

A Clear View of MMDS

Rod Cunningham

The wireless cable industry is growing at a remarkable rate. Rod Cunningham explains how to get the most out of MMDS.

Wireless Cable is an MMDS or Multichannel Multipoint Distribution System and broadcasts TV programmes at microwave frequencies from a central point or headend to small receive antennas on the subscriber's roof.

A down converter, usually a part of the antenna, converts the microwave signals into cable channels. As most signals are scrambled in order only to allow reception by subscribers, a set top unit is required to translate the signals for viewing.

MMDS began in the mid 1970s in the US with the allocation of two channels for sending business data. The service however became popular for TV subscriber programming and applications were made to allocate part of the ITFS (Instructional Television Fixed Service) band to wireless cable TV. Once the regulations had been amended it became possible for a wireless cable system to offer up to thirty-one 6MHz channels in the 2.5 to 2.7GHz Band.

Today, there are systems in use all around the US and in many other countries including Australia, South Africa, South America, Ireland and Canada. The most common frequencies used are between 2.1 and 2.7GHz although some countries are trying higher frequencies up to 40GHz. There is currently a trial in New York using frequencies from 27.5 to 29.5GHz.

For the system engineer and the operator, the key to the success (and profitability) of an MMDS system is to cover the maximum service area at the minimum cost. At the subscriber's home the receive antenna should have a clear line of site to the transmitting antenna. Poor design, resulting in weak signals in a service area, can be expensive! In a service area with 20,000 subscribers, costs will rapidly rise if each subscriber requires a high gain antenna and down converter rather than the standard unit. Receive antennas are available with gains from 12 to 27dBi with the higher gain system being larger and costing US\$10 to \$20 more per unit, ie an additional cost of \$200,000 to \$400,000 could result. Clearly, good headend design will result in improved signal levels and savings.

Key elements

The headend The key elements in optimising transmitted signal levels are selection of the headend site and the transmitting antenna, transmission feeders, channel combiners, channel diplexers and transmitters. The headend's task is to distribute the signal to as many subscribers as possible. Choosing a site with good elevation and a clear line of sight to the service area provides real dividends.

The transmit antenna The bandwidth allocated to MMDS operators can vary from 200 to over 300MHz depending on the number of channels and their spacing. Wide bandwidth is a requirement of MMDS antennas together with downward tilt and horizontal radiation patterns to concentrate signal in the service area. The use of modelling techniques to verify the down tilt and position the first null are critical to success and will reduce subscriber complaints of poor picture quality. The company Radio Frequency Systems has conducted extensive tests of its antennas to ensure consistent performance across the band and tight control of vertical radiation patterns, particularly in the area of the first null.

MMDS transmit antennas are available with gains from 10 to 18dBi with either vertical or horizontal polarisation and omnidirectional or cardioid patterns. It is common to use two antennas in one radome with two feeders where it is not possible to combine adjacent channels due to their close spacing. While a transmitter failure will only remove a single channel, the entire service is cut off if the antenna fails.

Antenna design and construction must concentrate on ensuring long life; the design of mountings and guying arrangements for larger (12 and 16 bay) antennas thus becomes critical. At major headend sites a standby antenna can be installed to ensure continuous service and minimal outages for antenna and feeder maintenance.

The transmission line This is another critical component which can have a substantial effect on system losses. Major headend sites typically use 50 or 100 watt transmitters yet often only 50 per cent of this power reaches the antenna after passing through channel combiners and transmission feeders. For long runs where losses are critical, elliptical waveguide (E20) has a loss of 1.1dB per 100m. The alternative is HF 1-5/8 air dielectric coaxial cable with a loss of 3.4dB per 100m. This cable is significantly cheaper and also imposes less wind loading on the tower structure. Obviously a detailed analysis is required to arrive at a cost effective solution and factors such as transmitter costs, transmitter room location and tower height need to be

considered.

Channel combiners MMDS sites normally transmit a number of channels. Special filters (channel combiners) are used to combine the outputs of the transmitters to the transmission feeder and antenna. The design of these combiners is critical to ensure they are stable with temperature, have low return loss and provide low pass band loss. RFS combiners are usually equipped with microwave relays which can switch a frequency agile (standby) transmitter into the combiner port should transmitter failure occur.

