Project	**IEEE 802.16 Broadband Wireless Access Working Group**
Title	**Broadband Wireless Access (BWA) System Overview (first draft)**
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Re:	This document has been prepared in response to the request at meeting #4, as noted in the minutes of the Co-existence Task Group.
Abstract	This document is a first draft System Overview for consideration as section 2 of the "Recommended Practices to Facilitate the Co-existence of Broadband Wireless Access (BWA) Systems"
Purpose	For discussion at session #5 and consideration for inclusion in section 2 of the Recommended Practices document.
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Broadband Wireless Access (BWA) System Overview (first draft)

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2. System Overview

Broadband Wireless Access (BWA) is a term referring to a range of fixed radio systems, used primarily to convey broadband services between users' premises and core networks. The term "broadband" is usually taken to mean the capability to deliver significant bandwidth to each user (in ITU terminology, greater than around 1.5 or 2 Mbits/s, though many BWA networks support significantly higher data rates). The networks operate transparently, so that users are not aware that services are delivered by radio. There is usually no direct user-to-user traffic. Such connections, if required, are made via a core network.

A typical BWA network supports connection to many user premises within a radio coverage area. It provides a pool of bandwidth, shared automatically amongst the users. Demand from different users is often statistically of low correlation, allowing the BWA network to deliver significant bandwidth-on-demand to many users, with a high level of spectrum efficiency.

The range of applications is very wide and evolving quickly. It includes voice, data and entertainment services of many kinds. Each subscriber may require a different mix of services, which is likely to change rapidly as connections are established and terminated. Traffic flow may be uni-directional, asymmetrical or symmetrical, again changing with time.

These radio systems compete with other wired and wireless delivery means for the "last mile" connection to services. The use of radio brings a number of benefits, including rapid deployment and relatively low "up-front" costs.

2.1 Co-existence between systems

IEEE through the 802.16.1 project is standardising the air interface (Physical and MAC layers) of a BWA system. However, the allocation of spectrum is not uniquely associated with 802.16.1 systems and so other multipoint solutions are likely to share the various frequency bands set aside for these types of service. Thus, arrangements for satisfactory co-existence of like and unlike systems are required, meaning that the mutual interference between them is low enough to have an acceptably small effect on performance.

Co-existence between the various like and unlike systems is a complex subject, requiring careful analysis on a case by case basis. Terrain effects are highly variable between system implementations. Fading due to rain and other atmospheric effects has to be taken into account. Statistical methods may be used to predict the probability that a certain level of interference will be exceeded. Despite these complexities, a number of recommendations and guidelines can be developed to assist planners to achieve acceptable levels of inter-system interference and make good use of the available spectrum. Such recommendations and guidelines are provided in this document.

The two main co-existence cases are:

(1) where two systems operate on the same radio channels, they must be geographically spaced to reduce mutual interference to acceptable levels

(2) where two systems are deployed in overlapping areas, they must operate on radio channels that are sufficiently frequency-spaced to reduce mutual interference to acceptable levels

