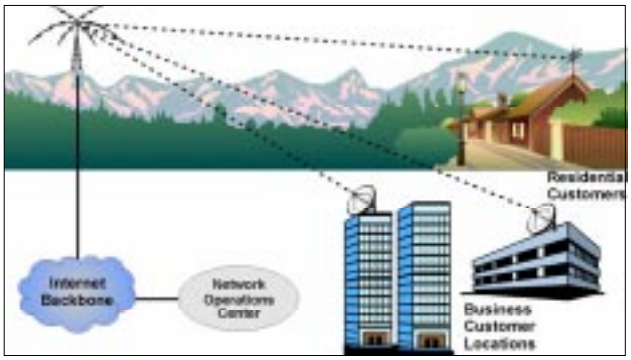
Broadband Wireless Access Overview



Wireless Internet serves both business and residential customers using the same infrastructure

1.0 Background

The fast paced demand for high-speed Internet access and wireless services continues to drive the development of new technology breakthroughs. First used to deliver one-way cable television services to rural areas, the 2 – 11 GHz frequency range is now used to allow for cost-effective deployment of two-way telephone service, video, data, Internet and CATV services to urban, suburban and rural markets throughout the world.

Pioneer Consulting predicts the global Broadband Wireless Access (BWA) market for these systems will grow from 58,000 to over 19 million installed customers by 2010. Cahners In-Stat predicts a faster customer take-up rate, growing to 6 million subscribers by 2004.

Service providers face the same issues regardless of whether they are deploying a new system or expanding an existing network. Customers are demanding basic and value-added services to meet their growing bandwidth needs, the financial markets are pushing for quicker revenue generation and a solid business case, while increasing competitive pressures from services offered via satellite, cable, DSL, and optical fiber make being “first to market” a necessity. A BWA system offers the potential to deploy a low cost system quickly that leverages existing wired and wireless equipment.

Moreover, for those countries with minimal telephony / Internet / CATV services who are finding themselves falling behind more industrialized nations, BWA systems offer a very cost-effective approach to deploying infrastructure.

Service providers can leverage the same BWA infrastructure to deliver a host of bundled services to their customers. For example, a residential consumer could watch a TV program while simultaneously connecting to the Internet at high speed and talking on their telephone. Or, a business customer could hold a videoconference between two branches while its employees surf the Internet and exchange e-mails.

2.0 Wireless Advantages

Broadband Wireless Access networks offer a number of benefits compared to traditional wired networks:

- The infrastructure is scalable and can be implemented rapidly, with less reliance on the existing telephone company's wireline-based infrastructure. There is no need to run cable or wires to individual customers, nor invest in labor-intensive tasks such as digging trenches to bury cable, or the specialized machinery required to hang cable.

- Customer turn-up is faster, and hence, revenue generation quicker, since the "last mile" is delivered to the customer simply by installing an antenna at the customer premise rather than running wired facilities.

- Unlike competing ISDN, DSL or cable modem alternatives, the wireless network costs can be better matched to revenues. Competiting technologies require large upfront capital costs because the delivery infrastructure must be over-built to make it possible to connect every potential customer in an area prior to initiating service.

- With no cables or wires, the system is simpler to maintain and problems are more easily isolated and corrected.

- Should customers churn, the equipment can be moved to a new customer's location which is a much more effective use of capital.

- A BWA system can be more reliable because there are no wires between the head-end and the subscriber that could be accidentally cut, or downed by falling debris, and "dirty" connections are eliminated. This means better customer service.

- Like high-speed cable or DSL service, the customer's Internet and data access is "always-on" to deliver service, unlike a dial-up modem service.

Furthermore, BWA networks in the 2-11 GHz range offer a number of benefits compared to higher frequency wireless systems:

