Optical Fibre Communication

Subject → MCS

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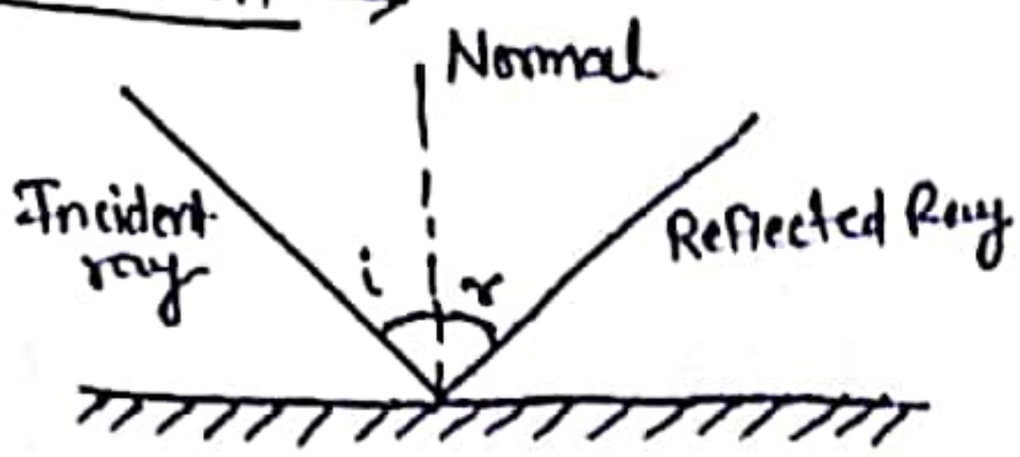
Reflection & Refraction

