

# An Introduction to Microwave and Satellite Communication

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Radio communication is in use since early 30's.

First use of radio was for broadcasting .

subsequently Radio was used  
for providing commercial communication

Radio was used for long distance telephone service also.

Telephone Network consists of the following parts:-

A number of telephone lines connected to an Exchange.

A number of telephone exchanges of the Area connected to TAX:-

TAX o/p is brought to Microwave station

Radio Equipment is classified under the following categories  
VHF ,UHF & Microwave Systems.

when there is the requirement for a few circuits  
VHF or UHF Radio is put to use.

For large no of circuits Microwave communication equipment is  
put to use .

Earlier the equipment was large in size  
was using analogue technology.

Since early 80''s we have been using Digital Radio  
which has better efficiency.

# MICROWAVE SYSTEMS

Microwave communication is line of sight radio communication.

we shall discuss the following aspects involved .

- 1 What is meant by radio transmission.
- 2 Radio Spectrum Used
- 3 Types of Radio Systems used.
- 4 Frequency bands used.

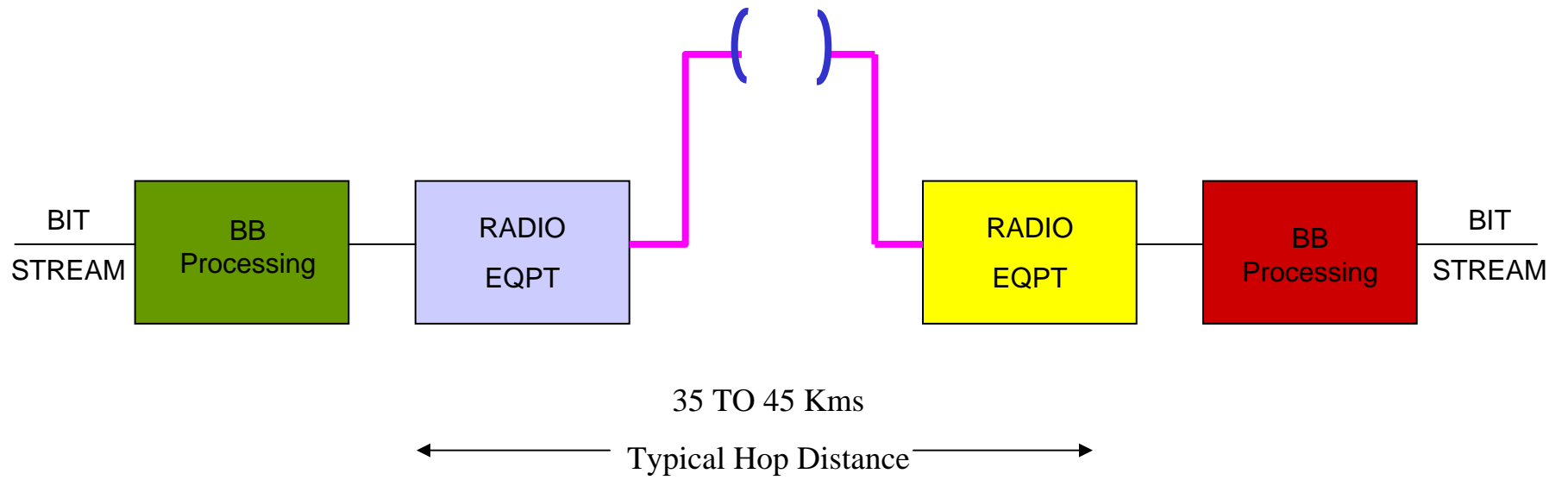
## **Radio Transmission :**

In Radio the speech signals are converted to electromagnetic power.

Power is transmitted in space towards the destination.

Electromagnetic waves are intercepted by receiving Antenna

signal power is collected at receive antenna .



RADIO  
EQPT

Antenna used can be

1. Omni directional – In this case radio power is transmitted uniformly in all the directions.

Such type of antenna are preferred where uniform coverage is desired such as in cellular systems.

2. Directional:- in case of UHF communication.
3. Highly Directional :- in case of microwave communication.

Microwave, signals are transmitted in very narrow beam.

