802.16e Handoff description

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802.16e
Handoff Description

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Entities

- **MSS** - Mobile Subscriber Station, contains MAC (CS), PHY layers
- **BS** - Base Station Sector, a single MAC entity covers a single air interface instance
- **ASA Server(s)** - Authentication and Service Authorization Server servicing the whole operator’s network. These may be implemented as a centralized or distributed entity
- **Serving BS** - BS with which the MSS has recently performed registration at initial network-entry or during an HO
- **Target BS** - The BS that a MSS intends to be registered with at the end of a HO
Network reference model

Operator 'A' backbone network

Gateway

Operator 'B' backbone network

ASA server(s)

BS backhaul connection

BS #1

BS #2

BS #3

MSS

ASA server(s)
BS and MSS protocol stack

• MSS protocol stack
  – No difference here compared to IEEE 802.16a standard
• BS protocol stack

```
Mobility Agent
  CS SAP
  CS
  MAC (common Part)
  PHY
 Backhaul Protocol Stack
```
Network Reference Model

• Control Plane Interfaces
Network Structure and HO (control plane)
Network Structure and HO (data plane)
• Network topology advertisement
  – A BS shall broadcast information about the network topology using the NBR-ADV MAC message.
  – An MSS may decode this message to find out information about the parameters of neighbor BS.
MSS scanning of neighbor BS

- A BS may allocate time intervals to MSS for the purpose of seeking and monitoring neighbor BS - **scanning interval**
- A MSS may request an allocation of a scanning interval using the SCN-REQ MAC message
  - The MSS indicates the duration of time it requires for the scan
- BS responds with placement of a Scanning_IE in the DL-MAP
  - The Scanning_IE either grants the requesting MSS a scanning interval that is at least as long as requested by that MSS, or deny the request
  - The BS may also place unsolicited Scanning_IE
- **Passive scanning**
  - A MSS shall use the allocated interval to seek neighbor BS
  - When neighbor BS are identified, estimate the connection quality
MSS scanning of neighbor BS – Cont’

- **Active scanning**
  - A MSS shall use the allocated interval to seek neighbor BS
  - When neighbor BS are identified, estimate the connection quality
  - A MSS may use the interval for UL ranging as well to in a procedure is called **association**.

- **When associating with a neighbor BS, two additional stages are performed**
  - **association-initial-ranging**
  - **association-pre-registration**

- **Association-initial-ranging** is performed by transmitting a RNG-REQ MAC message

- **Information on Association** is reported to the Serving BS
HO Process

- The HO process belongs to the break-before-make type
  - Make-before-break can still be implemented
- HO process consists of the following stages,
  - HO initiation
    - The decision to start the process is taken
    - Either MSS or BS can initiate HO
  - Termination of service with the serving BS
    - All connections belonging to the MSS are terminated
    - The context associated with connections is discarded (i.e. information in queues, ARQ state-machine, counters, timers, etc.)
- Can be done retroactively following a message from Target BS
• Network re-entry in target BS
  – The MSS re-enters the network using a fast network entry procedure
    • The BS may choose, instead of waiting for initial ranging request in MAINT region, to allocate non-contention transmission opportunity for the MSS (using its 48-bit MAC address).
  – MSS re-authorization
    • During this stage the MSS performs the re-authorization part of the PKM protocol used at initial network entry
    • The BS authenticates the user and as the security context has not changed (it is transferred from the old BS via backbone the security sub-layer can continue in normal operation.
  – After network re-entry, connection belonging to the MSS are re-established based on the availability of resources in the target BS
• **CS to MA: CS_MSS_ARRIVAL.indication**
  – Signals MSS arrival at the cell

• **CS to MA:**
  **CS_MSS_DEPARTURE.indication**
  – Signals MSS departure from the cell

• Both Primitives are used at the BS and MSS and can be used as L2 triggers to L3
Backbone Network Handoff procedures

- **Backbone network services**
  - Backhaul for traffic
  - Provide a BS with the identity of its neighbors
  - Provide a BS with the identity of the ASA server
  - Advertise the fact that a certain MSS has registered with a certain BS
  - Provide a BS information about a certain MSS
  - Information exchange during HO
• **Inter–base station messages:**
  - **I–am–host–of message**
    - Sent by a BS to notify other BS (or the ASA server) that a certain MSS is registered with it.
  - **MSS–info–request message**
    - Sent from one BS to another (or to the ASA server) to request information about an MSS.
  - **MSS–info–response message**
    - Response to MSS–info–request
  - **HO–notification message**
    - Sent by a BS to advertise an MSS intention to perform HO.
    - The message serves to alert the target base stations that a HO event is going to happen.
• **Inter–base station messages:**
  
  – **HO–notification–response message**
    
    • This message is sent from one BS to another BS, in response to a *HO-notification* message and provides the BS that sent the *HO-notification* message with information about the level of service the MSS could expect if it transitions to this BS.

  – **HO–notification–confirm message**
SAP for higher layer protocols

- Services between the MAC and higher layers for supporting the HO process. May be used to optimize higher layers HO process.
- The information is defined as set of messages sent by the MAC layer to the higher layers, providing indication of particular events before and after MAC layer HO.
- **MSS Movement**
  - Occurs at the MSS, indication that the MSS has registered to a new Target BS.
- **Serving BS Pre-HO**
  - Occurs at the Serving BS, indication that a MAC layer HO of a certain MSS is about to take place.
- **Target BS Pre-Ho**
  - Occurs at the Target BS, indication that a MAC layer HO of a certain MSS is about to take place.
SAP for higher layer protocols

• **BS Post-HO**
  – Occurs at the Target BS or MSS, indication that a MAC layer HO between the MSS and the Target BS has been completed.

• **Serving BS–Link Loss**
  – Occurs at the Serving BS, indication that MAC layer link between the Serving BS and a certain MSS has been lost.