**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 CID 2153, 2159, 2161 from LB113** |
| Date Submitted | 9 February 2016 |
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| Re: | 802.15.10 Consolidated Comment Entry Form, CID 2153, 2159, 2161 |
| Abstract | Provides a proposed resolution to CID 2153, 2159, 2161 |
| Purpose | To be used by the technical editor to apply the necessary changes to the draft to resolve CID 2153, 2159, 2161 |
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**Comments**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **CID** | **Commenter** | **Page** | **Clause** | **Line** | **Comment** | **Proposed change** |
| 2153 | Jussi Haapola | 37 | 5.2.7 | 22 - 24 | Why is the hop count the only applicable routing metric in L2R P2P route establishment? | If using only hop count as a metric is intentional, it would be convenient to state a reason for such limitation. |
| 2159 | Verotiana Rabarijaona | 37 | 5.2.7 | 20 | "it does not propagate the P2P-RQ IE but replies with a P2P-RP IE." is not really accurateIn storing mode, an intermediate hop only knows the next hop to the destination but not the entire path. Besides, the Hop Count is not recorded. In non-storing mode, only the destination knows the entire path. Unless there is an option to record the paths in intermediate nodes.In each case what kind of information should the Intermediate hop include in the P2P-RP IE? | Double check and revise the behavior of the intermediate hops for each mode |
| 2161 | Verotiana Rabarijaona | 37 | 5.2.7 | 22 | "the hop count therein" There is not "Hop Count field in the P2P-RP IE" | Add a Hop Count field or revise this description |

**Resolution: Revise**

The hop count was the only metric considered because so far the P2P destinations were recorded in the List of reachable destinations in the local NT. The PQMs recorded in the local NT are the PQMs of each neighbor w.r.t the mesh root. Therefore there was no way in the current table to store a PQM for a P2P destination.

The current NT format also poses the issue that only P2P destinations are recorded. The PSN and the hop count are not recorded. Therefore when an intermediate hop wants to reply to a P2P-RQ IE, it has no way to set the Hop Count field of the P2P-RP IE since it wasn’t stored in the first place. In this same way, a device should compare the Hop Count and the PSN between multiple P2P-RQ IEs before selecting a next hop. However, the comparison is not possible unless the first Hop Count is saved somewhere.

In order to address these issues, we need a different way to store P2P routes with more complete information (PSN and Hop Count)

Adding a “P2P” flag to the L2R Routing IE would indicate to a forwarding device whether it should look for a next in the P2P route info or in the regular local NT and list of reachable destinations. A similar flag is needed in L2R-DATA.request.

In doing so, we can also address the concern in CID 2153. Since P2P routes would be stored independently from the List of reachable destinations, the metric is not bound to the hop count anymore. A P2P route record would contain the P2P destination, the PSN and a P2P PQM.

The Hop Count field in the P2P-RQ IE and the P2P-RP IE would be replaced with a PQM field.

* ***Insert the following new row to table 1***

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Name** | **Type** | **Valid Range** | **Description** | **Condition to record** |
| P2P path list | List of P2P paths | List of the elements of a P2P path defined in Table xx in storing mode, or Table yy in non-storing mode | List of P2P paths available through the current neighbor. Omitted if on-demand P2P routing is disabled. | P |

* ***Insert the following tables after table 3***

Table xx – Elements of a P2P path in storing mode

|  |  |  |  |
| --- | --- | --- | --- |
| **Name** | **Type** | **Valid Range** | **Description** |
| Destination address | Address | EUI-64 or short address | Address of the P2P destination |
| PSN | Integer | 0x00-0xff | Sequence number of the latest P2P-RQ IE or P2P-RP IE from the destination device |
| Next hop | Address | EUI-64 or short address | Address of the neighbor from which the P2P-RQ IE or P2P-RP IE has been received |
| P2P PQM value | Integer | 0x00 – 0x0f | PQM between the current device and the destination |

Table yy – Elements of a P2P path in non-storing mode

|  |  |  |  |
| --- | --- | --- | --- |
| **Name** | **Type** | **Valid Range** | **Description** |
| Destination address | Address | EUI-64 or short address | Address of the P2P destination |
| PSN | Integer | 0x00-0xff | Sequence number of the latest P2P-RQ IE or P2P-RP IE from the destination device |
| Intermediate address list | List of addresses | List of EUI-64 or short address | List of addresses between the current device and the destination |
| P2P PQM value | Integer | 0x00 – 0x0f | PQM between the current device and the destination |

* ***Insert the following text after the third item in the dashed list on p.23***

- “P” indicates that the parameter is recorded when on-demand P2P routing is in use in the L2R mesh.