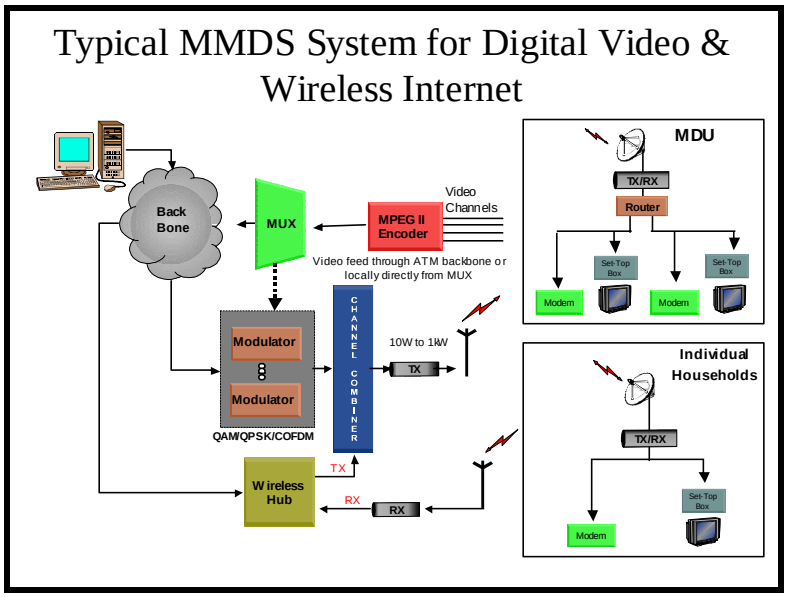
- With coverage per cell in the range of 35 miles, these BWA networks offer 50 times the coverage area compared to LMDS frequencies (less than 5 miles). With less cells per area, services can be turned-up faster with less upfront capital investment.

- The service is more reliable since lower frequency systems are less susceptible to environmental attenuation caused by moisture and foliage, or interference caused by moving vehicles and other objects.

- Equipment is typically less expensive at lower frequency bands.

3.0 Applications

3.1 Application 1: Wireless CATV and 2-way Internet / Data Leverage a Shared Infrastructure



In a traditional wireless CATV system, each analog program received from a satellite downlink, local programming, or other source, would be modulated into the proper RF format to ensure reliable reception, combined with other channels to be broadcast to the same coverage area, amplified and transmitted to customers. Receiving antennas and set-top boxes installed at the customer's site would re-convert the RF signal into the format to be played on the TV or stereo.

While a wireless analog system can deliver signals to a large coverage area, this still requires a large amount of RF spectrum to deliver a relatively small number of programs. One analog program would occupy one entire channel (between 6 – 8 MHz), thus a 30-channel system would require between 180 to 240 MHz of RF bandwidth. Therefore, it is advantageous for an operator to use the latest digital compression technologies to offer more channels, presumably at a higher

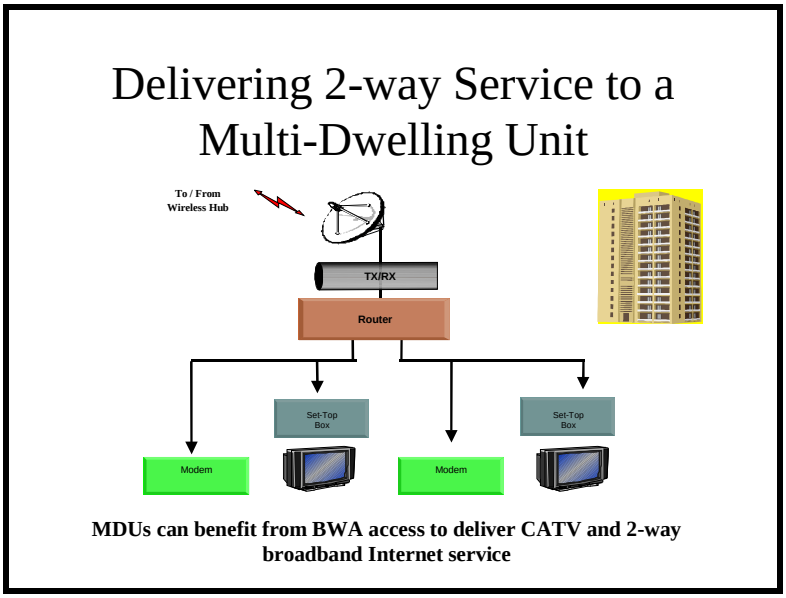
price, and perhaps offer premium-priced subscription services such as movies, sports, and pay-per-view.

Using MPEG-2 compression, without any reduction in viewing quality, four to five analog programs can fit into the same bandwidth that previously could only transmit one analog program. The compressed programs reduce the number of RF channels needed, which allows the operator to dedicate excess spectrum to non-CATV services such as wireless Internet, data networking, or telephony.

Typical commercial digital video compression equipment consists of a modular system that combines common software, hot-swappable encoding and decoding modules, multiplexers, multiple industry standard input and output digital / analog interfaces, PSIP management, and control management systems into a scalable system that can be tailored to any wireless CATV system design. The equipment supports standard and High Definition TV PAL and NTSC input formats, 4:2:2 Professional Level and 4:2:0 Main Level compression formats, and Dolby Digital and Musicam stereo audio. SNMP alarms and a LAN interface permit remote monitoring and network management.

