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Re:	The document is submitted in response to "Call for Contributions on Project 802.16e: Mobility Enhancements to IEEE Standard 802.16/802.16a" (IEEE 802.16e-02/01)	
Abstract	The document contains suggestions on additions to 802.16/802.16 OFDM/OFDMA MAC to implement the handover procedure	
Purpose	The document is submitted for consideration in IEEE 802.16 WG	
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Handover in 802.16e MAC

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1. Acronyms

DL	Downlink
DL-MAP	Downlink MAP message
FDD	Frequency Division Duplex
HO	Handover
IE	Information Element (e.g. of MAP message)
MC	Mobility Controller, an entity located in the network and responsible for authentication, authorization of services, accumulation of HO measurements from MS and BSs, HO decision at the network side
MS	Mobile Station (“mobile” SS)
OFDM	Orthogonal Frequency Division Multiplexing
OFDMA	Orthogonal Frequency Division Multiple Access

SS	Subscriber Station
TDD	Time Division Duplex
UL	Uplink
UL-MAP	Uplink MAP message

References

- [1] IEEE P802.16/D5-2001 IEEE Draft Standard for Local and Metropolitan Area Networks – Part 16: Air Interface for Fixed Broadband Wireless Access Systems, 2001-10-18
- [2] IEEE P802.16a/D7-2002 Draft Amendment to IEEE Standard for Local and Metropolitan Area Networks Part 16: Air Interface for Fixed Broadband Wireless Access Systems –Medium Access Control Modifications and Additional Physical Layer Specifications for 2-11 GHz, 2002-11-17
- [3] IEEE C802.16sgm-02/24. Overview and Guidelines for Handoff Procedures in 802.16, Avi Freedman, Zion Hadad

2. The Goal of the Document

The Goal of the Document is to provide tips for implementation of the handover procedure in 802.16e.

Some guidelines from the contribution [3] were used.

3. General

Terminal assisted HO will be implemented. It means that MS collects information related to potential HO and transfers it to the network; network collects relevant information (e.g. PHY measurements from BSs), makes decision and executes the handover.

Types of HO:

- Inter-channel HO: between channels (sectors) at the same BS. In this case BS makes HO decision and executes the handover
- Inter-cell soft HO: between two BSs. In this case serving BS makes HO decision and executes the HO.
- Inter-cell Hard HO in the case MS fails to communicate to the serving BS, it performs complete NW Entry procedure with the best possible BS; new BS informs old BS on the HO

4. Service Definition

Service for MS is defined as combination of the following:

- Home IP network identification
This component of service specifies IP network to which the MS belong. It means that when the MS roams from one BS to another, an IP stack located on the top of Packet Convergence Sublayer (see [1] , 5.2 “Packet Convergence Sublayer”) keeps operating as it were still at Home IP network.

- QoS Parameters for wireless communications

5. Mobility Controller

Network functions supporting mobile wireless communication are located at Mobility Controller (MC). These functions include for example authentication of MS and authorization of services. Mobility Controller may service a single BS or a set of BSs. MC can be integrated with BS; standalone MC communicates to BS(s) using any transport protocol.

6. Measurements

6.1. Vacation Periods

For inter-frequency measurements and Association activity a MS periodically leaves the cell for an integer number of frame durations and tries to receive DL transmissions from neighbor base stations (“visits” the neighbor BSs). Serving BS is responsible to arrange for the MS vacation periods with no data transfer scheduled between the MS and BS. Information on vacations is transferred to the MS. Vacation should last an integer number of frames.

6.2. Visited BSs

BS allocates MAINT transmission opportunities (TOs) for Association of visitors (see below).

6.3. Measurements Results

The list of parameters measured while a MS visits a BS, is TBD. It includes certain PHY parameters (like RSSI, SNR) and system parameters like service availability at the visited BS.

Results of measurements are transferred to the serving BS. Serving BS may share this information with MC and other BSs.

7. Detected, Monitored, Selected, Associated and Active Sets of Neighbor BSs

Each MS keeps the following lists of neighbor BSs

- Detected BSs
- Monitored BSs i.e. those that are visited for passive measurements
- A subset of Monitored BSs is defined as Selected (for Association attempts)
- After Association, the BS becomes an Associated BS. Association is performed with limited number of neighbor AUs (see 8)
- After completion of HO (Network Entry) the BS becomes Serving
- Upper layers at BS should include functions for authentication of SU and authorization of services through external server (functional equivalent of HLR at GSM/3G)
- Network should support mobility by changing the routing path for the IP datagrams

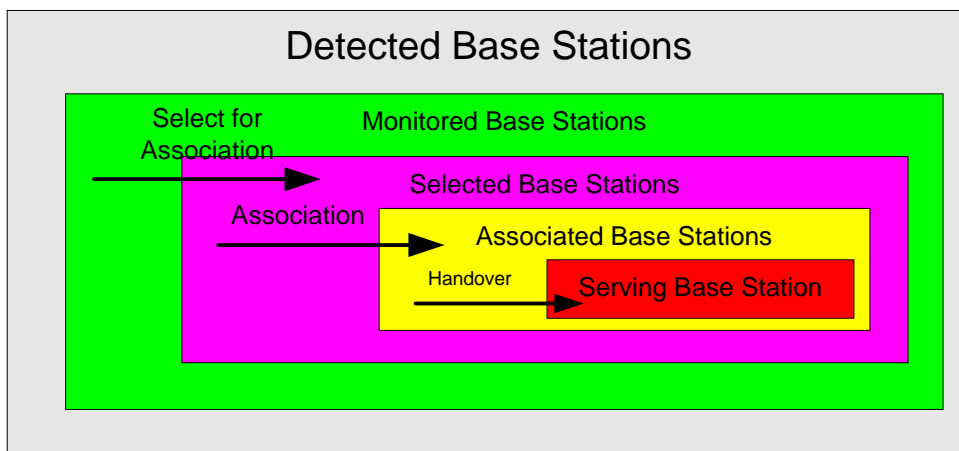


Figure 1. Sets of Neighbor BSs

8. Association Procedure

Visiting each Selected BS, the SS performs Association procedure similar to 802.16 Network Entry procedure specified in [1] :

- Scan for downlink channel and establish synchronization with the BS
- Obtain transmit parameters
- Initial ranging
- Negotiate basic capabilities
- Authorize SS and perform key exchange
- **Negotiate services requested by the SS**
- Perform pre-registration
- Transfer operational parameters

Information on Association is reported to the Serving BS.

9. Serving BS Operations

Serving BS

- Collects measurements information and Association information received from MS
- Performs measurement of signal received from MS
- Makes decision on HO of the MS to another BS and executes the decision

10. Handover

The following are steps of the HO

- The MS decides on HO to one of the Associated BSs together with the network according to measurements results.

Note. Details of the HO decision still need to be clarified. One of the options is that the decision is made by the network, either BS or MC, according to the results of measurements performed by MS, serving BS and associated BSs.

- The MS performs the rest of Network Entry procedure:
 - Informs the old BS and leaves
 - Jumps to the new BS's frequency and timing
 - Adjusts synchronization to DL
 - Informs the new BS on arrival using one of the following:
 - Periodic ranging TOs
 - RR contention slots
 - The new BS informs old BS (handshake) and the rest of Associated BSs on the HO. Also the network is informed for updating the IP routing paths [depends on the type of mobility support in the IP network]
 - BS sets up connections to the SS

After all that BS and SS continue regular operations.