**IEEE P802.15**

**Wireless Personal Area Networks**

|  |  |
| --- | --- |
| Project | IEEE P802.15 Working Group for Wireless Personal Area Networks (WPANs) |
| Title | Draft text of one-to-many and many-to-many peering and de-peering procedure |
| Date Submitted | January 2016 |
| Source | Huan-Bang Li (NICT)Marco Hernandez (NICT)Igor Dotlić (NICT)Ryu Miura (NICT) |  |
| Re: | TG8 draft text for peering and de-peering procedue for 802.15.8 |
| Abstract | This is the work in progress text of the MAC component for IEEE 802.15.8 group for PAC. |
| Purpose | This document provides the details of draft text to IEEE 802.15.8 |
| Notice | This document does not represent the agreed views of the IEEE 802.15 Working Group or IEEE 802.15.8 Task Group. It represents only the views of the participants listed in the “Source(s)” field above. It is offered as a basis for discussion and is not binding on the contributing individual(s) or organization(s). The material in this document is subject to change in form and content after further study. The contributor(s) reserve(s) the right to add, amend or withdraw material contained herein. |
| Release | The contributor acknowledges and accepts that this contribution becomes the property of IEEE and may be made publicly available by P802.15. |
| Patent Policy | The contributor is familiar with the IEEE-SA Patent Policy and Procedures:<http://standards.ieee.org/guides/bylaws/sect6-7.html#6> and<http://standards.ieee.org/guides/opman/sect6.html#6.3>.Further information is located at <http://standards.ieee.org/board/pat/pat-material.html> and<http://standards.ieee.org/board/pat>. |

# [This is draft text for subclause of Peering related command for TG8]

Black = existing text

Blue = proposed text

# MAC Layer

1. 1. Peering

MAC shall support the following procedures:

* Peering
* Re-peering
* De-peering

Peering is the procedure to establish a link between a pair of PDs or links among multiple PDs discovered during the discovery procedure.

Re-peering is the procedure to re-establish a link between a pair of PDs or links among multiple PDs which peered previously. In the re-peering procedure, peering may be simplified.

De-peering is the procedure to disconnect the link established by peering.

* + 1. Peering procedure

Peering procedure may include the following:

* Optional: Authentication & Authorization (full validation)
* Communication link parameters **are TBD**, such as link ID, device capability (i.e. number of antennas, MIMO), QoS, channel band, transmission power, round trip delay, etc.
* Establish the link.

The peering procedure is initiated by sending a peering request message including requested peering information. Responder may send a peering response message to requestor for indicating if the peering request is accepted or not. The response message may include peering information if the request is accepted.

* + - 1. One-to-one peering procedure

One-to-one peering occurs between a pair of PDs. One PD is the initiator PD (I-PD) and another PD is the responder PD (R-PD). The result of one-to-one peering is that the I-PD and the R-PD are peered each other. As illustrated in Figure 26, a one-to-one Peering procedure may contain the following steps.

1. A PD’s Higher Layer (i.e. PD1’s Higher Layer) triggers Peering procedure with a Peering Request to its MAC (i.e. PD1’s MAC).
2. The MAC receiving the Higher Layer’s Peering Request (i.e. PD1’s MAC) sends the Peering Request message to the targeted PD’s MAC (i.e. PD2’s MAC).
3. The targeted PD’s MAC (i.e. PD2’s MAC) receives the Peering Request message and sends ACK/NACK message to the PD requesting peering (i.e. PD1’s MAC*).*
4. The targeted PD’s MAC (i.e. PD2’s MAC), sends the detected Peering Request message to its Higher Layer (i.e. PD2’s Higher Layer).
5. The Higher Layer receiving the Peering Request (i.e. PD2’s Higher Layer) conducts Authentication and Authorization if required.
6. The Higher Layer receiving the Peering Request (i.e. PD2’s Higher Layer) decides either to accept the Peering Request or not and indicates it to the MAC (i.e. PD2’s MAC) accordingly.
7. The targeted PD’s MAC (i.e. PD2’s MAC) sends Peering Response message to the PD requesting peering (i.e. PD1’s MAC) as directed by the Higher Layer.
8. The PD’MAC receiving the Peering Response message (i.e. PD1’s MAC) sends ACK/NACK message to the target PD (i.e. PD2’s MAC).
9. The PD’MAC receiving the Peering Response message (i.e. PD1’s MAC) sends the Peering Response message to its Higher Layer (i.e. PD1’s Higher Layer).
10. A link between PD1 and Pd2 is established is the peering request is accepted.



