TTC SUBSYSTEM, TRANSPONDERS AND ANTENNA SUBSYSTEM

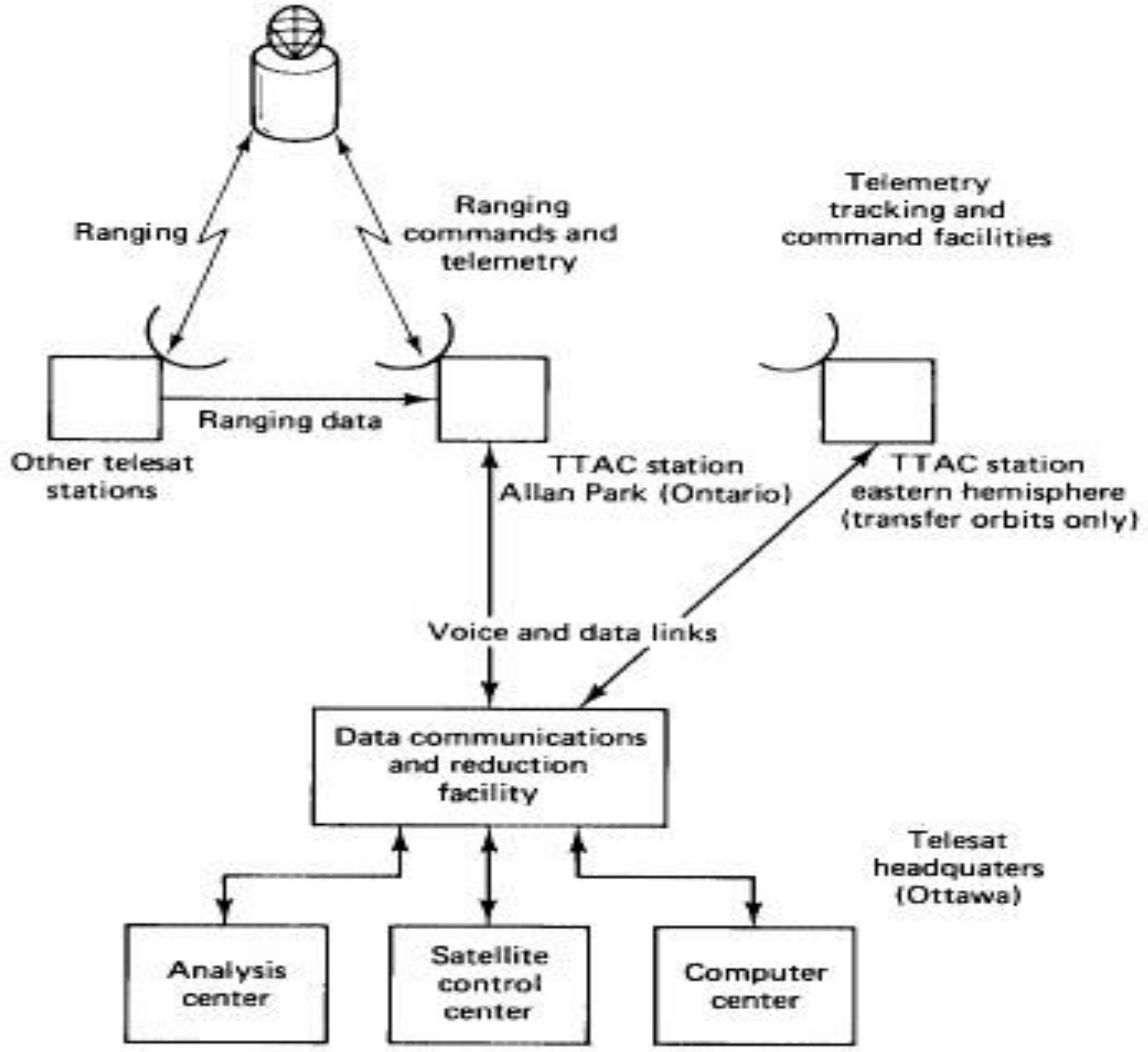
TT&C Subsystem

The telemetry, tracking, and command subsystem performs several routine functions aboard the spacecraft. The telemetry, or telemetering, function could be interpreted as measurement at a distance. Specifically, it refers to the overall operation of generating an electrical signal proportional to the quantity being measured and encoding and transmitting this to a distant station, which for the satellite is one of the earth stations. Data which are transmitted as telemetry signals include attitude information such as that obtained from sun and earth sensors; environmental information such as the magnetic field intensity and direction, the frequency of meteorite impact, and so on; and spacecraft information such as temperatures, power supply voltages, and stored-fuel pressure. Certain frequencies have been designated by international agreement for satellite telemetry trans missions. During the transfer and drift orbital phases of the satellite launch, a special channel is used along with an omnidirectional antenna. Once the satellite is on station, one of the normal communications transponders may be used along with its directional antenna, unless some emergency arises which makes it necessary to switch back to the special channel used during the transfer orbit.

Telemetry and command may be thought of as complementary functions. The telemetry subsystem transmits information about the satellite to the earth station, while the command subsystem receives command signals from the earth station, often in response to telemetered information. The command subsystem demodulates and, if necessary, decodes the command signals and routes these to the appropriate equipment needed to execute the necessary action. Thus attitude changes may be made, communication transponders switched in and out of circuits, antennas redirected, and station keeping maneuvers carried out on command. It is clearly important to prevent unauthorized commands from being received and decoded, and for this reason, the command signals are often encrypted. Encrypt is derived from a Greek word kryptein, meaning to hide, and represents the process of concealing the command signals in a secure code. This differs from the normal process of encoding, which is one of converting characters in the command signal into a code suitable for transmission. Tracking of the satellite is accomplished by having the satellite transmit beacon signals which are received at the TT&C earth stations. Tracking is obviously important during the transfer and drift orbital phases of the satellite launch. Once it is on station, the position of a geostationary satellite will tend to be shifted as a result of the various disturbing forces, as described previously. Therefore, it is necessary to be able to track the satellite's movement and send correction signals as required. Tracking beacons may be transmitted in the telemetry channel, or by pilot carriers at frequencies in one of the main communications channels, or by special tracking antennas. Satellite range from the ground station is also required from time to time. This can be determined by measurement of the propagation delay of signals especially transmitted for ranging purposes.