A conditional access system could be added to the network to restrict unauthorized users from viewing premium subscription services by scrambling and encrypting the programs. The subscriber would be issued a uniquely addressable set-top box, which would be programmed to only decode the channels, or individual one-time programs they have purchased.

A subscriber management system can be used to manage the customer database and allow a subscriber to self-administer their accounts by adding or deleting services using a telephone interface or via the web.

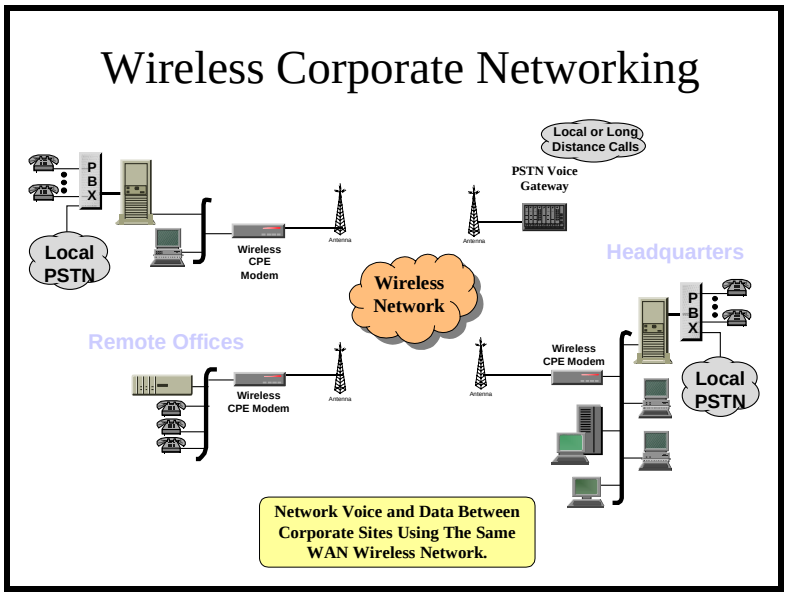


MDUs can benefit from BWA access to deliver CATV and 2-way broadband Internet service

3.2 Application 2: "Internet Ready" Multi-Tenant Dwelling Wireless Services

Using a single roof top antenna and the existing coaxial cable in a building, all the tenants in the building could enjoy BWA services. A router (and perhaps a distribution amplifier to maintain the signal strength) would be used to distribute the frequency signals throughout the building where they would be decoded by each individual subscriber's set-top box and / or data modem.

"Internet Ready" building owners can benefit from an increased attractiveness to tenants for their building in a highly competitive marketplace and possible revenue sharing opportunities with service providers. Tenants are likely to be retained when value-added services are offered and can be scaled to meet their increasing bandwidth needs.



3.3 Application 3: Corporate Wireless Voice and Data Networks

BWA networks can be used to create a cost effective bi-directional WAN infrastructure for connecting corporate sites together to share data, telephony, faxes, and video conferencing, in addition to offering Internet access. The ability to set up the network and install customers more rapidly than with traditional landline networks, makes BWA an excellent choice for connecting permanent and temporary sites, as well as for capturing and sending "Supervisory Control and Data Acquisition" (SCADA) telemetry information, such as meter reading. Traditional PBX's, key systems, ISDN phones, analog "Plain Old Telephone Service" (POTS) phones and new generation VoIP phones can all be connected together to form a seamless "on-net" network which can reduce corporate communication costs. "Off-net" calls can be connected to the PSTN for long distance routing. Remote sites can enjoy high-speed access to corporate resources over a network that is more secure than dial-up alternatives.

4.0 Value-Added Services

4.1 Flexible Service Offerings

Internet access and wireless CATV are not the only possible revenue and service opportunities that BWA offers. The same equipment allows the service provider to custom tailor their service offerings to each target market. For example, in one cell residential customers might be offered wireless Internet access only, while in a second cell business customers are offered wireless Internet, local telephony, and site-to-site corporate networking. The BWA equipment allows services to be delivered when, and where, needed in order to maintain competitive and continue to build profitable revenue.

