**IEEE P802.15**

**Wireless Personal Area Networks**

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| Project | IEEE P802.15 Working Group for Wireless Personal Area Networks (WPANs) | |
| Title | **Proposed comment resolution for CID3109 from LB116** | |
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| Re: | 802.15.10 Consolidated Comment Entry Form, CID3109 | |
| Abstract | Provides a proposed resolution to CID3109 | |
| Purpose | To be used by the technical editor to apply the necessary changes to the draft to resolve CID3109 | |
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**Comment**

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| **Commenter** | **Page** | **Clause** | **Line** | **Comment** | **Proposed change** |
| Don Sturek | 62 | 6.1.2 | 8 | What value does a service of "Data Collection" provide? I would have imagined that a device cares about what type of data is being collected. I would think every application would be looking for a specific data collection site and not a generic one. What if my device finds several meshes each advertising "data collection". How would it choose? | Is "data collection" adctually a viable service stand alone? |

**Resolution: Revise**

As discussed, we need a way to uniquely identify a mesh, to ensure that a device joins the appropriate mesh, especially if multiple meshes provide the same services. The services available are specific to the mesh and known to the higher layer of the joining device.

* ***Insert the following sentence in the second paragraph of 5.1.1.1***

A device should become the mesh root of only one L2R mesh at a time.

* ***Modify the last sentence of the third paragraph of 5.1 as follows:***

Alternatively, the function of L2R mesh root may optionally be implemented in one or more devices other than the PAN coordinator.

* ***Insert the new parameter MeshId to the L2RLME-MESH-START.request primitive as follows:***

|  |  |  |  |
| --- | --- | --- | --- |
| **Name** | **Type** | **Valid range** | **Description** |
| MeshID | String | Any string | Identifies the mesh to start |

* ***Modify the second and third paragraphs of 5.1.1.1 as follows:***

Before starting an L2R mesh, the next higher layer of a device initiates the discovery procedure described in 5.1.2.1. The device may decide to become a mesh root if it did not discover an existing L2R mesh with the same mesh ID as the L2R mesh it is about to start. In this case, the device should associate with a PAN as described in IEEE Std 802.1.5.4 before starting the L2R mesh. Otherwise, the device should join the existing L2R mesh. In an SSPAN, the PAN coordinator is the only device allowed to start an L2R mesh, called SSPAN L2R (SL2R) mesh.

An L2R mesh is started when the L2R sublayer in the L2R router that is to become the mesh root, receives the L2RLME-MESH-START.request primitive from the next higher layer. The L2R sublayer then initializes a mesh table (MT) described in Table 1. The mesh root address is set to the device’s own address. The Depth is set to zero. The mesh sequence number (MSN) is set to an initial value between 0xf0 and 0xff as described in 5.2.1. The local neighbor table (NT) is initialized as an empty table. The value of My PQM is initialized to zero. Other parameters in the MT are set as indicated by the parameters in the primitive. The L2R sublayer adds a new L2R mesh descriptor to *l2rMeshDescriptorList* for the L2R mesh the device is starting. The attributes of the new L2R mesh descriptor that are not set from the values of the L2RLME-START-MESH.request primitives are set to default values. At the end of the procedure to start the L2R mesh, the next higher layer may set these attributes to different values. The L2R sublayer then starts the periodic transmission of enhanced beacons (EB) containing a topology construction information element (TC IE) with the frequency indicated by *l2rTcIeInterval*. If the L2R router has a direct connection to the PAN coordinator (PanC DC), it sets the PAN Coord Connection field in the Descriptor field of the TC IE to 1. The Descriptor field of the TC IE is illustrated in Figure 36. Upon successful completion of this start-up procedure, the L2R router becomes the mesh root and the L2R sublayer sends an L2RLME-MESH-START.confirm primitive, with a status SUCCESS, to the next higher layer. The TC IE format is described in 6.1.2, the L2RLME-MESH-START.request and L2RLME-MESH-START.confirm primitives are described in 7.1.1.4 and 7.1.1.5 respectively. The procedure is illustrated in Figure 3.