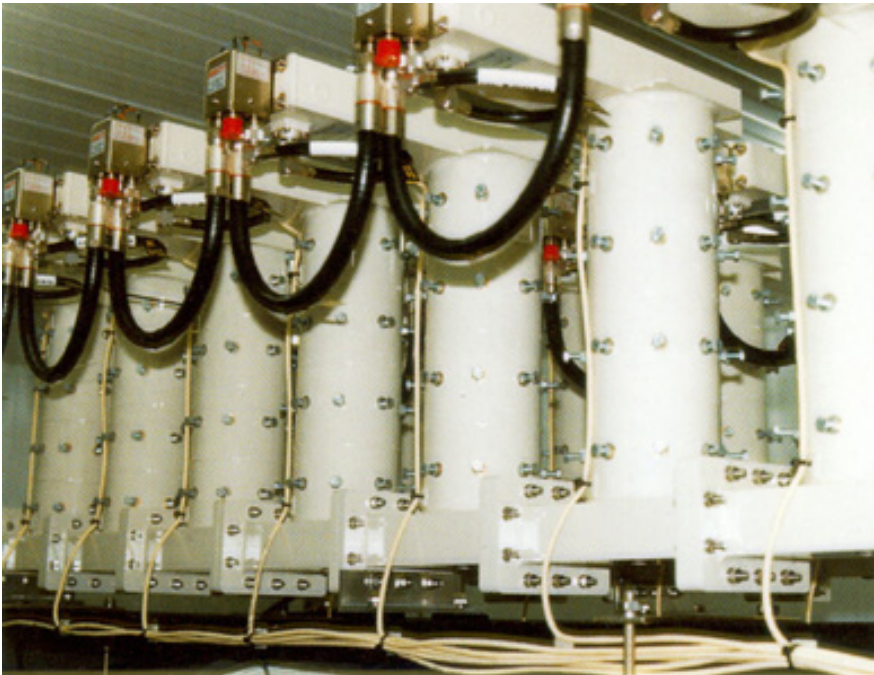


Fig. 1: MMDS channel combiners manufactured by RFS, South Australia. The combiners incorporate microwave switches to connect a frequency agile standby transmitter and are suitable for future digital transmission.

Extra margin

While various configurations of combiners exist it is common to set up two combiner chains for non-adjacent odd or even channels. RFS utilises a four cavity design to achieve wide passband and high isolation (50dB) between channels. This ensures an extra margin against RF interference between channel transmitters. Each combiner input is matched to ensure it presents a 50ohm impedance to the transmitter. The combiner has been designed to provide minimal group delay variation (115ns) across the channel bandwidth for future digital broadcasting.

Channel diplexers MMDS headends utilise two different methods for diplexing audio and video signals with internal diplexing used on headends up to 20 watts per channel. At higher transmitter power (50W+) external diplexing provides better quality signals. RFS has based its AV diplexers on a two cavity design utilising silver plated Invar cavities to minimise internal losses and frequency drift. Stereo broadcasting places an added requirement on the diplexer with the proximity of the second audio channel to the channel edge. These units are somewhat temperature sensitive; however, the RFS diplexer offers stability over a 11° C temperature range.

Transmitters The final component in the transmission path is the transmitter. If all other elements of the transmission path are fixed, the area covered is directly proportional to the transmitter power. There are three types of channel transmitters - fixed channel, frequency agile and multichannel transmitters.

The most common (fixed channel) is factory-tuned to the channel frequency. Agile transmitters may be tuned to any channel in the MMDS band and are used primarily as a back-up in case a fixed channel transmitter fails. Multichannel transmitters are less common and are usually found in low power systems transmitting up to eight channels.

Typical systems utilise output power levels of 10, 20, 50 and 100 watts. In designing a headend the relatively low efficiency and heat dissipation of the transmitter units must be recognised to ensure adequate air conditioning is provided in order to remove heat from the transmitter racks and equipment area.

In conclusion then, the design of the elements comprising the transmission path are critical in providing good

signals in the service area. From the transmitter through to transmission feeder every effort should be made to minimise losses.

The transmit antenna and its location is the final key to successfully providing signal in the service area and antenna selection and positioning must be designed to provide effective coverage.



Fig. 2: Shared free to air and pay-TV installation at Shepparton (Victoria). The 19 channel headend uses 50W Comwave transmitters and supplies signals via 1-5/8" feeders to a dual input antenna mounted at the 60 metre level. Program is received via satellite (KU and C Band) and emergency power from a 60KVA standby generator.



Fig. 3: Rigger Michael Harder installs a dual input 8 Bay MMDS antenna on the RFS test range for Horizontal Radiation Pattern testing. The antennas are available in vertical and horizontal polarisation and a range of

patterns.



Fig. 4: *Final touches to the alignment of AV channel diplexers in a 19 channel SOW MMDS headend installation. The headend is one of 12 supplied by RFS Australia to pay television company - Austar.*

Remark

The above article is a reprint from Communications Africa August/September 1996

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