CEC 352 - SATELLITE COMMUNICATION

Prepared

by

V. PARTHIBAN,
AP/ECE

Sri Muthukumaran Institute of Technology
Chikkarayapuram, Near Mangadu, Chennai – 600 069.

UNIT IV – SATELLITE ACCESS

SYLLABUS

Modulation and Multiplexing: Voice, Data, Video, Analog – digital transmission system,Digital video Broadcast, multiple access: FDMA, TDMA, CDMA, Assignment Methods,Spread Spectrumcommunication,compression–encryption

CHAPTER 4

EARTHSEGMENT

EARTHSTATIONTECHNOLOGY

The earth segment of a satellite communications system consists of transmit andreceiveearthstations.Thesimplestof thesearethehome*TVreceive-only*(TVRO)systems,andthemostcomplexaretheterminalstationsusedforinternationalcommunicationsnetworks.Alsoincludedin the earth segmentare those stations whichareonshipsatsea,andcommercialandmilitarylandandaeronauticalmobilestations.

TerrestrialInterface

Earthstationisavitalelementinanysatellitecommunicationnetwork.Thefunction of an earth station is to receive information from or transmit information to, thesatellitenetworkinthemostcost-effectiveandreliablemannerwhileretainingthedesiredsignal quality.Thedesign of earth station configuration depends upon manyfactors and its location. But it isfundamentally governed by its location which are listedbelow,

- Inland
- Ona ship atsea
- OnboardaircraftThefactorsare
- Type of services
- Frequencybandsused
- Functionofthetransmitter
- Functionofthereceiver
- Antennacharacteristics

TransmitterandReceiver

Anyearthstationconsistsoffourmajorsubsystems-

- Transmitter
- Receiver
- Antenna
- TrackingequipmentT

woother important subsystems are

- Terrestrial interface equipment
- Power supply

The earth station depends on the following parameters

- Transmitter power
- Choice of frequency
- Gain of antenna
- Antenna efficiency
- Antenna pointing accuracy
- Noise temperature

The functional elements of a basic digital earth station are shown in the below figure 4.1.

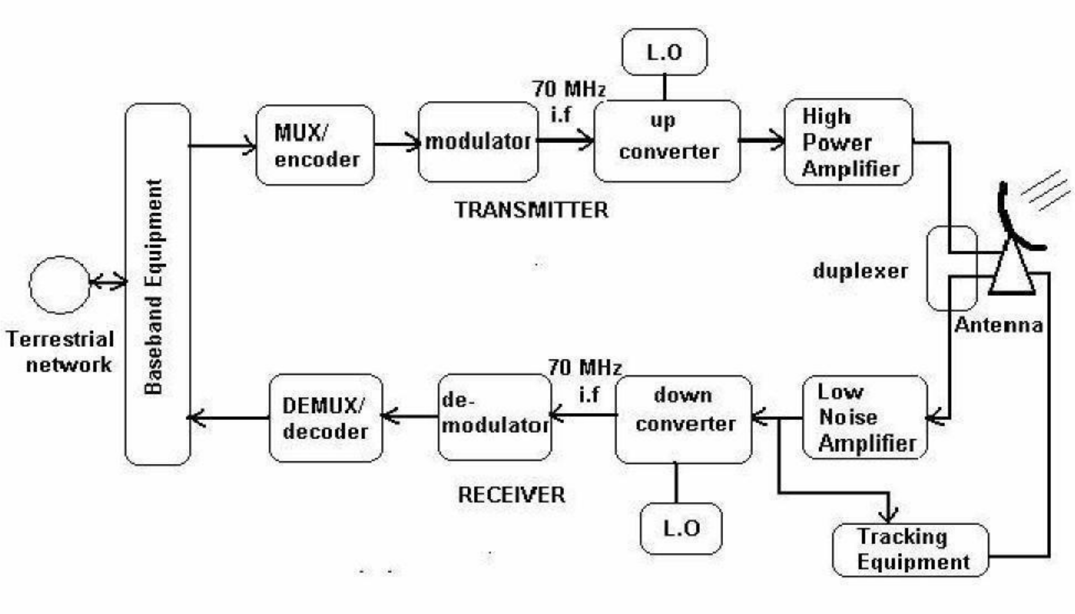

Figure4.1 Transmitter-Receiver

Digital information in the form of binary digits from terrestrial networks enters earthstation and is then processed (filtered,multiplexed,formatted etc.) by the base bandequipment. The encoder performs error correction coding to reduce the error rate, byintroducing extra digits into digital stream generated by the baseband equipment. Theextra digits carryinformation.

- In satellite communication, I.F carrier frequency is chosen at 70MHz for communication using a 36 MHz transponder bandwidth and at 140 MHz for a transponderbandwidth of 54 or 72 MHz On the receive side, the earth station antenna receives thelow-level modulated R.F carrier in the downlink frequency spectrum.
- The low noise amplifier (LNA) is used to amplify the weak receivedsignalsand

improve the signal to Noise ratio (SNR). The error rate requirements can be met moreeasily. R.F is to be reconverted to I.F at 70 or 140 MHz because it is easier design ademodulationtoworkatthese frequencies than4or12GHz.