Normally 3 M Diameter Antenna at 2 GHz BW has half power beam width of about 3.4 degrees



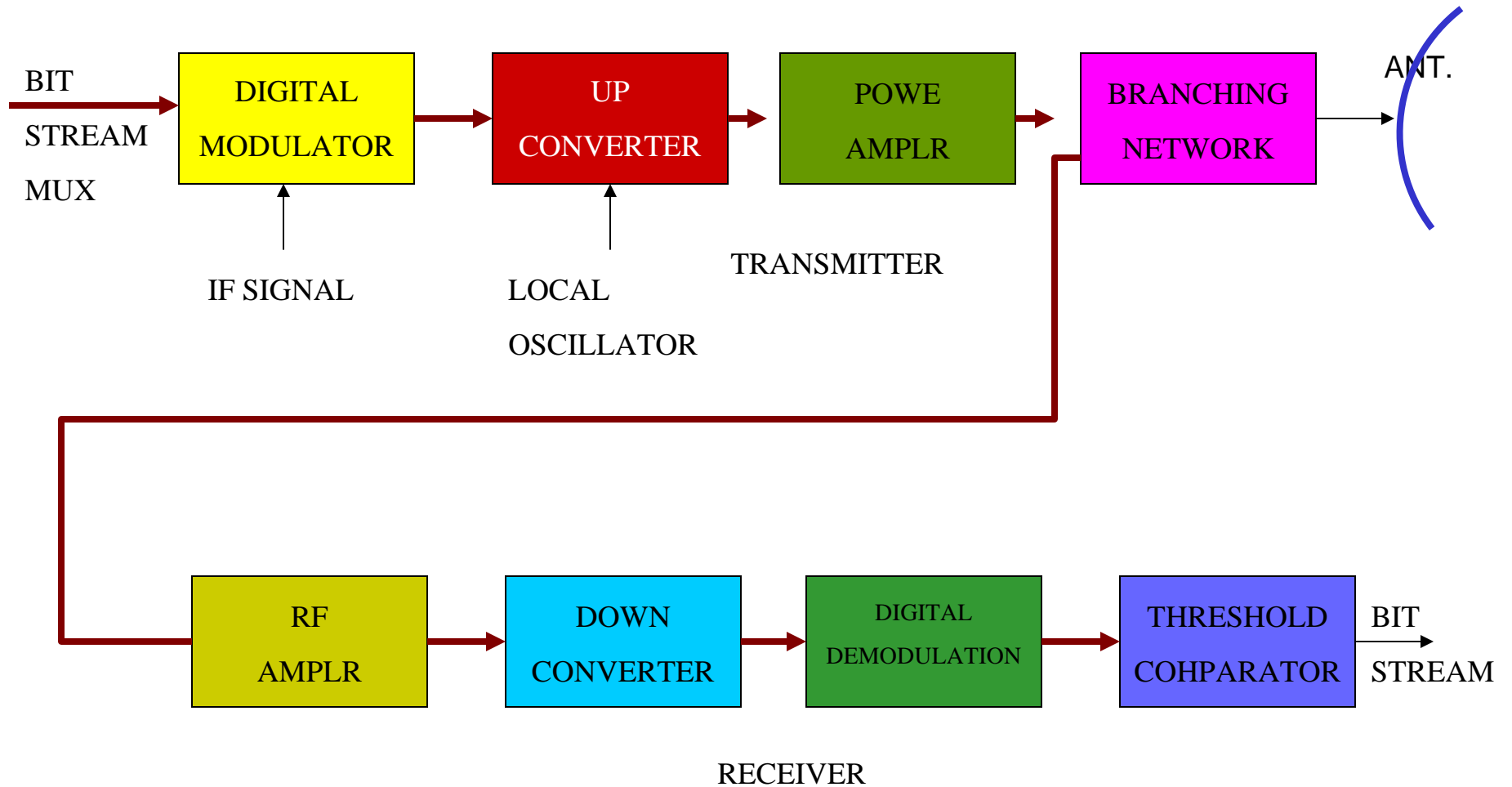
## System configuration:-

Wide band M/W system operates between the stations (hundreds of Kms apart)

Having number of repeaters in between.

Radio equipment required at the terminal :-

1. Base Band Processing equipment.
2. I.F modulation equipment,
3. i.e. modulator and demodulator.
4. UP converter/ Down Converter.
  - Power Amplifier
- 5 Antenna Sub. System.



# DIGITAL RADIO RELAY SYSTEM

## Radio Frequency Bands.

VHF band

30 – 300 MHz

UHF

300 – 3000 MHz

beyond 1000 MHz

LOS communication

SHF

3GHZ to 30 GHZ

EHF

30 GHZ to 300 GHZ

## Classification of Radio Equipment.:

- Low Capacity
  - 704 Kb/s UHF(400-700MHz)
  - 2 M/bs 2Ghz
  - 8 Mb/s 2Ghz
- Medium Capacity
  - 34 Mb/s 7 & 13 GHz
- Large Capacity
  - 140 Mb/s 4,6 & 11 GHz

