

## Multiple Access Techniques

### Learning Outcomes

- To Explain the Different Multiple Access Schemes used in Wireless Communication Systems.
- To identify the most appropriate Multiple Access Scheme based on the resources available and the application specified.

## Introduction

- Multiple access means access to a given facility or a resource by multiple users.
- Commonly used multiple access techniques include the following:
  - Frequency division multiple access (FDMA)
  - Time division multiple access (TDMA)
  - Code division multiple access (CDMA)
  - Space domain multiple access (SDMA)

## Transponder Assignment Modes

- **Preassigned multiple access (PAMA)**
- **Demand assigned multiple access (DAMA)**
- **Random multiple access (RMA)**

## Frequency Division Multiple Access

Different Earth stations are able to access the total available bandwidth of satellite transponder by virtue of their different carrier frequencies.

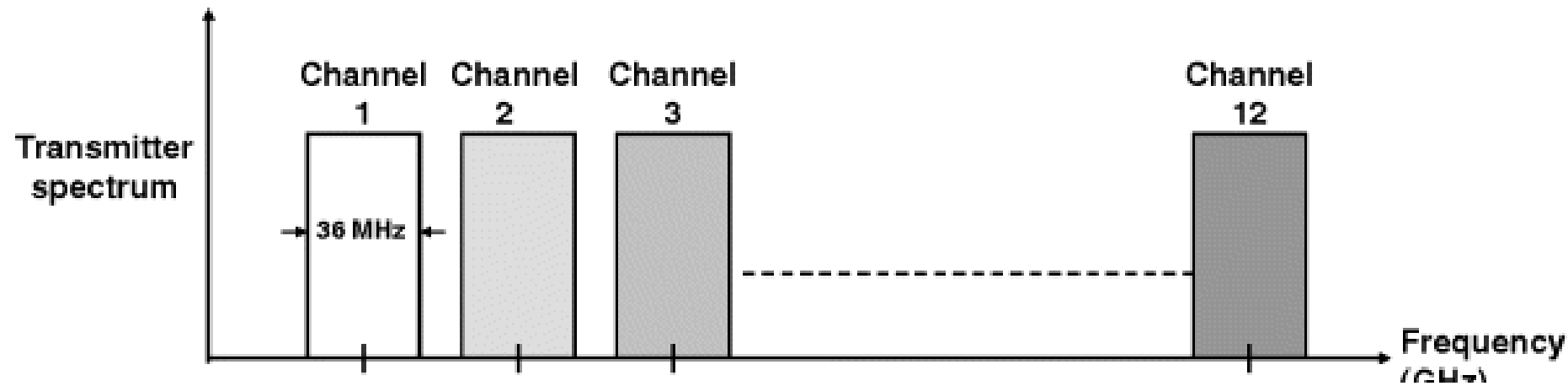
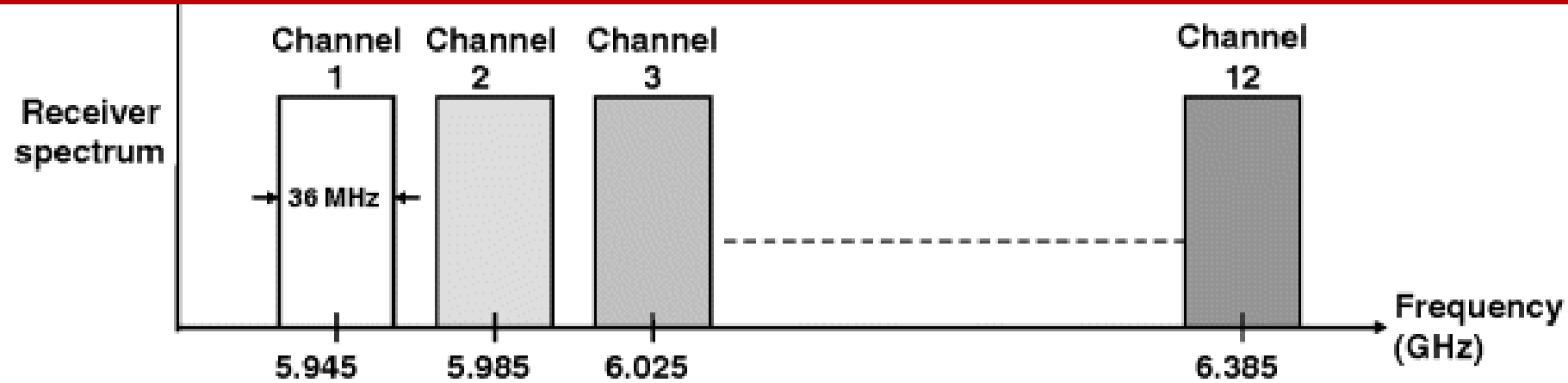
# School of Electrical, Electronics and Communication Engineering

