

Inter-RAT Mobility Support in 802.16m

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Venue:

IEEE 802.16m-08/024, “Call for Comments and Contributions on Project 802.16m System Description Document (SDD)”.

Target topic: “Upper MAC concepts and methods - mobility”.

Base Contribution:

This is the base contribution.

Purpose:

To be discussed and adopted by TGm for the 802.16m SDD

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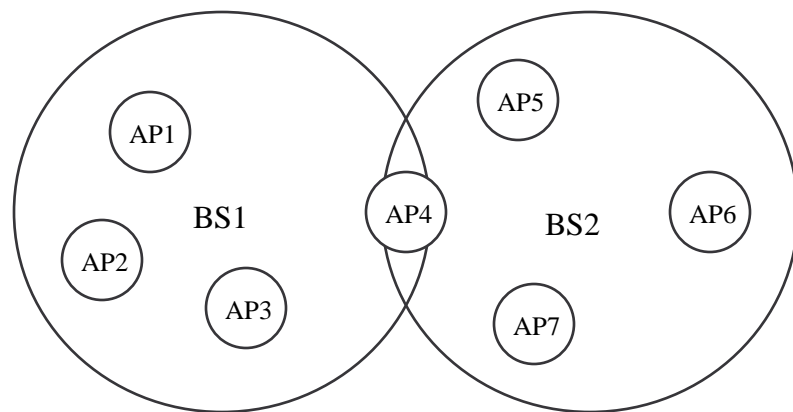
Inter-RAT Mobility

- Inter-RAT mobility is a mandatory requirement in 802.16m SRD.
- Mobility discussion for SDD should also consider inter-RAT mobility
- The complexity of inter-RAT mobility is contributed by the following factors in the context of 802.16m:
 - Device implementation
 - Single radio – Single transmit/Single receive or Single transmit/Dual receive
 - Dual radio – Dual transmit/Dual receive
 - RAN coupling
 - System information for the target RAT is provided to MS while in source RAT
 - MS provides measurement report of target RAT
 - Etc.
- Outline of this proposal
 - Mobility between 802.16m and 802.11
 - Mobility between 802.16m and 3GPP2 cdma2000
 - Mobility between 802.16m and 3GPP

Mobility between 802.16m and 802.11

Motivation for 802.16m-802.11 IW (1)

- While WiMAX BS provides large radio coverage for mobile users, WLAN AP provides hot spot access to mobile users for a better throughput or offloading traffic in WiMAX network.
- WLAN can be considered as hot spot coverage for WiMAX network, i.e., WiMAX is an overlay network on WLAN coverage.
- Small coverage area and fast fading characteristic of 802.11 technology results in a critical time requirement for 802.11-to-802.16m handover.
- Therefore handover scheme between 802.11 and 802.16m shall be optimized and could be different from those between 802.16m and other cellular technology.



Motivation for 802.16m-802.11 IW (2)

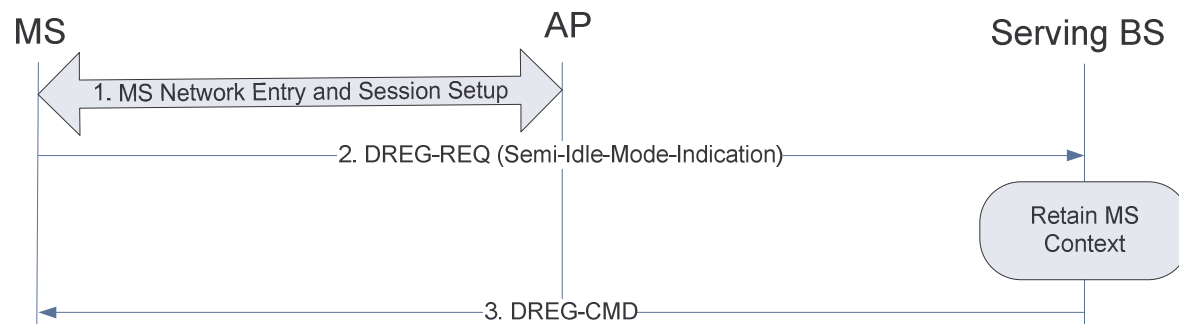
- 802.16m and 802.11 are two different radio technology. Therefore, the context information for the MS while in WLAN and WiMAX network cannot be directly reused.
- WiMAX -> WLAN HO
 - WiMAX network is normally always available, thus there is enough time for the MS to associate and authenticate with the WLAN before breaking the WiMAX connection.
 - After the WLAN connection is completely set up, the MS can disconnect from the WiMAX network.
- WLAN -> WiMAX HO
 - Due to small coverage area of WLAN, when MS decides to handover to WiMAX network due to poor 802.11 radio condition, it needs to do it as soon as possible to avoid loss of connection.
 - If the context of the MS in WiMAX network needs to be rebuilt, which require all the network entry procedures, it will introduce large handover delay.
 - Consequently, the MS may be disconnected from the WLAN before obtaining WiMAX connection.

