Sleep Mode and Idle Mode Operations for IEEE 802.16j

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Purpose:  
This document suggests the usages of IEEE 802.16e messages and introduces new parameters in these messages to facilitate the sleep mode and idle mode operations in IEEE 802.16j

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Sleep Mode Operation for IEEE 802.16j

- Admission control and buffering on MR-BS

* (power saving class type-1, start frame, initial sleep window, listen window, ...)

1. Sleep Request message (MOB_SLP-REQ)*
2. Sleep Request message (MOB_SLP-REQ)
3. Sleep Response message (MOB_SLP-RSP)*
4. Sleep Response message (MOB_SLP-RSP)
5. Incoming packets
6. Buffering
7. Incoming packets
Sleep Mode Operation for IEEE 802.16j

• Admission control and buffering on MR-BS
  – Reuse Sleep Request/Response messages between RSs, and between an RS and an MR-BS
  – Admission control of sleep mode operations on the MR-BS
  – MR-BS must take the relaying delay from the MR-BS to the serving RS into consideration while it forwards incoming packet to the MS via RSs
  – Buffering incoming packets on the MR-BS
Sleep Mode Operation for IEEE 802.16j

- Admission control and buffering on MR-BS

**Diagram Explanation:**

- **MS (Mobile Station):**
  - Sleep window
  - Listen window starts at frame I

- **RS (Remote Subscriber):**
  - Frame K
  - Buffer for M frames

- **MR-BS (Multi-Radio Base Station):**
  - 1. Incoming packets
  - 2. Buffering
  - 3. Incoming packets

**Calculations:**

- Relaying delay for J frames
- Start frame of the next listen window is I
- Buffering on MR-BS for M frames where M = I - (K + J)
Sleep Mode Operation for IEEE 802.16j

- Admission control on MR-BS/RS and buffering on RS

1. Sleep Request message (MOB_SLP-REQ)
2. Sleep Request message (MOB_SLP-REQ) *
3. Sleep Response message (MOB_SLP-RSP) **
4. Sleep Response message (MOB_SLP-RSP)
5. Incoming packets
6. Incoming packets
7. Buffering

* MOB_SLP-REQ(..., RSID) RSID: 0 to disable RS buffering, RSID indicates the RS that will buffer the packets
** MOB_SLP-RSP(..., RSID) RSID: 0 to disable RS buffering, the MR-BS acknowledges the RS for packet buffering

* parameters such as start frame, initial sleep window, listen window, and etc may be modified by the RS
Sleep Mode Operation for IEEE 802.16j

• Admission control on MR-BS/RS and buffering on RS
  - Reuse Sleep Request/Response messages between RSs, and between an RS and an MR-BS
    • New parameter of MOB_SLP-REQ/MOB_SLP-RSP: RSID
  - Admission control of sleep mode operations on the MR-BS/RS, sleep-mode parameters and state maintained on the MR-BS/RS
  - MR-BS forwards the incoming packets to RSs as soon as it receives the packets
  - Buffering incoming packets on an RS
Idle Mode Operation for IEEE 802.16j

• Definition of paging group in IEEE 802.16j
  - **PC (paging controller):** PC may be either co-located with BS, MR-BS or separated from BS/MR-BS across R6 reference point
  - **PA (paging agent):** PA is co-located with BS, MR-BS or RS
  - **PG (Paging group):** RSs and their associated MR-BS belong to the same paging groups
Idle Mode Operation for IEEE 802.16j

Paging group #1

Paging group #2

PC/LR

MR-BS/PA

RS/PA

RS/PA

RS/PA

RS/PA

RS/PA

RS/PA

RS/PA

RS/PA

RS/PA

RS/PA

RS/PA

RS/PA

RS/PA
Idle Mode Operation for IEEE 802.16j

• Enter idle mode

1. SS De-registration Request message (DREG-REQ) (Paging Cycle Request)
2. SS De-registration Request message (DREG-REQ) (... , RSID)*
3. MS Info Request (RSID)**
4. De/Re-register command message (DREG-CMD)***
5. De/Re-register command message (DREG-CMD)

*DREG-REQ(... , RSID) RSID: RSID indicates the serving RS for the mobile who decides to enter idle mode
**MS Info Request: reports the BSID or RSID to PC/LR
***DREG-CMD: both MR-BS/serving RS must store the paging parameters (PAGING_CYCLE/ PAGING OFFSET)
Idle Mode Operation for IEEE 802.16j

• Paging

1. MS-paging announce (PCID, BSIDs or RSI Ds)
2. BS Broadcast Paging message (MOB_PAG-ADV) (RSI D_List)*
3. MOV_PAGADV

Wait till the paging available interval

Network re-entry
Idle Mode Operation for IEEE 802.16j

• Summary
  - Defines functional entities in the paging architecture in IEEE 802.16j
  - Reuse DREG-REQ/DREG-RSP/MOB_PAG-ADV/RNG-REQ/RNG-RSP messages between RSs, and between an RS and an MR-BS
    • New parameters of DREG-REQ/RSP: RSID

• Future Work
  - Does there exist benefit to page part of RSs within an MR-cell?
References

• Harmonized definitions and terminology for 802.16j Mobile Multihop Relay, IEEE 802.16j-06/014r1
• Table of Contents of Task Group Working Document, IEEE 802.16j-06/017r2