ST. ANNE'S COLLEGE OF ENGINEERING AND TECHNOLOGY

Approved by AICTE, New Delhi. Affiliated to Anna University, Chennai

Accredited by NAAC

ANGUCHETTYPALAYAM, PANRUTI – 607 106.

INTERNAL COMPONENT

ST. ANNE'S COLLEGE OF ENGINEERING AND TECHNOLOGY

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ANGUCHETTYPALAYAM, PANRUTI – 607 106.

CEC352 SATELLITE COMMUNICATION L T P C 3 0 0 3

OBJECTIVES:

- Understand the basics of satellite orbits
- Understand the satellite segment and earth segment
- Understand Link Power budget calculation
- Understand the various satellite access and coding technology
- Understand the applications of satellite

UNIT I SATELLITE ORBITS 9

Kepler's Laws, Newton's law, orbital parameters, orbital perturbations, station keeping, geo stationary and non Geo-stationary orbits – Look Angle Determination- Limits of visibility – eclipse-Sub satellite point –Sun transit outage-Launching Procedures - launch vehicles and propulsion.

UNIT II SPACE SEGMENT 9

Spacecraft Technology- Structure, Primary power, Attitude and Orbit control, Thermal control and Propulsion, communication Payload and supporting subsystems, Telemetry, Tracking and command-Transponders-The Antenna Subsystem.

UNIT III SATELLITE LINK DESIGN 9

Basic link analysis, Interference analysis, Rain induced attenuation and interference, Ionospheric characteristics, Link Design with and without frequency reuse.

UNIT IV SATELLITE ACCESS AND CODING METHODS 9

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

UNIT V SATELLITE APPLICATIONS 9

INTELSAT Series, INSAT, VSAT, Mobile satellite services: GSM, GPS, INMARSAT, LEO, MEO, Satellite Navigational System. GPS Position Location Principles, Differential GPS, Direct Broadcast satellites (DBS/DTH).

TOTAL: 45 PERIODS

TEXT BOOK:

1. Dennis Roddy, "Satellite Communication", 4th Edition, Mc Graw Hill International, 2006.
2.Timothy,Pratt,Charles,W.Bostain,JeremyE.Allnutt,"SatelliteCommunication‖,2nd Edition, Wiley Publications,2002

REFERENCES:

1. Tri T. Ha, "Digital Satellite Communication", IInd edition, 1990
2.Wilbur L.Pritchard, Hendri G. Suyderhoud, Robert A. Nelson, "Satellite Communication Systems Engineering", Prentice Hall/Pearson, 2007.
3.M.Richharia, "Satellite Communication Systems-Design Principles", Macmillan, 1999.
4.Brian Ackroyd, "World Satellite Communication and earth station Design", BSP professional Books, 1990.

Name of the Staff : Mr. S. DURAI RAJ

Department of the Staff : ECE

Department of the Student : ECE

Semester : V

Subject Code & Name : CEC352 & SATELLITE COMMUNICATION

Period From : AUGUST 2024 to NOV 2024

To be Signed at the end of the each Assessment

Assessment Report	CIA-I	CIA-II	
Assessment Date	16.10.2024	20/11/2024	
Report Due on	18.10.2024	22/11/2024	
Signature - HoD of Students with Date	[signature]	[signature]	

To be Signed at the end of the Semester

Staff in - charge	HoD of Staff	HOD of Students	Principal
S.Durai [signature] 7/5/11/2024	[signature] 5/12/24	[signature] 5/12/24	[signature] 27.12.24

ATTENDANCE

Reg. No.	Name	Attendance 1 (19)	Attendance 2 (30)	Attendance 3
2122106 001	AAKASH · A	13	30	
002	ABINAYA · M	15	29	
003	AJAYKRISHNA	19	30	
004	ALEX DOMNIC	06	30	
005	AMIRDHA VAR	18	26	
006	ANTHONI DANI	07	29	
007	ARAVINDH · E	18	29	
008	ARCHANA ·	16	30	
009	ARTHI · S	17	25	
010	ARUN · N	18	27	
012	BALAJI · P	17	30	
014	CHANDRU · P	16	29	
015	CHERISHMA ·	18	29	
016	DESIKA · M	15	25	
017	DEVAGURU · S	13	30	
018	DHAMOTHARAN	15	30	
019	DHINESH · D	16	28	
020	DHIVYA · T	19	29	
021	GOBINATH ·	13	29	
022	JEEVITHA ·	17	28	
No. of Absentees				
Initial		2	2	

Assessment

Internal Component												Assessment	
Report -1 (R2021)						Report -2 (R2021)							
Assignment	Case study	Seminar	Mini Project		Total (40)	Assignment	Case study	Seminar	Mini Project		Total (40)	CIA-1	CIA-2
20	20				40			20	20		40	63	55
20	20				40			20	20		40	76	78
20	20				40			20	20		40	85	86
20	20				40			20	20		40	72	79
20	20				40			20	20		40	76	74
00	00				00			20	20		40	0	84
20	20				40			20	20		40	87	87
20	20				40			20	20		40	92	93
20	20				40			20	20		40	82	70
20	20				40			20	20		40	82	78
20	20				40			20	20		40	58	73
20	20				40			20	20		40	61	86
20	20				40			20	20		40	70	66
20	20				40			20	20		40	86	73
20	20				40			20	20		40	90	97
20	20				40			20	20		40	57	78
20	20				40			20	20		40	68	78
20	20				40			20	20		40	93	90
20	20				40			20	20		40	76	73
20	20				40			20	20		40	84	75
2	2				2			2	2		L	2	2

