Project	**IEEE 802.16 Broadband Wireless Access Working Group** <http://ieee802.org/16>
Title	**Proposed SDD Text to support Preferred and Restricted Access to BSs'**
Date Submitted	**2008-10-31**
Source(s)	Kamran Etemad Xiangying Yang Intel Corporation Kamran.etemad@intel.com
Re:	"Support for Femtocells". IEEE 802.16m-08/040 Call for Comments and Contributions on Project 802.16m System Description Document (SDD) for Session 58.
Abstract	Provides SDD text to support network entry and re-entry based on logical preference and restrictions is multilayer networks, including femtocells.
Purpose	For SDD discussion in the IEEE 802.16m.
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Preferred and Restricted Access and Handover for Femtocells or Private Networks

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1 Background/Problem Statement:

WiMAX and other broadband access systems targeting IMT ADV are expected to support multi-layer cellular network in which mobile stations access to each layer should be optimized not only based on radio channel conditions and traffic load/type but also some logically defined preference and restrictions.

There are requirements in SRD stating:

- "The air interface shall support features needed to limit MS's scanning, cell re-/selection, access for network entry/re-entry and handover to femtocell BS's with restricted access if they are designated as part of closed user group. "
- "The air interface shall support preferred access, during the handover and power saving operations (e.g. Location Update and Idle Mode Exit) of MS's to their designated femto-BS's."

However, the BS's defined in IEEE802.16-REV2 are treated as being in the same layer and all access and handover decisions are purely made based on radio channel conditions.

2 Proposed Approach:

The proposed scheme suggests simple mechanisms to provide mobile stations with the "type" of a BS using broadcast channels or messages and it also suggests procedures/rules which the MS should apply in attempting to access and handover between cells.

In general multiple types of BS's can be defined:

- Public BS's with open access to all users, which may be deployed as overlay of Macrocells over Micro and Pico cells.
- Private BS's, typically but not necessarily femtocells, which provide restricted access to a closed user group (CSG). These BS's form a private network which consists of one or more BS in one area or sparsely located to different areas.
- Semi-Private BS's with restricted access to a semi-closed user group (sCSG) but available to

other users with lower priority on best effort basis.

Here BS refers to one RF carrier, so different carriers on the same cell site may be categorized as different types. The type classification based on CSG may be combined with other type definitions such as macro-cell, micro-cell etc. Also within each category multiple layers may be defined to further refine preferred access and handover between overlay and underlay BS's.

The proposed approach consists of a flexible and extendable type identification to indicate the Cell Types as listed above. The type can be broadcast in different ways:

1. On Preamble or PHY synchronization channel. This can be done by dividing preamble sequences into multiple disjoint groups one for each type. These groups should be predefined in the standards or be programmed into the device upon provisioning.
2. As a short Cell Type index in the primary or secondary Broadcast Control Channel (BCH) or Frame Header which is broadcast every frame or superframe.
3. A short Cell Type index for each BS's in handover neighbor list or mobile neighbor advertisement message. For further overhead reduction, the Cell Type for neighbor BS's may be sent only if the neighbor BS's type is different than the serving BS.

The preamble option is preferred as it is transmitted in every frame allowing for faster indication to MS if it should skip a BS and look for alterative BS's, which results in faster scanning and cell selection.

Although not optimized, the existing 802.16-REV2 standard defines an optional parameter called "Cell Type" for MOB-NBR-ADV or DCD message. While the standard currently does not define the proper usage of this parameter, one can use it to enable preferred and/or restricted access based on the same proposed principals. In this case acquiring DCD message takes more time, typically multiple frames.