## DIGITAL M/W SYSTEMS

### \*High Capacity

6 Ghz, 4Ghz&5Ghz 140 Mb/s  
carrying 1920 voice channels

### Make

Fujitsu,  
NEC, BEL, ITI

Used in Main Trunk Routes

### \*Medium Capacity

7Ghz, 34 Mb/s

Fujitsu, NEC, BEL, ITI

Used in thin Routes

13 Ghz, 34 Mb/s

Used for junction Networking

### \*END LINKS

11 Ghz, 140 Mb/s

Used for satellite End Links

NEC & Others

# Communication Towers

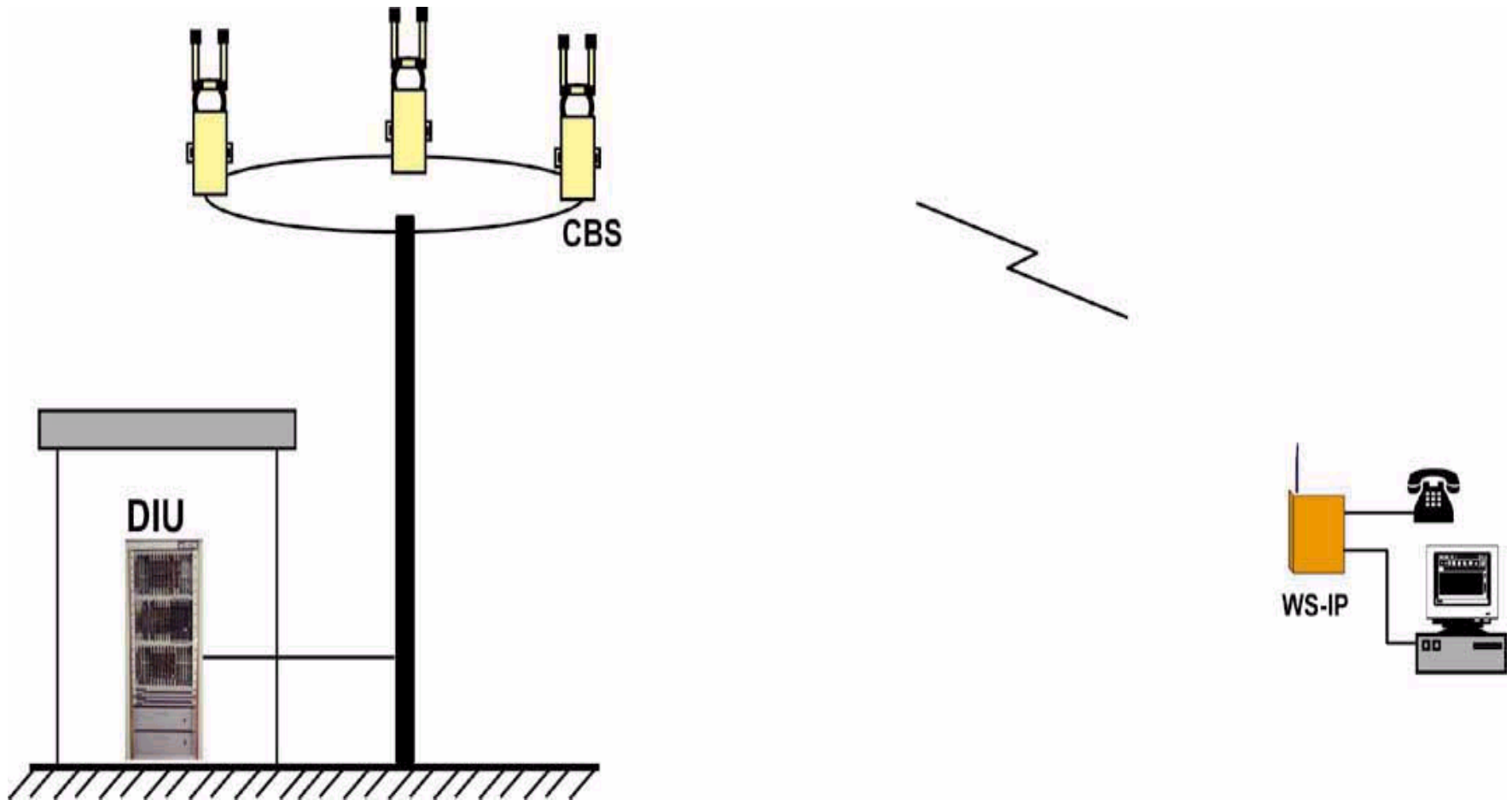
- Towers are used to Install the Antennas for providing Radio communication.
- The towers have following categories.
  - (1) Towers used to provide cellular communication,ie Mobile & “WLL”
  - Towers used to provide Microwave Communication.

- Cellular Communication Towers are light in weight.
- Galvanised Mild steel material is used for tower construction

These towers have normally 30 meter height

But the towers of height ie 40 meters& above are also used , Depending upon the requirement

For providing Cellular communication a no of Antennas at a particular height are installed around a circular platform.



The Antennas are pointed towards the sector which these they are supposed to cover.



Normally rooftops Should be preferred for tower construction.

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(2) Towers used for installing Microwave Antennas:-

Microwave hop distance is more then the cell radius

Perfect line of sight is the requirement for microwave communication

On each tower the Antennas of different routes are to be mounted in different directions.