Proposed Solution

- The MS always connects to WiMAX network after power on.
- Handover to WLAN may be activated if a better WLAN radio condition is detected.
- After handover to WLAN, MS enters into a semi-idle mode in WiMAX network.
 - Semi-idle means idle over the 802.16m air interface with no radio resource assigned and all connection identifier released except the basic connection identifier.
 - In addition to the paging controller, the serving 802.16m BS also keeps MS's idle mode context, so that network reentry can be done with all the HO optimization after MS moves back to the WiMAX network.
 - When MS becomes idle in WLAN, it is always paged through WiMAX network.
- When MS handover back to the WiMAX network, a network re-entry process can be conducted instead of a full network entry.
 - The service flow management procedures could be combined together with ranging procedure to reduce latency during MS network re-entry process.

Handover from 802.16m to 802.11 (1)

- A handover from WiMAX to WLAN network may be activated after a better radio condition is detected with WLAN.
- Since WiMAX network is always available, the MS has sufficient time to associate with the WLAN AP, perform authentication, acquire IP address if needed, and set up all the QoS for the data session.
- During this process, 802.16m connections are kept alive and data traffic flows through WiMAX network.

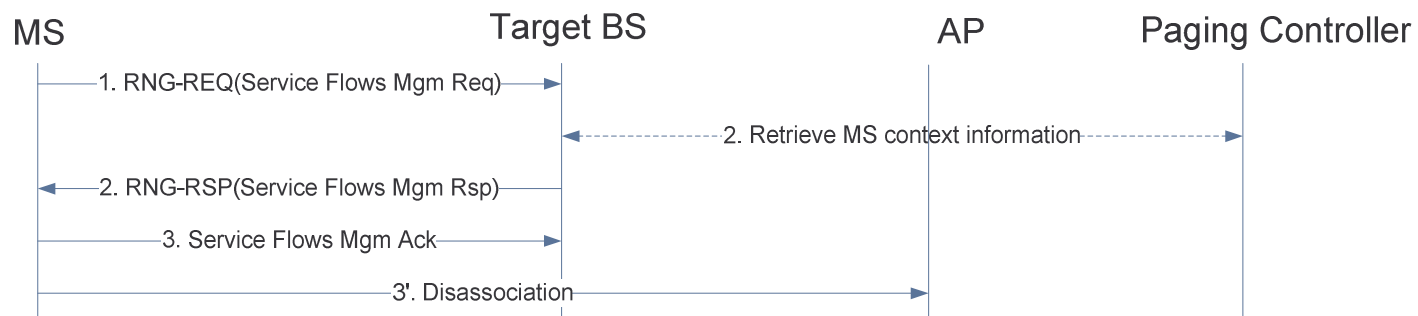


Handover from 802.16m to 802.11 (2)

- After WLAN connection is successfully established, the MS initiates switching to the semi-idle mode by sending a DREG-REQ with a semi-idle mode indication to the BS.
- The BS retains all the MS context information.
- MS and BS release all the connections assigned to MS except the basic connection, but keeps the other MS context such as service flow information.

Handover from 802.11 to 802.16m

- When handover from WLAN to WiMAX network is activated, the MS initiates network reentry with the target BS.
- The target BS may be the same BS that the MS connects before handover to WLAN or a different one.
- If the target BS still has the valid context information for the MS, it shall notify the MS seeking network reentry and omitting certain procedures by sending a RNG-RSP with HO Process Optimization TLV and completing the fast network reentry process accordingly; otherwise, it shall obtain the MS context from the Paging Controller.
- While the MS stays in WLAN, there may be new session established, or existing session could be modified or released. The service flow management procedures are combined together with ranging procedure.



Benefit

- Keeping MS context in the WiMAX network while MS connects to WLAN significantly reduces HO latency from WLAN to WiMAX.
- The proposed scheme to maintain the MS context in WiMAX network while MS is associated with WLAN is consistent with that for the MS associated with WiMAX network.
- The impact to the MS and BS implementation to support WLAN-WiMAX HO is minimum.