- The demodulator estimate which of the possible symbols was transmitted based onobservation of the receivedifcarrier. The decoder performs a function opposite that ofthe encoder. Because the sequence of symbols recovered by the demodulator may containerrors, the decoder must use the uniqueness of the redundant digits introduced by theencodertocorrecttheerrors andrecoverinformation-bearingdigits.
- Theinformationstreamisfedtothebase-bandequipmentforprocessingfordelivery to the terrestrialnetwork. The tracking equipments track the satellite and alignthe beamtowardsittofacilitatecommunication.

EarthStationTrackingSystem

Tracking is essential when the satellite drift, as seen by an earth station antenna isasignificantfractionofanearthstation’santennabeamwidth.Anearthstation’stracking system is required to perform some of the functions such as Satellite acquisition,Automatic tracking,Manualtracking,Programtracking.

ANTENNATERRESTRIALINTERFACE

Theantenna systemconsistof-

- ✓ FeedSystem
- ✓ AntennaReflector
- ✓ Mount
- ✓ AntennatrackingSystem

FeedSystem

Thefeedalongwiththereflectoristheradiating/receivingelementofelectromagnetic waves. The reciprocity property of the feed element makes the earthstationantennasystemsuitablefortransmissionandreceptionofelectromagneticwaves.

The way the waves coming in and going out is called feed configuration. EarthStation feed systemsmostcommonlyusedin satellite communicationare:

i) Axi-SymmetricConfiguration
ii)AsymmetricConfiguration

In an axi-symmetricconfiguration theantennaaxes aresymmetrical with respectto thereflectorwhichresultsinasimplemechanicalstructureandantennamount.

PrimaryFeed:

In primary, feed is located at the focal point of the parabolic reflector.Manydishes use only a single bounce, with incoming waves reflecting off the dish surface to thefocus in front of the dish, where the antenna is located. When the dish is used to transmitthe transmitting antenna at the focus beams waves toward the dish, bouncing them off tospace.Thisisthesimplestarrangement.

Cassegrain:

Many dishes have the waves make more than one bounce .This is generally calledas folded systems. The advantage is that the whole dish and feed system is more compact.There are several folded configurations, but all have at least one secondary reflector alsocalled a subreflector,locatedoutinfront of the dishtoredirectthewaves.

A common dual reflector antenna called Cassegrain has a convex sub reflectorpositioned in front of the main dish, closer to the dish than the focus. This sub reflectorbouncesback thewavesback toward afeedlocated onthemaindish'scenter,sometimesbehind a hole at the center of the main dish. Sometimes there are even more sub reflectorsbehind thedishto directthewavesto thefedforconvenienceorcompactness.

Gregorian

Thissystemhasaconcavesecondaryreflectorlocatedjustbeyondtheprimaryfocus.Thisalsobouncesthewavesbacktowardthedish.

AsymmetricConfiguration

The performance of an axi-symmetric configuration is affected by the blockage of theaperture by the feed and the sub reflector assembly. The resultis a reduction in theantenna efficiency and an increase in the side lobe levels. The asymmetric configurationcan remove this limitation..This is achieved by off- setting the mounting arrangement ofthe feed so that it does not obstruct the main beam. As a result, the efficiency and sidelobelevelperformanceareimproved.

AntennaReflector

Mostly parabolic reflectors are used as the main antenna for the earth stationsbecause of the high gain available from the reflector and the ability of focusing a parallelbeam into a point at the focus where the feed element is located .For large antenna systemmorethanonereflectorsurfacesmaybeusedinasinthecassegrainantennasystem.

Earthstationsarealsoclassifiedonthebasisofservices for example:

1. Two wayTV,Telephonyanddata
2. TwowayTV
3. TVreceive onlyandtwowaytelephonyanddata
4. Twoway data

Fromtheclassificationsitisclearthatthetechnologyofearthstationwillvaryconsiderablyontheperformanceandtheservicerequirementsofearthstation.

Formechanicaldesignofparabolicreflectorthefollowingparametersarerequiredtobeconsidered:

- ✓ Size ofthereflector
- ✓ FocalLength/diameterratio
- ✓ RMS errorofmain and subreflector
- ✓ Pointingandtrackingaccuracies
- ✓ Speedandacceleration
- ✓ Typeofmount
- ✓ CoverageRequirement

WindSpeed

The size of the reflector depends on transmit and receive gain requirement andbeamwidth of the antenna. Gain is directly proportional to the antenna diameter whereasthebeamwidthisinverselyproportionaltotheantennadiameter .forhighinclinationangleof the satellite, the tracking of the earth station becomes necessary when the beamwidth istoonarrow.

