MULTIPOINT DISTRIBUTION OF SATELLITE RECEPTION

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The size of satellite receive ground station antennas must be limited in metropolitan areas - both to avoid interference and to maximize the total nationwide satellite information handling capacity. In these metropolitan areas, then, local loops must be used to distribute the satellite signal to CATV systems and other users. MDS systems provide one method for such local loops. The MDS system in concept is similar to the satellite, and many of the economic advantages accrue to both. MDS provides distribution of the signal to any number of reception points, in an economic manner, and with high quality.

Introduction

A common problem of all long distance communications requirements is the final connection at each end to the final user. Thus, in establishing a telephone circuit between two distant points, a microwave or cable circuit is set up between two central offices, and the circuit in question becomes one of the many carried by the microwave or cable. Beyond each control office, local wire pairs are then used to provide the final connection to the end user.

In the case of satellite transmission of television signals, a similar situation exists. Ground stations must be established for both the transmit and receive functions to and from the satellite. Local loop connections are then established to serve the final user (except in those few cases where a ground station can be constructed at the physical site of the final user).

Satellite Reception in Metropolitan Areas

Generally speaking, in a metropolitan area, only a limited number of earth terminals can be established. The two major factors limiting the number of earth stations are signal interference; and the availability of suitable, economically feasible real estate for the receiving antenna.

Satellite transmission today is authorized in the 3.7-4.2 GHz band for satellite to earth transmission, and in the band 5.925-6.425 GHz for earth to satellite transmission. It should be noted that each of these bands of frequency is also used for terrestrial point-to-point microwave. Therefore, not only must there be some interference protection between signals from different satellites, but also there must be protection for interference between satellite and terrestrial systems.

Since Metropolitan areas are natural centers of communication needs, it follows that there are many terrestrial microwave paths into and out of each such area. Indeed, in many metropolitan areas, it is almost impossible to add another terrestrial link in either of these two frequency bands. Thus, additional demands are made on satellite ground stations which must not interfere with terrestrial reception (in the case of a satellite transmit station) and must not be interfered with by terrestrial transmissions (in the case of satellite receive stations). Consequently, finding a location for a satellite station in a metropolitan area becomes quite difficult, and results in a limit on the number of such satellite stations that may be located in that metropolitan area.

The ABC Petition

The American Broadcasting Company has petitioned the Federal Communication Commission to establish definitive licensing and allocation policies and guidelines so the satellite capacity in these two frequency bands will be utilized in accordance with appropriate principles of spectrum efficiency and management. ABC makes the point that satellite capacity in these two bands may be depleted within the next five years,due,at least in part, to the possibility that assignments may not be consistent with appropriate technical and operational criteria. In particular, proposals to utilize smaller size satellite receiving antennas can cause this result.

FCC Rules

The Federal Communications Commission has stated that they will not authorize earth station terminals of less than 9 meters in diameter, unless the applicant can demonstrate that satellite orbital separation need not be greater, and that no other constraints would be placed on the

operations of domestic satellites.

If a substandard antenna is used, then terrestrial stations, other earth stations, and space stations can be established without regard to the substandard antenna, and, of course, no protection against interference is provided to the substandard antenna.

The FCC rules also indicate that earth station antennas should be able to be directed to any point on the geostationary arc visible at the earth station location at which the elevation angle equals or exceeds 5°, and that they be capable of being used at all frequencies in the band.

In locating an earth station, interference studies must be conducted to any terrestrial stations within 100 kilometers, and it must be assumed that the terrestrial station uses an antenna specified by the FCC for non-congested locations.

Since earth stations do not have priority over terrestrial stations, and indeed, may even be subject to interference from future terrestrial stations if the earth station uses substandard components, the difficulty of locating earth stations becomes obvious.

Satellite Capacity

If there is an 80° longitudinal arc available for satellites in stationery orbit to serve the continental United States, and if a 4° spacing between satellites is assumed, then approximately 20 domestic satellites can be accommodated.

Studies conducted of message traffic demands (voice and data) show that as early as 1980 these services alone could completely occupy 20 satellites - and if the number of satellites has to be decreased because technical standards for earth stations are relaxed, the problem will become that much more difficult.

The inevitable conclusion must be that only a few earth stations can be accommodated in the metropolitan areas. Distribution of television signals from these earth stations to the final points of use can then be accomplished by appropriate terrestrial facilities.

Local Loops

Depending on the particular circumstances, these local loop facilities can take the form of CARS band system(s), either owned by the using CATV system, or co-operatively owned if several CATV systems are to be served by the earth station; regional point-to-point microwave common carriers; or MDS stations.

Point-to-point microwave systems use relatively expensive equipment for both transmitting and receiving. MDS stations, on the other hand, use expensive transmitting equipment, but employ very inexpensive receiving stations. This results in inherent cost advantages when a number of receiving points are to be served from one transmitting station.

MDS

Thus the MDS station can act as the local counterpart of the satellite service. Nationwide distribution by satellite involves one transmitting station - the satellite - which is very expensive, and many receiving earth stations. The MDS stations, in a restricted area, likewise employ one transmitter, and many receiving stations. The same types of cost advantages result.

MDS, or Multipoint Distribution Service, stations were first authorized by the FCC in 1970. They provide a common carrier service operating at present in the 2.150-2.162 GHZ frequency range. The FCC presently has authorized two channels, each 6 MHz wide, for the top 50 markets in the United States, and one 6 MHz plus one 4 MHz channel anywhere else that a station can be accommodated without mutual interference. Additional channels are being set forth in a Proposed Rule Making expected to be issued by the FCC in the near future.

The 6 MHz MDS channel, for television purposes, contains a vestigal sideband visual carrier, plus an FM aural carrier. These are

arranged according to standard television practice. Most MDS receivers are simply frequency convertors, and their output is a normal television signal on any standard or mid-band channel. The receiver output, therefore, can be fed directly into a CATV system head-end.

MDS stations operate with 10 to 100 watt transmitters, with radiated powers of up to 400 to 4,000 watts (56-66 DBM). Most transmitting stations are located at high elevations, since line-of-sight transmission is required at these frequencies.

The coverage area of an MDS station depends on the availability of line-of-sight, and on the gain and noise figure of the receiving installation. The nominal service area is 25 miles, but satisfactory reception has been obtained out to 35 or more miles.

In a metropolitan area where a number of CATV systems are located, either in town, in the suburbs, or both, broadcast quality reception of the satellite signal can be obtained with an MDS station. And that reception can be obtained at any number of reception points, and at any location (provided that line-of-sight can be obtained).

Conclusion

Thus the optimum satellite reception system in a metropolitan area can consist of a large size earth station antenna, reducing the possibility of interference, and maximizing the total domestic satellite information handling capability, coupled with an MDS station to provide unlimited, low cost, local distribution of the satellite signal.