

2 MARKS-EC 8094 SATELLITE COMMUNICATION

UNIT-I OVERVIEW OF SATELLITE SYSTEMS, ORBITS AND LAUNCHING METHODS

1. Describe briefly the main advantages offered by satellite communication.

Very economical

Distance insensitive

It can link many users who are widely separated graphically

Telephone, data and video services

Remote sensing like detection of water pollution and monitoring and reporting of weather condition.

2. How to facilitate frequency planning is done in the world for Satellite Services? How to divide Frequency Allocations for Satellite Services based regions?

Region1: Europe, Africa,(formerly the Soviet Union)and Mongolia

Region 2: North and South America and Greenland

Region3:Asia, Australia, and the south- west Pacific

3. What are various satellite services allocated depends on frequency bands? How to classify satellite services?

1. Fixed satellite service (FSS)

2. Broadcasting satellite service (BSS)

3. Mobile satellite services

4. Navigational satellite services and

5. Meteorological satellite services

4. Write about Fixed satellite service (FSS).

The FSS provides links for existing telephone networks as well as for transmitting television signals to cable companies for distribution over cable systems. The Ku band (12 to 14 GHz)is used for certain FSS. The C band (4to6GHz) is used for FSS.

5. Write about Broadcasting satellite services(BSS)

Broadcasting satellite services are intended for direct broadcast to the home, also called as direct broadcast satellite(DBS)service[in Europe it known as direct-to-home (DTH)service]. The Ku band (12 to 14 GHz) is used for DBS

6. What are uses of Mobile satellite services?

Mobile satellite services are used for land mobile, maritime mobile, and aeronautical mobile.

The L band is used for mobile satellite services. The very high frequency(VHF)band is used for certain mobile.

7. What are the purposes of Navigational satellite services and meteorological services?

Navigational satellite services include global positioning systems (GPS), and satellites intended for the meteorological services often provide a search and rescue service. The very high frequency (VHF) band and L band's are used navigational services and for data transfer from weather satellites.

8. Give to frequency ranges of VHF, UHF, L, S, C, X, Ku, K and KaBands.

Frequency range, (GHz) Band designation

0.1–0.3 VHF

0.3–1.0 UHF

1.0–2.0 L

2.0–4.0 S

4.0–8.0 C

8.0–12.0 X
12.0–18.0 Ku
18.0–27.0 K
27.0–40.0 Ka

9. What is INTELSAT?

INTELSAT stands for International Telecommunications Satellite. INTELSAT covers three main regions—the Atlantic Ocean Region (AOR), the Indian Ocean Region (IOR), and the Pacific Ocean Region (POR). INTELSAT satellites provide a much wider range of services than those available previously, including such services as Internet, DTH TV, telemedicine, teleeducation, and interactive video and multimedia.

10. What is DOMSAT?

Domsat is domestic satellite, which are used to provide various telecommunications services, such as voice, data, and video transmissions, within a country. In the United States, all domsats are situated in geostationary orbit.

11. What are Low earth orbiting (LEO) satellites?

Polar orbiting satellites orbit to cover the north and south Polar Regions of earth. In theory, there are an infinite number of polar orbits, whereas there is only one geostationary orbit. Weather satellites have led to use of relatively low orbits, ranging in altitude between 800 and 900 km, compared with 36,000 km for the geostationary orbit. These are called as Low earth orbiting (LEOSATS) satellites.

UNIT-2

1. What is sun transit outage?

The event which must be allowed for during the equinoxes is the transit of the satellite between earth and sun, such that the sun comes within the beam width of the earth-station antenna. When this happens, the sun appears as an extremely noisy source which completely blanks out the signal from the satellite. This effect is termed sun transit outage, and it lasts for short periods—each day for about 6 days around the equinoxes.