Figure 26—One-to-one peering procedure message sequence chart

* + - 1. One-to-many peering procedure

One-to-many peering occurs between an initiator PD (I-PD) and a number of responder PDs (R-PDs). The result of one-to-many peering is that the I-PD is peered with each one of the R-PDs. One-to-many peering doesn’t deal with peering between R-PDs. As illustrated in Figure 26\_x, a one-to-many peering procedure may contain the following steps.

1. An I-PD’s higher layer triggers one-to-many peering procedure with a Peering Request to its MAC layer (i.e. I-PD’s MAC layer).
2. I-PD’s MAC receiving the Higher Layer’s Peering Request sends the Peering Request message to a number of targeted R-PDs’ MAC layers (i.e. the MAC layers of #*i* R-PD, #*j* R-PD, and #*k* R-PD).
3. Each of the targeted R-PDs’ MAC layers (i.e. the MAC layers of #*i* R-PD, #*j* R-PD, and #*k* R-PD), respectively, receives the Peering Request message, then takes random backoff and sends ACK/NACK message to the I-PD’s MAC layer*.*
4. Each of the targeted R-PDs’ MAC layers (i.e. the MAC layers of #*i* R-PD, #*j* R-PD, and #*k* R-PD), respectively, sends the detected Peering Request message to its Higher Layer.
5. I-PD’s MAC broadcasts a group ACK with a list of the peered R-PDs’ IDs. Upon receiving the group ACK, a R-PD that sent an ACK/NACK at step c) but is not appear in the list of peered R-PDs re-sends an ACK/NACK as of step c).
6. Step e) is repeated up to three times before proceeding to next step. However, the repeat is omitted if I-PD has received ACK/NACK from all targeted R-PDs.
7. Each of the higher layers receiving the Peering Request (i.e. the higher layers of #*i* R-PD, #*j* R-PD, and #*k* R-PD), respectively, conducts Authentication and Authorization if required.
8. Each of the higher layers receiving the Peering Request (i.e. the higher layers of #*i* R-PD, #*j* R-PD, and #*k* R-PD), respectively, decides either to accept the Peering Request or not and indicates it to its MAC layer accordingly.
9. Each of the targeted R-PDs’ MAC layers (i.e. the MAC layers of #*i* R-PD, #*j* R-PD, and #*k* R-PD), respectively, sends Peering Response message to the I-PD’s MAC layer as directed by its higher layer.
10. The I-PD’s MAC layer receives the Peering Response message and sends ACK/NACK message to the target R-PDs (i.e. the MAC layers of #*i* R-PD, #*j* R-PD, and #*k* R-PD).
11. The I-PD’s MAC layer sends the Peering Response message to its higher layer.
12. Links between I-PD and each of the targeted R-PDs (i.e., #*i* R-PD, #*j* R-PD, and #*k* R-PD) are respectively established.
13. If anyone of the targeted R-PDs’ MAC layer, after sending Peering Response message, does not receive ACK/NACK message from the I-PD, it repeats step g).





**Figure 26\_x—One-to-many peering procedure message sequence chart**

* + - 1. Many-to-many peering procedure

Many-to-many peering occurs among an initiator PD (I-PD) and a number of responder PDs (R-PDs). The result of many-to-many peering is that any two PDs including the I-PD and all R-PDs get peered each other. As illustrated in Figure 26\_y, a number of N PDs are used to show many-to-many peering procedure which may contain the following steps.

1. The I-PD performs one-to-(N-1) procedure as of subclause 5.5.1.2.
2. Suppose that I-PD is peered with N1 (N1≤N-1) PDs at step a), it multicasts a list of these N1 peered PDs to the N1 peered PDs.
3. Set *i*=1.
4. Next PD in the peered PDs’ list performs one-to-N*i* peering as of subclause 5.5.1.2.
5. Suppose that this PD is peered with Ni+1 (Ni+1≤N1) PDs at step d), it multicasts a list of these Ni+1 peered PDs to the Ni+1 peered PDs. The updated peered PDs’ list is in the same sequence order as that of step b).
6. Set *i* = *i*+1 and go to step d), if the current PD is not the final PD in the peered PDs’ list. Otherwise, conclude the many-to-many procedure.