* ***Insert a new flag “P2P” in the L2R Routing IE Descriptor, with the following description:***

If P2P is set to 1, the current data frame is a P2P data frame and the forwarding device should search the P2P path lists in the MT to find a next hop. Otherwise, the current data frame should be sent US or DS. The forwarding device should search among its neighbors and/or their list of reachable destinations to find a next hop.

* ***Insert a “P2p” new flag in L2R-DATA.request with the following description:***

|  |  |  |  |
| --- | --- | --- | --- |
| **Name** | **Type** | **Valid Range** | **Description** |
| P2p | Boolean | TRUE, FALSE | Indicates whether the current data frame is a P2P data frame |

* ***Insert the following text before the last sentence of the first paragraph of clause 5.2***

If on-demand P2P routing is enabled, each device generates a P2P sequence number (PSN), incremented before the transmission of a P2P-RQ IE or a P2P-RP IE as the original source device.

* ***Modify the last sentence of the first paragraph of clause 5.2 as follows:***

The LSN, the SRA SN and the PSN (if used) are permitted to roll over.

* ***Modify clause 5.2.7 as follows:***

A P2P route is a path between devices established by exchanging a P2P-Request IE (P2P-RQ IE) and a P2P-Reply IE (P2P-RP IE). The P2P route discovery of a device is allowed to be used when on-demand P2P discovery is enabled by the mesh root. On-demand P2P discovery may be prohibited when most traffic occurs between a device and a mesh root, or in large scale networks in order to avoid flooding the L2R mesh with the P2P related IEs. If a device wants to reach another device that is not one of its neighbors or is not recorded in the list of reachable destinations of at least one of its neighbors, and if on-demand P2P route discovery is allowed in the L2R mesh, the device attempts to discover a path to the desired destination by transmitting a P2P-RQ IE addressed accordingly and with the TTL field initialized to *l2rDefaultTTL*. The Value field in the PQM field is set to 0. The Request Intermediate Response may either be set to 0 or 1 in storing mode but should be set to 0 in non-storing mode as in this case intermediate hops to not keep path records.

**5.2.7.1 Storing mode**

When a device receives a P2P-RQ IE, it stores the information retrieved from the P2P-RQ IE into a new entry in the P2P path list in the MT. The address of the neighbor from which the P2P-RQ IE is received is recorded in the Next hop of the P2P path. The device calculates or measures the LQM between itself and the neighbor from the previous hop and adds the LQM to the PQM value found in the IE. The device then stores the result into the PQM Value of the P2P path entry.

If there is an existing path to the source of the P2P-RQ IE, the device compares the P2P sequence number (PSN) currently recorded with the PSN of the P2P-RQ IE newly received. If the PSN of the new P2P-RQ IE is smaller than the recorded PSN, the latest P2P-RQ IE is discarded. If the PSN of new P2P-RQ IE is greater than the recorded PSN, all elements of the P2P path are updated to the information from the latest P2P-RQ IE. If the PSN in the new P2P-RQ IE is equal to the recorded PSN, the device compares the PQM Value field of the two P2P-RQ IEs. If the PQM value of the latest P2P-RQ IE is equal to or greater than that of the previous P2P-RQ IE, the latest P2P-RQ IE is discarded. Otherwise, the device replaces the value of Next hop with the address of neighbor from which the P2P-RQ IE has been received, and replaces the PQM value with the PQM provided by the current neighbor.

If the device receiving the P2P-RQ IE is not the desired destination, it decrements the value in the TTL field, sets the value of the PQM Value field to the value of the PQM previously computed for this path and forwards the P2P-RQ IE.

If the TTL reaches zero, the P2P-RQ IE is discarded.

If the device is the desired destination, it replies with a P2P-RP IE. The TTL field of the P2P-RP IE is set to *(l2rDefaultTTL - ttl),* where *ttl* isthe value of the TTL in the received P2P-RQ IE. The PQM Value is set 0. The PSN is set to the device’s current PSN. The P2P-RP IE is forwarded to the neighbor whose address is recorded in Next hop of the current P2P path entry.

When a device receives a P2P-RP IE, it processes the information in the IE in the same way as it processes the information in a P2P-RQ IE. A P2P path entry is created or updated accordingly.

If the address of the device receiving the P2P-RP IE does not match the address found in the Route Source Address, it forwards the P2P-RP IE through the Next hop recorded for the corresponding P2P path entry with the Destination address matching the address in the Route Source Address.

If the Request Intermediate Response field in the P2P-RQ IE is set to 1 and if an intermediate device has a path to the requested destination, it does not propagate the P2P-RQ IE but replies with a P2P-RP IE where the PSN and the PQM Value fields are set to the PSN and PQM value recorded for the path of interest in the P2P path list.

