Project	**IEEE 802.16 Broadband Wireless Access Working Group <http://ieee802.org/16>**
Title	**Low Latency Handover**
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Re:	This contribution is in response to the call for comments on Project 802.16g Baseline Task Group Document IEEE 802.16g-04/03r2
Abstract	The document proposes a reduced latency handover procedure with the help of primitives exchanged by the BSs through NCMS. It suggests text for section 14.5.9.7.1 Hard Handoff.
Purpose	The document should be considered during the resolution of comments on the baseline document.
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Low Latency Handover

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Problem Description

During handover procedure the MSS breaks the link with the serving BS, when it starts network re-entry procedure. The data traffic is not resumed with the MSS until after the completion of the network re-entry procedure and the data paths switchover in the network. This causes latency or break in the data traffic exchange, which is not acceptable for certain real time services, e.g. VoIP. The problem is more aggravated in terms of latency, if a full authentication procedure is performed during network re-entry.

Solution Summary

This contribution proposes a low latency HO procedure that virtually removes the data traffic break duration during network re-entry procedure.

Using the sleep mode feature of 802.16e, an MSS negotiates active/idle period from the BS. During the idle period the MSS can communicate with the other BSs. In the low latency handover procedure, the serving BS transfers the idle period to the target BS, as the available schedule for the target BS with the MSS. The MSS and the target BS performs network re-entry signaling during the available schedule. In this way it completes the network re-entry signaling with the target-BS, while exchanging data frames with the serving BS. Thus, achieves almost no latency during handover.

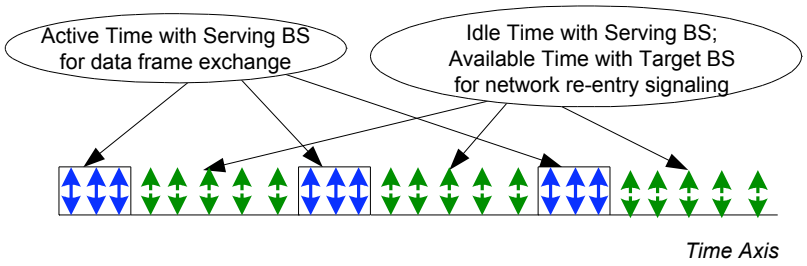

Figure-1: Low Latency Handover Principle

The low latency handover procedure exactly follows the regular handover procedure signaling steps over the air interface. This gives the advantage of selectively applying low latency handover only to certain real time Service Flows, e.g. UGS, ertPS, while the other Service Flows follow the regular handover procedure. The procedure assumes that the BSs are synchronized with a common time source, so they can interpret the time schedule from each other.

Contribution Overview

This contribution proposes text for section 14.5.9.7.1. It provides parameters needed for C_SAP to upper layer for low latency handover.

<Add the following in section 14.5.9.7.1>

14.5.9.7.1 Hard Handover

14.5.9.7.1.1 Network Initiated Handover

Figure xy.1 shows the handover procedure initiated by BS. The specifics for the low latency handover are identified in the steps.