Reflection →



i → Angle of Incident
r → Angle of Reflection

$i = r$

Reflection

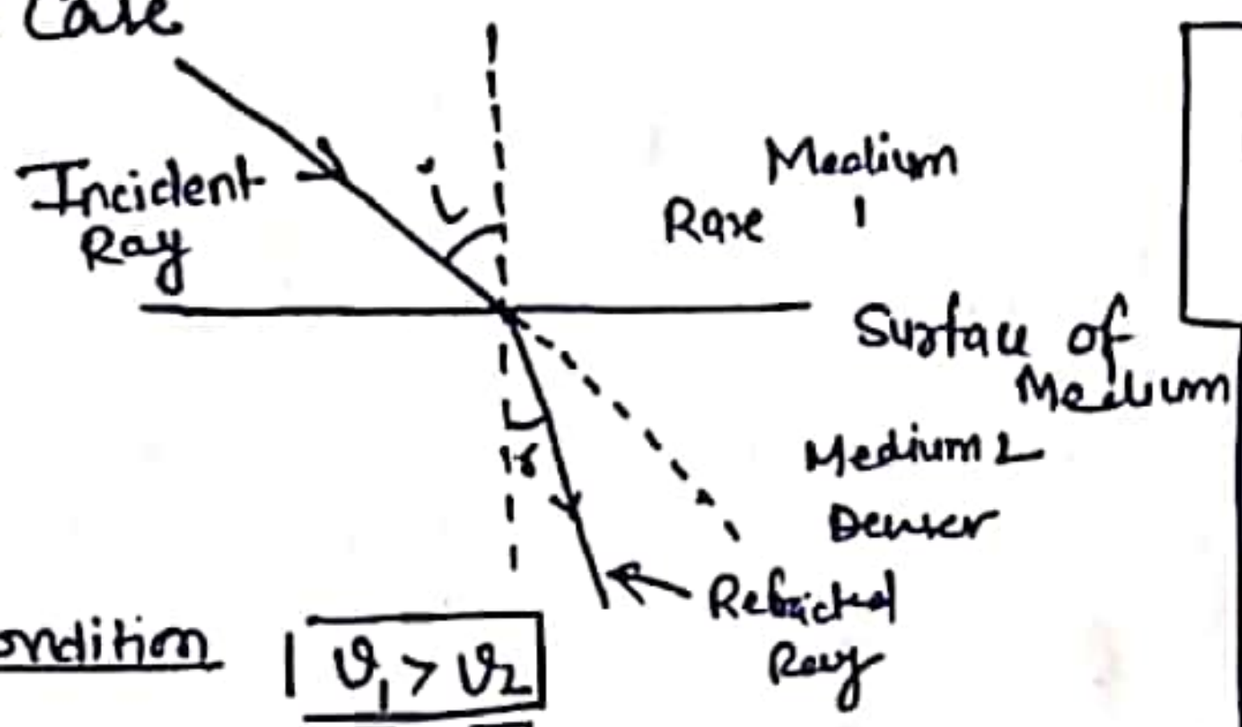
Refraction →

(1) There are two medium — Denser Medium, Rare Medium

(2) Velocity of light in Denser Medium is less.

(3) Velocity of light in Rare Medium is High.