Thegainofthe antennaisgivenbyGain=$(\eta 4\Pi A_{eff})/\lambda^2$

Where $A_{eff}$is the aperture Λis wave length, H is efficiency of antenna system. For aparabolic antenna withcircularaperture diameterD,the gainofthe antennais:

$$\text{Gain}=(\eta 4\Pi/\lambda^2)(\Pi D^2/4)$$

$$=\eta\,(\Pi D/\lambda)^2$$

Theoverallefficiencyofthe antennaisthenetproductofvariousfactorssuchas

1. CrossPolarization
2. Spillover
3. Diffraction
4. Blockage
5. Surfaceaccuracy
6. Phaseerror
7. Illumination

In the design of feed , the ratio of focal length F to the diameter of the reflector D of the antennasystem control themaximum angle subtended by the reflector surface on thefocal point.LargertheF/D ratiolargeristheapertureilluminationefficiencyandlowerthecrosspolarization.

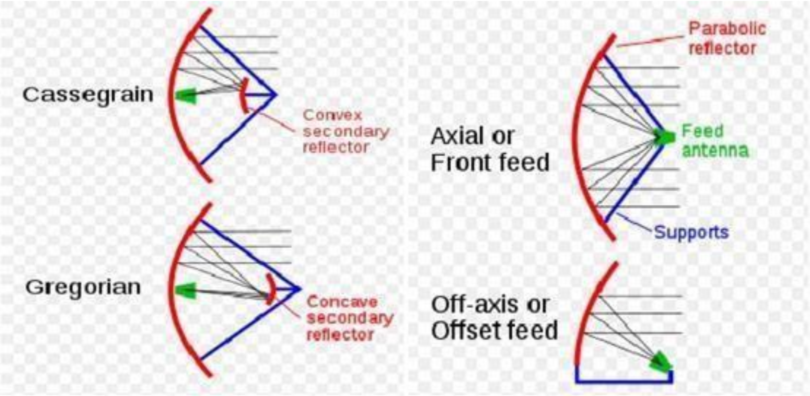

Figure4.2 AntennaSubSystems

AntennaMount

Type of antenna mount is determined mainly by the coverage requirement andtracking requirements of the antenna systems. Different types of mounts used for earthstationantennaare:

i) TheAzimuth–elevationmount

This mount consists of a primary vertical axis. Rotation around this axis controlsthe azimuth angle. The horizontal axis is mounted over the primaryaxis, providing theelevationanglecontrol.

ii) TheX-Ymount

It consists of a horizontal primary axis (X-axis) and a secondary axis (Y- axis) andat rightanglestoit.Movementaroundthese axesprovidesnecessarysteering.

AntennaTrackingSystem

Trackingisessentialwhenthesatellitedrift,asseenbyanearthstationantennaisa significant fraction of an earth station's antenna beam width. An earth station's trackingsystemis requiredtoperformsomeofthefunctions suchas

i) Satelliteacquisition
ii)Automatic
trackingiii)Manual
trackingiv)Programtr
acking

RECEIVE-ONLYHOMETVSYSTEMS(TVRO)

Planned broadcasting directly to home TV receivers takes place in the Ku (12-GHz) band. This service is known as *direct broadcast satellite* (DBS) service. There issome variation in the frequency bands assigned to different geographic regions. In theAmericas, for example, the down- link band is 12.2 to 12.7 GHz. The comparatively largesatellitereceivingdishes[rangingindiameterfromabout1.83m(6ft)toabout3-m(10ft)insomelocations],which maybeseeninsome“backyards”areusedto receivedownlinkTVsignalsatCband(4GHz).

Originally such downlink signals were never intended for home reception but fornetwork relay to commercial TV outlets (VHF and UHF TV broadcast stations and cableTV “head-end”studios).

The IndoorUnit

Equipment isnow marketed for home reception ofC-band signals, and somemanufacturers provide dual C-band/Ku-band equipment. A single mesh type reflector maybe used which focuses the signals into a dual feed- horn, which has two separate outputs, onefortheC-bandsignalsandonefortheKu-bandsignals.

Much of television programming originates as *first generation signals*, also knownas *master broadcast quality signals*. These are transmitted via satellite in the C band to thenetwork head- end stations, where they are retransmitted as compressed digital signals tocable anddirectbroadcastsatelliteproviders.

- Another of the advantages, claimed for home C-band systems, is the larger number ofsatellites available for reception compared to available for direct broadcast satellitesys-terms.
- Althoughmanyofthe C-bandtransmissionsarescrambled,thereare freechannelsthatcanbereceived,andwhat aretermed“wildfeeds.”
- These are also free, but unannounced programs, of which details can be found inadvancefromvariouspublicationsandInternetsources.
- C-band users can also subscribe to pay TV channels, and another advantage claimedis that subscription services are cheaper than DBS or cable because of the multiple-source programmingavailable.
- The most widely advertised receiving system for C-band system appears to be 4DTVmanufacturedbyMotorola.

