Project	**IEEE 802.16 Broadband Wireless Access Working Group** <http://ieee802.org/16>	
Title	**Overview of SON and Femtocell support**	
Date Submitted	**2008-10-31**	
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Re:	IEEE 802.16m-08/003r5: **TGm SDD: Femtocells**	
Abstract	This contribution provides ToC and brief description for each ToC on SON and Femtocell support	
Purpose	Discuss this contribution and adopt the proposed text.	
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Overview of SON and Femtocell Support

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Introduction

This contribution provides the ToC of SON and Femtocell together with brief description for each subsection.

Proposed text

==========Start of Text==========

17 Support for Self-organization networks and Femtocell

17.1 Types of Base stations

Beside Macro BS, following types of cells are defined and considered in this section.

Femtocell BS: A Femtocell BS is a low power BS, typically installed by a subscriber in his/her home or SOHO to provide access to closed or open group of users as configured by the subscriber and/or the access provider.

Hotzone BS: Hotzone BS is a low to mid power Femtocell BS, installed by an operator in the area of large traffic to provide access to public users and increase system capacity. Its coverage may overlap with macro BS.

17.2 Deployment scenario

Various deployment scenarios are considered based on following parameters.

Frequency: Femtocell BS and Hotzone BS typically operate in licensed spectrum and may use the same or different frequency as macro-cells.

Backhaul: Femtocell BSs use broadband connection such as cable or DSL for backhaul. Hotzone BSs use both broadband connection or dedicated leased line at operator's policy.

Installation location: Hotzone BSs are usually installed outside building to provide better coverage. Femtocell BSs are usually installed inside building.

Closed user group (CUG) access: Access to a group of Femtocell BSs can be allowed only for some closed user or MSs group. Unauthorized users or MSs should not try to access the Femtocell BSs and cause additional air-interface traffic to access the Femtocell BSs. Femtocell BSs belonging to a specific closed user group may not be installed in geographical vicinity. Macro BS can provide to the MS the information of closed user group deployed in the macro BS cell coverage.

Mobile speed: The MSs using access in a Femtocell and a Hotzone cell are typically stationary or moving at low (i.e. pedestrian) speed, even though higher speed might be supported in a Hotzone cell because the Hotzone BS can be installed outside a building.

17.3 PHY and MAC level identifier

17.3.1 PHY level cell identifier

S-SCH provides N different S-SCH sequences to identify different cells in PHY level. Different S-SCH sequences are grouped to groups. A S-SCH sequence in a group is assigned to a specific cell type: Macro cells, Hotzone cells, or Femto cells. It enables MSs to identify cells in PHY level and makes efficient network access. A S-SCH group can be further sub-grouped to identify whether the BS is closed user group or non-closed user group Femtocell BS.

17.3.2 MAC level identifier

Due to the limited number of PHY level identifiers, MAC level identifier is needed for the unique identification of a BS. For a closed user group access, the MAC level identifier should provide information on the closed group for an MS to decide an access to the BS with the MAC level identifier. The definition of CUG identity should be flexible enough to incorporate various deployment scenarios like a CUG for a single Femtocell BS deployment as in home or a CUG for multiple Femtocell BS deployment either in geographical vicinity or geographically dispersed.

17.4 Self organization functions

Self organization functions are applied to all types of BSs to automate the configuration of system parameters of BSs and to optimize its operational parameters. Most of functions are performed in each BS in cooperation with core networks or neighboring BSs. Furthermore, 16m MS can measure neighbor BSs system and operational parameters in solicited or unsolicited manner and report the measurements to the serving BS.

17.4.1 General SON Procedure

The flow chart of the IEEE 802.16m Self Organizing Network (SON) is shown in Figure 1. It consists of the following steps: self configuration, cell initialization, neighbor discovery, and self optimization. The last two steps might be repeated periodically or on-demand.

Self Configuration: At the first time of power on, the BS shall first complete self configuration with the core network. The BS should also establish synchronization within other BS in the network if required and supported.

Cell Initialization: The BS shall initialize basic MAC and PHY parameters before it could communicate with MSs in its cell.

Neighbor Discovery: The BS should command MSs to make measurement with or without cell-wide quite period, control the procedure for MS to report any neighbor BS discovered.