ATTENDANCE

Assessment

Reg. No.	Name	Attendance 1	Attendance 2	Attendance 3	Internal Component: Report -1 (R2021) Assignment	Case study	Seminar	Mini Project		Total (40)	Report -2 (R2021) Assignment	Case study	Seminar	Mini Project		Total (40)	Assessment CIA -1	CIA -2
		19	30															
122106 023	KALAIMATHI	17	26		20	20				40			20	20		40	52	74
025	KAVI PRIYA.	17	30		20	20				40			20	20		40	82	88
026	KUMARAN.	18	30		20	20				40			20	20		40	61	80
027	MAHALAKSH	17	30		20	20				40			20	20		40	75	82
029	MONIKA.	17	30		20	20				40			20	20		40	80	78
031	MURALI.	16	24		20	20				40			20	20		40	45	80
033	NAVITHA.	13	23		20	20				40			20	20		40	78	82
034	NIRANJAN	18	25		20	20				40			20	20		40	62	70
035	PARASURAMA	18	30		20	20				40			20	20		40	57	70
036	PATTABIRAM	18	26		20	20				40			20	20		40	73	78
037	PAVITHRA.	18	26		20	20				40			20	20		40	86	40
038	PRATHEEBA	17	24		20	20				40			20	20		40	88	82
039	PREM KUMAR	19	30		20	20				40			20	20		40	66	60
040	PRIYADHARS	18	26		20	20				40			20	20		40	50	60
041	RAJI. N	12	30		20	20				40			20	20		40	72	81
042	RAMANA. A	18	80		20	20				40			20	20		40	75	70
043	SAKTHI. R	18	20		20	20				40			20	20		40	61	40
044	SANKARI. S	18	20		20	20				40			20	20		40	90	90
045	SASIREKA.	17	30		20	20				40			20	20		40	78	78
046	SATHISHKUM	17	26		20	20				40			20	20		40	87	75
No. of Absentees																		
Initial																		

ATTENDANCE

Reg. No.	Name								Attendance 1	2	3
									19	30	
422122106 047	SIVAGAMASU										
048	SIVARAMAN.								19	30	
049	SIVA SELVAM								16	30	
050	SRIMATHI. S								18	30	
051	SUBASHINI.								19	30	
052	SUJITHA K								19	29	
053	SURESH. S								18	28	
054	SURYA. K								17	25	
055	THANGAPAN								18	30	
056	THIRUMALAI								19	30	
058	VINOTHKUMA								18	17	
501	LAKSHMI. S								12	10	
									13	27	
No. of Absentees											
Initial											

Assessment

Internal Component												Assessment	
Report -1 (R2021)						Report -2 (R2021)							
Assignment	Case study	Seminar	Mini Project		Total (40)	Assignment	Case study	Seminar	Mini Project		Total (40)	CIA -1	CIA -2
20	20				40			20	20		40	91	88
20	20				40			20	20		40	66	76
20	20				40			20	20		40	82	87
20	20				40			20	20		40	88	91
20	20				40			20	20		40	93	86
20	20				40			20	20		40	86	92
20	20				40			20	20		40	73	87
20	20				40			20	20		40	70	91
20	20				40			20	20		40	44	74
20	20				40			20	20		40	79	40
20	20				40			20	20		40	40	40
20	20				40			20	20		40	90	84

RECORD OF CLASS WORK

S.No.	Class Planned Date	Class Planned Period	Topic Name	BT	Book Referred	Class Conducted Date	Class Conducted Period	Reason for Deviation	TA	Staff Sign
			Unit-I - Satellite orbits							
	21.8.2024	2	Introduction to Satellite Communication and Kepler's Law & Newton's Law	K2	T1	21.8.2024	2		V	[signature]
	22.8.2024	7	Orbital Parameters	K2	T1	23.8.2024	1	Due to alteration	BB	[signature]
	23.8.2024	2	Orbital Perturbations	K3	T1	23.8.2024	2	"	BB	[signature]
	28.8.2024	2	Station Keeping, Geostationary and non geostationary orbits	K2	T1	28.8.2024	2		BB	[signature]
5	06/9/2024	3	Look angle Determination	K3	T1	06/9/2024	3	due to alteration	BB	[signature]
	11/9/2024	2	Limits of Visibility & eclipse	K3	T1	11/9/2024	2		BB	[signature]
	12/9/2024	7	Sub satellite Point, Sun transit Outage	K2	T1	12/9/2024	7		BB	[signature]
	13/9/2024	2	Launching Procedures and Launching Vechicles	K2	T1	13/9/2024	2		BB	[signature]
	18/9/2024	2	Problems based on Antenna Look angle and Limits of Visibility	K3	T1	18/9/2024	4	due to alteration	T BB	[signature]

*BT- Bloom's Taxonomy, TA-Teaching Aids

RECORD OF CLASS WORK

S. No.	Class Planned		Topic Name	BT	Book Referred	Class Conducted		Reason for Deviation	TA	St Si
	Date	Period				Date	Period			
			Unit-2 Space Segment							
10	18/9/2024	2	Spacecraft Technology - Structure	K2	T1	18/9/2024	2		PPT	
11	19/9/2024	7	Primary power needs	K2	T1	19/9/2024	7		PPT	
12	20/9/2024	2	Attitude and orbit Control system	K2	T1	20/9/2024	2		PPT	
13	23/9/2024	2	Thermal Control	K2	T1	20/9/2024	3	Due to alteration for FDP.	PPT	
14	3/10/2024	7	Propulsion Control	K3	T1	3/10/2024	7		PPT	
15	4/10/2024	2	Communication Payload and Supporting Subsystems	K2	T1	4/10/2024	2		PPT	
16	5/10/2024	2	Telemetry, Tracking and Command	K2	T1	5/10/2024	2		PPT	
17	9/10/2024	2	Transponder	K4	T1	9/10/2024	2		PPT	
18	16/10/2024	4	The Antenna Subsystem	K2	T1	16/10/2024	4		PPT	