(a) Case



Condition $v_1 > v_2$

$r < i$

If light enters from Rare to Denser Medium $v_1 > v_2$

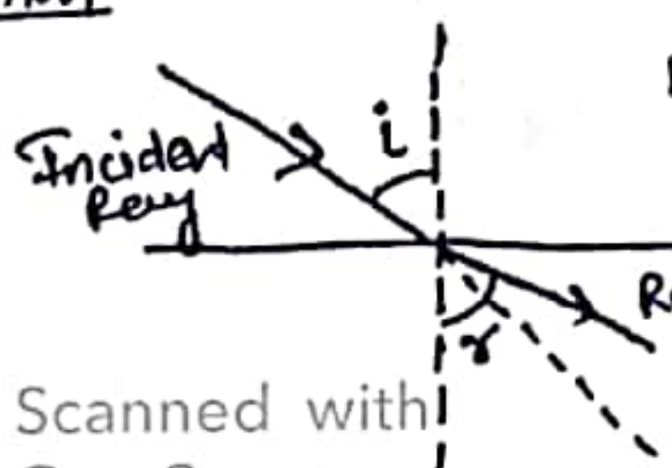
v_1 → Velocity of light in Rare Medium

v_2 → " " " Denser Medium

Angle of Incidence i > Angle of Refraction

(b) Case

Condition



$v_1 < v_2$

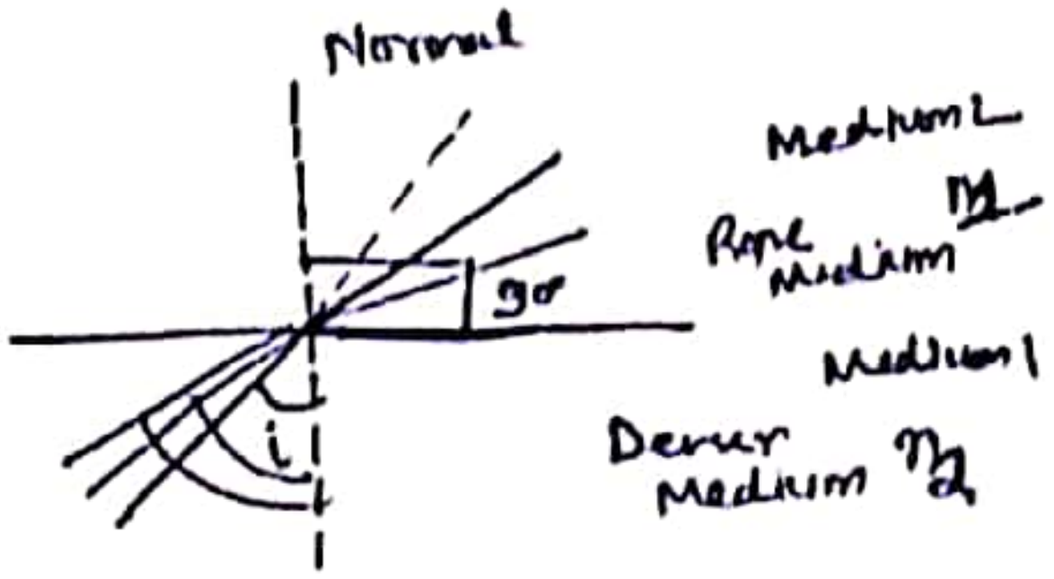
$r > i$

v_1 → Velocity of light in Denser Medium

v_2 → " " " Rare Medium

Total Internal Reflection

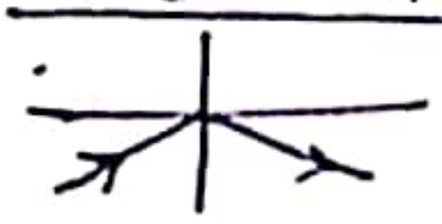
(1) Only possible when light enters from Denser Medium to Rare Medium



At Critical Angle

Angle of Refraction is 90°

If $i >$ Critical Angle



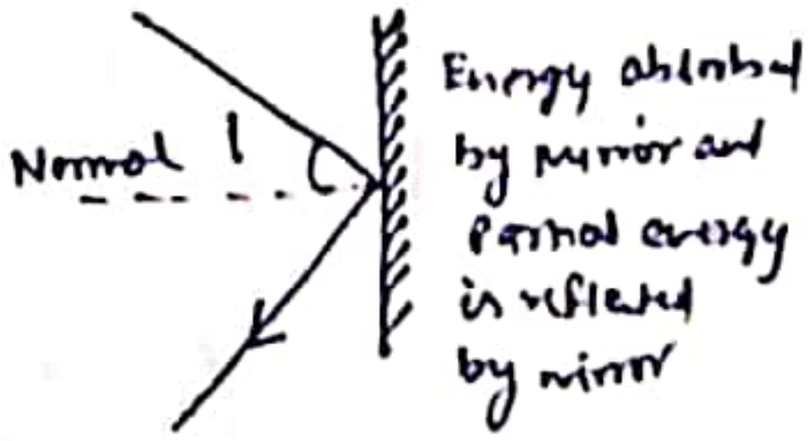
Critical Angle → is angle when rays either from denser medium to rare medium with refracted angle is 90°; angle of Incident is refracted as critical angle.

