IEEE P802.16q AWD

DRAFT Amendment to IEEE Standard for Local and metropolitan area networks

Part 16: Air Interface for Broadband Wireless Access Systems

Amendment for Multi-tier Networks

Sponsor

LAN/MAN Standards Committee
of the
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Introduction

This introduction is not part of IEEE Std 802.16q, IEEE Standard for Interface for Broadband Wireless Access Systems - Amendment: Enhancements to Support Multi-tier Networks.

This amendment specifies support for Multi-tier Networks. As of the publication date, the current applicable version of IEEE Std 802.16 is IEEE Std 802.16-2012, as amended by IEEE 802.16n-2013.

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This document was developend by the IEEE 802.16 Working Group on Broadband Wireless Access, which develops the WirelessMAN® Standard for Wireless Metropolitan Area Networks.

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NOTE-The editing instructions contained in this amendment define how to merge the material contained herein into the existing base standard IEEE Std 802.16. The editing instructions are shown in ***bold italic***. Four editing instructions are used: ***change***, ***delete***, ***insert***, and ***replace***. ***Change*** is used to make small corrections in existing text or tables. The editing instruction specifies the location of the change and describes what is being changed by using strike through (to remove old material) and underscore (to add new material). ***Delete*** removes existing material. ***Insert*** adds new material without disturbing the existing material. Insertions may require renumbering. If so, renumbering instructions are given in the editing instruction. ***Replace*** is used to make large changes in existing text, subclauses, tables, or figures by removing existing material and replacing it with new material. Editorial notes will not be carried over into future editions because the changes will be incorporated into the base standard.

1. Overview

Insert new subclause 1.9

1.9 Support for Multi-tier Networks

2. Normative references

3. Definitions

4. Abbreviations and acronyms

6. MAC common part sublayer

6.3.2 MAC PDU formats

10. Parameters and constants

11. TLV encodings

14. Management interface and procedures

Insert the following new subclause 17

17. Support for Multi-tier Networks

17.1 General

17.2 Mobility management

17.2.1 Handover (HO)

This subclause contains the procedures performed during HO. The HO procedures shall be the same as described in 6.3.20 with the exception of procedures specified in this subcluase.

17.2.1.1 Network topology acquisition

17.2.1.1.1 Network topology advertisement

A BS shall periodically broadcast the system information of the neighboring BSs using an MOB_NBR-ADV message. A broadcast MOB_NBR-ADV message may include the information of Open Subscriber Group (OSG), but shall not include information of neighbor Closed Subscriber Group (CSG) BSs.

A S-BS may unicast the MOB_NBR-ADV message to an MS upon reception of TBD message or in an unsolicited manner. When the MS needs to obtain the system information of CSG or OSG BS, it may indicate it through the TBD message. Upon receiving this TBD message, the S-BS may send the neighboring CSG or OSG BS information through the MOB_NBR-ADV message to the MS in an unicast manner.

17.2.1.1.2 MS scanning neighbor small BSs

17.2.1.2 Trigger condition definitions

17.2.1.3 HO decision

17.2.1.4 HO from Macro BS to small BS

[*Notes: this subcluase includes HO from Macro BS to OSG small BS as well as HO from Macro BS to CSG small BS*]

17.2.1.5 HO from small BS to Macro BS

17.2.1.6 HO between small BSs

[*Notes: this subcluase includes HO between OSG small BSs as well as HO from OSG small BS to CSG small BS*]

17.2.2 Idle mode

All types of small BSs shall support idle mode by use of the same procedures as specified in 6.3.22 for for macro BSs with the exception of procedures described in this subcluase.

A CSG-Closed BS shall not broadcast paging for a non-member MS.

17.3 Interference management

In multi-tier networks, a small cell overlaid by macro cell(s) may cause severe cross-tier interference to the macro cells, vice versa. A small cell may also cause cross-tier interference to macro cell(s), which are even not overlaying the small cell but adjacent to it, vice versa. In addition, a small/macro cell may generate co-tier interference to adjacent small/macro cell(s). In order to mitigate such interference among cells, mechanisms for resource management and multi-BS MIMO are provided in perspectives of interference mitigation.

17.3.1 Resource Management

The interference between small cells, and between macro cells and small cells may be mitigated by radio resource reservation and resource sharing using time-division and/or frequency-division resource management and/or downlink power control.

17.3.1.1 Fractional Frequency Reuse (FFR)

17.3.1.1.1 DL FFR

DL FFR allows different frequency reuse factors, different frequency partitions for each frequency reuse factor, and different transmit power levels on each frequency partition to enhance resource reuse and network throughput.

17.3.1.1.2 UL FFR

UL FFR allows different frequency reues factors, different frequency partitions for each frequency reuse factor, and different maximum per-tone power levels on each freqeuency partition to enhance resource reuse and network throughput.