The original source device may start routing data frames as soon as it receives a P2P-RP IE. When a device receives a new P2P-RP IE, it the PQM value therein is lower than the PQM value provided by the current next hop, the P2P path is updated with the information of the new P2P-RP IE. Otherwise the P2P-RP IE is discarded.

**5.2.7.2. Non-storing mode**

When a device receives a P2P-RQ IE, if the device is not the desired destination, it increments the value in the Number of Intermediate Addresses field and appends its own address to the Intermediate Address List field. The device calculates or measures the LQM between itself and the neighbor from the previous hop and adds the LQM to the PQM value found in the IE. The device decrements the TTL and forwards the P2P-RQ IE. The device keeps a record of the PSN and the Route Source Address of the P2P-RQ IE. Subsequent P2P-RQ IEs with the same Route Source Address and a PSN equal to or smaller than the recorded PSN are discarded. The PSN and Route Source Address records are purged periodically.

If the device is the desired destination, it creates a new entry in the P2P path list of the MT where the Destination address is set to the address retrieved from the Route Source Address field of the P2P-RQ IE, the PSN, the PQM value are set to the value retrieved from the corresponding fields in the IE. The Intermediate address list is set to the inverted list of addresses found in the Intermediate Address List field. The device generates a P2P-RP IE and copies the Intermediate Address List field of the P2P-RQ IE into the corresponding field in the P2P-RP IE and sets the PSN to its own current PSN. The PQM Value is set to the value of the PQM recorded for the P2P path of interest. The P2P-RP IE is then carried to the source through the path indicated.

When the P2P-RP IE reaches the device with the address found in the Route Source Address field, the device creates a new entry in the P2P path list of the MT where the Destination address is set to the address retrieved from the Route Destination Address field of the P2P-RP IE, the PSN, the PQM value and the Intermediate Address List are set to the values retrieved from the corresponding fields in the IE.

* ***Modify Figure 44 and 46 as follows:***

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Octets: 1** | **2/8** | **2/8** | **1** | **Variable** | **1** | **0/1** | **0/Variable** |
| Descriptor | Route Destination Address | Route Source Address | PSN | PQM | TTL | Number of Intermediate Addresses | Intermediate Address List |

Figure 44

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Octets: 2/8** | **2/8** | **2/8** | **1** | **Variable** | **1** | **0/1** | **0/Variable** |
| Mesh Root Address | Route Destination Address | Route Source Address | PSN | PQM | TTL | Number of Intermediate Addresses | Intermediate Address List |

Figure 46

* ***Replace 6.1.5.5 with:***

**6.1.5.5 PQM**

The PQM field is formatted as illustrated in Figure zz.

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

Figure zz: PQM field format in the P2P-RQ and P2P-RP IE

The PQM ID field identifies the metric in use. This field is set to one of the values listed in Table 12 and is encoded as an unsigned integer.

The Value field, indicates the value of the metric of the path between the source of a P2P-RQ or P2P-RP IE and the current device. The length of the Value field depends on the type of the PQM.

* ***Insert the following new subclause 6.1.6.5 and 6.1.6.6***

**6.1.6.5 PQM field**

The PQM field is defined as described in 6.1.5.5.

**6.1.6.6 TTL field**

The TTL field indicates the remaining number of times the current P2P-RQ IE is allowed to be forwarded and is encoded as an unsigned integer.

* ***Modify 5.4.1.1 as follows:***

If the L2R mesh is in non-storing mode, devices, with the exception of the mesh root, store only information about their neighbors but do not store routing information received with RA, SRAIEs. If on-demand P2P routing is enabled, only the end to end source and destination of a P2P path store routing information. In either case, source routing should be used for DS and P2P routing. When source routing is used, the path to the destination is included into the Intermediate Addresses List in the L2R Routing IE or the Short L2R Routing IE and data frames are routed on the path indicated. An L2R mesh working in non-storing mode is indicated by setting the Storing Mode field of the Descriptor field in the TC IE to 0.

* ***Modify the first paragraph on p.42 as follows:***

If on-demand P2P routing is allowed in the L2R mesh, a source device may establish a route to the destination through the procedure described in 5.2.7.1. If the route is established, the next hop is selected according to the newly found path. If a path has already been established, i.e. there is a path to the desired destination in the P2P path list, the transmitting device forwards the frame to the device with the address recorded in Next hop in the corresponding P2P path entry. If there is no existing route recorded and no route is found within *l2rP2pRouteDiscoveryTimeout*, the frame is forwarded US until the first common ancestor between the source and the destination. If the P2P field of the L2R Routing IE in a data frame is set to 0, the frame should be routed with a combination of US and DS routing. In the latter two cases, the next hop is selected according to the algorithm illustrated in Figure 20.