Self Optimization: The BS could fine tune some system-configuration parameters for load balancing, interference mitigation, handover, QoS, etc.

Self Maintenance: The BS should do self optimization periodically or on-demand, as well as self monitoring and self healing.

The general SON procedure also applies for BS, though the details might be different. MSs shall support measurement and reporting so that the BS could complete the entire SON procedure.

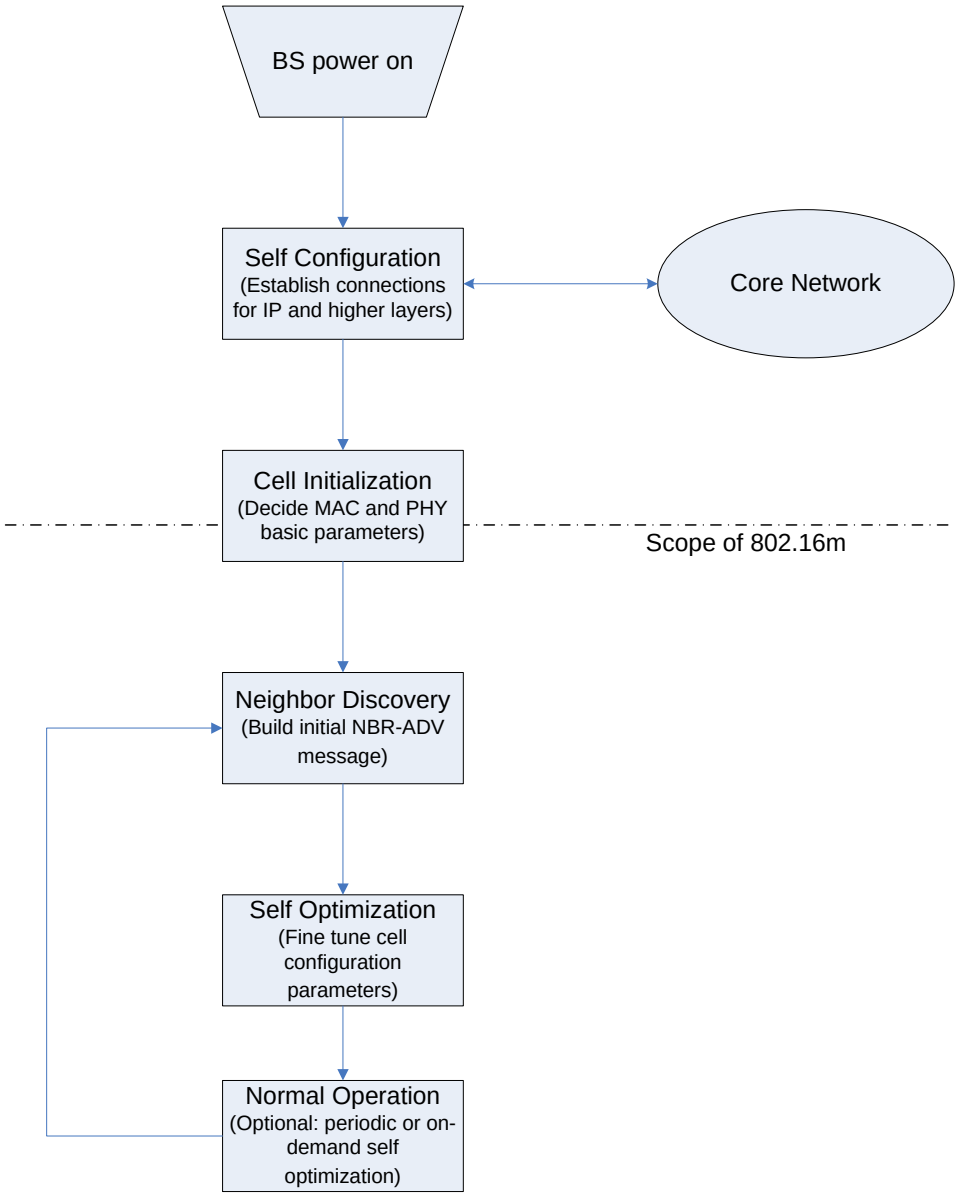

Figure 1. SON Procedures

17.4.2 MAC Management Messages for Supporting SON

16m MS should support SON by measuring neighbor BSs system and operational parameters and reporting the measurements to the serving BS. The BS may broadcast a list of known neighbor BSs in order to reduce the amount of measurement report.