Thisenablesreceptionof:

- ✓ Free,analogsignalsand “wildfeeds”
- ✓ Video Cipherllplussubscriptionservices
- ✓ FreeDigiCipher2services
- ✓ SubscriptionDigiCipher2services

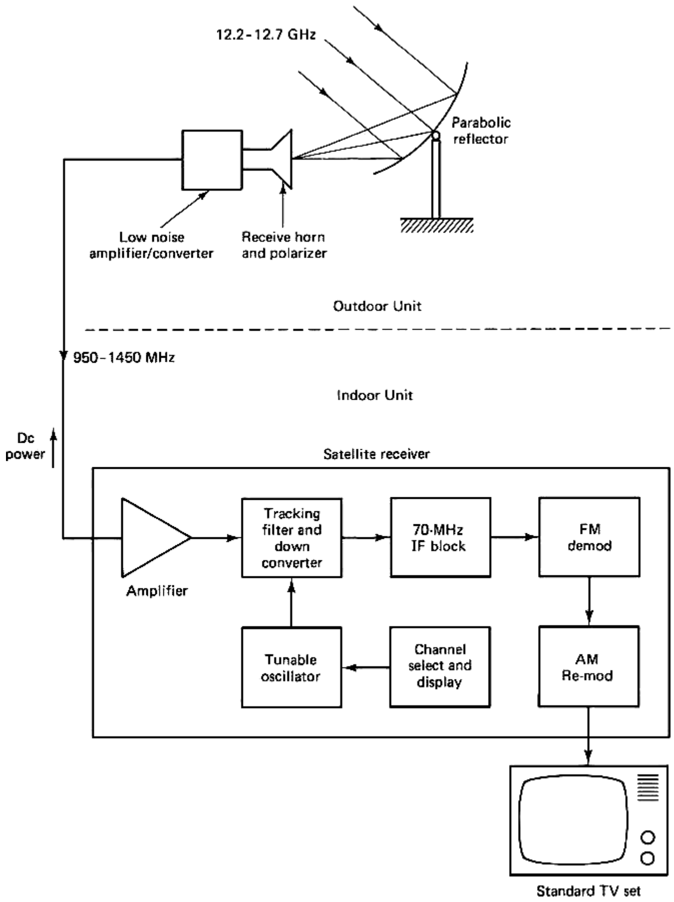

Figure4.3TVROSystemBlock Diagram

TheOutdoorUnit

Thisconsistsofareceivingantennafeedingdirectlyintoalow-noiseamplifier/convertercombination.Aparabolicreflectorisgenerallyused,withthereceiving horn mounted at the focus. A common design is to have the focus directly infront of the reflector, but for better interference rejection, an offset feed may be used asshown.Comparing the gain of a 3-mdish at4 GHz with a 1-mdish at12 GHz,theratio *D*/*l*equals40in eachcase,sothe gains will be aboutequal.Although thefree-spacelossesaremuchhigherat12GHzcomparedwith4GHz.

The downlink frequency band of 12.2 to 12.7 GHz spans a range of 500 MHz,which accommodates 32 TV/FM channels, each of which is 24-MHz wide. Obviously,someoverlapoccursbetweenchannels,butthesearealternatelypolarized*left-handcircular*(LHC)and*right-handcircular*(RHC)orvertical/horizontal,toreduceinterference toaccept- able levels. This is referred toas *polarization interleaving*. Apolarizer that may be switched to the desired polarization from the indoor control unit isrequiredatthereceivinghorn.

Thereceivinghornfeedsintoa*low-noiseconverter*(LNC)orpossiblyacombinationunitconsistingof a*low-noiseamplifier*(LNA)followedbyaconverter.The combination is referred to as an LNB, for *low-noise block*. The LNB provides gain for thebroadband12-GHzsignalandthenconvertsthesignaltoalowerfrequencyrangesothatalow-costcoaxialcablecanbe usedasfeedertotheindoorunit.

The signal fed to the indoor unit is normally a wideband signal covering the range950 to1450 MHz Thisis amplified and passed toa tracking filter which selects thedesired channel, as shown in Fig. 4.3. As previously mentioned, polarization interleavingis used, and only half the 32 channels willbe presentat the inputof the indoor unit forany one setting of the antenna polarizer. This eases the job of the tracking filter, sincealternatechannelsarewellseparatedinfrequency.

The selected channel is again down converted, this time from the 950- to 1450-MHz range toa fixedintermediate frequency, usually 70 MHz although other values inthe *very high frequency* (VHF) range are alsoused. The 70-MHz amplifier amplifies thesignal up to the levels required for demodulation. A major difference between DBS TV andconventionalTVisthatwithDBS,frequencymodulationisused,whereaswithconventional TV, amplitude modulation in the form of *vestigial single side- band* (VSSB)isused.

The70-MHz,FM*intermediatefrequency*(IF)carrierthereforemustbedemodulated, and the baseband information used to generate a VSSB signal which is fedintooneoftheVHF/UHFchannels ofastandardTVset.

MASTERANTENNATVSYSTEM (MATV)

A*masterantennaTV*(MATV)systemisusedtoprovidereceptionof DBSTV/FM channels to a small group of users, for example, to the tenants in an apartmentbuilding. It consists of a single outdoor unit (antenna and LNA/C) feeding a number ofindoorunits,as showninFig.4.4.

It is basically similar to the home system already described, but with each userhaving access to all the channels independently of the other users. The advantage is thatonly one outdoor unitis required,butas shown,separateLNA/Csandfeedercablesarerequiredforeachsenseofpolarization.