2. What is Space Transportation System (STS)?

Satellite launch vehicles may be classified as expendable or reusable. Typical of the expendable launchers are the U.S. Atlas-Centaur and Delta rockets and the European Space Agency Ariane rocket. Japan, China, and Russia all have their own expendable launch vehicles. Until the tragic mishap with the Space Shuttle in 1986, this was to be the primary transportation system for the United States. As a reusable launch vehicle, it was replacing expendable launch vehicles for the United States which are referred to as the Space Transportation System (STS).

3. What are the functionality of STS?

The Hohmann elliptical orbit is seen to be tangent to the low-altitude orbit at perigee and to the high-altitude orbit at apogee. At the perigee, in the case of rocket launch, the rocket injects the satellite with the required thrust into the transfer orbit. With the STS, the satellite must carry a perigee kick motor which imparts the required thrust at perigee. At apogee, the apogee kick motor (AKM) changes the velocity of the satellite to place it into a circular orbit in the same plane. Throughout the launch and acquisition phases, a network of ground stations, spread across the earth, is required to perform the tracking, telemetry, and command (TT&C) functions.

4. How to relate Geostationary and Geosynchronous satellites?

The period for a geostationary satellite is 23 h, 56 min, 4 s, or 86,164 s. The reciprocal of this is 1.00273896 rev/day. But satellites are geosynchronous, in that they rotate in synchronism with the rotation of the earth. However, they are not geostationary. The term geosynchronous satellite is used in many cases instead of geostationary to describe these near-geostationary satellites. It should be noted, however, that in general a geosynchronous satellite does not have to be near-geostationary, and there are a number of geosynchronous satellites that are in highly elliptical orbits with comparatively large inclinations.

5. What is need for station keeping? Or Effects of near geosynchronous orbits?

Station-keeping maneuvers must be carried out to maintain the satellite within set limits of its nominal geostationary position. There are a number of perturbing forces that cause an orbit to depart from the ideal Keplerian orbit. For the geostationary case, the most important of these are the gravitational fields of the moon and the sun, and the non spherical shape of the earth, and also solar radiation pressure and reaction of the satellite itself to motor movement within the satellite.

6. Write notes on transponder.

The transponder is an equipment channel which provides the connecting link between the satellite's transmit and receive antenna. It is a single communication channel which is formed by a series of interconnected units.

7. What is meant by spot beam antenna?

Spot beam antenna is a parabolic type of satellite antenna with a high gain and narrow beam. The narrow beam signal sent by the antenna covers only a limited geographic area on earth so that only earth stations in a particular intended reception area can properly receive the satellite signal. This antenna is suitable for earth stations handling large traffic of communication.

8. What is meant by frequency reuse?

The carrier with opposite senses of polarization may overlap in frequency. This technique is known as frequency reuse.

9. Describe the spin stabilized satellites.

In a spin stabilized satellite, the body of the satellite spins at about 30 to 100 rpm about the axis perpendicular to the orbital plane. The satellites are normally dual spin satellites with a spinning section & a despun section on which antennas are mounted. These are kept stationary w.r.t. to earth by counter rotating the despun section.

10. Write the formula for GST.

$GST = 99.6910 + 36000.7689Xt + 0.0004Xt^2 + UT \text{ deg.}$

11. Write short notes on attitude control system.

It is the system that achieves & maintains the required attitudes. The main functions of attitude control system include maintaining accurate satellite position throughout the life span of the system.

UNIT-3

1. What is LNB?

The receiving horn feeds into a low-noise converter (LNC) or possibly a combination unit consisting of a low-noise amplifier (LNA) followed by a converter. The combination is referred to as an LNB, for low-noise block.

2. What is the major difference between DBS TV and conventional?

A difference between DBS TV and conventional TV is that with DBS, frequency modulation is used, whereas with conventional TV, amplitude modulation in the form of vestigial single sideband (VSSB) is used.