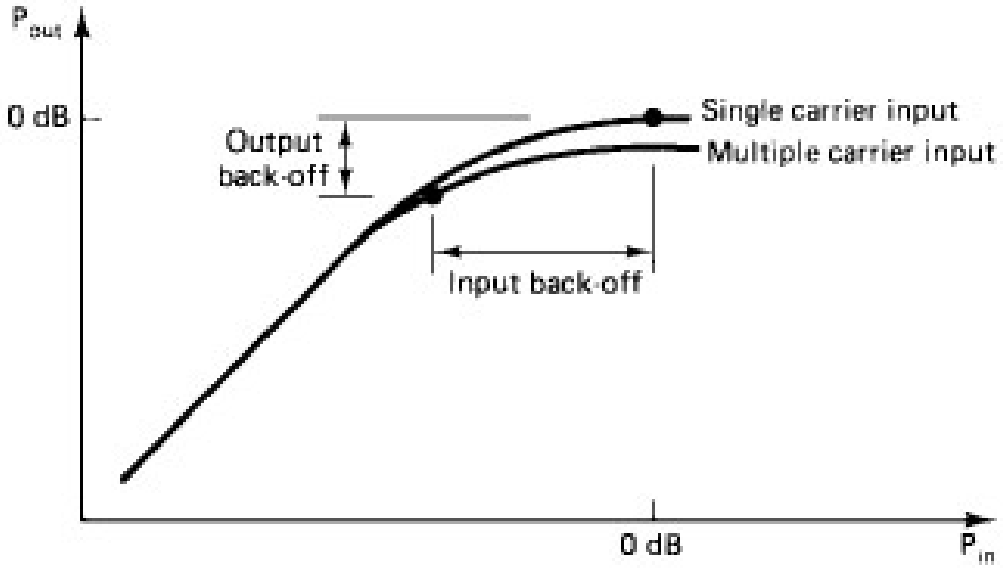
4.7 Transponders

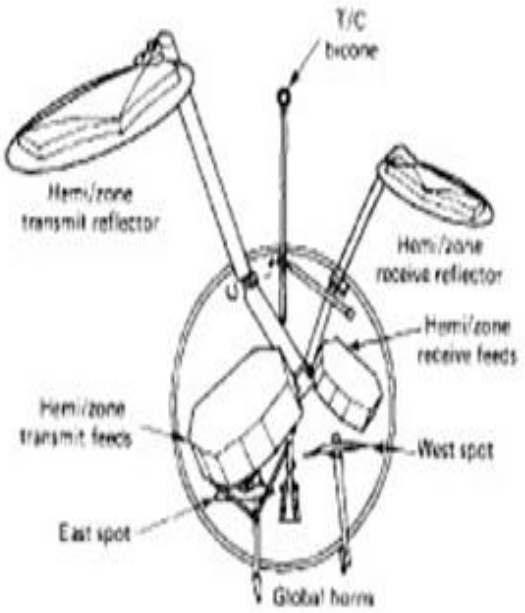
A transponder is the series of interconnected units which forms a single communications channel between the receive and transmit antennas in a communications satellite. Some of the units utilized by a transponder in a given channel may be common to a number of transponders. Thus, although reference may be made to a specific transponder, this must be thought of as an equipment channel rather than a single item of equipment.

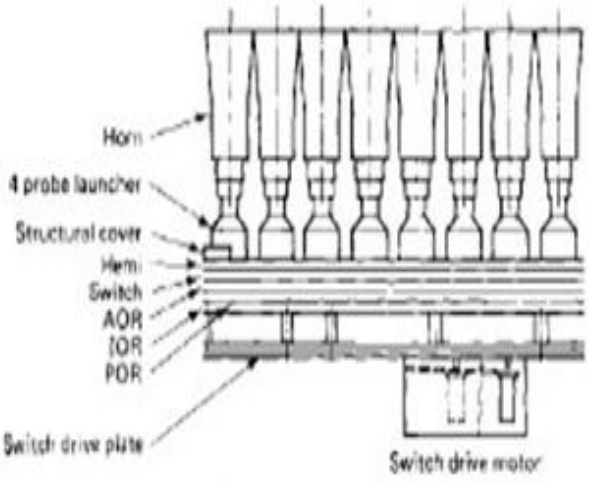


4.8 The Antenna Subsystem

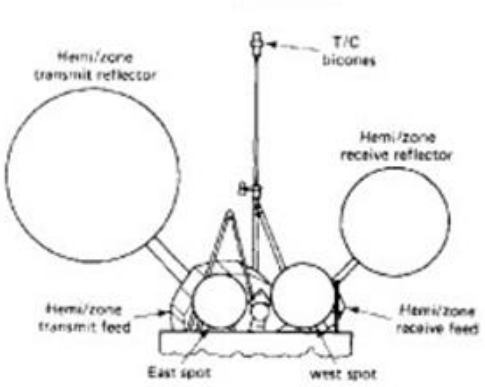