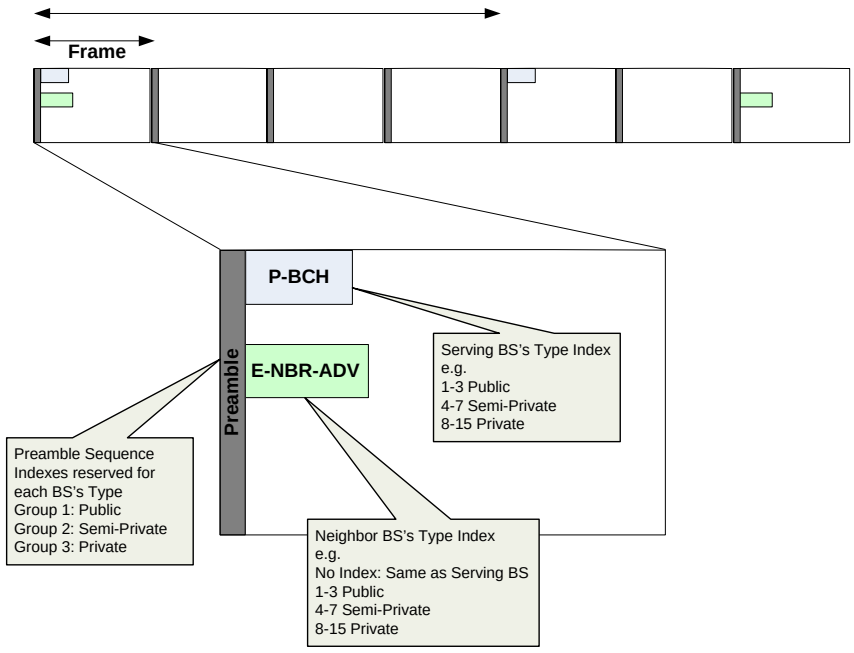


Figure xxx.1 Different broadcast scheme to indicate BS's type.

Using one or combination of the above broadcast mechanisms the MS's behavior should be as follows:

For initial cell selection and network entry:

The RF carrier scanning may be performed according preferred channel list for each spectrum, if available and provisioned in the MS.

Within each RF Channel the MS scans for all preambles, and checks for BS's types using indications on the SCH, PBCH or other relevant broadcast Information. The 802.16m MS shall apply the following pre-define priority rules if enabled by the network:

- *Preferred Access:* If the MS belongs to a Closed User Group (CSG) of any femtocell it should first scan for such preferred BS's, i.e. frequencies, preamble sequences and BSID's, which are provisioned in the device for its preferred/restricted access. The MS should access one of the BS's offering service to the CSG to which the MS is a member of, as long as they provide sufficient coverage and service. The MS may select another BS only if it can not find a BS in its Private Network. For example a MS belonging to the CSG of a home femtocell should look for frequency and preamble used in that BS before looking for other BS's.
- *Restricted Access:* A MS who is not part of a CSG of a Private BS should not attempt access or handover to that BS. Such MS should also avoid accessing semi-Private BS's unless there is no other public BS available or if the MS needs access to emergency services subject to regulation requirements.

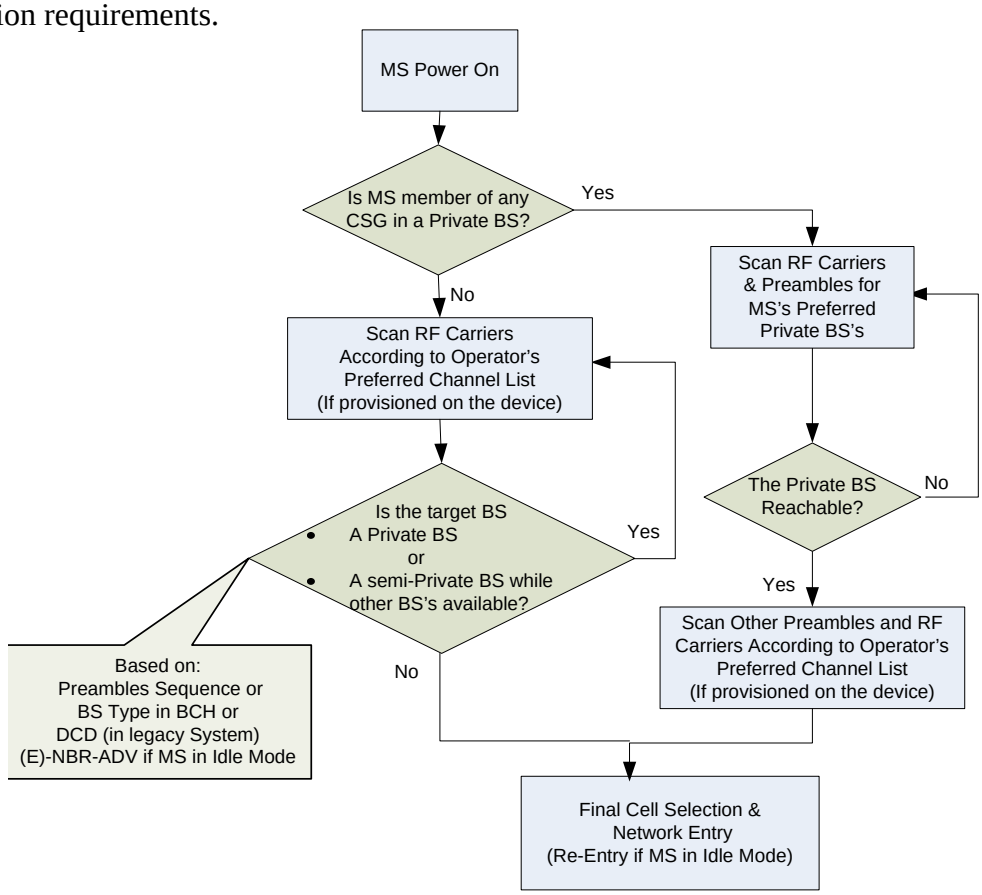


Figure xxx-2: MS Initial Preferred/Restricted Access to Private, Semi-Private and Public BS's.