3. What is as single carrier per channel (SCPC)?

Traffic can be broadly classified as heavy route, medium route, and thin route. In a thin-route circuit, a transponder channel (36 MHz) may be occupied by a number of single carriers, each associated with its own voice circuit. This mode of operation is known as single carrier per channel (SCPC).

4. Define Equivalent Isotropic Radiated Power.

A key parameter in link-budget calculations is the equivalent isotropic radiated power(EIRP).

The maximum flux density at distance r from the transmitting antenna.

An isotropic radiator with an input power equal to GPs would produce same flux density.

Hence $EIRP = GPs$

$$[EIRP] = [Ps] + [G] \text{ Dbw}$$

5. List out transmission losses?

Free-space transmission losses, Feeder losses, Antenna misalignment losses, Fixed atmospheric and ionospheric losses.

6. Define Free-space losses (FSL).

The free space losses are defined as $[FSL] = 10 \log \Phi$

The received power is given as the sum of the transmitted EIRP plus the receiver antenna gain minus a third term, which is called free space loss in dB.

$$[PR] = [EIRP] + [GR] - [FSL].$$

7. Define (receiver) feeder losses.

Losses will occur in the connection between the receive antenna and the receiver proper. Such losses will occur in the connecting waveguides, filters, and couplers. These are called as RFL, or $[RFL]$ dB, for receiver feeder losses.

8. Define Antenna misalignment losses

When a satellite link is established, the ideal situation is to have the earth station and satellite antennas aligned for maximum gain. There are two possible sources of off-axis loss, one at the satellite and one at the earth station. The off-axis loss at the satellite is taken into account by designing the link for operation on the actual satellite antenna contour. The off-axis loss at the earth station is referred to as the antenna pointing loss.

9. Write down the Link-Power Budget Equation

The $[EIRP]$ can be considered as the input power to a transmission link. The major source of loss in any ground-satellite link is the free-space spreading loss $[FSL]$, the basic link-power budget equation taking into account this loss only. The losses for clear-sky conditions are $[LOSSES] = [FSL] + [RFL] + [AML] + [AA] + [PL]$

The power at the receiver may be calculated as $[PR] = [EIRP] - [LOSSES] + [GR]$, where the last quantity is the receiver antenna gain.

10. What is system noise?

The major source of electrical noise in equipment is that which arises from the random thermal motion of electrons in various resistive and active devices in the receiver. Thermal noise is also generated in the lossy components of antennas, and thermal-like noise is

picked up by the antennas as radiation.

The available noise power from a thermal noise source is given by $P_N = kTb_n$

9. What is meant by INTELSAT?

International Telecommunication Satellite.

10. What is meant by SARSAT?

Search and rescue satellite.

11. What are the applications of Radarsat?

- a. Shipping and fisheries.
- b. Ocean feature mapping
- d. Iceberg detection
- e. Crop monitoring

UNIT-4

1. What is meant by single access?

A transponder channel aboard satellite may be fully loaded by a single transmission from an earth station. This is called as a single access mode of operation.

2. What is meant by multiple access?

A transponder to be loaded by a number of carriers, which may originate from a number of earth stations geographically separate and each earth station may transmit one or more of the carriers. This is called as multiple access.

3. What are commonly used methods for multiple access?

Frequency-division multiple access (FDMA) and 2. Time-division multiple access (TDMA).

4. How to classify the multiple access based on circuits are assigned to users?

1. pre-assigned multiple access Circuits may be pre- assigned, which means they are allocated on a fixed Or partially fixed basis to certain users. These circuits are therefore not available for general use. Pre assignment is simple to implement but is efficient only for circuits with continuous heavy traffic.

2. demand-assigned multiple access (DAMA). All circuits are available to all users and are assigned according to the demand. DAMA results in more efficient overall use of the circuits but is more costly and complicated to implement.

Both FDMA and TDMA can be operated as pre assigned or demand assigned systems. CDMA is a random-access system, there being no control over the timing of the access or of the frequency slots accessed.