Compared with the single- user system, a larger antenna is also required (2- to 3-mdiameter)inordertomaintaina goodsignal-to-noiseratioatalltheindoorunits.

Where more than a few subscribers are involved, the distribution system used issimilar to the*communityantenna*(CATV)systemdescribedinthefollowing section.

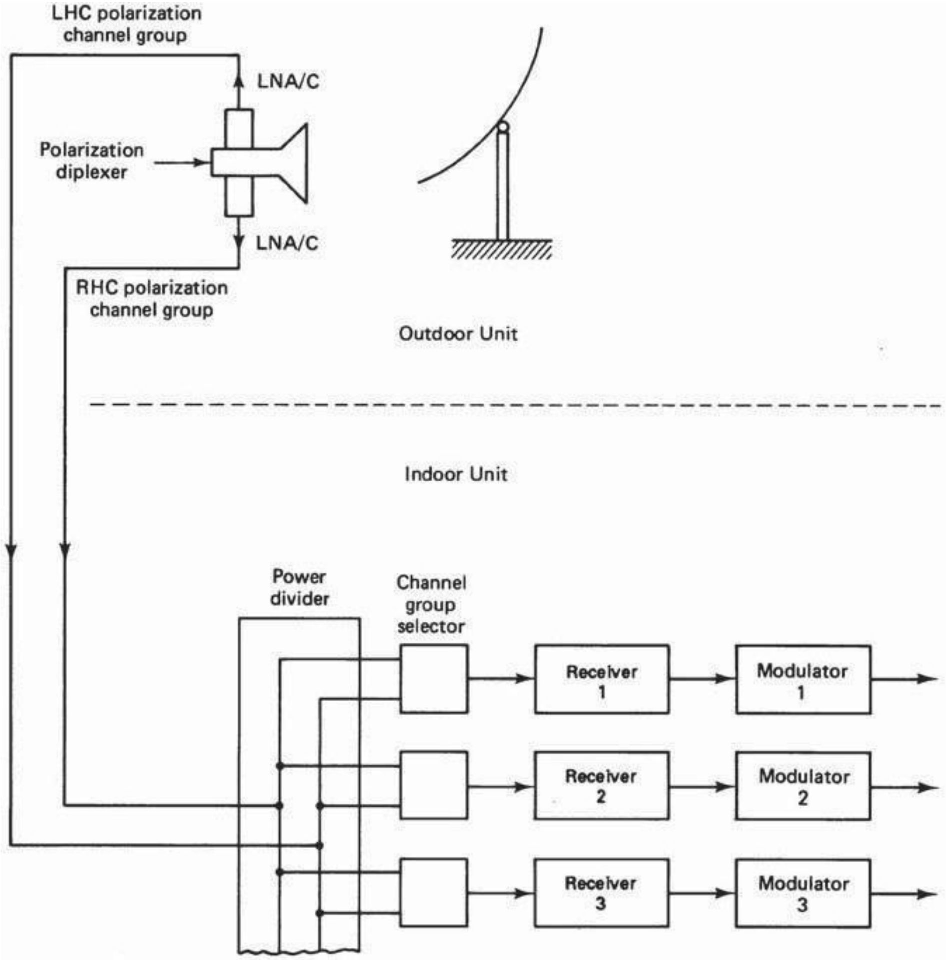

Figure4.4 MATVSystemBlockDiagrams

COMMUNITYANTENNATVSYSTEM

The CATV system employs a single outdoor unit, with separate feeds available foreach sense of polarization, like the MATV system, so that all channels are made availablesimultaneously at the indoor receiver. Instead of having a separate receiver for each user,all the carriers are demodulated in a common receiver-filter system, as shown in Fig. Thechannels are then combined into a standard multiplexed signal for transmission over cabletothesubscribers.

In remote areas where a cable distribution system may not be installed, the signalcan be rebroadcastfrom alow-power VHF TV transmitter.Figure4.5showsa remoteTV station which employs an 8-m(26.2-ft) antennafor reception of the satelliteTVsignalintheCband.

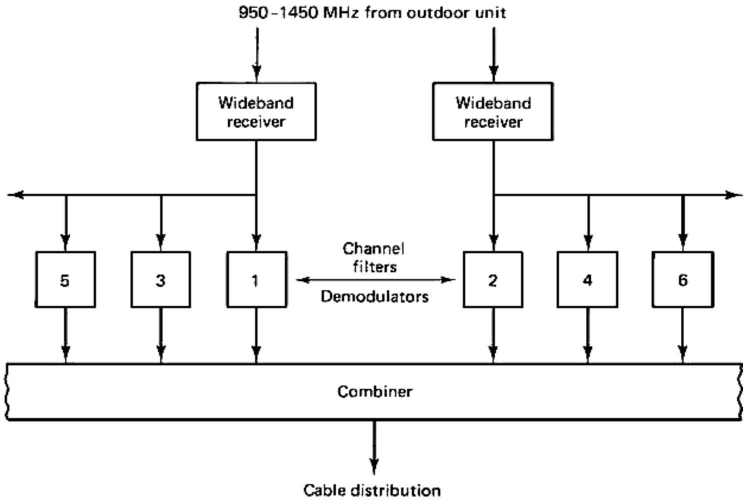

Figure4.5CATVSystem

WiththeCATVsystem,localprogrammingmaterialalsomaybedistributedtosubscribers,ano ptionwhichisnotpermittedinthe MATV system.