* BT- Bloom's Taxonomy, TA-Teaching Aids

RECORD OF CLASS WORK

Class Planned		Topic Name	BT	Book Referred	Class Conducted		Reason for Deviation	TA	Staff Sign
Date	Period				Date	Period			
		Unit-3 Satellite LINK Design							
16.10.2024	5	Basic Link analysis	K2	T1	16/10/2024	5		BB	[signature]
21/10/2024	1	Interference analysis	K2	T1	21/10/2024	1	Slip Test	BB	[signature]
28/10/2024	2	Link budget equation	K3	T1	28/10/2024	2		BB	[signature]
24/10/2024	7	Different types of losses	K2	T1	24/10/2024	7		BB	[signature]
25/10/2024	2	Uplink design and Downlink design	K5	T1	25/10/2024	2		BB	[signature]
6/11/24	2	Rain induced attenuation and Interference	K2	T1	6/11/2024	2		BB	[signature]
7/11/24	7	Ionospheric characteristics	K2	T1	7/11/2024	7		BB	[signature]
8/11/24	2	System Noise	K4	T1	8/11/2024	2		BB	[signature]
13/11/24	4	Antenna Noise temperature and University Problem solved	K3	T1	13/11/2024	4		BB	[signature]

BT- Bloom's Taxonomy, TA-Teaching Aids

RECORD OF CLASS WORK

Class Planned Date	Class Planned Period	Topic Name	BT	Book Referred	Class Conducted Date	Class Conducted Period	Reason for Deviation	TA	Staff Sign
		Unit-4 Satellite Access and Coding Methods							
13/11/24	5	Modulation and Introduction to Analog Vs Digital Communication	K2	T1	13/11/2024	5		PPT	[signature]
19/11/24	6	Multiplexing and its types	[illegible]	T1	19/11/2024	6		BB	[signature]
13/11/24	6	Voice, data, video Information Source system	K2	T1	13/11/2024	6		BB	[signature]
13/11/24	7	Analog to digital transmission system	K3	T1	13/11/2024	7		BB	[signature]
14/11/24	1	Digital video Broadcast	K2	T1	14/11/2024	1		PPT	[signature]
14/11/24	2	Multiple Access Techniques FDMA (Frequency Division multiple access)	K2	T1	14/11/2024	2		PPT	[signature]
14/11/24	3	TDMA (Time Division multiple Access)	K3	T1	14/11/2024	3		PPT	[signature]
14/11/2024	3	CDMA (Code Division multiple Access)	K2	T1	19/11/2024	3		PPT	[signature]
19/11/2024	4	DAMA assignment methods.	K2	T1	19/11/2024	4		BB	[signature]
19/11/2024	5	Compression and Encryption Coding schemes.	K2	T1	19/11/2024	5		BB	[signature]

BT- Bloom's Taxonomy, TA-Teaching Aids

RECORD OF CLASS WORK

Class Planned		Topic Name	BT
Date	Period	Unit-5 - Satellite Applications	
19/11/2024	7	INTELSAT Series	K2
24/11/24	1	INSAT Series	K2
24/11/24	2	VSAT	K2
24/11/24	3	Mobile Satellite Services	K2
24/11/24	4	GSM (Student Seminar - S. Srimathi) Global System for Mobile Communication	K2
24/11/24	5	GPS (Student Seminar - A. Archana) (Global Position System)	K2
24/11/24	6	INMARSAT, LEO & MEO	K1
24/11/24	7	Satellite Navigational System	K2
26/11/24	4,5	GPS Location Principles, Differential GPS	K2
26/11/24	6,7	Direct Broadcast Satellite	K2

BT- Bloom's Taxonomy, TA-Teaching Aids

Book Referred	Class Conducted		Reason for Deviation	TA	Staff Sign
	Date	Period			
T1	19.11.2024	7		PPT	
T1	24/11/24	1		PPT	
T1	24/11/24	2		PPT	
T1	24/11/24	3		PPT	
T1	24/11/24	4		PPT	
T1	24/10/24	5		PPT	
T1	24/11/24	6		PPT	
T1	24/11/24	7		PPT	
T1	26/11/24	4,5		PPT	
T1	26/11/24	6,7		PPT	

Time Table

ERIOD	1	2	3	4	5	6	7	8
nday								
day								
sday		Sat Comm						
sday								Sat Comm
lay								

Unit Completion Details

No.	Unit Description	Start Date	Finish Date	No. of Hours
	Satellite orbits	21.08.2024	13.9.2024	9
	Space Segment	18.09.2024	16.10.2024	9
	Satellite Link Design	16.10.2024	13/11/2024	9
	Satellite Access and Coding Methods	13/11/2024	19/11/2024	10
	Satellite Applications	19/11/2024	26/11/2024	10

26/11/24

ct In-Charge HoD of Students Principal 27.12.24

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Course Outcome:

CO No	Course Outcome	Knowledge Level
CO1	Identify the satellite orbits	K3
CO2	Analyze the satellite subsystems	K4
CO3	Evaluate the satellite link power budget	K5
CO4	Identify access technology for satellite	K3
CO5	Design various satellite applications	K2

BLOOM'S TAXONOMY: K-Level [K1-Remember, K2-Understand, K3-Apply, K4-Analyze, K5- Evaluate, K6-Create

CO – PO Mapping

Program Outcome	Course Outcome				
	CO 1	CO 2	CO 3	CO 4	CO5
PO 1	3	3	3	3	3
PO 2	3	2	3	3	2
PO 3	3	2	3	2	3
PO 4	3	3	2	3	2
PO 5	2	2	1	2	2
PO 6	3	3	3	3	1
PO 7	1	-	-	-	1
PO 8	1	-	-	-	1
PO 9	-	-	-	-	-
PO 10	1	-	-	-	1
PO 11	-	-	-	-	-
PO 12	1	1	1	1	1
PSO 1	3	3	3	3	3
PSO 2	3	3	3	3	3
PSO 3	3	3	3	3	3

Regulation 2021: 1 - low, 2 - medium, 3 - high, '-' - no correlation

Teaching Aids (Should be written in Log Book)

BB- Black Board	OHP- Over Head Projector	PPT - Power Point	L1 - Lecture 1
T1 - Tutorial 1	A1- Assignment 1	Tx1 - Text Book 1	Rx1 - Reference Book 1
M - Model and Demo	V- Video Lecture	A- Animation	

A. ALEX DOMNIC

ECE III year

SATELLITE COMMUNICATION

ASSIGNMENT - 01

20/20

1) A Ground station lies at latitude of 39.2906 degree N and longitude of 280°.2629 degree E. A Geostationary satellite at a radius of 42164 km has a longitude of 280°.2629 degree E. calculate the range and lookup angle (azimuth and elevation angle's) of the satellite.