5. Define space-division multiple access (SDMA).

Above multiple-access methods refer to the way in which a single transponder channel is utilized .A satellite carries a number of transponders, and normally each covers a different frequency channel. This provides a form of FDMA to the whole satellite .It is also possible for transponders to operate at the same frequency but to be connected to different spot-beam antennas. These allow the satellite as a whole to be accessed by earth stations widely separated geographically but transmitting on the same frequency. This is termed frequency reuse. This method of access is referred to as space-division multiple access (SDMA).

6. What is a single mode of operation?

A transponder channel aboard a satellite may be fully loaded by a single transmission from an earth station. This is referred to as a single access mode of operation.

7. What is in CDMA? & its types?

In this method each signal is associated with a particular code that is used to spread the signal in

frequency & or time.

*Spread spectrum multiple access

*Pulse address multiple access

8. What is a thin route service?

SCPC systems are widely used on lightly loaded routes, this type of service being referred to as a thin route service.

9. What is an important feature of Intelsat SCPC system?

The system is that each channel is voice activated. This means that on a two way telephone conversation only one carrier is operative at any one time.

10. What is a TDMA? What are the Advantage?

Only one carrier uses the transponder at any one time, & therefore intermodulation products, which results from the nonlinear amplification of multiple carriers are absent. Merits: The transponder traveling wave tube can be operated at maximum power o/p or saturation.

11. What is preamble?

Certain time slots at the beginning of each burst are used to carry timing & synchronizing information. These time slots collectively are referred to as preamble.

12. Define guard time.

It is necessary to between bursts to prevent the bursts from overlapping. The guard time will vary from burst to burst depending on the accuracy with which the various bursts can be positioned within each frame.

13. What is meant by decoding quenching?

In certain phase detection systems the phase detector must be allowed time to recover from one burst before the next burst is received by it. This is known as decoding quenching.

14. What is meant by direct closed loop feedback?

The timing positions are reckoned from the last bit of the unique word in the preamble. The loop method is also known as direct closed loop feedback.

15. What is meant by feedback closed loop control?

The synchronization information is transmitted back to an earth station from a distant, which is termed feedback closed loop control.

UNIT-5

1. Write the main components of GPS.

1. The Control segments 2. The Space segments 3. The User segments

2. What is INMARSAT?

It is the first global mobile satellite communication system operated at Lband and internationally used by 67 countries for communication between ships and coast so that emergency life saving may be provided. Also it provides modern communication services to maritime, land mobile, aeronautical and other users.

3. List out the regions covered by INMARSAT.

- Atlantic ocean region, east (AOR-E)
- Atlantic ocean region, west (AOR-W)
- Indian ocean region (IOR) • Pacific ocean region (POR)

4. What is INSAT?

INSAT – Indian National Satellite System.

INSAT is a Indian National Satellite System for telecommunications, broadcasting, meteorology and search and rescue services. It was commissioned in 1983. INSAT was the largest domestic communication system in the Asia-Pacific region.

5. List out the INSAT series.

- INSAT-1 • INSAT-2 • INSAT-2A
- INSAT-2E • INSAT-3

6. What is GSM?

GSM (Global System for Mobile communications: originally from Groupe Spécial Mobile) is the most popular standard for mobile phones in the world. GSM differs from its predecessors in that both signaling and speech channels are digital, and thus is considered a second generation (2G) mobile phone system. This has also meant that data communication was easy to build into the system.

7. What is GPRS?

General packet radio service (GPRS) is a packet oriented mobile data service available to users of the 2G cellular communication systems global system for mobile communications (GSM), as well as in the 3G systems. In the 2G systems, GPRS provides data rates of 56-114 kbit/s.

8. What is GPS?

In the GPS system, a constellation of 24 satellites circles the earth in near-circular inclined orbits. By receiving signals from at least four of these satellites, the receiver position (latitude, longitude, and altitude) can be determined accurately. In effect, the satellites substitute for the geodetic position markers.

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