Project	IEEE P802.16 Broadband Wireless Access Working Group
Title	Contribution to the Systems Document in the Issue of 802.16 Services and Applications.
Date Submitted	18 June,1999
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Re:	This is a response to Call For Contributions (802.16sc-99/12), Issue # 2, Services and Applications
Abstract	Broadband fixed wireless access systems are being planned for delivery of voice, data, and video services to subscribers. The planned data rates range from POTS (64 kbps) to over DS3 (45 Mbps) rates. This document proposes some of the services and applications that the customers of Bosch Telecom consider important for business success in services such as the local multipoint distribution service (LMDS).
Purpose	The author offers the text and figures for inclusion in various 802.16 documents including the systems requirements document.
Notice	
Release	

Contribution to the Systems Document in the Issue of 802.16 Services and Applications.

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Abstract

Broadband fixed wireless access systems are being planned for delivery of voice, video, and data services to subscribers. The planned data rates range from POTS (64 kbps) to over DS3 (45 Mbps) rates. This document proposes some of the services and applications that the customers of Bosch Telecom consider important for business success in services such as the local multipoint distribution service (LMDS).

802.16 Services and Applications

Systems that implement the 802.16 protocol are intended for delivery of high quality voice, data, and video services using fixed microwave radios. An 802.16 system provides the last few miles of outside plant transmission and distribution. An 802.16 system provides short-haul transmission for such wired distribution systems as digital loop carriers (DLCs), private branch exchanges (PBXs), and direct in-building wired distribution networks (twisted pair or coax). Systems implementing the 802.16 protocol also provide short-haul transmission capability for wireless distribution systems such as cellular, PCS, or wireless LANs (802.11).

For voice applications, 802.16 equipment normally transports a toll quality (64 kbps) digitized and time division multiplexed (TDM) version of an analog voice signal rather than directly transmitting an analog signal. Telecommunications equipment such as PBXs or DLCs often digitize and multiplex several voice signals before transmission by the 802.16 equipment which provides wireless versions of connection oriented T1, E1, or other wide area network (WAN) protocols. Equipment implementing the 802.16 protocol may also perform a multiplexing function that combines several low data rate subscriber connections into a small number of high data rate network connections. Performance requirements such as minimum delay and jitter place stringent real time transmission requirements on 802.16 equipment when used for voice applications and for emulating WAN protocols.

Data services are often transported using WAN protocols such as T1, E1, DS3, or OC3 at the physical layer. Systems implementing the 802.16 protocol are ideally suited to provide wireless versions of these protocols. An 802.16 system can also be part of a local area network (LAN) and use LAN protocols especially when logical sub-nets separate groups of subscribers.

Subscribers of services provided over 802.16 protocols can be segmented into wholesale and retail with retail having the further segmentation of large, medium, and small (Figure 1) data rate subscribers. Wholesale subscribers include PCS or cellular backhaul, e.g., the link between hub stations and the network or switching centers that routes calls over these services. Large subscribers have a need for trunked voice services, commercial grade data services, and access to remote offices. In some cases large subscribers may justify redundant paths to improve network availability. Medium subscribers need services similar to large subscribers but at less total aggregate data rate. Connection to the Internet is important for medium subscribers. Small subscribers are characterized by modest date rate needs.

For video applications, 802.16 equipment normally transports digital video signals. Early trials at 28 GHz proved that transmission of conventional AM-VSB TV broadcast, as used on the VHF/UHF bands, was possible. Other trials showed that analog FM-video transmission, as used on C and Ku band satellites, was feasible. But improved quality of service, increased bandwidth efficiency, and low cost of digital formats, now makes digital video transmission the preferred approach. An 802.16 system normally transports video service much like direct broadcast satellites (DBS), which transmit digital video in a TDM format. Digital video is often coded using MPEG II compression algorithms and multiple video/audio signal are transported using a TDM MPEG II transport stream.

Radio architectures for providing the above services include point-to-point (P-P) and point-to-multipoint (P-MP). A P-P radio is characterized by highly directional antennas at both ends of a link and symmetric full duplex connections. A P-P radio link emulates a simple two-terminal wire or fiber and is not normally capable of distribution topologies such as bus, ring, or star networks. A P-MP radio is characterized by broad coverage antennas at the hub side of a link and highly directional antennas on the subscriber side of the link. A P-MP radio can be characterized as a bus topology in the downstream direction (hub-to-sub) and a star topology in the upstream direction (sub-to-hub).

Bands suitable for implementing 802.16 protocols include Local Multipoint Distribution Service (LMDS). In the U.S., LMDS is a licensed service that is regulated under CFR47 Part 101. Other countries are assigning spectrum in a manner similar to the LMDS in the U.S. With a couple of exceptions, the licensee of the spectrum is free to choose the use of P-P and P-MP radio systems as best for the licensees' business model.

