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Re:	This contribution is for call for contribution IEEE P802.16e/D4
Abstract	This contribution proposes the SLPID update operation
Purpose	Propose the SLPID update mechanism for the IEEE802.16e Handoff Ad hoc group
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Method for SLPID Update in Sleep Mode

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1. Introduction

In current IEEE P802.16e/D4, each sleep-mode MSS is identified by Sleep Identification (SLPID). It is used in the MOB-TRF-IND message as a form of SLPID bitmap for indicating whether there is downlink data for each MSS. Based on the bit value at the corresponding location in the bit-map, MSS may remain in sleep mode or awaken to receive data.

The SLPID is assigned to MSS when MOB-SLP-RSP message is sent to MSS after SLP-REQ/RSP handshake, and released when MSS returns to normal mode. During that time span, it remains unchanged. This may cause a problem: active SLPIDs which are actually assigned to sleep-mode MSSs may be distributed quite sparsely. In worst case, an MSS can be assigned 1023 as its SLPID, although there are actually a few MSSs in sleep mode. This unnecessarily increases the size of SLPID bitmap which is mostly filled with unused bits. In order to solve this problem, we propose a SLPID update method to tightly pack the active SLPIDs into the bitmap.

The packing can reduce the size of the SLPID bitmap, especially the sparsely-distributed one described above. In an extreme case where there are two sleep-mode MSSs with SLPID 1 and 1023 respectively, the bitmap should be 1024 bits long under the assumption that each MSS occupies one bit in the bitmap. Its size can shrink to just two bits after packing by changing SLPID 1023 to 2. Even in the ordinary cases, the packing can be an effective way of maintaining the SLPID bitmap as small as possible.

2. Overview of Proposed Solution

As a way of packing the SLPID bitmap, we propose two complementary SLPID update methods: using RNG-RSP message and MOB-TRF-IND message.

Firstly, one of the major concerns about the sleep mode operation has been how to perform periodic ranging operation for the MSS in sleep interval. Since there is at least no objection on its necessity, we presume that there is a way of doing it. Without regard to whether it is performed in sleep mode or awake mode, a periodic ranging ends when MSS receives a RNG-RSP message with ranging status flag set to 'success'.

We propose that this last RNG-RSP message may have a TLV named SLPID_Update which includes 20-bit Old_New_SLPID as its compound value. The first ten bits are for current Old_SLPID and the last half for New_SLPID to be updated. This TLV is appended to the RNG-RSP message only when there is any need to update SLPID. On receiving the RNG-RSP message, MSS changes its SLPID to New_SLPID and continues with its sleep mode operation.

For example, let an MSS have a SLPID 'Y'. At the end of a periodic ranging with the MSS, BS checks to see if there is any inactive SLPID – SLPID that is currently not assigned to any MSS – lower than 'Y'. Assume that the smallest one among them is 'X'. Then BS makes a SLPID_Update TLV with its value set to 'YX', and appends it to the last RNG-RSP message. When the MSS reads the TLV from the received RNG-RSP message, it changes its SLPID to 'X'.

Secondly, MOB-TRF-IND message can be used to carry the SLPID_Update TLV encodings. MSS receiving a negative indication in the MOB-TRF-IND message may return to sleep mode. So it is a good time to update SLPID if needed. In this regard, BS may perform the same SLPID update procedure described above for all MSSs negatively indicated in a MOB-TRF-IND message. For selected MSSs, BS makes a SLPID_Update TLV including Old_New_SLPID values and appends it to the MOB-TRF-IND message. When receiving a MOB-TRF-IND message, every negatively-indicated MSS shall search through the TLV and update its SLPID if it finds an Old_New_SLPID including Old_SLPID equal to its current SLPID.

Above two methods can operate complementarily so that the SLPID bitmap can be maintained as small as possible. As a result, MOB-TRF-IND broadcast message can be kept to be small.

3. Proposed Text Changes

We propose the following remedies in IEEE P802.16e/D4 to provide a SLPID update operation.

