SPACE SEGMENT

4.1 Introduction

A satellite communications system can be broadly divided into two segments, a ground segment and a space segment. The space segment will obviously include the satellites, but it also includes the ground facilities needed to keep the satellites operational, these being referred to as the tracking, telemetry, and command (TT&C) facilities. In many networks it is common practice to employ a ground station solely for the purpose of TT&C.

The equipment carried aboard the satellite also can be classified according to function. The payload refers to the equipment used to provide the service for which the satellite has been launched. The bus refers not only to the vehicle which carries the payload but also to the various subsystems which provide the power, attitude control, orbital control, thermal control, and command and telemetry functions required to service the payload.

In a communications satellite, the equipment which provides the connecting link between the satellite's transmit and receive antennas is referred to as the transponder. The transponder forms one of the main sections of the payload, the other being the antenna subsystems.

4.2 The Power Supply

The primary electrical power for operating the electronic equipment is obtained from solar cells. Individual cells can generate only small amounts of power, and therefore, arrays of cells in series-parallel connection are required.

For the HS376 satellite manufactured by Hughes Space and Communications Company. The spacecraft is 216 cm in diameter and 660 cm long when fully deployed in orbit. During the launch sequence, the outer cylinder is telescoped over the inner one, to reduce the overall length. Only the outer panel generates electrical power during this phase. In geostationary orbit the telescoped panel is fully extended so that both are exposed to sunlight. At the beginning of life, the panels produce 940 W dc power, which may drop to 760 W at the end of 10 years. During eclipse, power is provided by two nickel-cadmium long-life batteries, which will deliver 830 W. At the end of life, battery recharge time is less than 16 h.

4.3 Attitude Control

The attitude of a satellite refers to its orientation in space. Much of the equipment carried aboard a satellite is there for the purpose of controlling its attitude. Attitude control is necessary. To exercise attitude control, there must be available some measure of a satellite's orientation in space and of any tendency for this to shift. In one method, infrared sensors, referred to as horizon detectors, are used to detect the rim of the earth against the background of space. With the use of four such sensors, one for each quadrant, the center of the earth can be readily established as a reference point. Any shift in orientation is detected by one or other of the sensors, and a corresponding control signal is generated which activates a restoring torque. Usually, the attitude-control process takes place aboard the satellite, but it is also possible for control signals to be transmitted from earth, based on attitude data obtained from the satellite. Also, where a shift in attitude is desired, an attitude maneuver is executed. The control signals needed to achieve this maneuver may be transmitted from an earth station.

4.4 Station Keeping

In addition to having its attitude controlled, it is important that a geostationary satellite be kept in its correct orbital slot. The equatorial ellipticity of the earth causes geostationary satellites to drift slowly along the orbit, to one of two stable points, at 75°E and 105°W. To counter this drift, an oppositely directed velocity component is imparted to the satellite by means of jets, which are pulsed once every 2 or 3 weeks. This results in the satellite drifting back through its nominal station position, coming to a stop, and recommencing the drift along the orbit until the jets are pulsed once again.

These maneuvers are termed east-west station-keeping maneuvers. Satellites in the 6/4-GHz band must be kept within ±0.1° of the designnated longitude, and in the 14/12-GHz band, within ±0.05°. A satellite which is nominally geostationary also will drift in latitude, the main perturbing forces being the gravitational pull of the sun and the moon. These forces cause the inclination to change at a rate of about 0.85°/year. If left uncorrected, the drift would result in a cyclic change in the inclination, going from 0 to 14.67° in 26.6 years (Spilker, 1977) and back to zero, at which the cycle is repeated. To prevent the shift in inclination from exceeding specified limits, jets may be pulsed at the appropriate time to return the inclination to zero. Counteracting jets must be pulsed when the inclination is at zero to halt the change in inclination. These maneuvers are termed north-south station-keeping maneuvers, and they are much more expensive in fuel than are east-west station-keeping maneuvers. The north-south station-keeping tolerances are the same as those for east-west station keeping, ±0.1° in the C band and ±0.05° in the Ku band.

4.5 Thermal Control

Satellites are subject to large thermal gradients, receiving the sun's radiation on one side while the other side faces into space. In addition, thermal radiation from the earth and the earth's albedo, which is the fraction of the radiation falling on earth which is reflected, can be significant for low-altitude earth-orbiting satellites, although it is negligible for geostationary satellites. Equipment in the satellite also generates heat which has to be removed. The most important consideration is that the satellite's equipment should operate as nearly as possible in a stable temperature environment. often used to remove heat from the communications payload In order to maintain constant temperature conditions, heaters may be switched on (usually on command from ground) to make up for the heat reduction which occurs when transponders are switched off. In INTELSAT VI, heaters are used to maintain propulsion thrusters and line temperatures (Pilcher, 1982).

Source : http://elearningatria.files.wordpress.com/2013/10/ece-vi-satellite-communications-10ec662-notes.pdf