Total Internal Reflection

↓ Total Energy

↓ It Happens in Same Medium

↑ $i > C$



$$\frac{n_2}{n_1} = \frac{\sin 90}{\sin C} = \frac{1}{\sin C}$$

$$\frac{n_2}{n_1} \cdot \frac{1}{\sin i}$$

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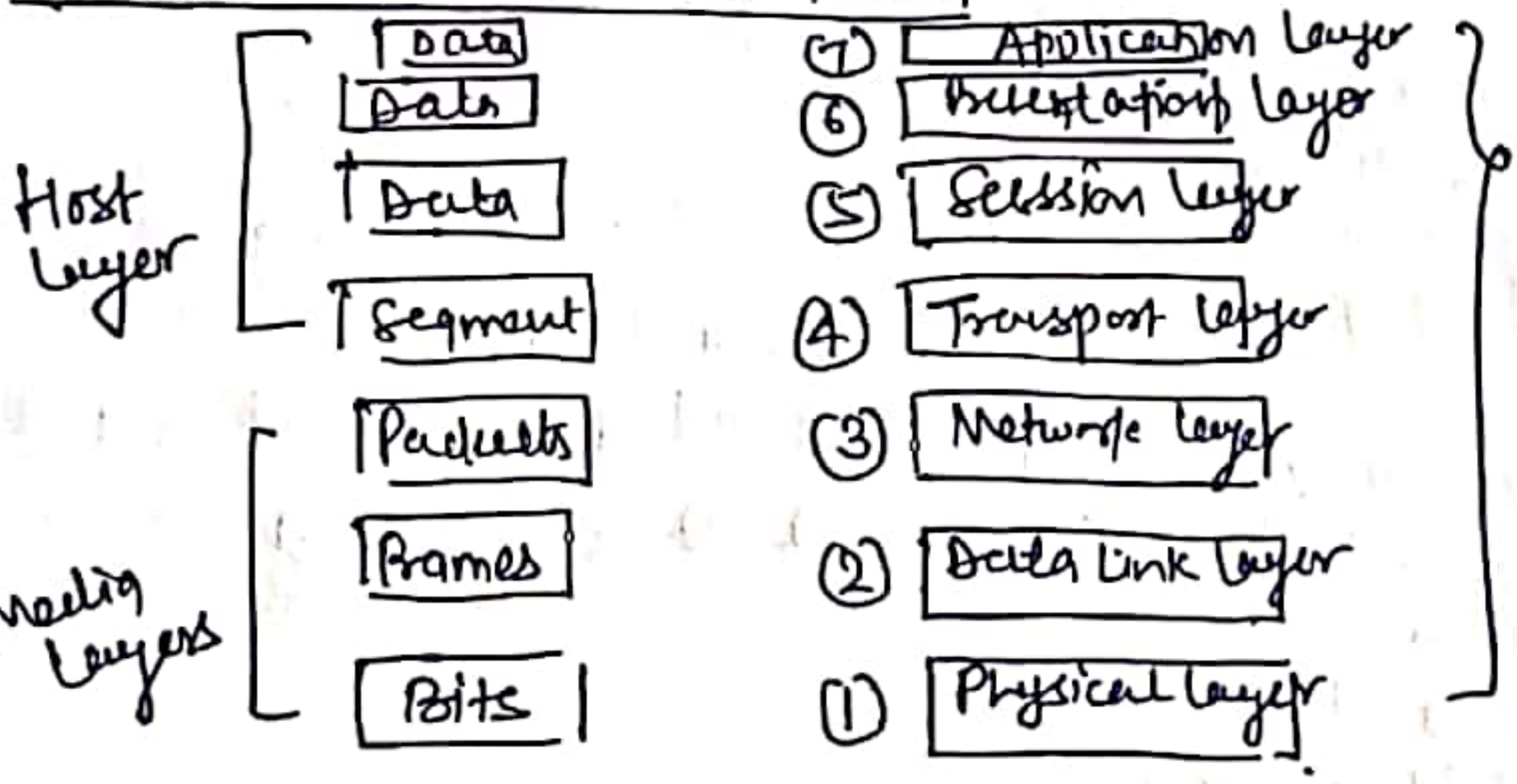
OSI

(1) Open System Interconnection
(2) OSI Layer Model को International Organization for Standards के द्वारा तैयार किया गया
(3) OSI से Communication System को सात अलग-2 Layers में बांटा जाता है
(4) यह Model ISO द्वारा सन् 1984 में बनाया गया
(5) OSI Model को Open System Interconnection इसलिए कहा जाता है क्योंकि यह Model allow करता है किसी दो अलग-अलग System को Communicate करने में चाहे उनकी underlying Architecture कुछ भी क्यूं न हो।