For Handover and Network Re-entry:

Each BS broadcasts the list and parameters associated with its neighbor BS's to help MS in scanning and identifying hand over candidates. The BS also broadcasts the "types" of each BS in the neighbor list, e.g. in Enhanced (E)-NBR-ADV message . While no type indication for a neighbor would imply the neighbor BS having the same type as the serving BS, the specific type indexes would include indications for Public, Private and Semi-private BS's.

- *Restricted Handover:* The MS who is not a member of CSG for any Private BS should not scan such BS's and focus only on BS's which are Public. The MS may also scan semi-Public BS's in the neighbor list only if it can not find a Public BS in the list with acceptable coverage. The MS should only attempt handover in connected mode or network re-entry in idle mode to a Private BS only the MS is a member of CSG for that Private BS.
- *Preferred Hanover:* The MS who is a member of CSG for a Private or Semi-Private BS or group of such BS's, should first scan for those BS's if present in the neighbor list and then other BS's. Such MS should then request preferred handover or attempt for network re-entry to one of its private BS's or semi-Private BS's unless the signal from such BS's is not sufficient for service, in which case the MS may request hand over to re-enter the network through other public BS's. Similarly a MS served by one of its private BS's shall not request for handover to BS outside its private BS network unless there is no coverage available from any of its private BS's.

Up on provisioning of the MS when the MS is added to the CSG of a private BS (femtocell) network, the list of BSID's of that private BS network and their corresponding neighboring public BS's (Macrocells) may also be stored and updated in the network and/or on the MS. In this case when the MS is in one of Public BS's (macrocells) neighboring one of its private BS's (home femtocells), even if the private BS is not listed in E-NBR-ADV of the public BS, the MS may proactively trigger scanning and reporting of measurements for such nearby home femtocells to the serving public BS. When an MS who is a member of a private BS network is in connected mode in a nearby public BS, the network may command the MS through unicast messages to scan for it private BS's if not already listed in it E-NBR-ADV message.

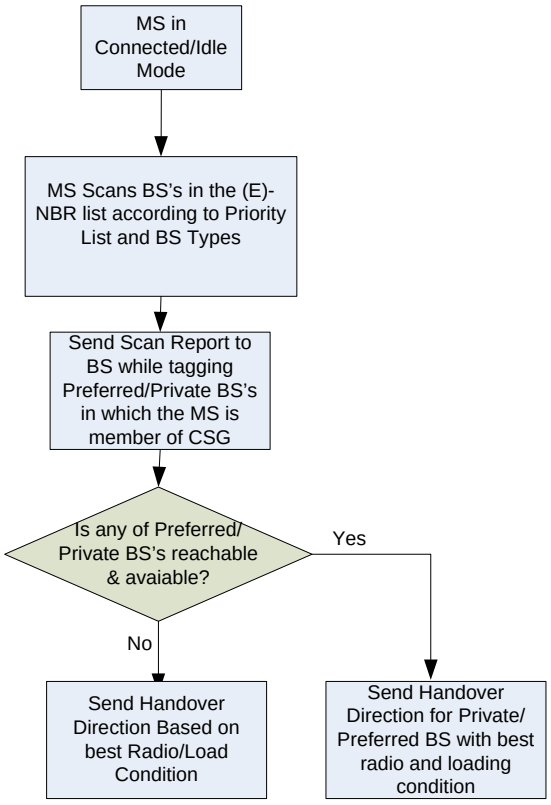


Figure xxx-3: MS Preferred/Restricted Hanover and Re-entry to Private, Semi-Private and Public BS's.

3 Text proposal

Add the following text into Section 17 of SDD:

---------- Text Start ----------

17.x Preferred and Restricted Access to Private Femtocell Networks

In 802.16m different types of BS's can be defined:

- Public BS's with open access to all users, which may be deployed as overlay of Macrocells over Micro and Pico cells.
- Private BS's, typically but not necessarily femtocells, which provide restricted access to a closed user group(CSG). These BS's form a private network which consists of one or more BS in one area or sparsely located to different areas.
- Semi-Private BS's with restricted access to a semi-closed user group (sCSG) but available to other users with lower priority on best effort basis.