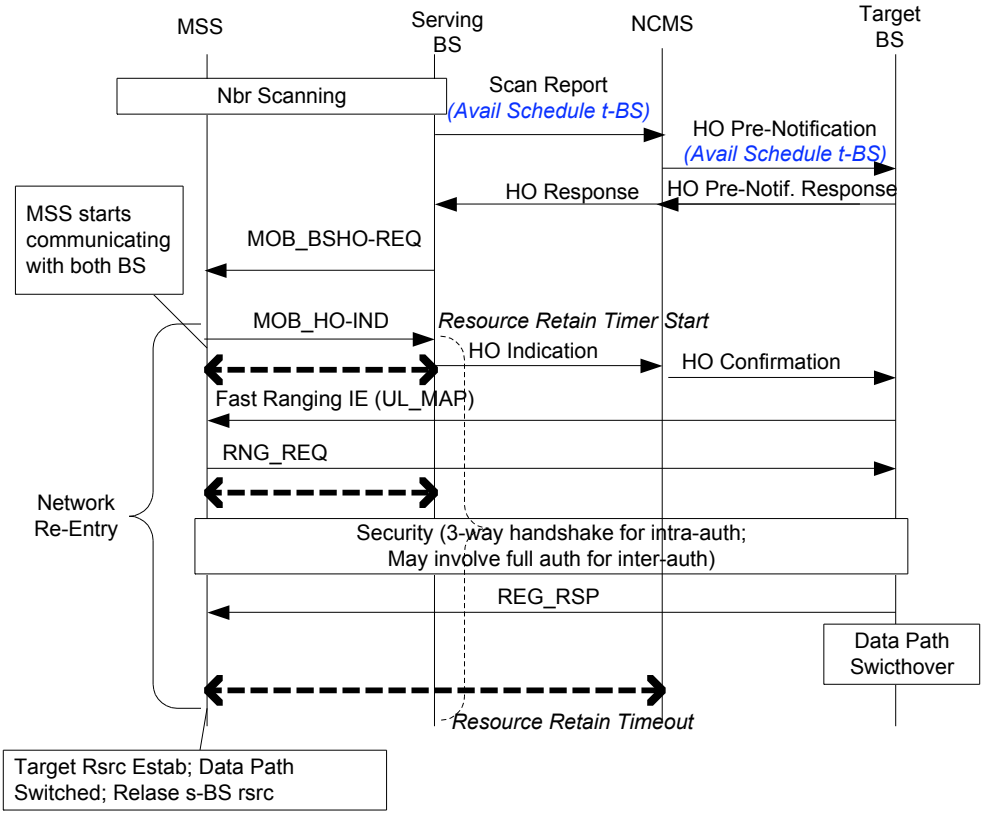

Figure xy.1 Network Initiated Handover

1. An MSS performs scanning/association with the neighbor BSs, and sends radio measurement reports to the serving BS. The serving BS may send the reports to NCMS for handover evaluation in *Scan Report* primitive. The serving BS includes *Available Schedule t-BS* parameter by considering the active schedule with the MSS for a certain set of SF Scheduling Type, e.g. UGS, ertPS.
2. The NCMS sends *HO Pre-Notification Request* primitive to a list of candidate BSs for permission to handover a MSS. The primitive carries the *Available Schedule t-BS* parameter for the MSS with the target BS.
3. The candidate BSs respond back with the *HO Pre-Notification Response* primitive.
4. NCMS informs the serving BS with *HO Response*, indicating the candidate target BS list.
5. The MSS receives MOB_BSHO-REQ with the list of recommended target BSs.
6. The MSS selects a target BS and sends MOB_HO_IND to the serving BS. For low latency handover, it uses HO_IND_Type=0b00 and Resource Retain Type= 1 for indicating that the serving BS resources should not be released and continue to be used for the Resource Retain Timer value.
7. The Serving BS informs the NCMS about handover initiation by sending *HO Indication* primitive. The NCSM sends *HO Confirmation* primitive to the serving BS.
8. The MSS starts the network re-entry procedure. It performs signaling with the target BS according to the *Available Schedule t-BS*. It continues exchanging data frames with the serving BS using its active schedule with the serving BS. Network re-entry also involves security procedure. If the handover is

intra-authenticator, the security procedure involves 3-way handshake for re-keying. If the handover is inter-authenticator, the security procedure may involve full authentication with AAA server.

9. After the network re-entry procedure, the data paths are switched in the network and exchanged through the target BS. When the Resource Retain Timer expires, the serving BS resources are released.

14.5.9.7.1.2 MSS Initiated Handover

Figure xy.2 shows the handover procedure initiated by MSS. The specifics for the low latency handover are identified in the steps.