Target Applications and Value-Added Services

Basic Services

- Wireless Cable (basic, pay-per-view, premium cable services such as news, stock, weather, traffic & local information)
- 2-way Wireless Internet

Enhanced Consumer Services

- Multi-line Telephony / Voice over IP
- Interactive gaming
- Home banking
- Video on demand
- Home shopping
- Interactive learning
- Software distribution
- E-Commerce
- CD-quality music distribution

Enhanced Business Services

- Virtual Private Networks (VPN)
- PBX interconnectivity
- ISDN line replacement
- Hosting
- File sharing
- White boarding / collaboration
- WAN backbone link replacement
- Video broadcasting
- Video conferencing
- Data networking between sites
- LAN extension
- Data backup

Wholesale opportunities

4.2 Local and Long Distance Telephony Build Brand Loyalty

Bundling local and long distance telephony using the latest high quality Voice over IP (VoIP) technology over the BWA network can increase revenue and reduce the likelihood of customer churn. Customers can benefit from lower local and long distance fees, a single integrated bill, and enhanced bundled features.

An IP Telephony gateway would be added at the network side to interconnect telephone calls from the wireless network with the Public Switched Telephone Network (PSTN). The subscriber could use a VoIP telephone, a VoIP application on their PC (such as Microsoft's NetMeeting), or their existing phone connected through a VoIP adapter (such as an Integrated Access Device or VoIP-enabled router) to make the telephone call.

5.0 The System

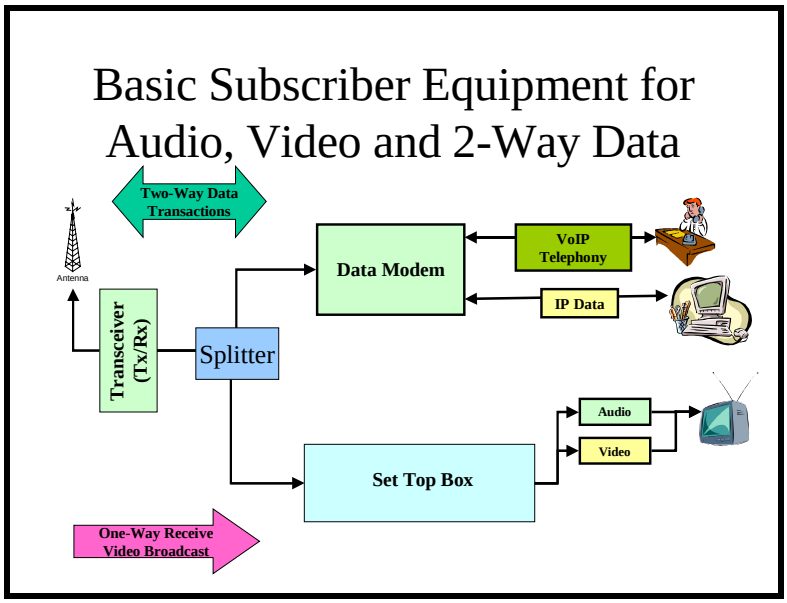
5.1 Overview

In the simplest network design, a single transmission site consists of one wireless CATV head-end, transmitter(s) and an omni-directional antenna. All signals are broadcast in essentially a large ring around the antenna which can typically reach a 35 miles radius "cell" using MMDS

(2.5 – 2.7 GHz) frequencies. Similar to cellular phone networks, the network may be designed so the cell is split up into smaller cells (either shorter range, or narrowed focus) or sectorized to allow for more capacity in the same geographic area.

Adding two-way high speed Internet access to any BWA system is fairly straightforward. With up to 30 Mbps data throughput per 6 MHz channel, the resulting system is well suited to target a market of residential customers, small and medium sized business, and telecommuters in urban, rural and suburban locations. These customers typically have small to moderate bandwidth requirements (between 128 Kbps to 2 Mbps per customer) compared to large corporate users who require 10 Mbps or larger access per site.

The system can be configured with symmetrical links between sites, or asymmetrical links. Capacity in terms of customers served is a function of available spectrum, modulation scheme used and access speeds and service levels offered. The UBS system is frequency independent and supports multiple modulations schemes: QPSK, 16-QAM and 64-QAM with multiple upstream and downstream channel sizes to allow the operator to tailor their data throughput to their local subscriber's needs and local conditions.



These building blocks would be added to the network:

- Wireless Hub – provides the wireless interface to transmit and receive data to and from the wireless modem located at the customer premises. The hub includes all the processing cards to modulate and demodulate signals at an IF level.

- In many networks it is possible to use the existing combiner, RF transmitter and antenna that deliver the CATV programs also to broadcast the downstream Internet data to the customer.

- A receiver and antenna are required for the upstream transmissions from individual customers' wireless data modems.

- Customer Premise Equipment (CPE): wireless data modems and transceivers connected via coaxial cable are used for each customer to send and receive Internet data. Splitters would be used to connect the set-top box and wireless data modem to the transceiver if a customer purchases both wireless CATV and Internet service.

- A router connected to the wireless hub to control the data being sent and received to the Internet gateway.