Given :

$\phi_{ss} \Rightarrow 280.2629°$

$\lambda_E \Rightarrow 32.2906°$; $\phi_E \Rightarrow 280.2629°$

$R \Rightarrow 6371$ km ; $a_{GSO} \Rightarrow 42164$ km

$B = \phi_E - \phi_{ss}$

$B = 0°$

$b = \text{arc} \cos(\cos B \cos \lambda_E)$

$= \text{arc} \cos(\cos 0° . \cos 39.2906)$

$= \cos^{-1}(1 \times 0.7739)$

$= \cos^{-1}(0.7739)$

$b = 39.2906$

$A = \text{arc} \sin\left(\frac{\sin |B|}{\sin b}\right)$

$= \text{arc} \sin\left(\frac{\sin 0}{\sin 39.2906}\right)$

$= \text{arc} \sin(0)$

$= \sin^{-1}(0)$

$A = 0°$

Condition

$\lambda_E = 39.2906° > 0$. $B = 0° > 0$

Range,

$$d = \sqrt{R^2 + a_{GSO}^2 - 2Ra_{GSO}\cos b}$$

$$= \sqrt{(6371)^2 + (42164)^2 - 2(6371)(42164)\cos(39.296)}$$

$$= \sqrt{40589641 + 1777802896 - 415772262}$$

$$= \sqrt{1402620275}$$

$$\boxed{d = 37451.5}$$

$$ele = \arccos\left(\frac{a_{GSO}}{d}\sin b\right)$$

$$= \arccos\left(\frac{42164}{37451.5}\sin 39.296^\circ\right)$$

$$= \cos^{-1}(1.12582 \times 0.633326)$$

$$= \cos^{-1}(0.71301)$$

$$\boxed{le \Rightarrow 44.52}$$

"

Name : Archana.A

Dept /yr : 3rd yr /ECE

Title : Communication using Medium Earth Orbit (MEO) (Satellites communication case study)

20/20

1. Introduction

Telecommunication market is based on a demand and supply of new more and more attractive services. Telecommunication companies develop and offer new reliable broadband multimedia and interactive services for users situated in urban as well as rural and remote areas with or without robust infrastructure or whether they use a small handheld or desktop end terminal. In order to fulfill the ever growing demand of connectivity, satellite systems are also incorporated in global communications systems. The opportunities in the satellite space are mushrooming at an incredible pace in military and defense applications, broadband IP services, and ground- and space- segment products and services. Satellite systems based on their orbital location can be classified as GEO (Geostationary Earth Orbit), MEO (Medium Earth Orbit) or LEO (Low Earth Orbit). Each of these systems has its own application area.

In India, the communication satellites are generally in the GEO orbit, and there are still studies and deliberations on usage of MEO and LEO communication satellites in this field. The Medium Earth Orbit (MEO) offers a greater width of satellite view and a greater proximity to the earth's surface than the geostationary earth orbit. Global positioning systems and ionospheric sounding satellites have already operated in this orbit and the MEO will appeal to satellite missions undertaking Earth observations, communications, positioning, and scientific explorations. This paper explores general characteristics of medium earth orbit satellites (MEO) communication systems, their global deployment examples and their potential low latency applications in various segments.

2.Current satellite communication systems

Three types of satellite-based communications systems are currently being deployed. The fundamental difference between them lies in the altitude at which the satellites orbit the earth.

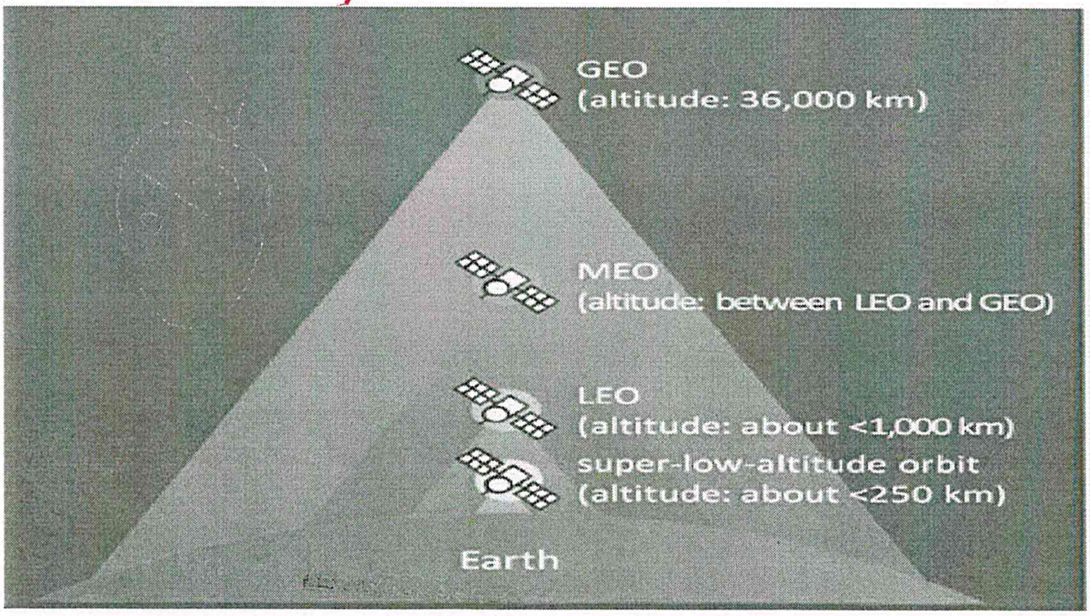
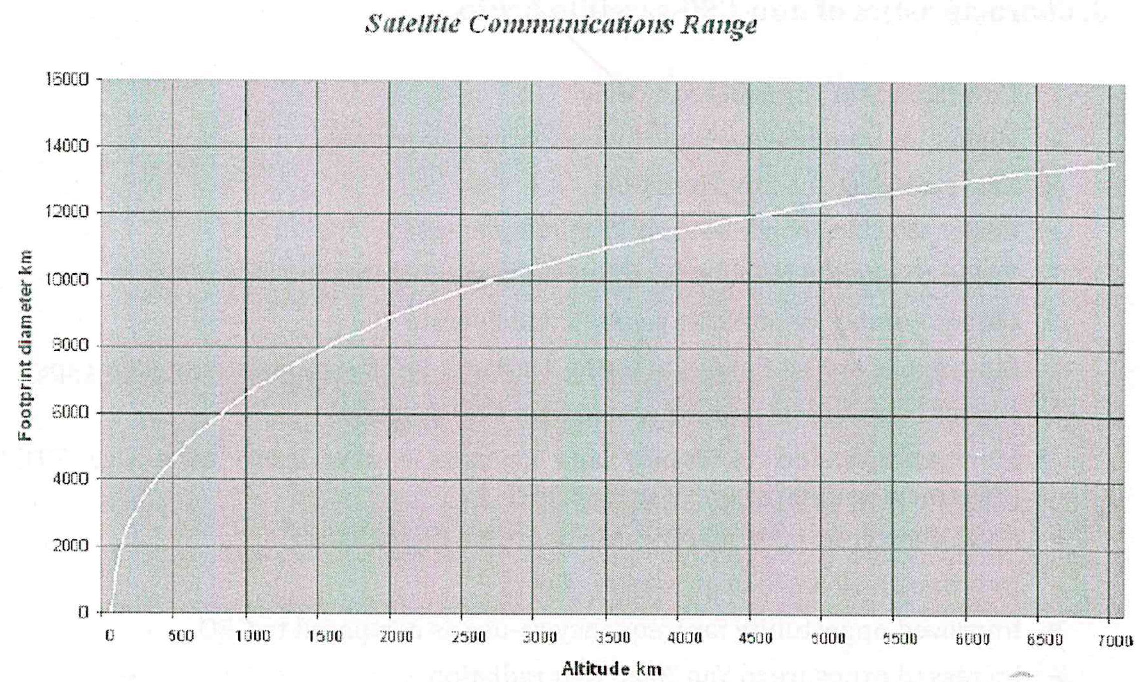