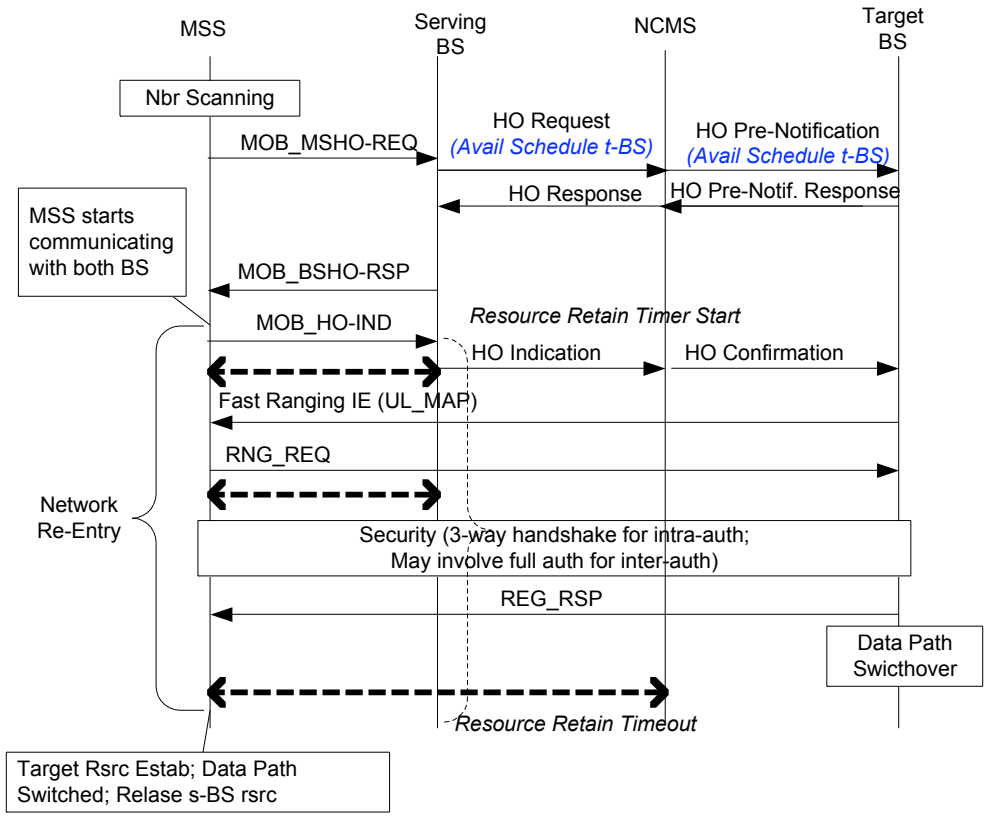

Figure xy.2 MSS Initiated Low Latency Handover

1. An MSS performs scanning/association with the neighbor BSs, and sends radio measurement reports to the serving BS.
2. The MSS initiates handoff preparation by sending MOB_MSHO_REQ message to the serving BS, with a list of recommended target BSs.
3. The serving BS sends *HO Request* to NCMS. The serving BS includes *Available Schedule t-BS* parameter by considering the active schedule with the MSS for a certain set of Service Flow Scheduling Type, e.g. UGS, ertPS.
4. The NCMS sends *HO Pre-Notification Request* primitive to the candidate BSs for permission to handover a MSS. The primitive carries the *Available Schedule t-BS* parameter for the MSS with the target BS.
5. The candidate BSs respond back with the *HO Pre-Notification Response* primitive.
6. The NCMS informs the serving BS with *HO Response*, indicating the candidate target BS list.
7. The MSS receives MOB_BSHO-RSP with the list of recommended target BSs.

8. The MSS selects a target BS and sends MOB_HO_IND to the serving BS. For low latency handover, it uses HO_IND_Type=0b00 and Resource Retain Type= 1 for indicating that the serving BS resources should not be released and continue to be used for the Resource Retain Timer value.
9. The Serving BS informs the NCMS about handover initiation by sending *HO Indication* primitive. The NCSM sends *HO Confirmation* primitive to the serving BS.
10. The MSS starts the network re-entry procedure. It performs signaling with the target BS according to its Idle schedule with the serving BS. It continues exchanging data frames with the serving BS using its active schedule with the serving BS. Network re-entry also involves security procedure. If the handover is intra-authenticator, the security procedure involves 3-way handshake for re-keying. If the handover is inter-authenticator, the security procedure may involve full authentication with AAA server.
11. After the network re-entry procedure, the data paths are switched in the network and exchanged through the target BS. When the Resource Retain Timer expires, the serving BS resources are released.

<Add the following in section 14.5.11. The following text suggests primitive changes only specific to this contribution. The parameter list is likely to change as the draft evolves.>

Table xy.1 Primitives for C_SAP

Primitive Name	Direction	Parameter
HO_Request	BS -> NCMS	Available Schedule t-BS
Scan_Report	BS -> NCMS	Available Schedule t-BS
HO Pre Notification Request	NCMS -> BS	Available Schedule t-BS

Available Schedule t-BS:

Start Timestamp (4 bytes) – The absolute time from which the Source BS Active Interval is counted.
Serving BS Active Interval (1 byte) – The number of msecs after the start timestamp in a time period.
Target BS Available Interval (1 byte) – The number of msecs after the Serving BS Active Interval in a time period.