Systems that implement 802.16 protocols are suitable for mass market and high-capacity applications (Figure 2) in which the data rates per subscriber circuit range from 64 kbps to over 155 Mbps. High capacity links greater than 155 Mbps are best serviced by P-P radios. In-building wireless distribution can be served by using unlicensed bands and implementing protocols such as 802.11.

Conclusion

Systems that implement the 802.16 protocol are intended for delivery of toll quality (64 kbps) voice, data, and digital video services and provide the last few miles of the outside-plant portion of a network. Systems implementing 802.16 can be used for distribution or transmission in the short haul and access portion of a telecommunications network.

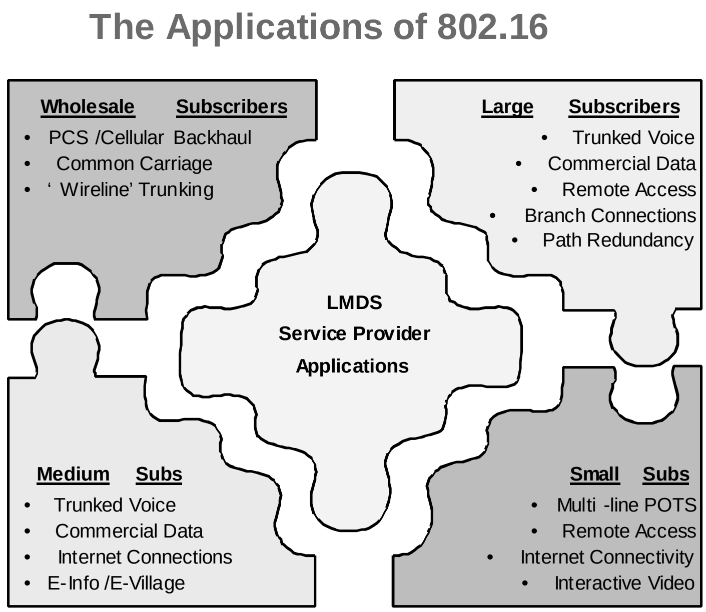

Figure 1, Summary of 802.16 Applications and Services

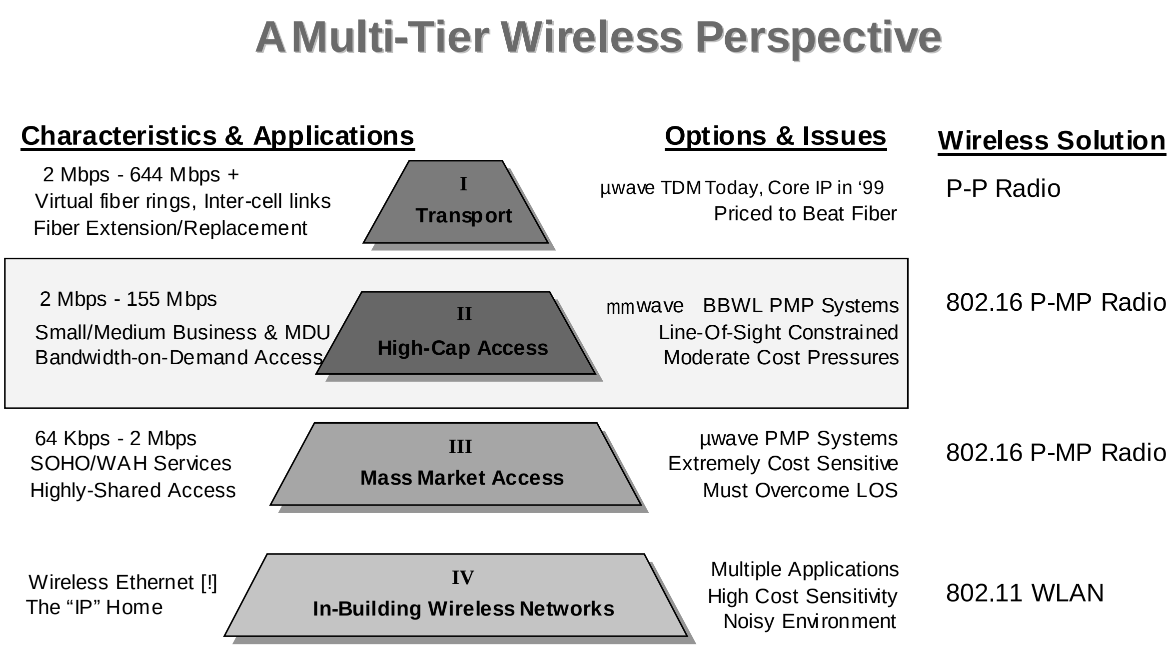

Figure 2, Multi-Tier Perspective of Wireless Transmission and Distribution Systems