Fig 1. Various orbits under satellite communication systems

GEO: Geostationary satellite systems have few satellites covering earth. Satellites sit at an orbit altitude of about 36,000km and as few as three may be enough to provide global coverage. For many years, communication satellites have been maintained in GEO so that the ground antennas could point to a fixed location. Only three or four satellites are then needed to cover entire world for communications services. To make up for the loss of power over sparsely populated regions due to a fixed footprint, earth stations are rather complex and expensive. Also due to distance the propagation delays are long and may cause echo degrading quality of the signal.

MEO: Medium-earth orbit systems are a compromise between LEO and GEO systems. The altitude of the orbit is about 10,000km for these systems and requires fewer and less complex satellites than the LEO systems. Signal propagation delays are more acceptable than a GEO system and number of satellite networks required are less compared to LEO satellite to cover the area.

LEO: Low earth orbit systems, as their name implies, have the closest proximity orbit to earth. Typically satellites orbit the earth at about 900km. Since they do not have high view angle, to offer adequate global coverage these systems require a large number of satellites (24 to 66). These satellites then must be served by a large number of earth stations, perhaps 200 or more. Another option for these are using satellite cross links which requires many complex onboard processing. Low altitude may also increase the risk of "shadowing" of the signal by vegetation, terrain and buildings, this may cause interruptions in transmission.



The following table compares some of the basic aspects of different types of satellite systems:

Parameter	LEO	MEO	GEO
Satellites Needed	Large (Typically more than 30 for global coverage)	Medium (Typically 10 to 15 for global coverage)	Low (Typically 3 to 4 for global coverage)
Satellite Life	3 to 7 years	10 to 15 years	More than 15 years
Hand-held Terminal	Less complex and possible	Medium complexity	Highly complex
Transmission Delay	<20 ms per hop	100 to 150 ms per hop	>200 ms per hop
Propagation Loss	Low	Medium	High
Network Complexity	Complex	Medium	Simple
Signal Hand-off	Frequent	Minimum	None
Visibility of a Satellite	Short	Medium	Almost always
Broadcast Capability	Poor	Poor	Good

3. Characteristics of non-GSO satellite orbits.

- Low latency or transmission delay
- Higher look angle (especially in high-latitude regions)
- Less path loss or beam spreading
- Easier to achieve high levels of frequency re-use
- Easier to operate to low-power/low-gain ground antennas
- Larger number of satellites to build and operate
- Coverage of areas of minimal traffic (oceans, deserts, jungles, and polar caps)
- Higher launch costs and expensive than GEO systems
- More complicated to deploy and operate – also more expensive TTC&M (Teletracking Control and Management)
- Much shorter in-orbit lifetime due to orbital degradation
- Improved look angle to ground receivers
- Improved opportunity for frequency re-use as compared to GEO
- Increased exposure to Van Allen Belt radiation

4. ITU Frequency Ranges, Allocations and Services

- **L-Band**-(1-2 GHz)-Includes allocation for MobileSatellite Services (MSS)
- **S-Band**-(2-4 GHz)-Includes allocation for MSS, Digital Audio Radio Services
- **C-Band** –(4-8 GHz)-Included allocation for Fixed Satellite Service(FSS)
- **Ku-Band**-(12-18 GHz)-Includes allocations for FSS, Broadcast Satellite Service(BSS)
- **Ka-Band-(**17.7-21.2 GHz and 27.5-31 GHz)-Includes allocation for FSS Broadband and inter satellite links

  MSS: Voice and data, remote data telemetry, maritime and aeronautical Communications
  FSS: Video distribution, private networks/vast networks, data broadcasting.

The satellites operating in the lower frequency bands L, S, C bands have low power (EIRP) while those in Ku, Ka, X and V bands have high power and hence provide higher throughputs and enhanced broadband service delivery. Medium Earth orbit satellites (MEO) satellites generally use high frequency range for effective communications.

