INTERFERENCE AND SATELLITE ACCESS

Interference may be considered as a form of noise, and as with noise, system performance is determined by the ratio of wanted to interfering powers, in this case the wanted carrier to the interfering carrier power or C/I ratio. The single most important factor controlling interference is the radiation pattern of the earth station antenna.

Comparatively large-diameter reflectors can be used with earth station antennas, and hence narrow beamwidths can be achieved. For example, a 10-m antenna at 14 GHz has a 3-dB beamwidth of about 0.15°. This is very much narrower than the 2° to 4° orbital spacing allocated to satellites. To relate the C/I ratio to the antenna radiation pattern, it is necessary first to define the geometry involved.

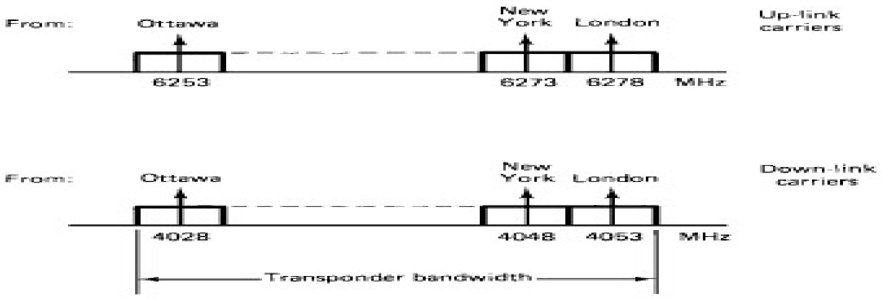
The orbital separation is defined as the angle subtended at the center of the earth, known as the geocentric angle. However, from an earth station at point P the satellites would appear to subtend an angle ß. Angle ß is referred to as the topocentric angle. In all practical situations relating to satellite interference, the topocentric and geocentric angles may be assumed equal, and in fact, making this assumption leads to an overestimate of the interference (Sharp, 1983).

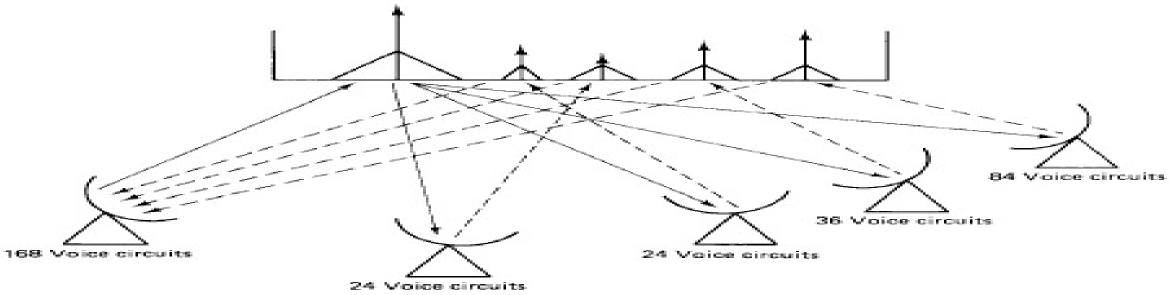
6.1 Single Access

With single access, a single modulated carrier occupies the whole of the available bandwidth of a transponder. Single-access operation is used on heavy-traffic routes and requires large earth station antennas such as the class A antenna. As an example, Telesat Canada provides heavy route message facilities, with each transponder channel being capable of carrying 960 one-way voice circuits on an FDM/FM carrier. The earth station employs a 30-m-diameter antenna and a parametric amplifier, which together provide a minimum [G/T] of 37.5 dB/K.

6.2Preassigned FDMA

Frequency slots may be preassigned to analog and digital signals, and to illustrate the method, analog signals in the FDM/FM/FDMA format ill be considered first. As the acronyms indicate, the signals are frequency-division multiplexed, frequency modulated (FM), with frequency-division multiple access to the satellite. In Chap. 9, FDM/FM signals are discussed. It will be recalled that the voice-frequency (telephone) signals are first SSBSC amplitude modulated onto voice carriers in order to generate the single sidebands needed for the frequency-division multiplexing. For the purpose of illustration, each earth station will be assumed to transmit a 60-channel supergroup. Each 60-channel supergroup is then frequency modulated onto a carrier which is then upconverted to a frequency in the satellite uplink band.