* ***Modify the l2rLsnSaRecordTimeout as follows:***

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Name** | **Type** | **Valid range** | **Description** | **Default** |
| *l2rLsnSaRecordTimeout* | Integer | 0x00-0xff | Duration after which a record of a LSN and SA is deleted in *l2rIntervalUnit*. | 0x03 |

* ***Add new field "Mesh ID" in the L2R-D IE formatted as:***

|  |  |  |
| --- | --- | --- |
| **Bits: 0-3** | **4-7** | **Octets: Variable** |
| Length | Reserved | ID |

The Length field indicates the length of the ID field in octets and is encoded as an unsigned integer.

The ID field is a string identifying the L2R mesh and is encoded in UTF-8.

* ***Modify the third paragraph of 6.1.1.1 as follows:***

When the Small Scale PAN field is set to 1, the PAN is an SSPAN. The Service List and the MeshID fields are omitted and the Number of Services field is set to 000. Otherwise, the Service List field is present.

* ***Insert a new “SSPAN” flag in Figure 36 with the following description:***

If the SSPAN field is set to 1, the Number of Services field is set to 000 and the Service List field is omitted. Otherwise, the Service List is present.

* ***Remove*** MeshRootAddress ***and*** MeshAddressMode ***from L2RLME-PAN-SCAN.request.***
* ***Insert a new parameter in the semantics of the L2RLME-PAN-SCAN.request defined as follows:***

|  |  |  |  |
| --- | --- | --- | --- |
| **Name** | **Type** | **Valid range** | **Description** |
| MeshID | String | Any string | Identifies the mesh to discover |

If the MeshID is a NULL string, the device should discover and return all the existing meshes in the ScanResultList.

* If MeshID is not a NULL string, the device returns a Status of MESH\_NOT\_FOUND if the mesh specified by MeshID was not found, with an empty ScanResultList. Otherwise, Status is set to SUCCESS, and the ScanResultList contains one entry corresponding to the mesh of interest. ***In Table 20, replace “NO\_DESIGNATED\_MESH” with “MESH\_NOT\_FOUND”***
* ***Modify the second paragraph of p.85 as follows:***

If the L2R mesh indicated in the request primitive is not found, a MESH\_NOT\_FOUND Status is returned. A MESH\_NOT\_FOUND Status means that the mesh identified by MeshID was not found, but does not necessarily mean that there is no other mesh.

* ***Insert a new parameter in the scan result in Table 21 as follows:***

|  |  |  |  |
| --- | --- | --- | --- |
| **Name** | **Type** | **Valid range** | **Description** |
| MeshID | String | Any string | Identifies the mesh from which the L2R-D IE was received. |

* Modify the discovery process in 5.1.2.1 based on the use of MeshID instead of MeshRootAdress as follows:

**5.1.2.1 Mesh discovery procedure**

A device wishing to join or to start an L2R mesh should perform a mesh discovery procedure summarized in Figure 5.



Figure 5—Message sequence chart to discover an L2R mesh

The next higher layer of a joining device invokes the L2RLME-PAN-SCAN.request primitive to request the broadcast of an enhanced beacon request (EBR) with an L2R Discovery (L2R-D) IE where the Content field is omitted. The L2R-D IE is defined in 6.1.1. The scan procedure is performed on the channels indicated in L2RLME-PAN-SCAN.request primitive. The next higher layer indicates which L2R mesh it wishes to discover with the parameter MeshID of the primitive. The L2R-D IE is sent in an EBR with the Destination PAN Identifier and the Destination Address fields set to 0xffff. The L2RLME-PAN-SCAN.request primitive is described in 7.1.1.1.

When an FFD that can act as a coordinator and that belongs to an L2R mesh receives the EBR with the L2R-D IE, it replies with an EB with an L2R-D IE containing the information pertaining to the L2R mesh to which belongs. If the Mesh ID field in the L2R-D IE contains a non-NULL string, a device should respond only if it belongs to an L2R mesh corresponding to the mesh ID indicated.

During the discovery phase of a joining device in an SL2R, if an L2R router already part of the SL2R receives an L2R-D IE where the mesh root address does not match the mesh root address recorded in its MT, it informs the higher layers of the irregular behavior with an L2RLME-NOTIFY.indication primitive where Notification is set to ROOT\_CONFLICT. If the mesh root address matches that of the MT, the L2R router discards the L2R-D IE.5.1.2.1.1 Discovery of a specific mesh

If MeshID is a non-NULL string, the L2R sublayer should attempt to discover the L2R mesh identified by Mesh ID.