Architecture of OSI Model

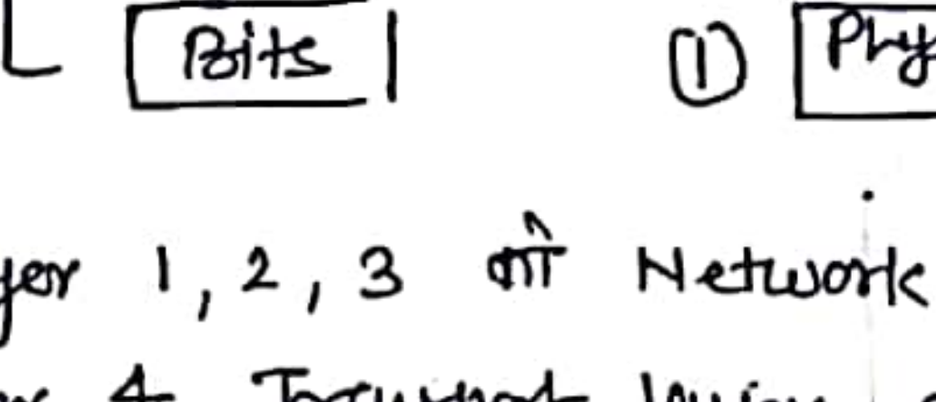


(1) Layer 1, 2, 3 को Network Support Layers भी कहा जाता है
(2) Layer 4, Transport Layer end to end Reliable Data transmission प्रदान करता है
(3) Layer 5, 6, 7 को User Support Layers कहा जाता है

Layers को याद करने का तरीका →

APS TNDP

APS TNDP

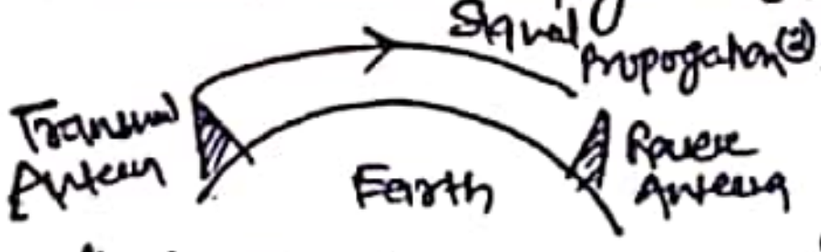


(1) 2 computer को आपस में बात करने के लिए या data आदान प्रदान करने के लिए जो Rules follow किये जाते हैं उसे OSI Model कहते हैं।

Modes of Propogation

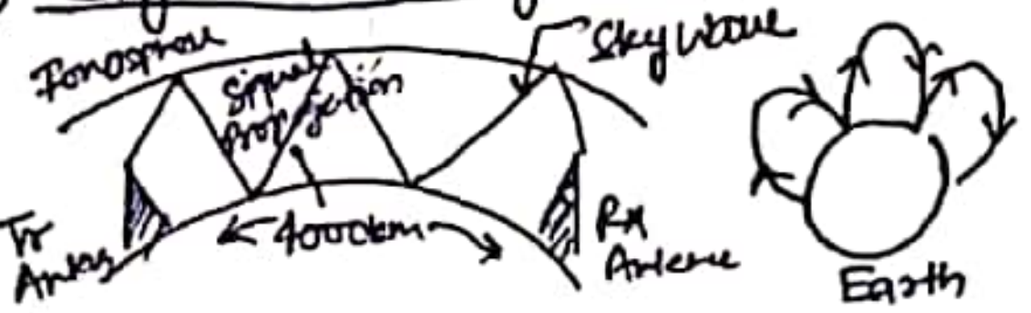
Subject → MCS

(1) Ground Wave Propogation



- Also known as Surface Wave Propogation
- Occurs in Earth's Surface
- Upto 2MHz frequency
- Attenuation of wave by Atmospheric's permittivity, Conductivity and Surface Irregularity
- AM, FM TV Broadcast