Towers of 30M to 100M are required

For Microwave communication.

usually parabolic Disk type Antennas are used

The number of Antennas are to be mounted on the tower

(a) Classification of microwave towers :-

The type of tower to be used depends upon the following factors.

(1) Number & types of antennas to be mounted on the tower.

(2) Wind load of the place.



If the wind pressure is very high

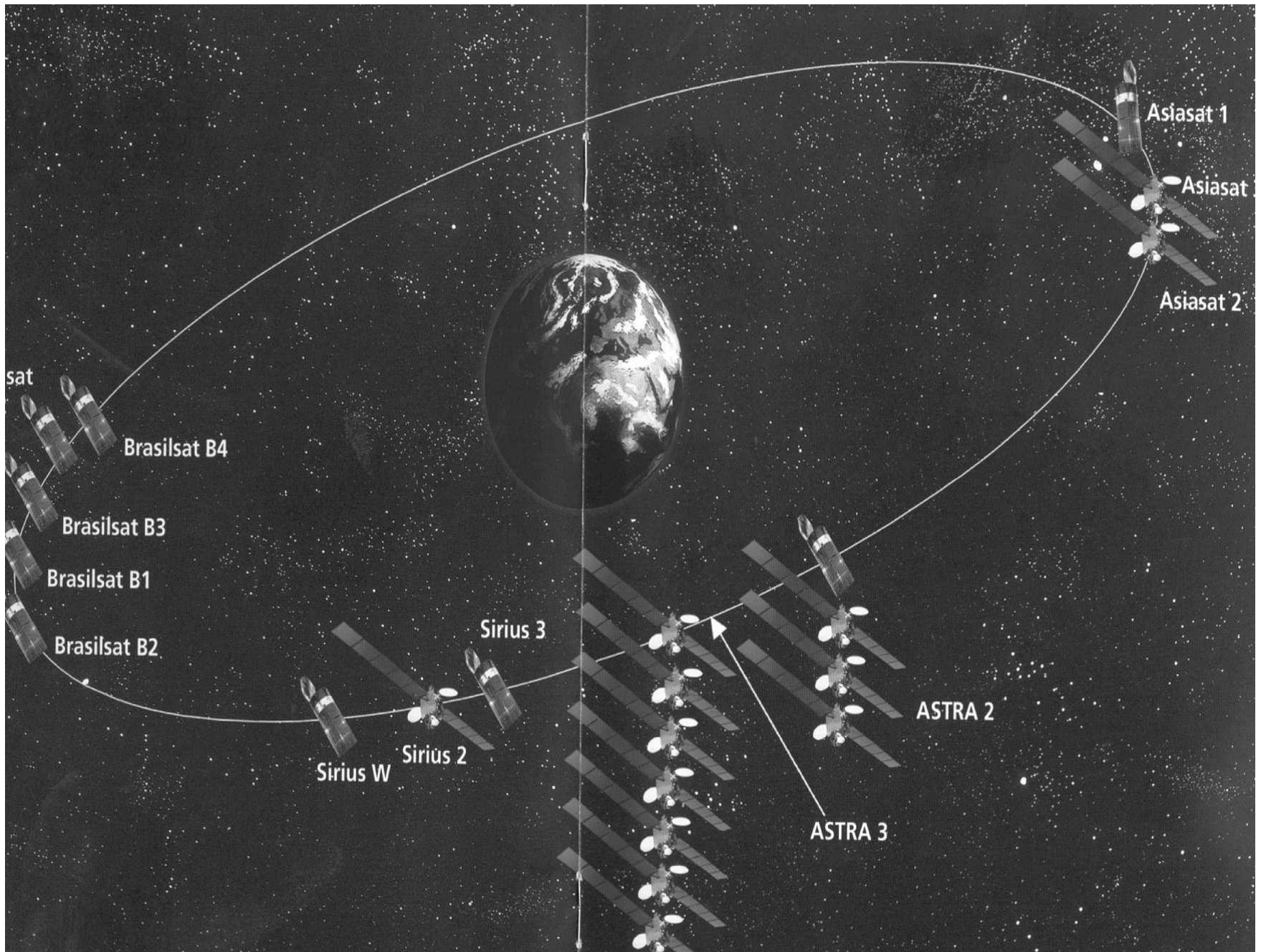
And the no of antennas (more than 4), the requirement will be the special heavy weight tower.