If the *macAutoRequest* MAC PIB attribute is set to FALSE, the L2R sublayer is notified with an MLME-BEACON-NOTIFY.indication primitive upon receiving each EB frame. If the L2R-D IE is received from a device belonging to the mesh corresponding to MeshID, the L2RLME-PAN-SCAN.confirm is returned with a Status SUCCESS and with one entry in the ScanResultList corresponding to the mesh of interest, and the scan is interrupted. Otherwise, the L2R-D IE is discarded.

If the L2R mesh matching MeshID is not found at the end of the scan, the L2RLME-PAN-SCAN.confirm is returned with a Status MESH\_NOT\_FOUND and with an empty ScanResultList.

If *macAutoRequest* is set to TRUE, the L2R sublayer is notified of all the scan results with the MLME-SCAN.confirm primitive from the MAC layer at the end of the scan. If at least one received EB contains a L2R-D IE from a device belonging to the L2R mesh identified by MeshID, the L2RLME-PAN-SCAN.confirm is returned with a Status SUCCESS and with one entry in the ScanResultList corresponding to the mesh of interest. Otherwise, the L2RLME-PAN-SCAN.confirm is returned with a Status MESH\_NOT\_FOUND and with an empty ScanResultList.

5.1.2.1.2 Discovery of all existing meshes

If MeshID is a NULL string, the L2R sublayer discovers all the existing meshes in the device’s vicinity.

If the *macAutoRequest* MAC PIB attribute is set to FALSE, the L2R sublayer is notified with an MLME-BEACON-NOTIFY.indication primitive upon receiving each EB frame. In this case, the L2R sublayer issues an L2RLME-PAN-SCAN.indication primitive to the next higher layer after receiving each MLME-BEACON-NOTIFY.indication primitive from the MAC layer. After the scan is completed the L2R sublayer invokes the L2RLME-PAN-SCAN.confirm primitive with an empty ScanResultList.

If *macAutoRequest* is set to TRUE, the L2R sublayer is notified of all the scan results with the MLME-SCAN.confirm primitive from the MAC layer at the end of the scan. The L2R sublayer submits the L2RLME-PAN-SCAN.confirm primitive with the available coordinator candidates in the ScanResultList parameter. After the discovery, the device associates with a PAN containing at least one L2R mesh providing the desired service. The L2RLME-PAN-SCAN.confirm and the L2RLME-PAN-SCAN.indication are described in 7.1.1.2 and 7.1.1.3 respectively.

5.1.2.1.3 Discovery within a PAN

If a device is already associated with a PAN, it may also discover the L2R mesh(es) deployed within its PAN. In this case, the device sends the L2R-D IE on the channel of the current PAN within an EBR where the Destination PAN Identifier field is set to the current PAN ID and the Destination Address field is set to 0xffff to allow a response from all potential neighbors. This procedure is illustrated in Figure 6.

* ***Insert a new row in Table 21 after PanDescriptor as follows:***

|  |  |  |  |
| --- | --- | --- | --- |
| **Name** | **Type** | **Valid range** | **Description** |
| MeshID | String | Any string | Identifies the L2R mesh from which the L2R-D IE was received. |

* ***Insert a new row in Table 1 before Mesh address mode as follows:***

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Name** | **Type** | **Valid range** | **Description** | **Condition to record** |
| MeshID | String | Any string | Identifies the L2R mesh. | M |

* ***Move the following text from 5.1.2.1 to 5.1.2.5***

If short addressing is used in the discovered L2R mesh and the device does not have a short address assigned yet, but short address assignment is not managed by a higher layer, then the device should perform the short address assignment procedure described in 5.1.2.5. As the maximum *macResponseWaitTime* allowed between an Association Request frame and an Association Response frame at the MAC sublayer does not provide enough time to request a short address to the PAN coordinator over multiple hops, short address assignment is conducted after association to the PAN.