5. Global MEO deployments

NAVSTAR

In the case of MEO satellites, the constellation of from 8 to about 24 satellites is configured in orbits that are typically 10,000 to 20,000 km above Earth's surface. Because the satellites are higher, fewer satellites are need to cover Earth, but the path loss due to the spreading of the antenna beams means the flux density of the beams is less when they reach the ground. The number of satellites in the constellation depends on not only the altitude but also the particular mission the satellites are designed to perform. Space navigation satellites such as the NAVSTAR Global Positioning Systems (GPS) for instance, requires that a user access four or more satellites to get an accurate fix on location. Thus this constellation, although in are latively high orbit, still has some 24 to 27 operational satellites in order that multiple satellites can be seen at the same time. (See Fig. 2.)

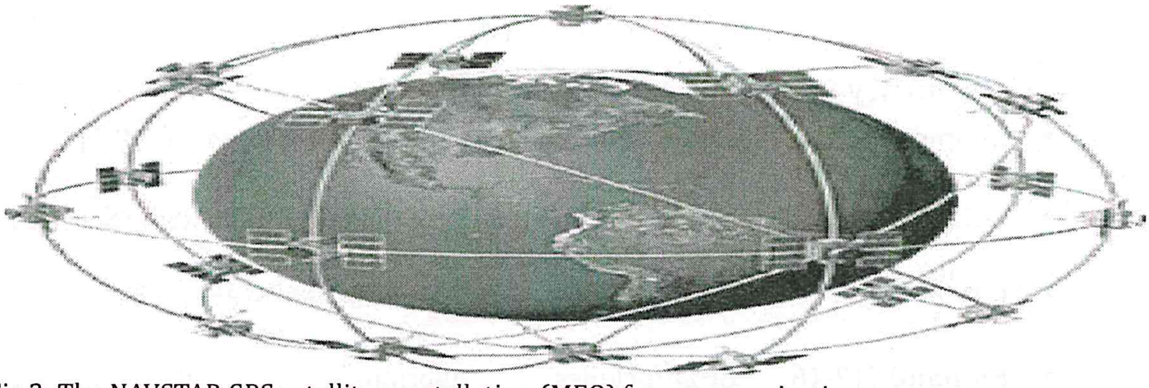


Fig 2: The NAVSTAR GPS satellite constellation (MEO) for space navigation

O3b constellation deployment at 8000 Km

At an 8000 km orbital altitude, round trip latency is typically below 130 msec. and is guaranteed to always be less than 150 msec. within the coverage region being served. This is comparable to long haul fiber routes and about four times less than GEO satellite round trip latency. Operation in the higher frequency satellite Ka Band and the use of small steerable parabolic antennas on the satellites allowed the system to deliver high data rate services into concentrated areas (700 km diameter spot beams).

Bringing the satellites closer to Earth meant that signals between satellites and ground stations incur 13 dB less path loss. MEO satellites can deliver the same flux density at the Earth's surface as GEO satellites with 13 dB less Equivalent Isotropic Radiated Power (EIRP) from the satellites and can achieve similar receive sensitivity as GEO satellites with much smaller aperture antennas. Operation in the commercial Ka band with shorter wavelengths vs. C or Ku band systems also helps reduce the satellite and ground station antenna aperture size while delivering similar receive sensitivity and radiated power levels. By operating with 13 dB less radiated power, it was possible to reduce the power required by the satellite and reducing the size of the satellite's solar panel area and number of batteries.

Tradeoffs between coverage area and orbital altitude indicated that an initial MEO constellation in a circular equatorial orbit 8000km above sea level would provide contiguous coverage to territories within the underserved (but highly populated) parts of the developing world.

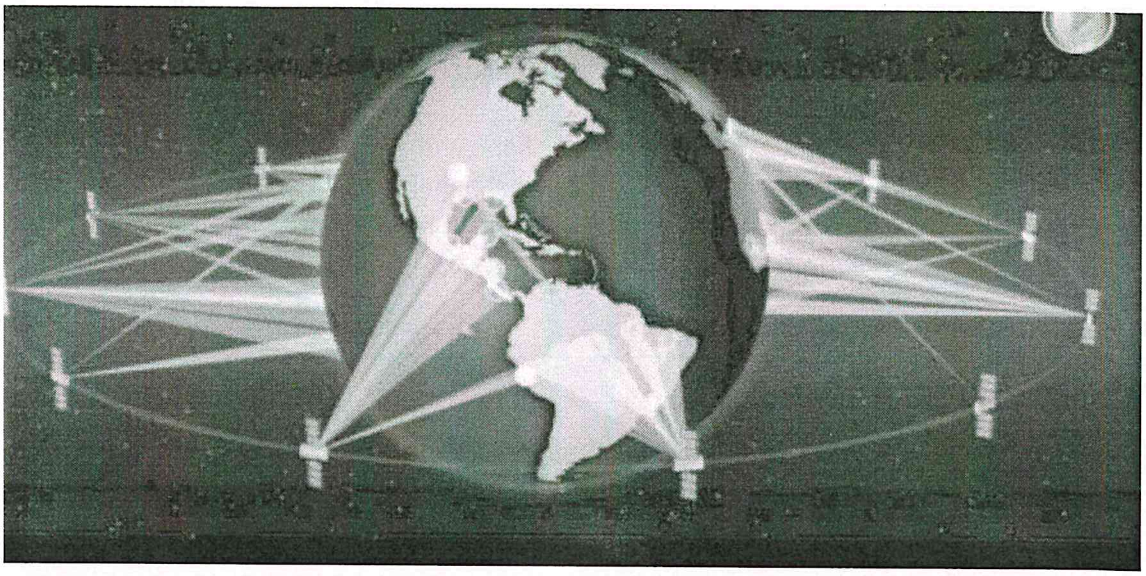


Figure 3 shows the MEO satellite constellation coverage area from an Equatorial orbit

Operating at this orbit, and placing satellites only around the Equator, reduced the number of satellites required and significantly lowered the cost of the services provided. An initial constellation of eight satellites, at this equatorial MEO altitude, provides continuous service to all parts of the Earth within 45 degrees of the Equator. This constellation can also provide high bandwidth services for emergency responders, disaster relief, and fiber restoral.