Here BS refers to one RF carrier, so different carriers on the same cell site may be categorized as

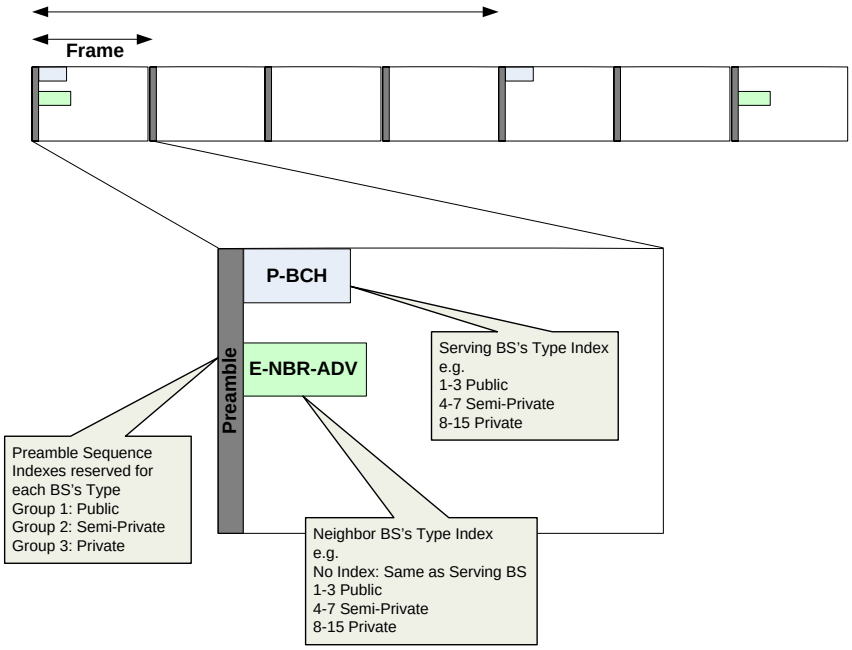
different types. The type classification based on CSG may be combined with other type definitions such as macro-cell, micro-cell etc. Also within each category multiple layers may be defined to further refine preferred access and handover between overlay and underlay BS's.

The proposed approach consists of a flexible and extendable type identification to indicate the Cell Types as listed above. The type can be broadcast in different ways:

1. On Preamble or PHY synchronization channel. This can be done by dividing preamble sequences into multiple disjoint groups one for each type. These groups should be predefined in the standards or be programmed into the device upon provisioning.
2. As a short Cell Type index in the primary or secondary Broadcast Control Channel (BCH) or Frame Header which is broadcast every frame or superframe.
3. A short Cell Type index for each BS's in handover neighbor list or mobile neighbor advertisement message. For further overhead reduction, the Cell Type for neighbor BS's may be sent only if the neighbor BS's type is different than the serving BS.

The preamble option is preferred as it is transmitted in every frame allowing for faster indication to MS if it should skip a BS and look for alterative BS's, which results in faster scanning and cell selection.

Although not optimized, the existing 802.16-REV2 standard defines an optional parameter called "Cell Type" for MOB-NBR-ADV or DCD message. While the standard currently does not define the proper usage of this parameter, one can use it to enable preferred and/or restricted access based on the same proposed principals. In this case acquiring DCD message takes more time, typically multiple frames.



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17.x.1 For initial cell selection and network entry:

The RF carrier scanning may be performed according preferred channel list for each spectrum, if available and provisioned in the MS.

Within each RF Channel the MS scans for all preambles, and checks for BS's types using indications on the SCH, PBCH or other relevant broadcast Information. The 802.16m MS shall apply the following pre-define priority rules if enabled by the network:

- *Preferred Access:* If the MS belongs to a Closed User Group (CSG) of any femtocell it should first scan for such preferred BS's, i.e. frequencies, preamble sequences and BSID's, which are provisioned in the device for its preferred/restricted access. The MS should access one of the BS's offering service to the CSG to which the MS is a member of, as long as they provide sufficient coverage and service. The MS may select another BS only if it can not find a BS in its Private Network. For example a MS belonging to the CSG of a home femtocell should look for frequency and preamble used in that BS before looking for other BS's.
- *Restricted Access:* A MS who is not part of a CSG of a Private BS should not attempt access or handover to that BS. Such MS should also avoid accessing semi-Private BS's unless there is no other public BS available or if the MS needs access to emergency services subject to regulation requirements.