(2) Sky Wave Propogation

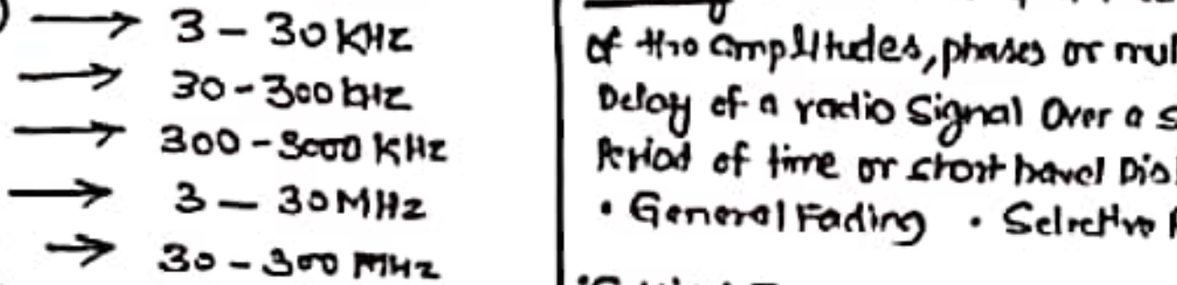


(1) 2MHz to 30MHz frequency wave propogate
(2) Point to point Comm. • Occurs in Ionosphere
(3) एक बार Ionosphere से टकराने के बाद 4000 km Travel कर सकती है।
(4) 30MHz से अधिक Frequency की wave Ionosphere में परिवर्तित नहीं होती

(3) Space Wave Propogation → >30MHz

30MHz – 300MHz

LOS



- Occurs in troposphere
- These Occurs within the lower 20km of Atmosphere
- These Waves can travel directly or can travel after reflecting from the earth's Surface to the troposphere Surface from the earth, so it is called Tropospherical Propogation
- Radar & Television Comm.
- Frequency Range of Television Signal 80 to 200MHz. These Waves are not refracted by Ionosphere.

Common RF Band Designations

ELF (Extremely)	3 - 30 Hz
SLF (Super)	30 - 300 Hz
ULF (Ultra)	300 - 3000 Hz
VLF (Very)	3 - 30 KHz
LF	30 - 300 KHz
MF	300 - 3000 KHz
HF	3 - 30 MHz
VHF (Very)	30 - 300 MHz
UHF (Ultra)	300 - 3000 MHz
SHF (Super)	3 - 30 GHz
EHF (Extremely)	30 - 300 GHz

Fading → means rapid fluctuations of the amplitudes, phases or multipath delay of a radio signal over a short period of time or short travel distance
- General Fading
- Selective fading

Critical Frequency → Is the highest magnitude of frequency above which the wave penetrates the Ionosphere & below which the waves reflected back from the Ionosphere, it is denoted by f_c. Its value is not fixed, depends upon electron density of Ionosphere

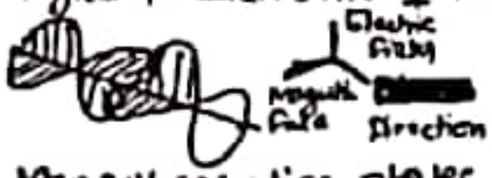
$f_c = 9\sqrt{N_{max}}$ N_{max} → Maximum Electron Density per m^3, f_c → Hz

Maximum Usable Frequency →

$MUF = \frac{\text{Critical Frequency}}{\cos\theta} \simeq 3 f_c$

Skip Zone → स्किप ज़ोन का वह भाग जिसमे न तो स्काई वेव और न ग्राउंड वेव पायी जाती है। स्किप ज़ोन कहलाता है।

Radio Waves → • Maxwell predict the existence of EM Waves
- EM Waves in Free space or TEM wave consist of Electric & Magnetic fields, each at right angles to each other & the direction of propagation



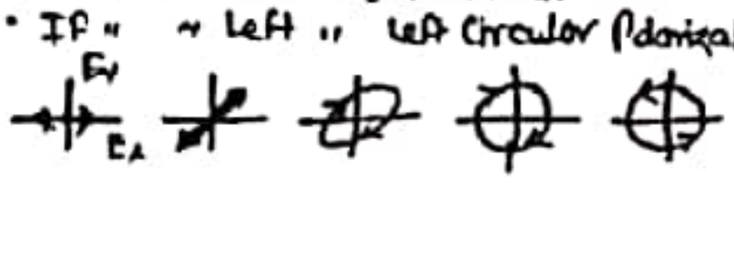
- Maxwell equation states that time varying Magnetic field produces an electric field, Electric field produces a Magnetic Field
- Radio Wave → Transmission Medium → Freespace → travel in straight line; Atmosphere → Generally travelled in curved path
- Radio Wave interact with object in three principle ways
- Reflection → Radio Wave bounces off an object larger than its wavelength
- Diffraction → Wave bend around objects
- Scattering → A Radio wave bounces off an object smaller than its wavelength