17.3.1.2 Time-Division Multiplexed Resource Scheduling

A BS may not allocate some OFDMA symbols to any MS based on coordination among BSs.

17.3.1.3 DL Power Control

The BS may control the transmit power to mitigate interference.

17.3.1.4 Trigger Conditions

A S-BS may send the BS_ID(s) to a subordinate MS and request the MS to scan the corresponding BS(s). The MS scans and reports the channel measurement result to the S-BS, if certain conditions are met. Based on the channel measurement report from the MS, the S-BS and its interfering BS(s) may perform resource management for interference mitigation.

17.3.2 Multi-BS MIMO

Multi-BS MIMO techniques improve sector throughput and cell-edge throughput through multi-BS cooperative signaling. These include DL single-BS precoding with multi-BS coordination and DL/UL multi-BS joint processing.

17.3.2.1 DL Multi-BS MIMO

17.3.2.1.1 DL single-BS precoding with multi-BS coordination

When DL single-BS precoding with multi-BS coordination is enabled, interference from adjacent BSs is mitigated by coordinating the precoders applied in the adjacent BSs.

17.3.2.1.2 DL multi-BS joint processing

When DL multi-BS joint processing is enabled, radio resource allocation, data mapping, and pilot pattern allocation shall be aligned among coordinating BSs. The same data packet is transmitted by the coordinating BSs on the same time and frequency resources.

17.3.2.1.3 Channel feedback for closed-loop transmit precoding

17.3.2.1.3.1 Sounding-based feedback

[*Note: In this subclause, operations of sounding-based feedback will be provided to support DL multi-BS MIMO.*]

17.3.2.1.3.2 MIMO-coefficeint-based feedback

[*Note: In this subclause, operations of MIMO-coefficient-based feedback will be provided to support DL multi-BS MIMO when MIMO midamble is supported.*]

17.3.2.1.3.3 Codebook-based feedback

[*Note: In this subclause, operations of codebook-based feedback will be provided to support DL multi-BS MIMO when MIMO midamble is supported.*]

17.3.2.1.3.4 Antenna-selection/grouping-index-based feedback

[*Note: In this subclause, operations of antenna-selection/grouping-index-based feedback will be provided to support DL multi-BS MIMO when MIMO midamble is supported.*]

17.3.2.1.4 Channel quality measurement and report

An S-BS may request a subordinate MS to scan the neighbor BS(s) which are participating in cooperative transmission. The MS scans and reports the channel measurement result to the S-BS, if certain conditions are met.

17.3.2.1.5 Trigger conditions

[*Note: In this subclause, trigger conditions for DL multi-BS MIMO will be provided.*]

17.3.2.2 UL Multi-BS MIMO

17.3.2.2.1 UL multi-BS joint processing

When UL multi-BS joint processing is enabled, radio resource allocation, data mapping, and pilot pattern allocation shall be aligned among coordinating BSs. The same data packet is received by the coordinating BSs on the same time and frequency resources.

17.3.2.2.2 Trigger conditions

[*Note: In this subclause, trigger conditions for UL multi-BS MIMO will be provided.*]

17.4 BS power management

17.4.1 General Description

This subclause describes the power management functions of base stations for energy efficient operation. The power management function under this subclause details not only operation of single base station but also cooperative operations of adjacent base stations.

Base stations including macro and small base stations always operate in Normal mode when the base station power management is not supported at the base stations.

Base stations supporting the base station power management in this subclause can operate in one of the power saving operation modes such as Duty-cycled mode or Standby mode when the operation condition is met.

17.4.2 Duty-cycled Mode

Duty-cycled mode is one of power saving operation mode in which a base station changes its operation state between active period and inactive period. A base station in the inactive period does not transmit/receive data to/from its subordinate mobile stations. A base station may enter Duty-cycled mode when the base station has small number of subordinate mobile stations and small traffic demands from the mobile stations.

The base station in the Duty-cycled mode goes into the inactive period when all of its associated mobile stations are in unavailability interval. The inactive period of the base station shall be informed to the mobile stations to prevent UL attempts of mobile stations during inactive period of the base station.

To increase the inactive period of the base station (i.e. a common unavailability interval of mobile stations), base station may adjust the configurations of Sleep mode (i.e. start frame number, window sizes, etc.) of associated mobile stations.

17.4.3 Standby Mode

Standby mode is an another power saving operation mode in which a base station deactives its air interface to conserve energy consumption. A base station may enter Standby mode when the base station has no subordinate mobile stations.

Base stations in Standby mode wake up (i.e. change its operation mode into the Normal mode) when predefined inactive period timer expires or the network requests changes of state of the base station.

17.4.4 Cooperation of Base Stations for Power Management

The base stations cooperate with other adjacent base stations and/or NCMS (Network Control and Management System) to increase the power saving performance and to prevent the performance degradation (e.g. throughput decreases and coverage holes) due to the power saving operation of base stations.