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| Re: | This is a contribution to IEEE 802.16a. | |
| Abstract | This contribution describes the proposed changes to the periodic ranging mechanism. | |
| Purpose | To enhance the periodic ranging mechanism for TGa systems. | |
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Periodic Ranging Enhancement

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1. Introduction

This document proposes an enhancement to the periodic ranging.

2. References

[TGa/D4] IEEE P802.16a/D4 – 2002.

[TG1/D5] IEEE P802.16/D5-2001

3. Periodic Ranging in [TG1/D5] and [TGa/D4]

Periodic ranging is a process for the SSs during normal operations to adjust transmission parameters, such as, time offset and Tx power level, so that the SSs can communicate with the BS properly. The following summarizes the current periodic ranging mechanism as described in [TG1/D5] and [TGa/D4]:

- 1) Both the BS and the SSs uses a timer, called T4, for periodic ranging, where the timer T4's value range is from 30 seconds to 35 seconds;
- 2) The BS shall provide each SS a periodic ranging opportunity at an interval sufficiently shorter than T4;
- 3) For GPC (Grant Per Connection) mode SSs, a periodic ranging opportunity is an UL transmission identified by station Maintenance UIUC in UL-MAP;
- 4) For GPSS (Grant Per SS) mode SSs, a periodic ranging opportunity can be any allocation of UL bandwidth;
- 5) Upon getting a ranging opportunity, the GPC mode SS sends a RNG-REQ message to the BS;
- 6) Upon receiving an allocation of UL bandwidth, the GPSS mode SS typically sends data based upon QoS. It may send a RNG-REQ message but is not required to. During periodic ranging the DBPC-REQ message or the RNG-REQ message can both be used to request a change in DL burst profile; [This is not well documented in the spec.]
- 7) Upon receiving a RNG-REQ message, the BS sends a RNG-RSP message;

- 8) The BS may send an unsolicited RNG-RSP with adjustments based on any UL transmission it received from the SS; [This is not well documented.]
- 9) Upon receiving a RNG-RSP message, the SS adjusts transmission parameters accordingly.

4. Discussion on the Current Periodic Ranging Mechanism

The current periodic ranging mechanism requires the GPC mode SSs to send RNG-REQ message every time the periodic ranging is conducted. This is unnecessary and wastes UL bandwidth, because the BS shall monitor the UL when receiving from the SSs, not just receiving RNG-REQ messages. The BS can send unsolicited RNG-RSP messages to the SSs at the interval sufficiently shorter than T4, and whenever the BS feels that a Tx parameter adjustment is necessary for a SS. It is not well documented in the current periodic ranging section that the GPSS SS never needs to transmit a RNG-REQ message. This could lead to implementations which waste UL bandwidth.

For GPC mode SSs, the current periodic ranging mechanism requires a separate UL transmission with station maintenance UIUC to send RNG-REQ. There is only one station maintenance UIUC per BS. If a SS's regular UIUC is different from the station maintenance UIUC, then the SS has to switch between these two UIUCs for its UL transmission. This can be avoided by simply polling or otherwise allocating bandwidth to the SS using its regular UIUC.

The current periodic ranging mechanism does not provide the SSs an active way to start the periodic ranging process. It will be useful that the SSs can actively and timely start a periodic ranging procedure, particularly for mobility support. This can be done by allowing the SSs to use contention-based ranging slot, that is, the initial ranging slot, to send RNG-REQ for periodic ranging.

The value range of the T4 timer, 30s to 35s, may be too long. For 10-66 GHz systems to meet fade requirements it really needs to be no more than about 80 ms. For 2-11 GHz systems, analysis needs to be done on this parameter. Maybe we need to move it from its current table to the PHY specific part of chapter 10.

5. Proposed Changes

We proposed following changes to enhance the periodic ranging mechanism:

- 1) Don't need RNG-REQ for periodic ranging, that is, the BS will periodically send RNG-RSP messages to the SSs based upon measurements taken on data transmitted by the SS in bandwidth allocated at an interval sufficiently shorter than T4, without requiring the SSs to send RNG-REQ messages first. Thus, there are two cases that the BS will send RNG-RSP messages to the SSs:
 - a. Upon receiving a RNG-REQ message; or
 - b. Unsolicited, as needed based on measurements from other UL bandwidth allocations given at an interval sufficiently shorter than T4.

- 2) Don't use a separate maintenance UIUC for sending RNG-REQ messages, that is, allocate bandwidth for a more useful purpose such as polling for the GPC mode SSs and take measurements off these UL transmissions;
- 3) Remove station maintenance UIUC from the UIUC definition table;
- 4) Allow the SSs to use the contention based ranging slot (initial maintenance slot) to send periodic ranging RNG-REQ messages.

The following changes are required in [TGa/D4] to reflect the above-proposed changes:

- 1) Page 141, line 16, change the table entry to:

| IE Name | UIUC | CID | Mini-slot Offset |
|--------------|------|---------|---|
| Data Grant | 3 | unicast | Starting offset of Data Grant Burst Type 0 assignment |
| Burst Type 0 | | | |

- 2) Page 98, line 11, insert the following text:

There are two different ranging procedures: initial ranging and periodic ranging. The initial ranging is for a new SS to acquire correct transmission parameters, such time offset and Tx power level, so that the new SS can communicate with the BS properly. See section 6.2.9.5 in IEEE p802.16/D5-2001 for details.

Periodic ranging is for the SSs during normal operations to adjust transmission parameters so that the SSs can communicate with the BS properly. The following summarizes the periodic ranging:

- 1) *Both the BS and the SSs uses a timer, called T4, for periodic ranging, where the timer T4's value range is TBD (it may be PHY-specific);*
- 2) *The periodic ranging shall be conducted periodically at an interval sufficiently shorter than T4;*
- 3) *A periodic ranging procedure can be originated by either the BS or the SSs;*
- 4) *If the BS originates a periodic ranging procedure, the BS sends an unsolicited RNG-RSP with adjustments based on any UL transmission it received from the SS;*
- 5) *If a SS originates a periodic ranging procedure, then*
 - a. *The SS sends a RNG-REQ message in an allocation of UL bandwidth or a contention-based initial ranging slot;*
 - b. *Upon receiving a RNG-REQ message, the BS sends RNG-RSP to the SS;*
- 6) *Upon receiving a RNG-RSP message, the SS adjusts transmission parameters accordingly.*