Polarization → the ability of Wave to oscillate in more than one direction

Polarization of EM Wave refers to the direction of Electric field

Linear Polarization → field oscillate in single direction

Circular or Elliptical Polarization → Field rotates at constant rate in a plane as the wave travels. The rotation can have two direction
- If field rotates right hand sense with respect to direction of wave travel, right circular.
- If " " left " left circular Polarization



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Satellite → A Satellite is a body that moves around another body in a Particular Path.

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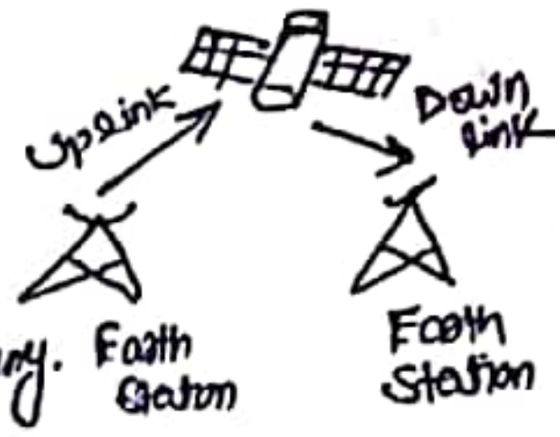
A communication Satellite is nothing but a microwave repeater Station in space. A repeater is a circuit which increase the strength of the recieved Signal & transmit it.

Uplink Frequency → The Frequency with which the Signal is sent into space is called Uplink Frequency.



Downlink Frequency → The Frequency with which the Signal is sent by the transponder is called Downlink Frequency.

Advantage of Satellite Communication

(1) Area of Coverage is more than that of terrestrial systems
(2) Each & Every Corner of the earth can be covered.
(3) Transmission Cost is independent of coverage area
(4) More bandwidth & broadcasting Possibilites

Disadvantage of Satellite Communication

(1) Launching of Satellite into Orbit is a Costly procss
(2) Free space loss is more.
(3) Propogation Delay of satellite system is more than that of conventional terrestrial system
(4) There can be Congestion of frequencies

Application
- Radio broadcasting & Voice Communication
- DTH
- Internet Application
- Military Application
- Remote Sensing application
- Weather Condition monitoring & Forcasting

Launching of Satellite → The process of placing the satellite in a proper Orbit is known as *launching process*. During this process from earth Station we can control the Operation of Satellite.
Mainly there are four Stage in launching a satellite

(1) **First Stage** → The first stage of launch vehicle contains rocket & fuel for lifting the Satellite along with launch vehicle from ground.
(2) **Second Stage** → The Second Stage of launch vehicle contains small rockets. These are ignited after Completion of first Stage. They have their own fuel tanks in order to send the satellite into space.
(3) **Third Stage** → The third (upper) Stage of launch vehicle is connected to the satellite fairing. This fairing is a metal shield, which contains the Satellite and its protects the Satellite
(4) **Fourth Stage** → Satellite gets seperated from the Upper Stage of launch vehicle when it has been reached to out of earth's atmosphere, Then the Satellite will go to a transfer orbit. This Orbit sends the Satellite higher into space

When the Satellite reached to desired height of the Orbit, its subsystem like Solar panel and communication anteenas gets unfurled. Then the Satellite takes its position in the Orbit with other satellite, Now the satellite is ready to provide servie to the public

Satellite launch Vehicle → Satellite launch vehicle launch the satellite into a particular orbit based on the requirement.
2 types → (1) Expendable launch vehicle (ELV) (2) Reusable launch Vehicle (RLV)