The antennas carried aboard a satellite provide the dual functions of receiving the uplink and transmitting the downlink signals. They range from dipole-type antennas where omnidirectional characteristics are required to the highly directional antennas required for telecommunications purposes and TV relay and broadcast. Directional beams are usually produced by means of reflector-type antennas, the paraboloidal reflector being the most common.

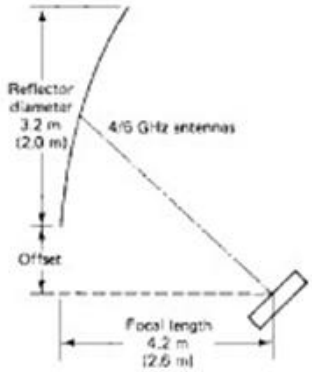


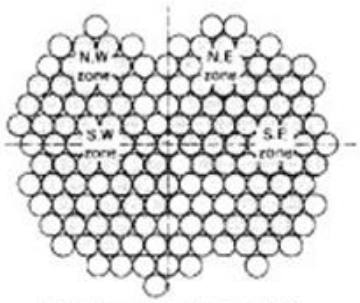




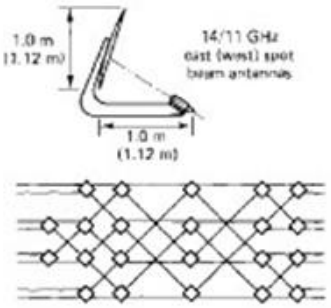
Section through part of the feed array







Excitation of 4 zone beams in AOR



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