17.4.3 Cell ID selection for Femtocell BS and Hotzone BS

The set of Cell ID for Femtocell BS shall be disjoint with the set used by macro BSs. Neighbor Femtocell BS

shall use distinct Cell ID. The Femtocell BS shall use the Cell ID if the ID is assigned by the core network. Otherwise, the Femtocell BS shall first try to collect what Cell IDs are being used by neighbor Femtocell BSs. It could try to scan signals from neighbor Femtocell BSs. Then, the Femtocell BS randomly picks up a Cell ID that does not collide with neighbor Femtocell BSs.

If the Cell ID is not assigned by the core network, the Femtocell BS shall periodically evaluate whether any neighbor Femtocell BSs are using the same Cell ID. When it decides to change its Cell ID, the Femtocell BS shall inform the MSs of the new Cell ID before it is applied to the cell in order to smoothly resolve the Cell ID collision.

The same procedure applies for macro BSs, and Hotzone BSs if their Cell IDs are not assigned by the operator.

17.5 Operation mode

A Femtocell BS has two operation modes: one is normal mode like a macro BS does, the other is low-duty mode when the Femtocell BS transmits once every *K* superframes.

As long as there is at least one MS operating in active mode, the Femtocell BS shall operate in normal mode. If there is no MSs operating in the cell in either active or idle mode, the Femtocell BS should operate in low-duty mode. The Femtocell BS shall switch to normal operation mode whenever it receives network entry request, HO request, or paging request. The Femtocell BS could operate in either mode if all the MSs in the cell are in idle mode.

17.6 Idle mode operation

The Femtocell BS could page an MS selectively based on the knowledge of pre-registration of the MSs, the bookkeeping of the MSs in idle mode, etc.

17.6 Handover support

17.6.1 Neighbor list management and BS detection

Femtocell/Hotzone BSs information may not be provided in neighbor list of macro/Hotzone/Femtocell BS. When no information is available in neighbor list, MS needs to detect Femtocell/Hotzone BSs and request serving BS to provide information on the BSs. When neighbor list provides information of a Femtocell/Hotzone BS, the information may include the location of the BS. The MS capable of location based service can exploit the information to detect BS efficiently. Femtocell/Hotzone BSs can transmit a special signal to help MS to detect the BS.

17.6.2 Handover

16m supports the following handover scenarios:

17.6.3 Macro BS to Femtocell/Hotzone BSs

A macro BS does not include Femtocell BS in the regular neighbor list message used for Macro-to-Macro HO. On the request of an MS, the serving macro BS may transmit the system information of target Femtocell/Hotzone BSs in support for the MS to handover to a Femtocell or Hotzone. Inclusion of the information of Hotzone BSs in the regular neighbor list message is FFS.

17.6.4 Femtocell/Hotzone BSs to Macro BS

The Femtocell/Hotzone BS could obtain the list of neighbor macro BSs from the core network, and broadcasts

the neighbor list messages periodically or only on-demand when there is HO request from an MS.

17.6.5 Femtocell/Hotzone BSs to Femtocel/Hotzone BSs

Femto-to-Femto HO could work just like a regular Macro-to-Macro HO. Alternatively, the Femtocell/Hotzone BS could broadcast the neighbor list messages only when there is HO request from an MS.

17.7 Cell detection

Femtocell BS can transmit control signal in the macro BS's FA regardless of Femtocell BS's FA: whether it uses the same FA or different FA as the macro BS. If an MS that is in communication with the macro BS receives the control signal from the Femtocell BS, it identifies the existence of the Femtocell BS. The control signal contains the information necessary for the MS to perform HO operation as well as the on/off state of the Femtocell BS. The MS can then wakeup the Femtocell BS or initiate HO to the Femtocell BS.
The same scheme can be applied to Hotzone BS

17.8 Hotzone support

A hot zone BS can reserve resource in cooperation with macro BS where the hot zone is installed. The reserved resource can be used to keep the connection between an MS in the hot zone coverage and the macro BS. MS can report macro BS to allocate the reserved resource in hot zone.

==========End of Text==========