EMCEE

WORLD LEADER IN WIRELESS CABLE

WHAT IS WIRELESS CABLE?

Wireless Cable is a broadband service that delivers addressable multi-channel television programming, Internet access, data transfer services, and other interactive services over a terrestrial microwave platform. The systems are growing rapidly, and now serve 5 million customers in 90 nations, with over 1 million customers in some 250 U.S. systems.

Multipoint Multi-channel Distribution Service (MMDS) is often used as a synonym for "Wireless Cable." Operators broadcast multiple channels of television or related services at microwave frequencies from an antenna located on a tower, tall building, or mountain. The signals are received by a small microwave dish typically about 16 x 20 inches in size, or perhaps larger in outlying areas. A block down-converter integrated into or mounted on an antenna mast translates the receive signals into the band utilized by standard cable TV. A set top converter identical in function to a standard cable TV channels selector is located near the TV receiver.

INDUSTRY REGULATION

Regulatory Jurisdiction

Wireless cable, unlike traditional cable TV, requires no easements to operate and thus requires no franchise. Cable TV gets its authority in the form of a franchise from the local city government to use its community easements (rights-of-way) for the construction of the cable system. Wireless cable, in contrast, is regulated by the Federal Communications Commission (FCC) in the US or communications ministry in foreign nations.

Channel Allocations

The predecessor to MMDS was Multipoint Distribution Service (MDS). MDS began in the US in the mid-1970s with the earlier allocation by the Federal Communications Commission (FCC) of two 6 MHz channels between 2,150 and 2,162 MHz (2.150 and 2.162 GHz). (In some markets, the 6 MHz MDS 2 channel is replaced by a 4 MHz MDS 2-A channel.) Although these channels were intended for business data, they were more commonly used to deliver TV programming on a single-channel subscription basis. It was, in fact, on these early MDS channels that Home Box Office (HBO) was shown. Later, HBO moved to satellite transmission, and thus began the move to TVRO reception of premium programming.

In order to be competitive in the multi-channel environment, MDS operators needed more bandwidth and wanted to use an additional 31 channels between 2,500 and 2,686 MHz. In the US, these channels were originally designated to educational institutions for Instructional Television Fixed Service. From these, eight channels in the E and F groups were reallocated in the early 1980s for use by wireless cable, and officially dubbed MMDS channels by the FCC.

ITFS Channels

The remaining 23 Instruction Fixed Television Service (ITFS) channels, in groups A, B, C, D, G and H, were made available to wireless cable operators from educational license-holders on a lease basis. In exchange for access to ITFS channels, the FCC required that wireless cable operators broadcast up to 40 hours of educational programming per week. With the addition of these channels, wireless cable now had the potential to deliver 33 analog channels of television.

Channel Allocations Outside of the US

Many countries outside of the US have adopted the 2500-2686 MHz band plan for wireless cable utilization. However some nations have adopted band plans which differ. Check with your national regulator to find available frequencies for this service in your country.

NEW DEVELOPMENTS

Digital Transmission

By 1996, technological advances had made feasible digital compression of video channels in the broadband communication industry. As one measure to foster competition, the FCC issued in July 1996 a declaratory ruling saying that wireless cable operators could digitize their licensed MDS and ITFS (MMDS) channels as long as adjacent wireless cable systems experienced no interference from the process of the analog-to-digital conversion. With this FCC declaratory ruling and the advances in digital technology, wireless cable can now deliver between 100 and 200 virtual channels of video.

High-Speed Internet Access and Data Transmissions

In October 1996, the FCC cleared the way for wireless cable operators to use their spectrum for high-speed digital data applications, including Internet access. The equipment currently available for providing access to the Internet downloads data at a rate up to 27 Mbps, using a telephony return path. The Wireless Cable Association International, along with over 100 companies, petitioned the FCC in March 1997 to grant the industry the right to use MMDS spectrum for two-way access. Two way authorizations will effectively enable voice, video, and data over wireless cable. Following are some of the cities that have systems offering high-speed access to the Internet over wireless cable, including: Chicago, Washington, DC; Las Vegas, NV; Lakeland, FL; Colorado Springs, CO; Santa Rosa, CA; etc.