Proposed text changes for 802.16m SDD

- Section 10.x: Inter-RAT Mobility
- Section 10.x.1: Mobility between 802.16m and 802.11
 - When WLAN provides hot spot coverage for WiMAX network, the following procedures apply.
 - After handover from 802.16 to 802.11 network, MS enters a semi-idle mode in 802.16m network, where no radio resource is assigned over 802.16m air interface. The serving 802.16m BS retains MS's idle mode context.
 - When MS becomes idle in 802.11 network, it can be always paged via 802.16 network.
 - When MS handover back to 802.16m network, network re-entry process to 802.16m is conducted.

Mobility between 802.16m and cdma2000

IW between 802.16m and cdma2000 (1)

- Providing solutions for interworking between 802.16m and cdma2000 will help service provider providing complementary service coverage to MS implementing two access technology.
- Since the radio technology used in cdma2000 and 802.16m is totally different from each other, although feasible, it may be difficult to make single RF to accommodate the need for both technology.
- Dual radio mode shall be supported for the interworking.
 - With dual radio mode, the MS connects to both 802.16m BS and cdma2000 BS simultaneously.
 - In order to reduce battery consumption, the second radio is only switched on when needed.

IW between 802.16m and cdma2000 (2)

- In the overlapping coverage area of WiMAX and cdma2000 networks, the BS broadcasts or multicasts the indication of neighboring target BS supporting cdma2000 in the neighbor advertisement.
- After detecting the indication, the dual mode MS may switch on the secondary radio to scan for cdma2000 network based on its PRL (Preferred Roaming List) and other policies defined.
- Furthermore, the serving BS may also provide the system information of the target BS in the neighbor advertisement, which can be used by MS to access and register with the target BS.
- The connection with the serving BS is kept alive until the handover completes. The connection between the MS and serving BS shall be released after handover completes.

Proposed text changes for 802.16m SDD

- Section 10.x: Inter-RAT mobility
- Section 10.x.2: Mobility between 802.16m and 3GPP2 cdma2000
- Section 10.x.2.1: Dual radio mode
 - In the overlapping area of WiMAX and cdma2000 networks, the serving BS advertises the presence indication or system information of neighboring BS supporting cdma2000.
 - The MS connects to both 802.16m BS and cdma2000 BS simultaneously. The second radio is only switched on when needed.
 - The network entry and connection setup processes with the target BS are all conducted over the secondary radio interface.
 - The connection with the serving BS is kept alive until handover completes.

Mobility between 802.16m and 3GPP

IW between 802.16m and 3GPP (1)

- The support for interworking between 802.16m and 3GPP is beneficial
 - for customers, being allowed to easily access to services offered by both technologies
 - for service providers, able to exploit advantages from both systems and complementary service coverage
- Difficult to make single RF to accommodate the need for both technologies
 - different air interface between 802.16m and 3GPP
 - objectives and requirements not always aligned in 3GPP and IEEE
- Dual radio mode shall be supported for the interworking
 - MS implementing two access technologies can connect to both 802.16m BS and 3GPP BS simultaneously.
 - In order to reduce battery consumption, the second radio is only switched on when needed.

IW between 802.16m and 3GPP (2)

- The BS may broadcast or multicast the presence of neighboring target 3GPP BS using neighbor advertisement.
- After detecting the indication, the dual mode MS may switch on the second radio to scan for 3GPP target networks, based on e.g. its local policies, subscription type and operator preferences.
- Furthermore, the serving BS may also provide the system information of the target BS in the neighbor advertisement, which can be used by MS to access and register with the target BS.
- The connection with the serving BS is kept alive until the handover completes. The connection between the MS and serving BS shall be released after handover completes.

Proposed text changes for 802.16m SDD

- Section 10.x: Inter-RAT mobility
- Section 10.x.3: Mobility between 802.16m and 3GPP
- Section 10.x.3.1: Dual radio mode
 - In the overlapping area of WiMAX and 3GPP networks, the serving BS advertises the presence indication or system information of neighboring BS supporting 3GPP technology.
 - The MS connects to both 802.16m BS and 3GPP BS simultaneously. The second radio is only switched on when needed.
 - The network entry and connection setup processes with the target BS are all conducted over the secondary radio interface.
 - The connection with the serving BS is kept alive until handover completes.