Since the MEO satellites are moving in their orbit, they provide the same coverage over the oceans as they do over the landmasses within the +/-45 degree latitudes coverage area. This covers many of the world's ocean areas of interest to navies.

Based on the above-mentioned trade-offs a study for MEO utilization should involve the following:

(a) To obtain a mission value that offsets the above-mentioned financial disadvantages.

(b) To analyze the orbital environment and the practicality and efficiency of a radiationproof design.

(c) An orbital design that achieves a good balance between (a)and (b) is required. (If an orbit is designed only for the advantages of the orbital environment, the mission values may be affected negatively.)

1. 6. Applicati

Remotesensing

Agricultural observation	Survey of paddy fields and rice growing conditions.

Forest observation	Detection of wildfires and estimate of global forestry biomass
Ocean observation	Forecasting and management of variation in fishery resources. Measurement of velocities and directions of ocean wind.
Air pollution observation	Technical development and demonstration of atmosphere and weather observations.

8. Global regulations related to MEO

WP 4A is studying rules to regulate the a) Bringing into use, and b) deployment of nonGSO satellites systems.

Conclusion

Medium earth orbit (MEO) satellites deliver lower latency to underserved locations on Earth. This paper describes different features of MEO constellation. Lower latency means that bits transit the system quickly, therefore supporting business applications that are latency sensitive. The close proximity to Earth also allows MEO to concentrate more power on its small beams. These beams can be easily repointed to cover new areas, hence offering flexibility to the markets.

This paper is an attempt to give a concise overview about MEO satellite based satellite systems and further studies can be taken up in this direction to understand and explore their future need and use in the Indian telecom scenario.

REFERENCES.

[1] "ITU-T Recommendation G.107 The E-model: A Computational Model for Use in Transmission Planning," Dec. 2011.

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[3] Oracle Corporation White Paper, "How to Tune Your Oracle Forms Server Applications", March 2000.

[4] C. Partridge and T. Shepard, "TCP/IP Performance over Satellite Links," IEEE Network, Sept./Oct. 1997, pp. 44-49.

[6] Loral Cyberstar, Inc., "TCP/IP Performance over Satellite Links – Summary Report", March 2000.

STUDENT SEMINAR

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

CIRCULAR

(2024-2025)

CIR. No.: SANCET/ECE/CIR/18 **Date: 05.11.2024**

It is to be informed that the **Student Seminar** will be held for III Year/ Vth Sem students at Room No. MB 202. All interested staff and students are invited for the seminar.

Name of the Student	:	**S. SRIMATHI**
Register Number	:	**422120106050**
Year/Semester	:	**III/V**
Date and Time	:	**06.11.2024 @ 11:40 pm**
Topic of the Seminar	:	**"Global System for Mobile Communication"**

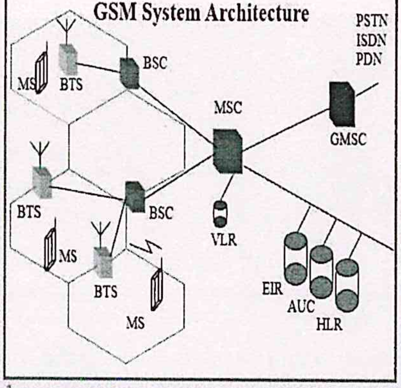
5/11

HoD

Head of the Department
Department of Electronics and Communication Engineering
St. Anne's College of Engineering and Technology
Anguchettypalayam, Panruti-(T.k) Cuddalore-(Dist.),Pin:607 106

Board Presentation Content

GSM System Architecture



1

GSM System Architecture-I

- **Mobile Station (MS)**
  - Mobile Equipment (ME)
  - Subscriber Identity Module (SIM)
- **Base Station Subsystem (BSS)**
  - Base Transceiver Station (BTS)
  - Base Station Controller (BSC)
- **Network Switching Subsystem(NSS)**
  - Mobile Switching Center (MSC)
  - Home Location Register (HLR)
  - Visitor Location Register (VLR)
  - Authentication Center (AUC)
  - Equipment Identity Register (EIR)

2

GSM RF

- RF Spectrum

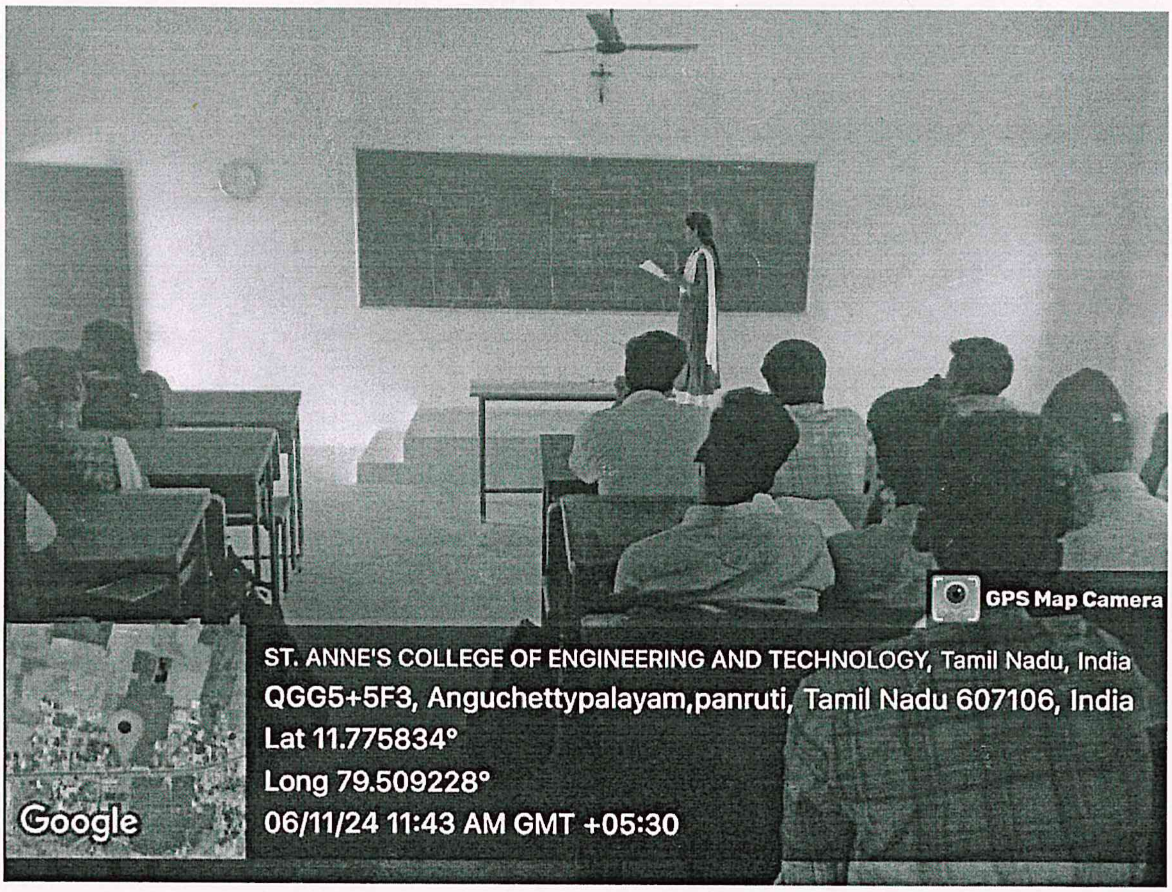
GSM 900
Mobile to BTS (uplink): 890-915 Mhz
BTS to Mobile(downlink):935-960 Mhz
Bandwidth : 2* 25 Mhz