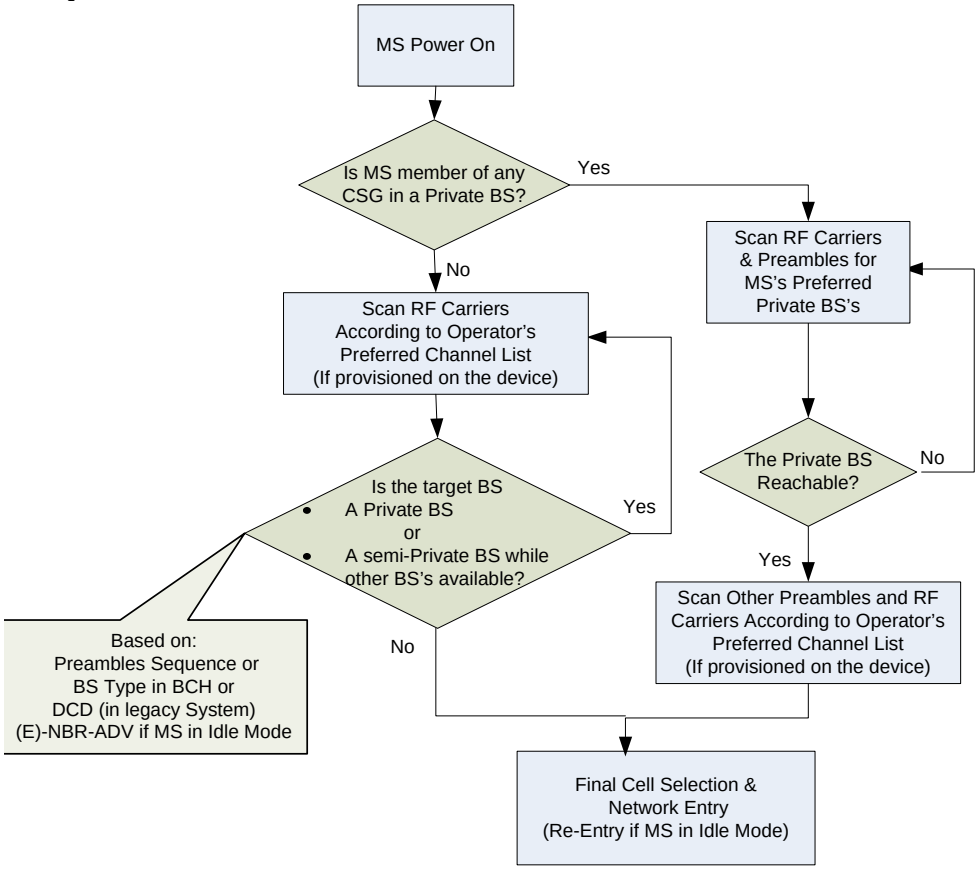

Figure xxx-2: MS Initial Preferred/Restricted Access to Private, Semi-Private and Public BS's.

17.x.2 For Handover and Network Re-entry:

Each BS broadcasts the list and parameters associated with its neighbor BS's to help MS in scanning and identifying hand over candidates. The BS also broadcasts the "types" of each BS in the neighbor list, e.g. in Enhanced (E)-NBR-ADV message. The specific type indexes would include indications for Public, Private and Semi-private BS's.

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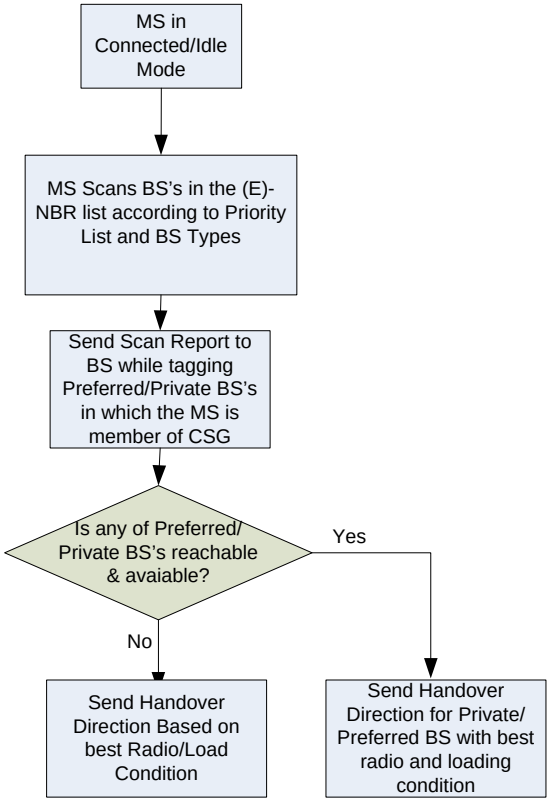

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