* ***Modify 5.1.2.2 as follows:***

**5.1.2.2 Procedure to join an L2R mesh**

A mesh root manages one L2R mesh at a time; therefore once the discovery procedure described in 5.1.2.1 is completed, the L2R mesh is identified by the mesh root address which is used the joining procedure and for all other L2R operations.

**5.1.2.2.1 Mesh selection by the L2R sublayer**

If *l2rMeshSelection* is TRUE, the mesh selection is handled by the L2R sublayer. When a device wishes to join a mesh, the next higher layer invokes the L2RLME-JOIN-MESH.request primitive to request the L2R sublayer to join a mesh with managed by one of the mesh roots in the MeshRootList indicated in the primitive. Upon reception of this primitive, the L2R sublayer initiates an enhanced active scan and broadcasts an EBR with a TC IE with an empty Content field. The TC IE is defined in 6.1.2. When an L2R router receives the TC IE, it immediately replies with an EB containing a TC IE then resumes its regular periodic TC IE transmissions. When the joining device receives the response TC IE, it computes its own depth and PQM as described in 5.2.1 and creates (regardless of the condition to record the parameters indicated in Table 1) or updates an MT entry related to the L2R mesh advertised in the TC IE. The device also creates (regardless of the condition to record the element indicated in Table 6) or updates a global NT entry for the neighbor transmitting the TC IE. If the device receives multiple TC IEs from different meshes within the same PAN, and if these TC IEs are not encrypted or are encrypted but can be decrypted, the device creates as many MTs as meshes. At the end of the scan, the L2R sublayer selects the L2R mesh providing the best PQM among the L2R meshes whose mesh root are found in the MeshRootList. If multiple meshes with different PQMs are available, the algorithm to select the L2R mesh is out of the scope of this document. The L2R sublayer adds a new L2R mesh descriptor to *l2rMeshDescriptorList* for the L2R mesh the device is joining. The attributes of the new L2R mesh descriptor that are not set from the content of the TC IE are set to default values. At the end of the procedure to join the L2R mesh, the next higher layer may set these attributes to different values. The device is allowed to join an L2R mesh if its depth does not exceed the value in the L2R Max Depth field of the TC IE. The device deletes unnecessary MTs, MT entries or MT entry elements and global NT entries or elements according to the condition to record each element as described in 5.2.1. The device then transmits its own TC IE. The L2R sublayer sends an L2RLME-JOIN-MESH.confirm primitive with a SUCCESS Status to the next higher layer. This procedure is illustrated in Figure 7.

If no TC IE is received during the scan or if no mesh satisfies the requirements set by the L2RLME-JOIN-MESH.request primitive, the L2R sublayer may reattempt to trigger an enhanced active scan to find the desired L2R mesh up to *l2rMaxScanRetry* times. The L2RLME-JOIN-MESH.request and L2RLME-JOIN-MESH.confirm primitives are described in 7.1.1.8 and 7.1.1.9 respectively.

If *l2rSwitchMesh* is TRUE, a device should hold a list of mesh root addresses managing an L2R mesh with the desired mesh ID. After joining an L2R mesh, if a device receives a TC IE that is not encrypted or that is encrypted but can be decrypted from one of the L2R meshes with the same meshID and with a better PQM, the L2R sublayer may optionally disconnect from the current L2R mesh and join the new one.

If the joining device is an L2R router, the L2R sublayer starts the periodic transmission of EBs with a TC IE at an interval of *l2rTcIeInterval*. The value of *l2rTcIeInterval* may differ from device to device depending on their sleeping or duty cycling patterns. These patterns are determined by the low energy mechanism used at the MAC sublayer defined in IEEE Std 802.15.4.

If the RA IE Required field of the TC IE Descriptor field is set to 1, L2R routers and end devices should transmit MP frames with a route announcement IE (RA IE) or a short route announcement IE (SRA IE) periodically at an interval of l2rRaIeInterval to establish DS routes.