2.2 General System Diagram

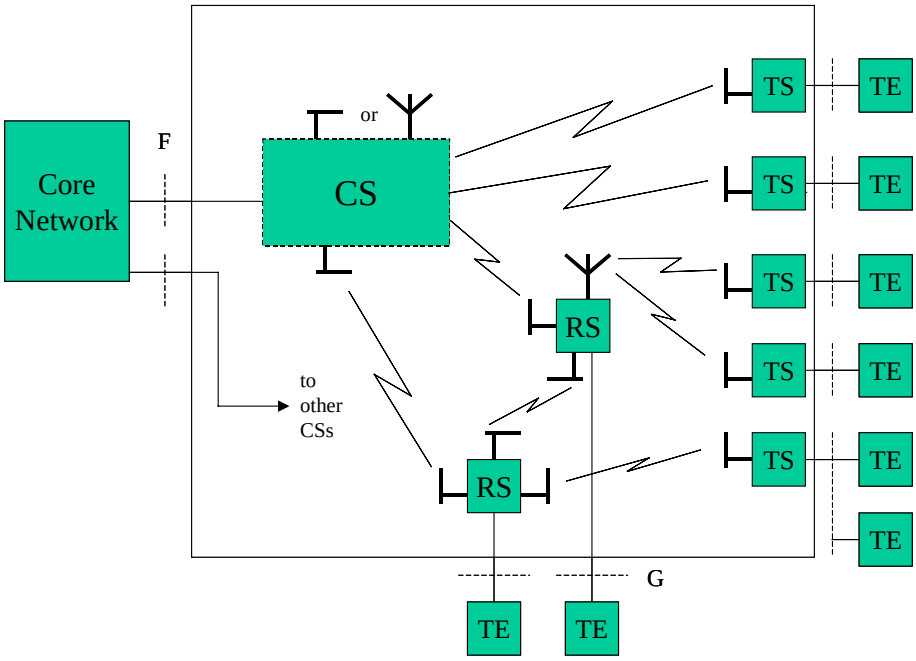

Fig. XX General System Diagram

Key to diagram

CS = Central Station (hub of a PMP system, or access point of a MP-MP system)
A CS may, optionally, be divided into two parts – control/ interface part and radio part. One control part could support one or a number of radio parts. The interface between the parts is not standardised.
TS = Terminal Station
TE = Terminal Equipment (a TS could be connected to more than one TE, dependent on the services required at the user's premises). The TE/TS interface could be standardised (e.g. telephone interface) or proprietary.
RS = Repeater Station, with optional connection to local terminal equipment


Directional antenna


Omni-directional or sectored antenna

Fig.XX shows a generalised diagram of a BWA network. A system comprises at least one central station (CS) and a number of terminal stations (TS). Systems may also optionally deploy repeater stations (RS). The boundary of the BWA network is at the interface points F and G. The F interfaces are generally standardised, being points of connection to core networks. The G interfaces, between terminal stations and terminal equipment may be standardised or proprietary.

2.3 System Architecture

BWA systems are generally of multipoint architecture. The term multipoint includes Point to Multipoint (PMP) and Multipoint-to-Multipoint (MP-MP). The 802.16.1 project will define a PMP system with hub stations and end user stations communicating over a fully specified air interface. A similar PMP standard is in preparation in Europe, in ETSI Project BRAN, which is producing an interoperability standard titled “Hiperaccess”. Co-existence specifications for this project are being prepared by the ETSI TM4 committee. In addition, there are a number of proprietary BWA systems, for which the air interface is not standardised.

2.3.1 PMP Systems

PMP systems comprise hub stations, terminal stations and, in some cases, repeaters. Hub stations have relatively wide beam antennas, divided into one or several sectors to provide 360 degree coverage. To achieve complete coverage of an area, more than one hub station may be required. The connection between hubs is not part of the BWA network itself, being achieved by use of radio links, fibre optic cable or equivalent means. Routing to the appropriate hub is a function of the core network. Terminal stations use directional antennas, facing a hub and sharing use of the radio channel. This may be achieved by various access methods, including frequency division, time division or code division.

2.3.2 MP-MP Systems

Multipoint-to-multipoint (MP-MP) systems have the same functionality as PMP systems. Hub stations are replaced by access points, which provide connections to core networks on one side and radio connection to other stations on the other. A subscriber stations may be a radio terminal or (more typically) a repeater with local traffic access. Traffic may pass via one or more repeaters to reach a subscriber. Antennas are generally narrow beam directional types. By providing means for remote alignment of antennas and suitable network configuaration tools, it is possible to achieve high levels of coverage and spectrum efficiency.

2.3.3 Repeaters

Some systems deploy repeaters. In a PMP system, repeaters are generally used to improve coverage to locations where the hub(s) have no line of sight. A repeater relays information from a hub to one or a group of subscribers. It may also provide a connection for a local subscriber. In MP-MP systems, most stations are repeaters, which also provide connections for local subscribers.