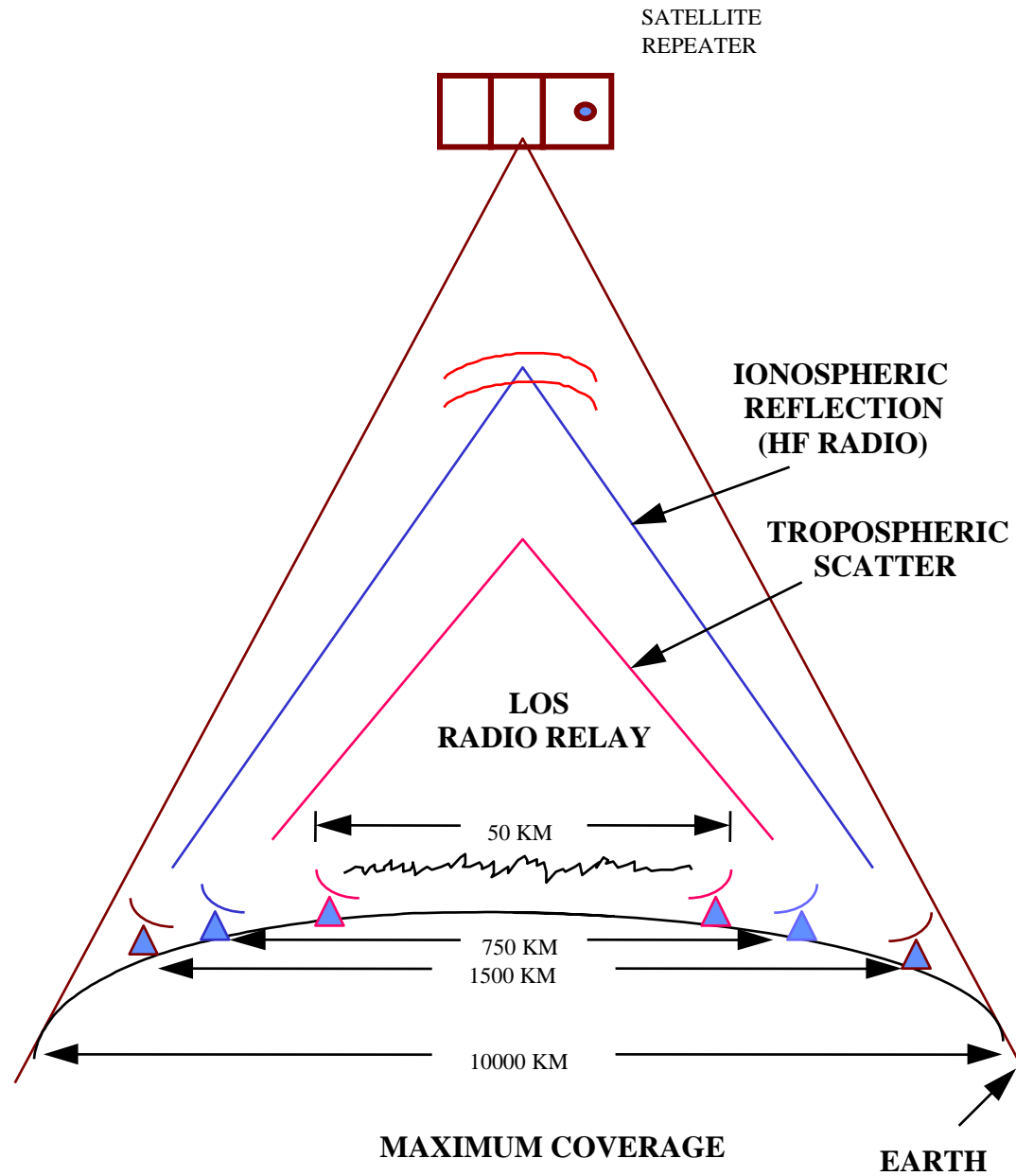
- If the requirement is one or a few antennas
- Light Weight or Heavy Weight Tower will be constructed.

For providing Mobile Communication normally light weight towers mounted on the rooftops are used.