Course Code : BECE3103

Course Name: Satellite Communications

## FDMA

- Each of the Earth stations within the satellite's footprint transmits one or more message signals at different carrier frequencies.
- Each carrier is assigned a small guard band, as mentioned above, to avoid overlapping of adjacent carriers.
- The satellite transponder receives all carrier frequencies within its bandwidth, does the necessary frequency translation and amplification and then retransmits them back towards Earth.



## Types of FDMA Techniques

- **MCPC** - The Earth station frequency multiplexes several channels into one carrier base band assembly, which then frequency modulates an RF carrier and transmits it to an FDMA satellite transponder.
- **SCPC** - Each signal channel modulates a separate RF carrier, which is then transmitted to the FDMA transponder.

## Advantages of FDMA

- Simplicity of Earth station equipment
- No complex timing and synchronizing techniques are required.

## Disadvantages of FDMA

- Likelihood of intermodulation problems with its adverse effect on the signal-to-noise ratio.

## Demand Assigned FDMA

- **Polling Method**

- Master Earth station continuously polls all of the Earth stations in sequence and if the request is encountered, frequency slots are assigned to that Earth station which had made the request.

- **Drawbacks**

- introduces delays more when the number of Earth stations is large.



## Demand Assigned FDMA

- **Random Method**
  - Centrally Controlled
  - Distributed Control

## Pre - Assigned FDMA

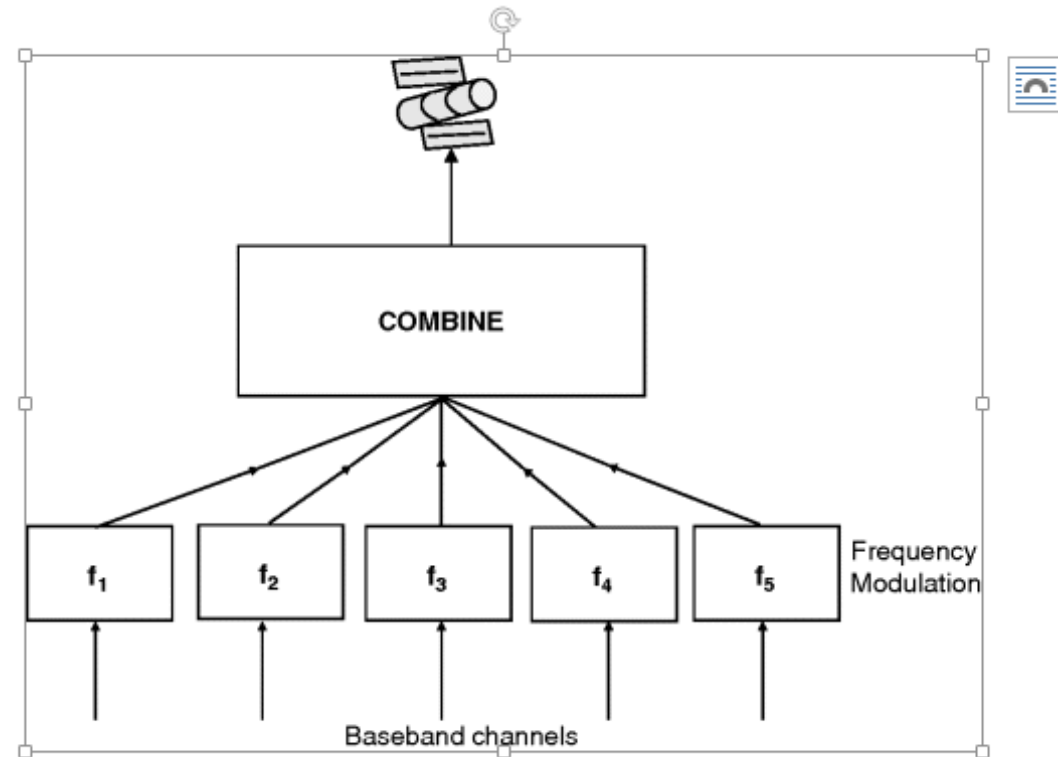
- In a pre-assigned FDMA system, the frequency slots are pre-assigned to the Earth stations.
- The slot allocations are pre-determined and do not offer flexibility.
- Some slots may be facing the problem of over-traffic, while other slots are sitting idle.