SYSTEM ARCHITECTURES

Basic Wireless Cable System

The basic wireless cable system consists of a transmitter site that provides a broadband signal to multiple customer receive sites, distributed in the line-of-sight service area. Depending on the transmitter's output power, it can provide service to an area within a radius of 5 to 35 miles. A basic system is designed to consider the local terrain, structures and foliage, and still provide a high-quality signal to as many customer receive sites in its service area as possible from a single transmitter.

Complex Wireless Cable System

A more complex system configuration may be required in an area with several hills. Such topography would result in "shadowed" areas (e.g., areas where line-of-sight reception is blocked) if served by one transmitter. By strategically positioning several transmitters (signal booster/repeater stations) in the service area, the shadowed areas can be reduced.

The receive antennas in each of the smaller areas are pointed to the polarized transmit antenna serving that area. The receive antennas are polarized in the same direction (horizontal or vertical) as the transmit antenna serving them.

SYSTEM ELEMENTS

The major elements of a wireless cable system include: (1) the transmit site, (2) the signal path and (3) the receive site. The components of the transmit and receive sites are discussed here. Although some references to digital mode transmissions are included for purposes of comparison, unless noted all transmissions should be considered analog.

Transmit Site Components

The major components of the transmit site include: (1) the tower and transmit antenna, (2) the signal processing equipment and (3) the billing system.

Tower and Transmit Antenna. The tower supporting the transmit antenna is strategically located to provide the greatest height in the service area. This may be on a tall building or hill. The transmitted signal strength may be designed to any one of several standard transmitter output powers: 10, 15, 20, 50 or 100 watts.

As the signal travels from the transmitter to the antenna, it loses power as it passes through the combiners, filters, waveguide, associated jumpers and connectors. The signal arriving at the transmit antenna is then increased by the gain of the antenna, which yields the effective isotropic radiated power (EIRP) for which the station is licensed by the FCC.

The transmit antenna typically broadcasts signal energy in an omni-directional pattern (i.e., a donut-shaped circular azimuthal radiation pattern) that has a slight (a half degree) downward tilt (elevation) for an optimum delivery of signal energy to the customers in the immediate surrounding service area.

In special cases, an antenna may be designed with a transmit pattern to conform with an irregular-shaped topography in a service area. For example, a transmit antenna may be located near a body of water. Here the antenna is designed with a cardioid transmit pattern to direct, in this case, most of its energy away from the water and toward the customers on land. This provides customers with higher signal levels than would have been delivered with an omni-directional transmit antenna because the energy is concentrated and radiated over a smaller area.

Signal Processing Equipment. Signals from all sources are scrambled, as in a typical cable TV headend, and each signal is delivered to a transmitter for the individual channel. Then each transmitter is fed into a channel combiner/filter. The combiner/filter feeds, at the bottom of the tower, the main transmission line serving the transmit antenna at the top of the tower. In some cases, to provide more output transmit power, two transmit antennas are used, each served by a channel combiner/filter that combines non-adjacent channels that are then transported by way of two waveguides, one to each antenna. Multi-Channel transmitters are also available, and are popular with many system operators.

The video and data information carried on the transmitted signal is originally imported from a number of program sources via satellites, microwave, over-the-air TV broadcasts, or locally originated studios (LO) or tape decks. TVRO equipment may be located either at the transmitter site, or at some distance where the signals are transported by way of microwave, cable or fiber. Incoming signals received from satellites at the transmit site may have been previously encoded. These signals must be decoded at the transmit site and then scrambled before transmission on the MMDS system. The scrambled channels are ultimately received by the customers and descrambled by the set-top converter/decoder in each home.

Billing System. The computerized billing system is connected to the outgoing scramblers at the transmit site to easily facilitate the various programming options and configurations available to the customer, each with a different monthly billing rate.

Receive Site Components

Receive sites may be installed on either a single dwelling unit (SDU), such as a house, or a multiple dwelling unit (MDU), like an apartment or commercial building. The components included are hardware, antennas, down converters, set-top converters (with powering capabilities for down converters) and cabling.

Installation Hardware. Some antennas are roof-mounted using a mast, while others may be attached to a small tower that is ground-mounted near the structure. To accomplish this, specific hardware is used for installing the antennas and the down converter at the receive site. The primary items are the antenna mast and the mounting apparatus (e.g., chimney straps, tripod, base or side mounts) used to attach the mast to the receive site.