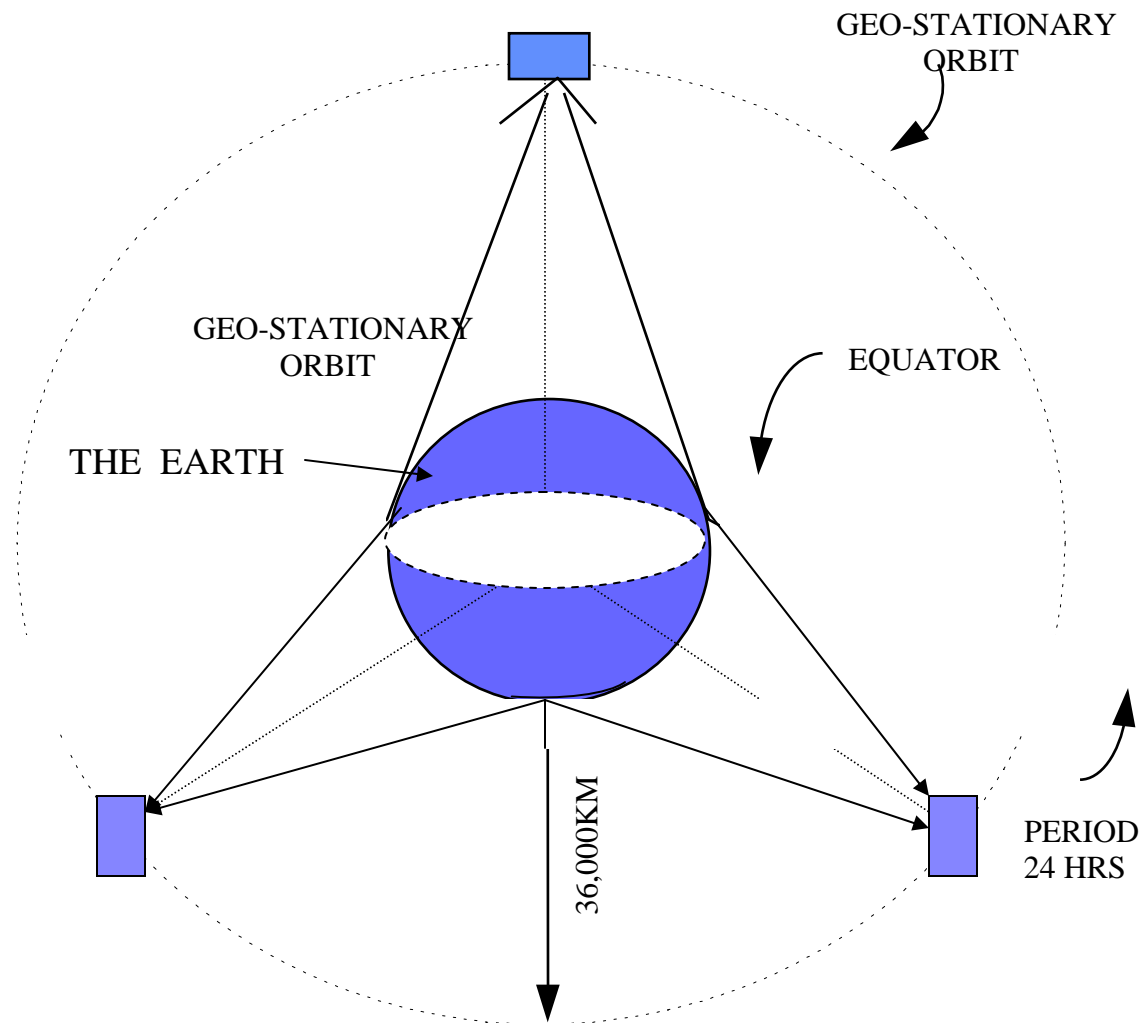
# SATELLITE COMMUNICATION

- 1.1 Only one repeater in the link
- 1.2 Covers  $1/3$  of earths surface.
- 1.3 Provides high quality communication.
- 1.4 Insensitive to fading.
- 1.5 Large areas could be covered if the height of the microwave repeater could be increased by putting it on board an artificial earth satellite **(FIG. 1)**.





**FIG. 1: MODES OF COMMUNICATION**



**FIG. 2: GLOBAL COVERAGE WITH GEOSTATIONARY SATELLITES  
CLARKE'S CONCEPT**



1.1 In 1965 INTELSAT launched first communication Satellite named “EARLY BIRD”

The satellite was having the capacity of 240 voice circuit .

1.2 The Satellite had the life of one and a half years.

1.3 Rapid advances in launch vehicles & developments in reliable microwave devices, have made satellite communication systems quite affordable and common.

1.4 The present generation satellites carry a no of radio channels called communication Transponders and have the expected life span of 10 to 12 years.

## 2.0 ADVANTAGES OF SATELLITE COMMUNICATIONS

### (i) Large Coverage

Almost one-third of the earth with the exception of polar regions, is visible from Geo stationary orbit.

### (ii) High Quality

Satellite links can be designed for high quality performance.

It is free from Ionospheric disturbances and multi-path effects.

### (iii) High Reliability

Reliability is high since only one repeater is involved in the communication link.

#### iv) Speed of Installation

Installation of earth terminals can be achieved in a short time as compared to laying of cables or installation of radio relay links.

#### (v) Mobile, Short-term or Emergency Communication

With air-liftable or road transportable terminals, short-term or emergency communication can be provided quickly

Reliable long distance land mobile, maritime mobile and Aeronautical mobile services are feasible only by means of satellite.

#### (vi) Broadcast Nature of Transmissions

Ideally suited for point to multi-point transmission or broadcasting over large areas.

Application of satellites for TV broadcasting, and teleconferencing, facsimile data and news dissemination is therefore, increasing rapidly.