## Single Channel Per Carrier (SCPC) Systems

- SCPC/FM/FDMA system
- SCPC/PSK/FDMA system

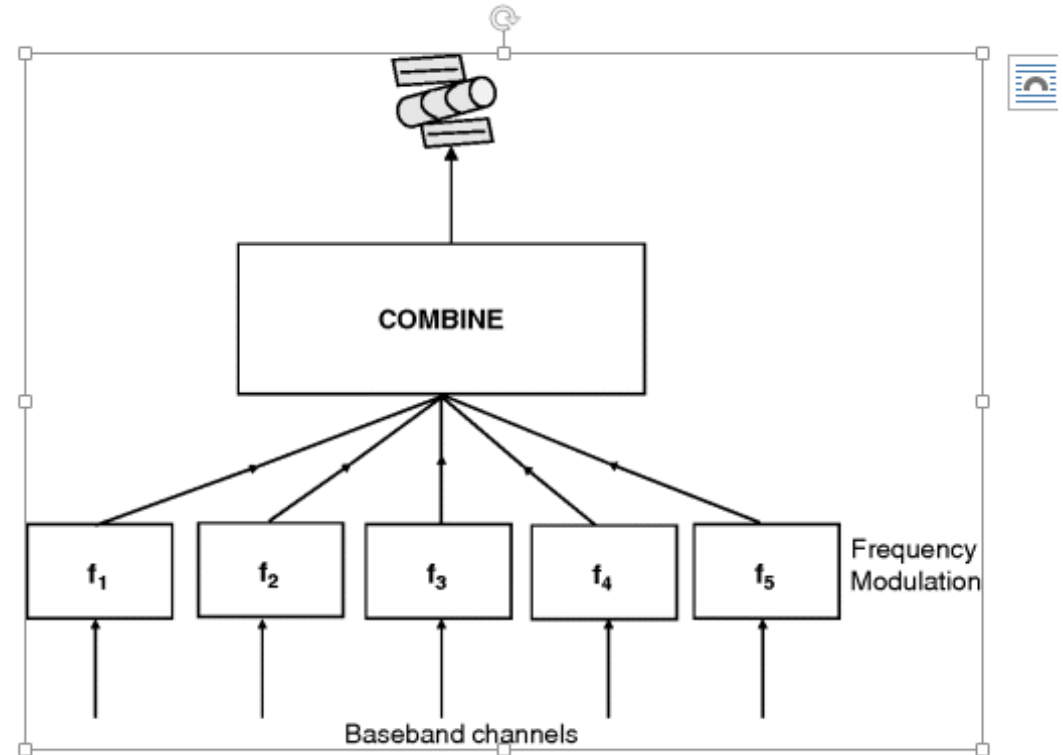
## SCPC/FM/FDMA system

- Each signal channel modulates a separate RF carrier
- Modulation used is frequency modulation
- Each base band signal channel is allocated a separate transponder subdivision and an individual carrier.
- Enable a larger number of Earth stations to access and share the capacity of the transponder.
- Facilitates the use of voice activated carriers.
- Automatic frequency control to maintain spectrum centering for individual channels



## SCPC/PSK/FDMA SYSTEM

- Digital form of the SCPC system
- Employs PCM for base band signal encoding and QPSK as the carrier modulation technique.

