The Digital  NavigatorEG

Satellite Communication: Briefing Paper

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A communication satellite is essentially a microwave relay in the sky, operating at 22,300 miles above the earth's equator. It receives microwave signals in a given frequency and retransmits them at a different frequency. Satellites provide an efficient means of reaching isolated places on the earth and are considerably less expensive than terrestrial communication links for select applications. Communication satellites are a versatile form of wireless communication. What distinguishes communication satellites from other forms of wireless communication (broadcasting, cellular telephone etc.) is its high orbital position and movement.

Geosynchronous Orbit

The term "geosynchronous orbit" refers to a satellite that operates at 22,300 miles above the earth's equator. The satellite rotates at the speed of the earth. Hence, the satellite appears to be stationary in its orbital position.

Fixed Satellite Services (FSS)

The term Fixed Satellite Services (FSS) is used to describe satellites that operate in the GSO. Satellites that operate in the GSO can provide 24 hour service which is essential for broadcast

television, cable television, telephone and Internet communication.

Satellite Links

In principle, a complete satellite link requires a line of sight path extending between the earth station and the satellite. The term *uplink* refers to that portion of the satellite link where a signal is being transmitted from the earth station to the satellite. The term *downlink* refers to that portion of the satellite link where a signal is being transmitted from the satellite to the earth station below. See Figure 1.

Figure 1.
Satellite Transmission Link

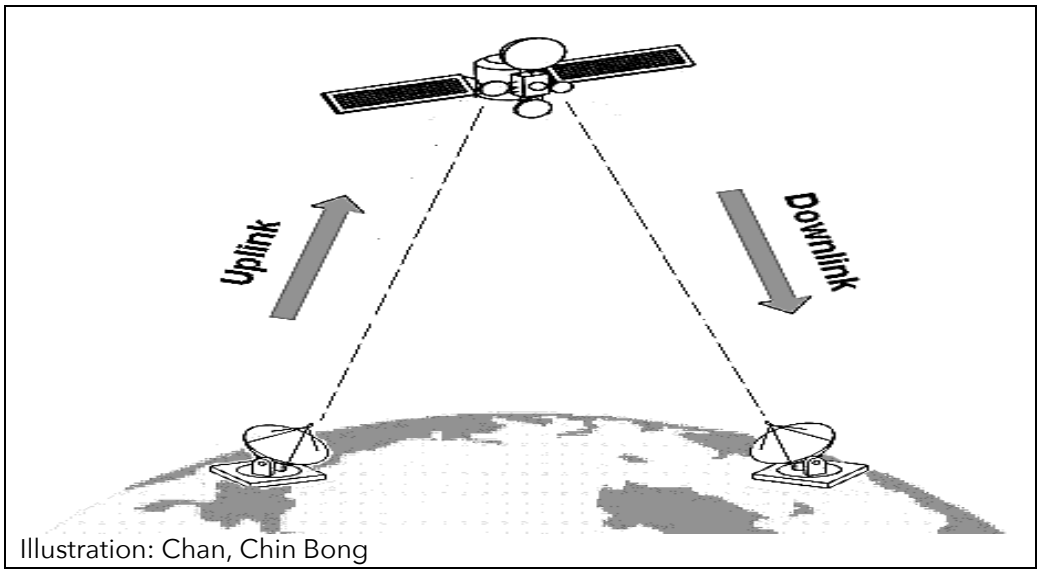


Illustration: Chan, Chin Bong

Transponder

A transponder is a contraction of two words: transmitter and responder. A transponder is analogous to a channel. A transponder provides the connection between the satellite's receiver and transmit antennas. It receives the signal in one frequency and then converts it to another for the down-link portion. Satellites operate in the Super High Frequency (SHF)

range which is measured in GHz. or billion cycles per second. Satellite engineers recognize that the higher the frequency, the greater the susceptibility to weather conditions, which can degrade performance. Therefore, the higher frequency is always assigned to the uplink portion, whereas, the lower frequency is assigned to the downlink.