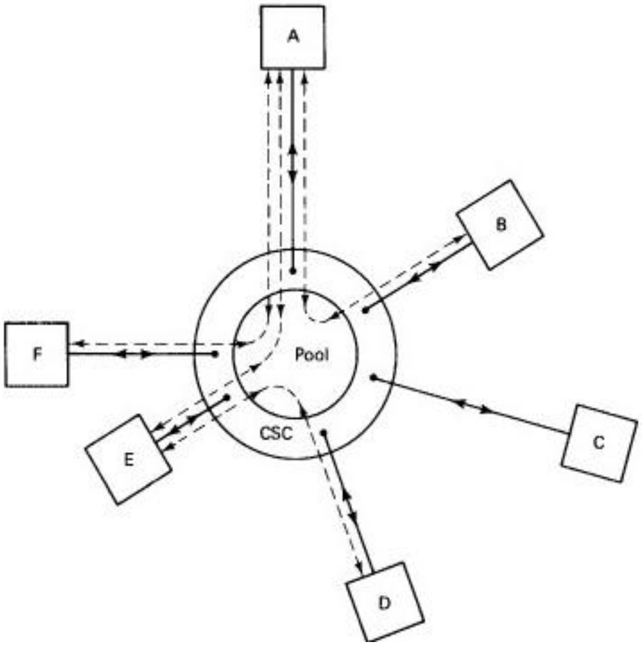
6.3 Spade System

The word Spade is a loose acronym for single-channel-per-carrier pulse-code-modulated multiple-access demand-assignment equipment. Spade was developed by Comsat for use on the INTELSAT satellites (see, e.g.,Martin, 1978). However, the distributed-demand assignment facility requires a common signaling channel (CSC). The CSC bandwidth is 160 kHz, and its center frequency is 18.045 MHz below the pilot frequency. To avoid interference with the CSC, voice channels 1 and 2 are left vacant, and to maintain duplex matching, the corresponding channels 1′ and 2′ are also left vacant. Recalling from Fig. 14.5 that channel 400 also must be left vacant, this requires that channel 800 be left vacant for duplex matching. Thus six channels are removed from the total of 800, leaving a total of 794 one-way or 397 full-duplex voice circuits, the frequencies in any pair being separated by 18.045 MHz.(An alternative arrangement is shown in Freeman, 1981).

All the earth stations are permanently connected through the common signaling channel (CSC). This is shown diagrammatically in Fig. for six earth stations A, B, C, D, E, and F. Each earth station has the facility for generating any one of the 794 carrier frequencies using frequency synthesizers. Furthermore, each earth station has a memory containing a list of the frequencies currently available, and this list is continuously updated through the CSC. To illustrate the procedure, suppose that a call to station F is initiated from station C in Fig. Station C will first select a frequency pair at random from those currently available on the list and signal this information to station F through the CSC. Station F must acknowledge, through the CSC, that it can complete the circuit. Once the circuit is established, the other earth stations are instructed, through the CSC, to remove this frequency pair from the list.

Cities chosen at station C may be assigned to another circuit. In this event, station C will receive the information on the CSC update and will immediately choose another pair at random, even before hearing back from station F. Once a call has been completed and the circuit disconnected, the two frequencies are returned to the pool, the information again being transmitted through the CSC to all the earth stations. As well as establishing the connection through the satellite, the CSC passes signaling information from the calling station to the destination station, in the example above from station C to station F. Signaling information in the Spade system is routed through the CSC rather than being sent over a voice channel. Each earth station has equipment called the demand assignment signaling and switching (DASS) unit which performs the functions required by the CSC.

Some type of multiple access to the CSC must be provided for all the earth stations using the Spade system. This is quite separate from the SCPC multiple access of the network's voice circuits. Time division multiple access, described in Sec. 14.7.8, is used for this purpose, allowing up to 49 earth stations to access the common signaling channel.



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