A Communication satellite essentially consists of two parts

- i) Communication Payload – consists of communication transponders & transmit/receive antenna.
- ii) Support Sub-system – consists of
  - a) Structure
  - b) Attitude and orbit control
  - c) Propulsion system
  - d) Electric Power System
  - e) Thermal control
  - f) Telemetry and Tele command system

## FREQUENCY BANDS

4.1 Most of the satellite communication systems are using 6 GHz freq band for uplink and 4 GHz for downlink.

14 GHz band for uplink and 11 GHz band for downlink.

Use of 11/14 GHz band permits use of customer premises terminals as the terrestrial usage of this frequency band is very much limited.

## INDIAN COMMUNICATION SATELLITES LAUNCHED SO FOR.

NAME OF SATELLITE	DATE OF LAUNCH	LAUNCH VEHICLE
APPLE	JUNE 19, 1981	ARIANE
INSAT-1A	APRIL 10, 1982	DELTA (US)
INSAT-1B	AUGUST 30, 1983	US Space Shuttle.
INSAT-1C	JULY 22, 1988	ARIANE
INSAT-1D	JUNE 12, 1990	DELTA (US)
INSAT-2A	JULY 10, 1992	ARIANE
INSAT-2B	JULY 23, 1993	ARIANE
INSAT-2C	DECEMBER 7, 1995	ARIANE
INSAT-2D	JUNE 4, 1997	ARIANE

(INSAT 2D failed after 2 months of its launch.)

(INSAT 2-D FAIFED AFTER 2 MONTHS OF ITS LAUNCH.)

INSAT-2DT	JANUARY, 1998	IN-ORBIT
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(Satellite was purchased from ARABSAT communication payload withdrawn now)

INSAT-2E	APRIL 3,1999	ARIANE
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INSAT-3B	MARCH 22,2000	ARIANE
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GSAT-1	APRIL 21, 2001	GSLV
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INSAT 3C	January 24 2002	ARIANE
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NSAT 3A	10 <sup>th</sup> April 200 3	ARIANE
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# SATELLITE COMMUNICATION IN INDIA

## (A) EXISTING EARTH STATIONS.

1.	TYPE A (MAIN Earth station)	14
2.	TYPE B (PRIMARY Earth station)	59
3.	TYPE C (REMOTE Earth Station)	13
4.	MCPC VSATs	345
5.	IDRs (Digital Satellite Equipment)	56
6.	Analogue SATCOM Equipment.	216 voice ccts
7.	Total VSATs including private.	24000

### Types of Services available via Satellite.

1. Point to multipoint video service
2. Point to point Telephone service
3. Remote area business messaging service.
4. Multi channel per carrier (MCPC-VSAT)



6. High Speed VSAT Network. (HVNET)
7. Fly Away Terminals for Emergency communication.

Satellites used for providing services in INDIA.