TESTEQUIPMENTMEASUREMENTSONG/T,C/NO,EIRP

Measurement of G/T of small antennas is easily and simply measured usingthespectrum analyzer method. For antennas with a diameter of less than meters it is notnormally necessary to point off from thesatellite. A step in frequency would be requiredintooneofthesatellitetransponderguardbands.

However antennas with a G/T sufficiently large to enable the station tosee thetransponder noise floor either a step in frequency into one of the satellite transponderguard bands and/or in azimuth movementwould berequired. The test signal can beprovidedfromanSESWORLDSKIESbeacon.

Procedure:

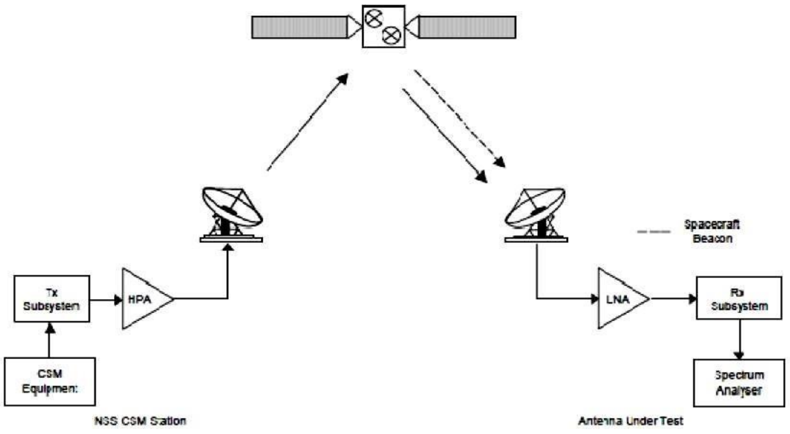

Figure4.6 OnepossiblearrangementforMeasurementofG/T

- Setupthetestequipmentasshownbelow.Allowhalfanhourtowarm up,andthencalibrate inaccordance withthemanufacturer'sprocedures.
- AdjustthecentrefrequencyofyourspectrumanalyzertoreceivetheSESWORLDSKIESbeacon(datatobeprovidedonthesatelliteusedfortesting)
- Carefullypeaktheantennapointingandadjustthepolarizer bynulling
- Thecrosspolarizedsignal.YoucannotadjustpolarizationwhenusingthecircularlypolarizedSES WORLDSKIESbeacon.

(a) Configurethespectrumanalyzerasfollows:

CentreFrequency:Adjustforbeaconortestsignalfrequency(tobeadvised).Usemarkertopeakandmarkertocentrefunctions.

- ✓ FrequencySpan:100KHz
- ✓ ResolutionBandwidth:1KHz
- ✓ Video Bandwidth:10Hz(orsufficientlysmalltolimitnoisevariance)
- ✓ Scale:5dB/div
- ✓ SweepTime:Automatic
- ✓ Attenuator Adjust to ensure linear operation. Adjust to provide the "Noisefloordelta" describedinsteps 7and8.

(b) To insure the bestmeasurement accuracy during the following steps, adjustthe spectrum analyzers amplitude (reference level) so that the measured signal, carrier ornoise,isapproximatelyonedivisionbelowthetoplineofthespectrumanalyzersdisplay.

(c) Record the frequency and frequency offset of the test signal from the nominalfrequency:*Forexample,assumethenominaltestfrequencyis11750MHzbutthespectrum analyzer shows the peak at 11749 MHz The frequency offset in this case is -1MHz*

(d) Change the spectrum analyzer centre frequency as specified by SES WORLDSKIES so that the measurement is performed in a transponder guard band so that onlysystem noise power of the earth station and no satellite signals are received. Set thespectrumanalyzerfrequencyasfollows:

CentreFrequency=NoiseslotfrequencyprovidedbythePMOC

(e) Disconnect the input cable to the spectrum analyser and confirm that the noisefloor drops by at least 15 dB but no more than 25dB. This confirms that the spectrumanalyser's noise contribution has an insignificant effect on the measurement. An inputattenuationvalueallowinga"NoisefloorDelta"inexcessof25dBmaycause overloading of the spectrum analyser input. (i) Reconnect the input cable to the spectrumanalyser.

(j) Activatethe displaylineonthe spectrumanalyser.

(k) Carefullyadjustthedisplaylinetothenoiselevelshownonthespectrumanalyser.Recordthedisplaylinelevel.

(l) Adjustthespectrumanalysercentrefrequencytothetestcarrierfrequencyrecordedinstep(e).

(m) Carefullyadjustthedisplaylinetothepeaklevelofthetestcarrieronthespectrumanalyser.Recordthedisplaylinelevel.

(n) Determinethedifferenceinreferencelevelsbetween steps(l)and(j)whichisthe(C+N)/N.

