target AP MLD and the current AP MLD shall accept such a request:

* The next SN for existing DL block ack agreements.
* The latest SN that has been passed up for existing UL block ack agreements.

### Downlink data transmission(#3459)

(#203)(#3757)If the current AP MLD sends an ST execution response that indicates accepted status to a non-AP MLD in response to an ST execution request sent by the non-AP MLD, the current AP MLD may transmit DL frames to the non-AP MLD for a duration of the DLDrainTime after the reception of the acknowledgement of the ST execution response, unless the DLDrainTime duration is terminated early according to rules in this section (see Figure 37-x3). After the expiration or early termination of the DLDrainTime, the current AP MLD should refrain from transmitting DL Data frames to the non-AP MLD.

(#203)NOTE 1 – The current AP MLD might transmit DL frames to the non-AP MLD in the interval between receiving the ST execution request and transmitting the ST execution response.

When the non-AP MLD receives an ST execution response to an ST execution request, (#3006)(#3367) the non-AP MLD may choose to receive individually addressed buffered Data frames from its current AP MLD (#520)for the DLDrainTime (upon reception of the ST execution response) if the DLDrainTime is greater than 0. During tthe DLDrainTime, the following applies:

* The non-AP MLD is not required to listen to any Beacon frames of the APs affiliated with the target AP MLD.
* (#524) The non-AP MLD shall send the indication of termination of the DLDrainTime to the target AP MLD if the non-AP MLD terminates the DLDrainTime before the DLDrainTime expires.
* The current AP MLD shall support signaling termination of DL data transmission to the non-AP MLD before the DLDrainTime expires (actual signaling TBD).
* The current AP MLD should send the indication of termination of DL data transmissions when any of the following is true:
  + The current AP MLD has no more pending DL data and is not expecting more DL data from the DS for (#535) DL transmissions during the DLDrainTime.
  + The current AP MLD has transferred the next SN for DL as part of context to the target AP MLD and the current AP MLD has used the last SN available to the current AP MLD for all TIDs during the DLDrainTime.
* If the non-AP MLD had requested the current AP MLD to not transfer DL SNs as described in 37.14.8 (Context) during the SMD BSS transition preparation procedure:
  + The target AP MLD shall not transmit DL Data frames to the non-AP MLD until receiving an indication of termination of the DLDrainTime from the non-AP MLD.
  + After receiving an indication of termination of the DLDrainTime from the non-AP MLD, the target AP MLD is allowed to transmit DL frames to the non-AP MLD subject to the Power states of the affiliated STAs of the non-AP MLD.
  + The target AP MLD shall reset the SNs to 0 for all DL TIDs before starting transmissions to the non-AP MLD.
* If the non-AP MLD had requested the current AP MLD to transfer DL SNs as described in 37.14.8 (Context) during the SMD BSS transition preparation procedure:
  + The target AP MLD is allowed to transmit DL frames to the non-AP MLD subject to the Power states of the affiliated STAs of the non-AP MLD. The target AP MLD shall start DL transmissions for all DL TIDs with the next SN values that were received during the context transfer.
  + The target AP MLD shall not transmit DL frames to the non-AP MLD with SN values above *WinStartO* + Buffer Size (of the current AP MLD) received during context transfer, unless the non-AP MLD has indicated termination of the DLDrainTime.
  + The target AP MLD shall not advance the DL buffer control for any TID unless the non-AP MLD has indicated termination of the DLDrainTime.
* When the DLDrainTime expires without any early termination, the non-AP MLD shall indicate to the target AP MLD using the same signaling as the early termination that the DLDrainTime has expired.
* The current AP MLD should provide information that allows the non-AP MLD to identify the completion of downlink retrieval for a partial set of traffic categories (TID or AC) if requested by the non-AP MLD in the execution request.

### Downlink data forwarding

As part of SMD BSS transition, the current AP MLD may forward DL data to the target AP MLD (when and how to initiate the forwarding of DL data is TBD).

**Text to be adopted ends here.**