1. Insat 2E
2. Thi com 3
3. Insat 3B.
4. Insat 3C.
5. Intelsat 703
6. Insat 3A.

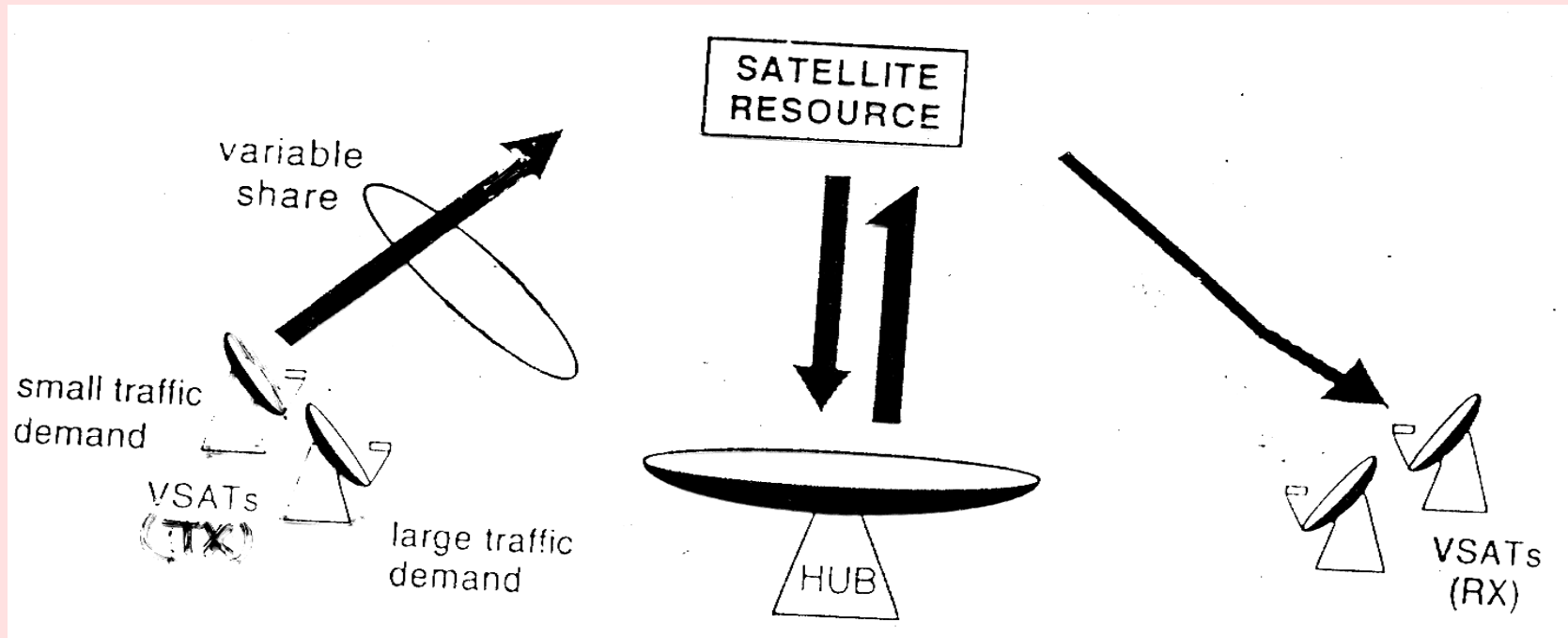
# MCPC V-SAT

## Govt of India Plan

All Tehsil HQs to be connected on STD map irrespective of their exchange capacities.

All industrial growth centers, important tourist places should be provided with STD facilities.

All such divisional HQs and exchanges of more than 500 lines are to be linked to national network.



## VSAT to VSAT Communication via HUB

# MCPC V-SAT

Objective:- to have a reliable x mission media between trunk exchanges and the places mentioned above.

Present scenario :- for some places mentioned above networks are based on O/H lines running through forests to having difficult terrain and therefore are vulnerable.

At many places the traffic is thin and even 2 hop UHF sys. is not fear able.

# MCPC V-SAT

MCPC is a sat. based network and is very much reliable.

It provides connection between RAX AND TAX directly W/O involving any link in between these two points.

MCPC provides.

Voice chls → 7 (16KBPs each)

Esc → 1 (9.6KBPs)

# MCPC V-SAT

Data chls.of 19.2 kbps –4 ( in lieu of voice)  
an a signal carrier chl.

Network Design.

In case of SCPC one carrier is used for one  
voice chl.

For N Voice chls. The requirement will use  
N carriers.

This needs a back off power in HPA, on the  
other hand if a no. of chls are carried on one  
carrier, the size of the HPA will be reduced.

# MCPC V-SAT

MCPC is basically a digital system, BB is converted to If by QPSK Mod. Tech- Max bit rate offered is 128kBP/s for 8 channel.

Any sat station is broadly sub divided into 3 sub. Systems.

- i. Antenna
- ii. RF/IF Unit.
- iii. Base band unit.

# MCPC V-SAT

MCPC Network ARCHITECTURE has two main parts.

1. Hub station
2. Remote STN (V-SAT)



# RURAL COMMUNICATION

- SINGLE VOICE CHANNEL
  - FLYAWAY TERMINALS FOR CRISIS MANAGEMENT
  - SUITCASE TYPE TERMINAL FOR VVIPs
  - PROVISION OF TELEPHONE TO GRAME PANCHAYAT
  - LONG DISTANCE SATELLITE TELEPHONE
- MULTIPLE VOICE TERMINALS
  - MCPC VSAT FOR PROVIDING LONG DISTANCE TRUNK CIRCUITS TO REMOTE, HILLY AND INACCESSIBLE

# RABM NETWORK OFFERS

- INTERACTIVE DATA COMMUNICATION AT SPEEDS UPTO 1200 Bps IN GENERAL BUT LIMITED TERMINALS UPTO 9600 Bps
- ACCESS TO PUBLIC TELEX NETWORKS
- ACCESS TO PACKET PUBLIC SWITCHED DATA NETWORKS (I-NET)
- ACCESS TO INTERNATIONAL DATA NETWORK THROUGH (GPSS)
- PRESENTLY 500 VSATS (CAPACITY 1000 VSATS)

# **V-SAT COMMUNICATION “RABMN”**

- **USES SSMA**
- **MASTER EARTH STATION ( MES) COLOCATED WITH DOT’S DELHI EARTH STATION AT SIKANDRABAD (UP)**
- **MICRO EARTH STATIONS AT USER’S PREMISES**
- **STAR CONFIGURATION OF N/W**
- **SPACE – SEGMENT (INSAT-3C)**
- **MASTER EARTH STATION IS CONNECTED TO DELHI TRANSMISSION CENTRE BY MICROWAVE/ OPTICAL FIBRE LINK.**
- **MICRO EARTH STATION HAVE BEEN SUPPLIED BY M/s IESL BANGALOURE.**

**THANKS !!**