A communication satellite contains 24 – 96 transponders plus spares depending on the size of the satellite. The transponder bandwidth can vary in size, ranging between 36MHz., 54 Mhz. or 72MHz. A single transponder can deliver a digital combination of voice, data and television channels. Many of today's satellites use a hybrid approach; that is, a combination of C and Ku band set of transponders. Subsequent improvements in Digital Video Compression using an MPEG 2 or MPEG 4 standard format allows satellite common carriers to maximize their transponder delivery capability. This becomes especially important when it come to the delivery of cable television and DBS video signals.

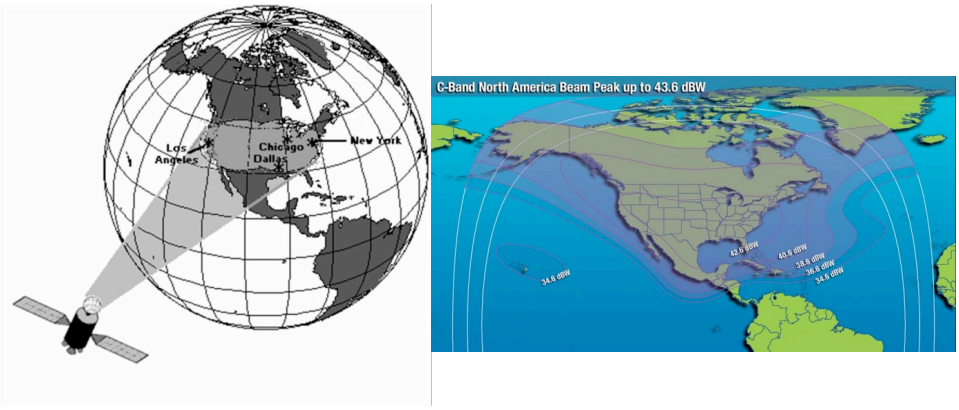
Satellite Frequency Bands

International satellite communication requires that all fully deployed satellites be assigned a frequency according to class of service (i.e., application) and power levels. Satellite frequency assignments are fully administered and regulated under the auspices of the International Telecommunications Union (ITU) in cooperation with a host country's major communication regulatory agency. Media and telecommunications companies like cable television have a need to down convert satellite frequencies and manipulate the signal within the confines of their master antenna site facility. The cable facility must be able to manipulate and transport the data without causing undue interference with other radio communications in the area.

Footprint

A satellite footprint refers to the signal's area of coverage. Premium television services, for example, like HBO utilizes a east Coast and West Coast feed in order to blanket the entire U.S. Similarly, Direct Broadcast Satellite (DBS) services like DirecTV have a fleet of satellites but use three primary satellites for distributing their signal in the U.S. Therefore, any earth station that falls within the footprint of a satellite fed signal and that is locked on to the appropriate transponder is capable of receiving the same signal. Figure 2. illustrates a satellite footprint and its coverage in North America. Figure 2. provides a second example of a satellite footprint whose area of coverage includes Europe, the middle east and major portions of Russia.

Figure 2.
Satellite Footprint Display



Sources: Chan Chin Bong and Intelsat

Earth Station

The earth station (or satellite dish) is the antenna that receives satellite fed voice, data and video signals. While some earth stations are capable of transmitting and receiving signals, most satellite dishes such as a cable head-end or DBS receiver is a television receive only (TVRO) device. The satellite dish contains a parabolic reflector as well as the internal electronics for

downlinking and converting the signal. By forming an arc, the parabolic dish concentrates incoming signals to a small point at the center above the dish. (See Figure. 3). The larger the diameter of the reflecting surface, the greater the sensitivity to weak incoming signals. Once the signal has been concentrated and delivered to the focal point, it must be collected and passed on with a minimum of signal loss.

Figure 3.
Satellite TVRO Earth Station

Source: Gershon R.A. (2013). *Media, Telecommunications and Business Strategy*. (2nd ed.) New York: Routledge.

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