**5.1.2.2.2 Mesh selection by the next higher layer**

If *l2rMeshSelection* is FALSE, when a device wishes to join a mesh, the next higher layer invokes the L2RLME-MESH-DISCOVERY.request primitive to request the L2R sublayer to discover the L2R meshes around the joining device. Upon reception of this primitive, the joining device initiates an enhanced active scan and broadcasts an EBR with a TC IE with an empty Content field. When an L2R router receives the TC IE, it replies with an EB containing a TC IE. When the joining device receives the response TC IE, computes its own depth and PQM as described in 5.2.1. The device creates (regardless of the condition to record the parameters indicated in Table 1) or updates an MT entry related to the L2R mesh advertised in the TC IE. The device also creates (regardless of the condition to record the parameters indicated in Table 6) or updates a global NT entry for the neighbor transmitting the TC IE. If the device receives multiple TC IEs from different meshes that can be decrypted or that are not encrypted, the device creates as many MTs as meshes. At the end of the scan, the L2R sublayer sends an L2RLME-MESH-DISCOVERY.confirm primitive with a SUCCESS Status to the next higher layer. The next higher layer selects the L2R mesh to join based on the information in the MT stored in the L2R sublayer and informs the L2R sublayer by issuing the L2RLME-MESH-SELECT.request primitive. The device deletes unnecessary MTs, MT entries or MT entry elements, and global NT entries or elements according to the condition to record each element as described in 5.2.1. The L2R sublayer adds a new L2R mesh descriptor to *l2rMeshDescriptorList* for the joining L2R mesh. The attributes of the new L2R mesh descriptor that are not set from the content of the TC IE are set to default values. At the end of the procedure to join the L2R mesh, the next higher layer may set these attributes to different values. The device then transmits its own TC IE. The L2R sublayer sends an L2RLME-MESH-SELECT.confirm primitive with a SUCCESS Status to the next higher layer. This procedure is illustrated in Figure 8.

If *l2rSwitchMesh* is TRUE, a device should hold a list of mesh root addresses managing an L2R mesh with the desired mesh ID. Whenever the device receives and is able to decrypt a TC IE from one of the L2R meshes other than the current mesh with the same mesh ID and with a better PQM, the L2R sublayer informs the next higher layer with the L2RLME-NOTIFY.indication primitive where the Notification is set to BETTER\_MESH\_DETECT. If the next higher layer decides whether or not to request the L2R to disconnect from the current L2R mesh and join to the new L2R mesh. The L2RLME-MESH-DISCOVERY.request, L2RLME-MESH-DISCOVERY.confirm, L2RLME-MESHSELECT.request and L2RLME-MESH-SELECT.confirm are described in 7.1.1.10, 7.1.1.11, 7.1.1.12 and 7.1.1.13 respectively.

If the joining device is an L2R router, the L2R sublayer starts the periodic transmission of EBs with a TC IE at an interval of *l2rTcIeInterval*. The value of *l2rTcIeInterval* may differ from device to device depending on their sleeping or duty cycling patterns.

If the RA IE Required field of the TC IE Descriptor field is set to 1, L2R routers and end devices transmit MP frames with an RA IE or an SRA IE periodically at an interval of *l2rRaIeInterval*.

* ***Modify the 2nd and 3rd paragraph of 5.1.2.3 as follows:***

The device may rediscover an L2R mesh according to the procedure described in 5.1.2.1.1 or 5.1.2.1.2 and associate with the appropriate PAN.

If the device wishes to remain within the same PAN, it may try to rediscover the L2R meshes within its PAN according to the procedure described in 5.1.2.1.3.

Then the device attempts to join the L2R mesh according to the procedure illustrated in Figure 7 if *l2rMeshSelection* is TRUE, or according to the procedure illustrated in Figure 8 if *l2rMeshSelection* is FALSE.

* ***Insert a new row in Table 52 before meshAddressMode as follows:***

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Name** | **Type** | **Valid range** | **Description** | **Default** |
| *meshID* | String | Any string | Identifies the L2R mesh. | \_ |

* ***Modify the second list item of 5.2.1 as follows:***

— “M” indicates that recording the parameter depends on *l2rMeshRecordMode* L2IB attribute. If *l2rMeshRecordMode* is set to JOINED\_MESH, the parameter is recorded only when the device is a part of the mesh. If *l2rMeshRecordMode* is set to SAME\_MESH\_ID, the parameter is additionally recorded in MTs of L2R meshes with the same mesh ID as one of the L2R meshes the device has joined. If *l2rMeshRecordMode* is set to ALL\_MESH, the parameter is recorded for all existing L2R meshes. If *l2rMeshRecordMode* is set to ALL\_MESH, recording the local neighbor table (NT) depends on *l2rNeighborRecordMode*. If *l2rNeighborRecordMode* is set to JOINED\_MESH, the local NT is recorded only in the MT of the L2R mesh the device has joined. If *l2rNeighborRecordMode* is set to SAME\_MESH\_ID, the local NT is also recorded in the MT of the L2R mesh(es) providing with the same mesh ID as that of the L2R mesh(es) the device as joined. If *l2rNeighborRecordMode* is set to ALL\_NEIGHBORS, the local NT is recorded in all MTs.