- The Internet gateway interconnects the BWA system with the Internet via a local ISP's network. All the data to be sent to and from the Internet will go through this gateway.

Based on the cable industry DOCSIS standard, the wireless data system essentially creates an IP-based Ethernet bridged link between the Wireless Modem Termination System (WMTS) at the head-end and the Wireless Modem Unit (WMU) at the customer site, to deliver highly reliable, high speed broadband Internet connectivity. The system requires a clear line of sight between customer transceiver and wireless hub antenna.

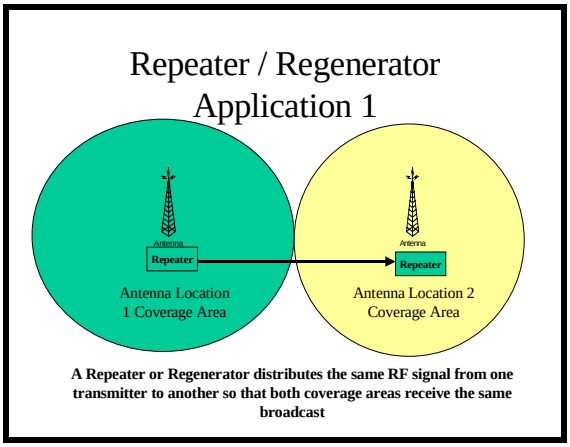
Quality of Service (QOS) features built into the WMTS support Service Level Agreements (SLAs). An optional bandwidth manager (not shown) could be added to enforce premium SLAs paid by customers who want higher guaranteed bandwidth access, rather than just a shared best-effort Internet connection.

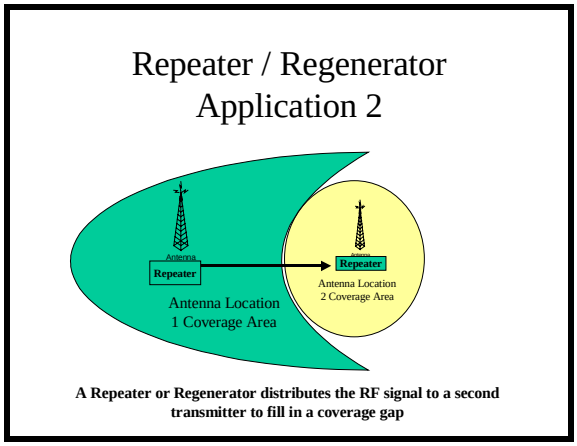
The WMTS network management will integrate into existing network management systems thereby giving operators a complete view of, and control over, the entire network. This allows for a single interface to manage configurations, track performance and alarms, and help with diagnosing problems to maximize customer satisfaction.

A telephone company (telco) return path modem is also available that uses an integral 33 Kbps dial-up modem to create the upstream path instead of the wireless connection. A dial-modem bank would be added to the network to receive the upstream Internet traffic instead of a wireless receiver. However, a wireless upstream system provides a more robust, higher speed access for customers, and therefore is the preferred solution.

5.2 Extending Coverage: Repeaters and Regenerators

Suppose a service provider wishes to extend their wireless CATV coverage area or fill a coverage gap with the minimal cost. Instead of investing in a completely new head-end with modulators, amplifiers, combiners, etc. a UBS repeater or regenerator would be used to feed the second transmitter site and simultaneously broadcast the program in this new coverage area. A repeater essentially broadcasts the RF signal using a coaxial cable from one location to another. A regenerator will rebuild the RF signal to its original characteristics before broadcasting over coaxial cable to the other location.





6.0 BWA Networks Summary

Broadband Wireless Access networks offer a number of benefits to both service providers and customers. Television and audio programs can be offered in conjunction with value-added communication services like high speed Internet access and corporate networks. Leveraging the existing infrastructure such as transmitters, towers and combiners with a minimal up front investment allows the service provider to deploy new services custom tailored on a cell-by-cell basis. Revenue generation can match service rollout ensuring capital spending is contained – a necessity in today's extremely competitive financial climate.

7.0 Unique Broadband Systems – A Partnership for Success

To succeed in these deployments a service provider must partner with a supplier who can deliver a total BWA solution, and whose global experience from operating in different markets around the world can be leveraged to maximize operator profitability. Unique Broadband Systems (UBS) can deliver complete end-to-end BWA solutions using our state of the art transmitters, receivers, modulators, regenerators and repeaters, and integrating them with products from other leading-edge companies. In addition to off-the-shelf components, UBS offers custom design solutions and has in-house expertise to design complete RF networks.

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