GSM 1800
Mobile to BTS (uplink): 1710-1785 Mhz

GSM RF

- Carrier Separation : 200 Khz
- Duplex Distance : 45 Mhz
- No. of RF carriers : 124
- Access Method : TDMA/FDMA
- Modulation Method : GMSK

Photo


GPS Map Camera
Google
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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

STUDENT SEMINAR

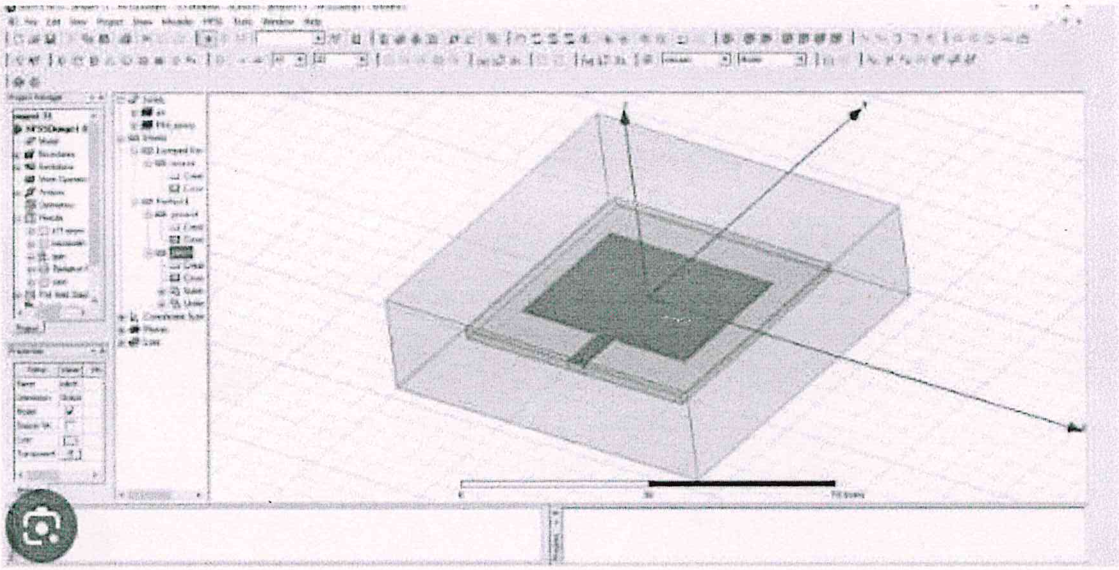
EVALUATION SHEET

Name of the Student : **S. SRIMATHI**
Register Number : **422120106050**
Year/Semester : **III/V**
Date and Time : **06.11.2024 @ 11:40 pm**
Topic of the Seminar : **"Global System for Mobile Communication"**

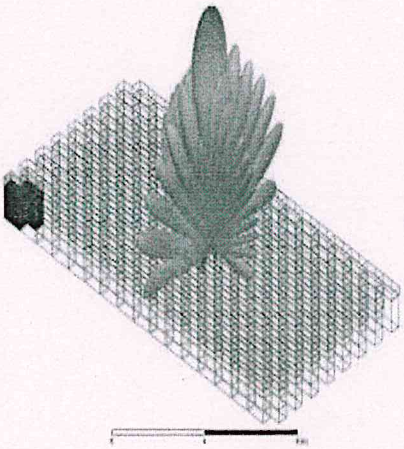
	PRESENTATION CONTENT (10)	PRESENTATION STYLE (10)	ANSWERING QUESTIONS (10)	REMARKS
Class Incharge	9	10	8	Good
HOD	10	9	7	Good. Need to improve your presentation

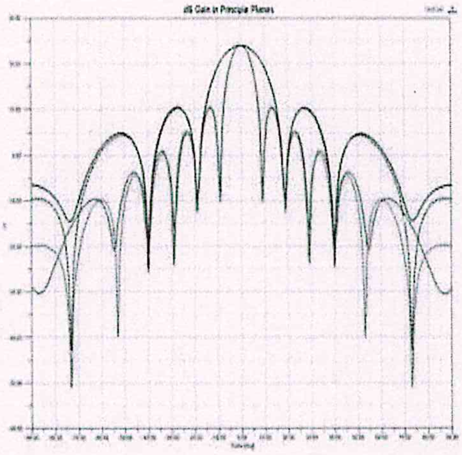
Mini Project on Microstrip Patch antenna for Satellite Applications

Design Using HFSS



Output





Submitted by

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