Receive Antennas. There are two types of receive antennas commonly used by wireless cable systems: (1) microwave antennas for receiving the wireless cable signals, and (2) VHF/UHF antennas for receiving the local over-the-air channels. However, some analog wireless cable systems do deliver the local channels via microwave. In those systems, or if the system is digital, only the microwave antennas are required.

Microwave receive antennas perform several functions: (1) they capture the airborne signal, (2) they increase the signal received, (3) they provide directivity, and (4) they provide polarized selectivity.

Receive antennas capture the airborne microwave signal from the transmit antenna and deliver the signal to the frequency block down converter. Signal gain is accomplished by manufacturing the antenna so that its size is several multiples larger than a signal's wavelength. The greater the number of wavelength multiples encompassed within the antenna, the greater the gain. The greater the gain of an antenna, the larger its size and the more it costs.

Directivity is achieved by constructing the antenna (e.g., a dish) to focus incoming signals from one direction only. This function allows an antenna to amplify the signal originating from the direction the antenna is pointed, while attenuating signals originating from all other directions.

To accomplish polarized selectivity, the antenna feed is positioned to receive the signal either in the vertical or horizontal plane. This allows the antenna to selectively receive the signal from the appropriate polarized transmit antenna while rejecting a signal from an adjacent, cross-polarized undesirable transmitter.

Down converters. The down converter provides frequency conversion and also more gain to the received microwave signal without significantly degrading it with electrical noise (snow). The down converter receives the input signal at microwave frequencies (2,154 to 2,681 MHz) and block converts them to a lower frequency range usable by a set-top converter (116 to 128 MHz for MDS channels and 222 to 408 MHz for MMDS/ITFS channels). While some down converters are designed to convert 33 channels (which includes MDS and MMDS/ITFS channels), others are designed to convert only the 31 MMDS/ITFS channels.

All down converters are mounted close to the antenna to eliminate any cable loss from the cable between the antenna and the down converter. To eliminate this loss, most manufacturers integrate the down converter within the antenna feed.

Rejection Filters. Since aeronautical navigational radar, PCS, cellular telephones, and microwave ovens produce signals with frequencies near those of the wireless cable signal, special filters may be required to eliminate interference from these sources. These filters may be incorporated within the down converter or mounted externally to it.

Down converter Powering. Since the down converter is an active electronic device, it requires power from an external source. This power is provided either by a stand-alone power supply or the set-top converter manufactured for the wireless cable industry. The stand-alone 24 VDC power supply is used together with a power inserter. The power supply is usually located within the customer's premises and power is delivered up the same coaxial cable that delivers the RF signals from the down converter to the set-top converter.

Set-Top Converters. In addition to commonly providing downconverter powering, wireless cable set-top converters incorporate a tuner with two input ports, one for the over-the-air signals and the other for the scrambled wireless cable channels. Within the set-top converter is circuitry that descrambles the scrambled channels when authorized to do so by the billing computer at the transmit site.

Whole-House Down Converters. Some manufacturers provide down converters with an integrated descrambler that simultaneously decodes all received channels, eliminating the need for individual set-top converters at multiple outlets within the customer's home. These may be integrated into the antenna or may be installed as a stand-alone unit. They are powered by a stand-alone power supply.

Cabling. There are two types of coaxial cable used to connect the antenna/down converters to the set-top converter. In the case where the local channels are carried on the MMDS system, a single cable is used. Where the local channels are received by a VHF/UHF antenna, a dual cable may be used. Both of these cables are available with or without an integrated ground wire and typically are of Series 6 configuration. A separate ground wire must be used where integral grounded cable is not used. In either case, the ground wire must be in accord with the National Electrical Code.

Wireless cable has superior signal quality when compared to wired cable because the signals are not required to go through miles of cable and multiple stages of signal degrading amplification. In addition, service interruption is significantly reduced as there is nothing to fail between the transmit facility and the receive site. Modern MMDS transmit equipment has proven to be very reliable. Also, frequency agile equipment is available that will automatically replace a failed transmitter or receiver within seconds.

With the advent of digital transmission and data transfer capabilities over MMDS systems, the expansion of channel capacity, and the inclusion of the local channels, wireless cable offers a competitive alternative to all other broadband delivery systems.

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