(o) Changethe(C+N)/NtoC/Nbythefollowingconversion:

Thisstepisnotnecessaryifthe(C+N)/Nratioismorethan20dBbecausetheresultingcorrectionis lessthan0.1dB.

$$\left(\frac{C}{N}\right) = 10\log_{10}\left(10^{\frac{\left(\frac{C+N}{N}\right)}{10}} - 1\right) \quad \text{dB}$$

(p) Calculatethecarriertonoisepowerdensityratio(C/No)using:

$$\left(\frac{C}{No}\right) = \left(\frac{C}{N}\right) - 2.5 + 10\text{lcg}_{10}(RBW \quad x \quad SA_{corr}) \quad \text{dB}$$

The 2.5 dB figure corrects the noise power value measured by the log converters in thespectrum analyser to a true RMS power level, and the SA_{corr}factor takes into account theactualresolutionfilterbandwidth.

(q) CalculatetheG/T usingthefollowing:

$$\left(\frac{G}{T}\right) - \left(\frac{C}{No}\right) - (EIRP_{SC} - A_{corr}) + (\Gamma SL + L_a) - 228.6 \quad \text{dB / K}$$

where,

$EIRP_{SC}$–

DownlinkEIRPmeasuredbythePMOC(dBW)A_{corr}–

AspectcorrectionsuppliedbythePMOC(dB) FSL–

FreeSpaceLossto theAUT supplied bythePMOC(dB)L_a–

Atmospheric attenuationsuppliedbythe PMOC(dB)

(r) Repeatthemeasurementseveraltimestocheckconsistencyoftheresult.

AntennaGain:

Antenna gain is usually **defined**as the ratio of the power produced bythe**antenna** from a far-field source on the **antenna's** beam axis to the power produced by ahypothetical lossless isotropic **antenna**, which is equally sensitive to signals from alldirections.

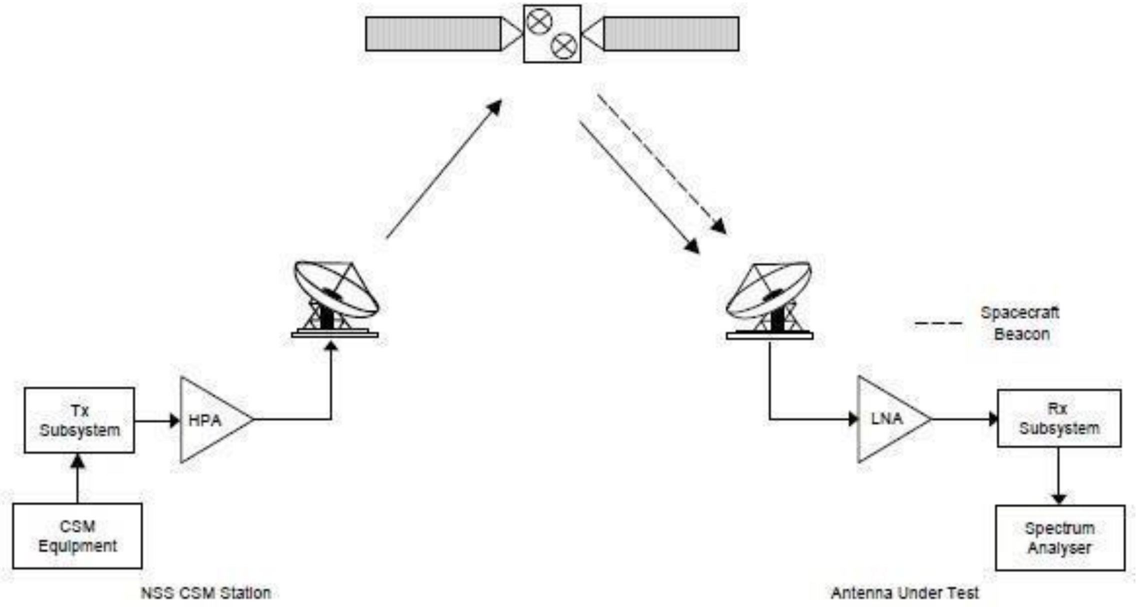

Figure4.6 MeasurementofAntenna Gain

Two direct methods of measuring the Rx gain can be used; integration of the Rxsidelobe pattern or by determination of the 3dB and 10dB beamwidths. The use of patternintegration will produce the more accurate results but would require the AUT to have atracking system. In both cases the test configurations for measuring Rx gain are identical,andareillustratedinFigure4.6.

In order to measure the Rx gain using pattern integration the AUT measures theelevationandazimuthnarrowband(±5°corrected)sidelobepatterns.TheAUTthencalculates the directive gain of the antenna through integration of the sidelobe patterns.TheRxgainisthendeterminedbyreducingthedirectivegainbytheantennainefficiencies.

In order to measure the Rx gain using the beamwidth method, the AUT measuresthe correctedazimuthandelevation3dB/10dBbeamwidths.