**Figure 26\_y—Many-to-many peering procedure chart**

* + 1. De-peering procedure

De-peering procedure may include the following:

* Disconnect the link
* Release the link resources if needed.

De-peering procedure starts with a de-peering request, which is replied by a de-peering response message. De-peering response may be optional

* + - 1. One-to-one de-peering procedure

As illustrated in Figure 28, a one-to-one De-peering procedure may contain the following steps.

1. A PD’s Higher Layer (i.e. PD1’s Higher Layer) triggers De-peering procedure with a De-peering Request to its MAC (i.e. PD1’s MAC).
2. The MAC receiving the Higher Layer’s De-peering Request (i.e. PD1’s MAC) sends the De-peering Request message to the targeted PD’s MAC (i.e. PD2’s MAC).
3. The targeted PD’s MAC (i.e. PD2’s MAC) receives the De-peering Request message and sends ACK/NACK message to the PD requesting de-peering (i.e. PD1’s MAC*).*
4. The targeted PD’s MAC (i.e. PD2’s MAC), sends the received De-peering Request message to its Higher Layer (i.e. PD2’s Higher Layer).
5. *Optional*: the Higher Layer receiving the De-peering Request (i.e. PD2’s Higher Layer) decides either to accept the De-peering Request or not and indicates it to the MAC (i.e. PD2’s MAC) accordingly.
6. *Optional*: the targeted PD’s MAC (i.e. PD2’s MAC) sends De-peering Response message to the PD requesting de-peering (i.e. PD1’s MAC) as directed by the Higher Layer.
7. *Optional*: the PD’MAC receiving the De-peering Response message (i.e. PD1’s MAC) sends ACK/NACK message to the target PD (i.e. PD2’s MAC).
8. *Optional*: the PD’MAC receiving the De-peering Response message (i.e. PD1’s MAC) sends the De-peering Response message to its Higher Layer (i.e. PD1’s Higher Layer).
9. *Optional:* the link between PD1 and Pd2 is disconnected.



Figure 28—One-to-one de-peering procedure message sequence chart

* + - 1. One-to-many De-peering procedure

One-to-many De-peering means that the I-PD in a one-to-many peered group starts the De-peering procedure. The result of the one-to-many De-peering is the breakup of the one-to-many peered group. As illustrated in Figure 28\_x, the one-to-many De-peering procedure may contain the following steps.

1. The I-PD’s higher layer triggers De-peering procedure with a De-peering Request to its MAC layer.
2. The MAC layer receiving the higher layer’s De-peering Request (i.e. the I-PD’s MAC layer) multicasts the De-peering Request message to all the other PDs’ MAC layers (i.e. the MAC layers of #*i* R-PD, #*j* R-PD, and #*k* R-PD).
3. *Optional:* the links between I-PD and other R-PDs (i.e., #*i* R-PD, #*j* R-PD, and #*k* R-PD) are disconnected.





Figure 28\_x—One-to-many de-peering procedure message sequence chart

A R-PD in a one-to-many peered group may require to De-peering with this one-to-many peered group. The result of this De-peering is that the required R-PD leaves the one-to-many peered group. As illustrated in Figure 28\_y, the R-PD required De-peering procedure may contain the following steps.

1. The R-PD’s higher layer (i.e., the #*i* R-PD’s higher layer) triggers De-peering procedure with a De-peering Request to its MAC layer (i.e., the #*i* R-PD’s MAC layer).
2. The MAC layer receiving the higher layer’s De-peering Request (i.e. the #*i* R-PD’s MAC layer) sends a De-peering Request message to the I-PDs’ MAC layer.
3. *Optional:* the link between I-PD and other required R-PD (i.e., #*i* R-PD) is disconnected.





Figure 28\_y—One-to-many de-peering procedure message sequence chart

* + - 1. Many-to-many De-peering procedure

The many-to-many De-peering is simply done as the following. That is, any PD that intends to de-peer performs the one-to-many de-peering procedure.

* + 1. Access scheme in Peering Period

A PD shall transmit management messages for peering, re-peering, and de-peering in Peering Period using *p*-EIED protocol described in 5.6.1. A PD shall maintain and update independent *TM* and *p*basic for Peering Period separate from *TM* and *p*basic for CAP. See 5.6.1 for the detailed description of *p*-EIED.