* ***Modify the third item of the list on p.32 as follows:***

— Additionally, if *l2rMeshRecordMode* is set to SAME\_MESH\_ID, if the content of the Link Quality Metric ID and the Mesh Root Address fields match the corresponding parameters in the MT of an L2R mesh has the same mesh ID as an L2R mesh the device has already joined, the content of the Value field is also recorded as the incoming metric of the neighbor in the global NT.

* ***Delete ServiceList from L2RLME-JOIN-MESH.request***
* ***Insert a new parameter MeshRootList to L2RLME-JOIN-MESH.request as follows:***

|  |  |  |  |
| --- | --- | --- | --- |
| **Name** | **Type** | **Valid range** | **Description** |
| MeshRootList | List of (address mode, address) tuples | - | List of (address mode, address) of mesh roots whose L2R mesh the device may join |

* ***Delete MeshAddressMode and MeshRootAddress from L2RLME-JOIN-MESH.request***
* ***Insert a new attribute in Table 51 as follows***

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Name** | **Type** | **Valid range** | **Description** | **Default** |
| *l2rSwitchMesh* | Boolean | TRUE or FALSE | Indicates whether a device may switch between L2R meshes with the same mesh ID | FALSE |

* ***Replace SAME\_SERVICE\_ID with SAME\_MESH\_ID in l2rMeshRecordMode in Table 51***
* ***Replace SAME\_SERVICE with SAME\_MESH\_ID in l2rNeighborRecordMode in Table 51***
* ***Delete Service List from the L2R-D IE in Figure 30 and in 6.1.1.2***
* ***Delete Service List from the TC IE in Figure 35 and in 6.1.2.5***
* ***Delete Service List from the RA IE in Figure 57 and in 6.2.1.2***
* ***Delete “Number of Services from the L2R-D IE, the TC IE and the RA IE***
* ***Modify the definition of mesh root as follows:***

**mesh root**: Device in the layer 2 routing mesh with the depth zero that manages the mesh.

* ***Insert the following new acronym in 3.2***

**ID** identifier

* ***Insert the following text after the first sentence of 4.3***

The L2R mesh is identified by a mesh identifier (ID). The services available in an L2R mesh are tied to the mesh ID.

* ***Replace “L2R mesh” with “L2rMeshId1” in Figure 1***
* ***Modify the second paragraph of 4.3 as follows:***

An example of the basic topology of an L2R mesh is illustrated in Figure 1, where the L2R mesh L2rMeshId1 enables access to an internet connection service.

* ***Modify the last sentence of p.8 as follows:***

Figure 2 illustrates an example of multiple L2R meshes deployed over a PAN providing two services: internet and data collection. L2rMeshId1 managed by mesh root 1 provides both services while L2rMeshId2 managed by mesh root 2 only provides the data collection service.

* ***Replace “L2R mesh” with “L2rMeshId” in Figure 2***
* ***Modify the second paragraph of 4.4 as follows***

An L2R mesh enables access to one or more service tied to their mesh ID. A device that can provide access to a particular service may optionally become a mesh root and advertises the service(s) that it makes available.

* ***Delete Service list from Table 1, delete Table 2***
* ***Insert the following text at the end of 6.2.2.2***

The Sub-Service field is provided for an implementer wishing to define sub-services under the same service (e.g.: Temperature data collection, air quality data collection etc. under the data collection service).

The definition of service and sub-service identifiers is out of the scope of this document.

* ***Delete ServiceList from the scan result in Table 21, delete Table 22***
* ***Delete ServiceList from L2RLME-MESH-START.request and from Table 24***