FromtheseresultstheRxgainoftheantennacanbedirectlycalculatedusingtheformulabelow.

$$G = 10\mathrm{Log}_{10}\left[\frac{1}{2}\left(\frac{31000}{(Az_3)(El_3)}+\frac{91000}{(Az_{10})(El_{10})}\right)\right]-F_{Loss}-R_{Loss}$$

Where,

Gistheeffectiveantennagain(dBi)

Az_3isthecorrectedazimuth3dBbeamwidth(°)El_3istheelevation3dBbeamwidth(°)Az_{10}isthecorrected azimuth10dBbeamwidth(°)El_{10}istheelevation10dBbeamwidth(°)$F_{Loss}$is theinsertionloss ofthefeed(dB)

R_{Loss}isthereductioninantennagainduetoreflector inaccuracies, andisgivenby:

$$R_{Loss}=4.922998677(S_{dev}f)^2\,\mathrm{dB}$$

where:S_{dev}isthestandarddeviationoftheactual reflectorsurface(inches)fisthefrequency(GHz).

APPLICATIONSOFSATELLITES:

Satellites that are launched in to the orbit by using the rockets are called man-made satellites orartificial satellites. Artificial satellites revolve around the earth because of the gravitational forceof attraction between the earth andsatellites.Unlike the natural satellites (moon), artificialsatellitesareusedinvariousapplications. Thevariousapplicationsofartificialsatellites include:

1. Weatherforecasting
2. Navigation
3. Astronomy
4. Satellitephone
5. Satellitetelevision
6. Militarysatellite
7. Satelliteinternet
8. Satelliteradio.

1. Weatherforecasting

Weather forecasting is the prediction of the future of weather. The satellites that are used topredictthefutureofweatherarecalledweathersatellites.Weathersatellitescontinuouslymonitor the climate and weather conditions of earth. They use sensors called radiometers formeasuring the heat energy released from the earth surface. Weather satellites also predict themostdangerous storms suchashurricanes.

2. Navigation

Generally, navigation refers to determining the geographical location of an object. The satellitesthat are used to determine the geographic location of aircrafts, ships, cars, trains, or any otherobjectarecallednavigationsatellites.GPS(GlobalPositioningSystem)isanexampleofnavigation system. Itallowstheusertodeterminetheirexactlocationatanywhereintheworld.

3. Astronomy

Astronomy is the study of celestial objects such as stars, planets, galaxies, natural satellites,comets, etc. The satellites that are used to study or observe the distant stars, galaxies, planets, etc.are called astronomical satellites. They are mainly used tofind the new stars, planets, andgalaxies. Hubble space telescope is an example of astronomical satellite. It captures the high-resolutionimages ofthedistantstars,galaxies,planetsetc.

4. Satellitephone

Satellitephoneisatypeofmobilephonethatusessatellitesinsteadofcelltowersfortransmitting the signal or information over long distances.Mobile phones that use cell towerswill work only within the coverage area of a cell tower. If we go beyond the coverage area of acell tower or if we reach the remote areas, it becomes difficult to make a voice call or send textmessageswith themobilephones. Unlikethemobilemobiles,satellitephoneshaveglobalcoverage. Satellites phones uses geostationary satellites and low earth orbit (LEO) satellites fortransmitting the information. When a person makes a call from the satellite phone, the signal issent to the satellite. The satellite will receives that signal, processes it, and redirects the signalback to the earth via a gateway. The gateway then send the signal or call to the destination byusing the regular cellular and landline networks. The usage of satellite phones is illegal in somecountrieslike Cuba,NorthKorea,Burma,India,andRussia.

5. Satellitetelevision

Satellite television or satellite TV is a wireless system that uses communication satellites todeliverthe televisionprogramsortelevisionsignalstothe users orviewers.

TV or television mostly uses geostationary satellites because they look stationary from the earth.Hence, the signal is easily transmitted. When the television signal is send to the satellite, itreceives the signal, amplifies it, and retransmit it back to the earth. The first satellite televisionsignalwassendfromEuropetoNorthAmericabyusingthe Telstarsatellite.

6. Militarysatellite

Militarysatelliteisanartificialsatelliteusedbythearmyforvariouspurposessuchasspyingonenemycountries,militarycommunication,andnavigation.

Militarysatellitesobtainthesecretinformationfromtheenemycountries.Thesesatellitesalsodetectthe missileslaunchedbytheothercountriesinthe space.

Militarysatellites areusedbyarmedforces tocommunicatewitheachother.Thesesatellites alsousedtodeterminethe exactlocationofanobject.

7. Satelliteinternet

Satellite internet is a wireless system that uses satellites to deliver the internet signals to users.High-speedinternetis themain advantage of satelliteinternet. Satelliteinternetdoes notusecablesystems,butinsteaditusessatellitestotransmittheinformationorsignal.

8. Satelliteradio

Satelliteradioisawirelesstransmission servicethatusesorbitingsatellitestodelivertheinformation or radio signals to the consumers. It is primarily used in the cars. When the groundstation transmit signal to the satellite that is revolving around the earth, the satellite receives thesignal,amplifiesit,and redirectsthesignalback totheearth(radioreceiversinthecars).