Remedy 1:

[Change the followings in line 58-63 page 59 section 6.3.19.1 Introduction]

If MSS finds that there will be a periodic ranging opportunity within next sleep window, it may return to and remain in sleep mode until the start of the periodic ranging operation indicated by Ranging Frame Offset. And then it shall awaken to decode the UL-MAP for periodic ranging opportunity. When the received RNG-RSP message with ranging status flag set to success includes SLPID_Update TLV, the MSS shall decode the TLV and update its SLPID to a new one. After periodic ranging operation, the MSS may return to sleep mode or remain in awake mode based on the indicator in the SLPID bit-map.

[Insert the followings after line 8 page 60 section 6.3.19.1 Introduction]

If the Serving BS receives RNG-REQ message from the MSS in sleep mode and there is any need to update SLPID assigned to the MSS, the BS shall append SLPID_Update TLV to the RNG-RSP message with ranging status flag set to success.

[Insert the following after line 11 page 19 section 6.3.2.3.6]

The following TLV parameter shall be included in the RNG-RSP message when the periodic ranging in sleep operation completes and the Serving BS decides to assign a new SLPID for the MSS:

SLPID_Update (11.16.1)
The SLPID_Update is a compound TLV value that provides a shorthand method for changing the SLPID used by the MSS during sleep mode operation. The SLPID_Update TLV specifies new SLPID replacing old SLPID.

Remedy 2:

[Change the followings in line 5-8 page 34 section 6.3.2.3.46 Traffic Indication message (MOB-TRF-IND)]

MOB-TRF-IND message may have one of the two formats depending on FMT field. When FMT=0, the MSS finds its own SLPID in the MOB-TRF-IND message. If it fails, the MSS considers this a negative indication. The MSS shall update its SLPID if it finds its own Old_New_SLPID in SLPID_Update TLV. And then it may return to sleep mode. When FMT=1, if the MSS does not find its own Basic CID in the MOB-TRF-IND message, it will consider this is a negative indication and may return to sleep mode.

[Insert the following after the end of SLPID bit-map parameter description in page 35]

When MOB-TRF-IND message has FMT=0, it may include the following TLV:

SLPID_Update (11.16.1)
The SLPID_Update is a compound TLV value that provides a shorthand method for changing the SLPID used by the MSS in sleep mode operation. The SLPID_Update TLV specifies a new SLPID that replaces an old SLPID. The SLPID_Update TLV may contain multiple Old_New_SLPID values for the MSSs negatively indicated in MOB-TRF-IND message.

[Change the followings in line 49-51 page 59 section 6.3.19.1 Introduction]

If there is no SLPID or Basic CID to be addressed, the BS sends an empty indication message, that is, MOB-TRF-IND message without SLPID bit-map or Basic CID. In such case, if there is any need to update SLPID for any MSS, the BS appends SLPID_Update TLV in the MOB-TRF-IND message.

[Change the followings in line 61-62 page 67 section 6.3.19.3 Traffic indication signaling]

If the MSS receives a MOB-TRF-IND message with a negative indication, it searches through the SLPID_Update TLV and updates its SLPID if it finds an Old_SLPID equal to its current SLPID, and it may continue in sleep mode. For an example of sleep mode operation, see Annex E.

Remedy 3:

[Insert the followings after the end of section 11.15 in page 202]

11.16 Sleep mode management encodings
11.16.1 SLPID_Update

The SLPID_Update TLV specifies a new SLPID that replaces an old SLPID. This TLV may include multiple Old_New_SLPID values for the MSSs negatively indicated in MOB-TRF-IND message.

Table xxx – SLPID_Update

Type	Length	Value	Scope
1	Variable	See table yyy	RNG-RSP MOB-TRF-IND

Table yyy

Field	Length	Note
Old_New_SLPID	20bits	First 10 bits indicates old SLPID and the second 10 bits indicates new SLPID