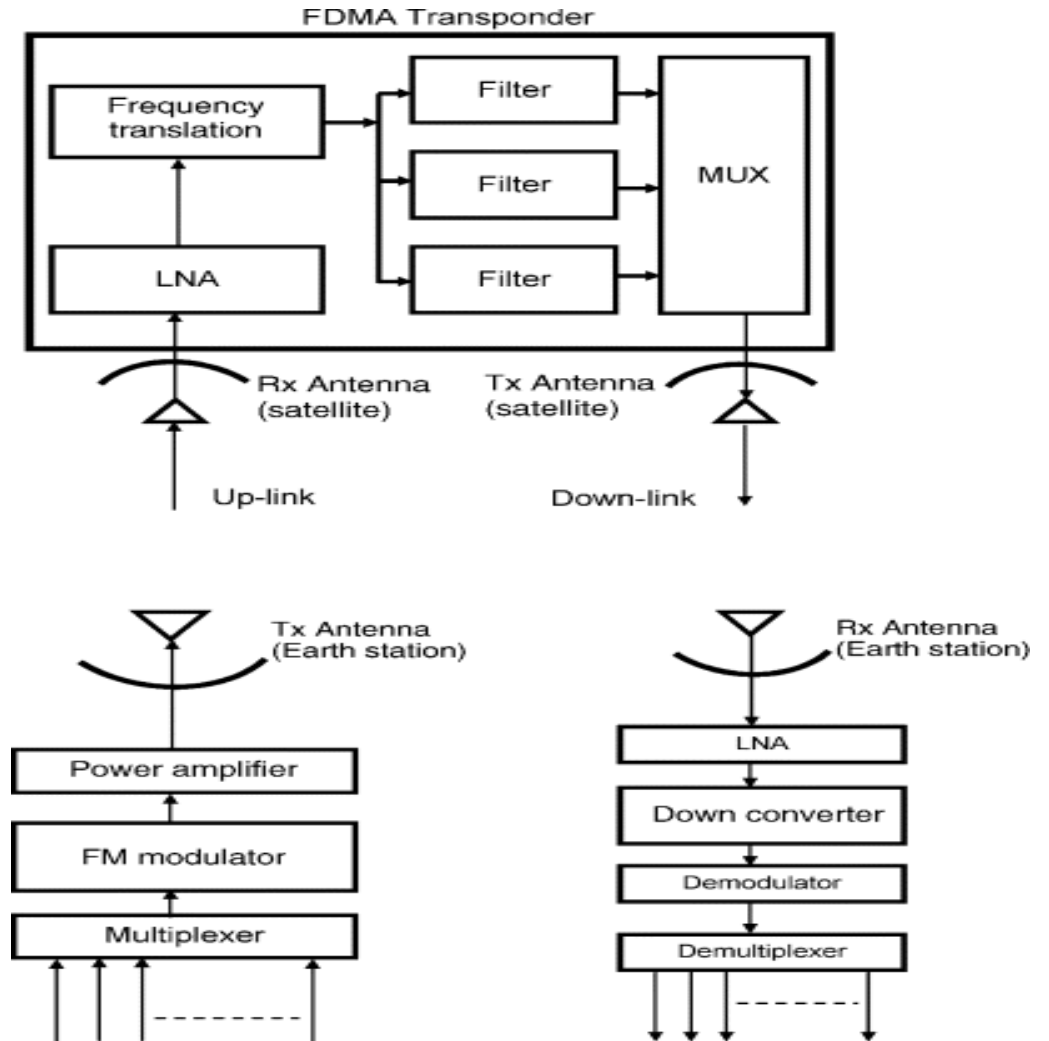


## Multiple Channel Per Carrier (MCPC) Systems

- MCPC/FDM/FM/FDMA system
- MCPC/PCM-TDM/PSK/FDMA system

## MCPC/FDM/FM/FDMA system

- Multiple base band signals are grouped together by using frequency division multiplexing to form FDM base band signals.
- The FDM base band assemblies frequency modulate pre-assigned carriers and are then transmitted to the satellite.
- The FDMA transponder receives multiple carriers, carries out frequency translation and then separates out individual carriers with the help of appropriate filters.
- Multiple carriers are then multiplexed and transmitted back to Earth over the downlink. The receiving station extracts the channels assigned to that station.



## MCPC/PCM-TDM/PSK/FDMA System

- In this arrangement, multiple base band signals are first digitally encoded using the PCM technique and then grouped together to form a common base band assembly using time division multiplexing.
- This time division multiplexed bit stream then modulates a common RF carrier using phase shift keying as the carrier modulation technique.
- The modulated signal is then transmitted to the satellite, which uses FDMA to handle multiple carriers.



## References

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