

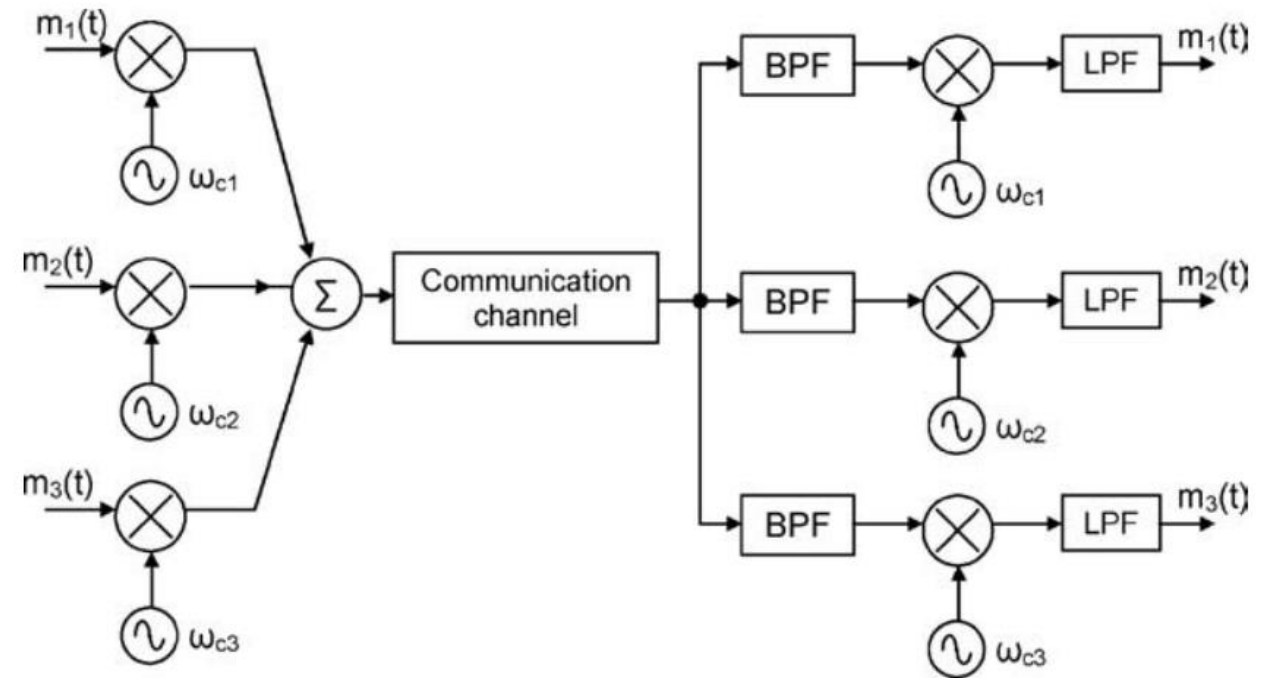
FREQUENCY DIVISION MULTIPLE ACCESS (FDMA)

EEEN 462 – ANALOGUE COMMUNICATION

Monday, June 30, 2025

WHAT IS FREQUENCY DIVISION MULTIPLE ACCESS?

1. **Frequency Division Multiple Access (FDMA)** is a method for allowing multiple users to transmit data simultaneously in satellite communication systems.
2. **FDMA works by dividing the available bandwidth into non-overlapping frequency bands and assigning each band to a specific user or group of users.**



Further Reading:

[What is Frequency division multiplexing? Working and hierarchy - Electronicscoach](#)

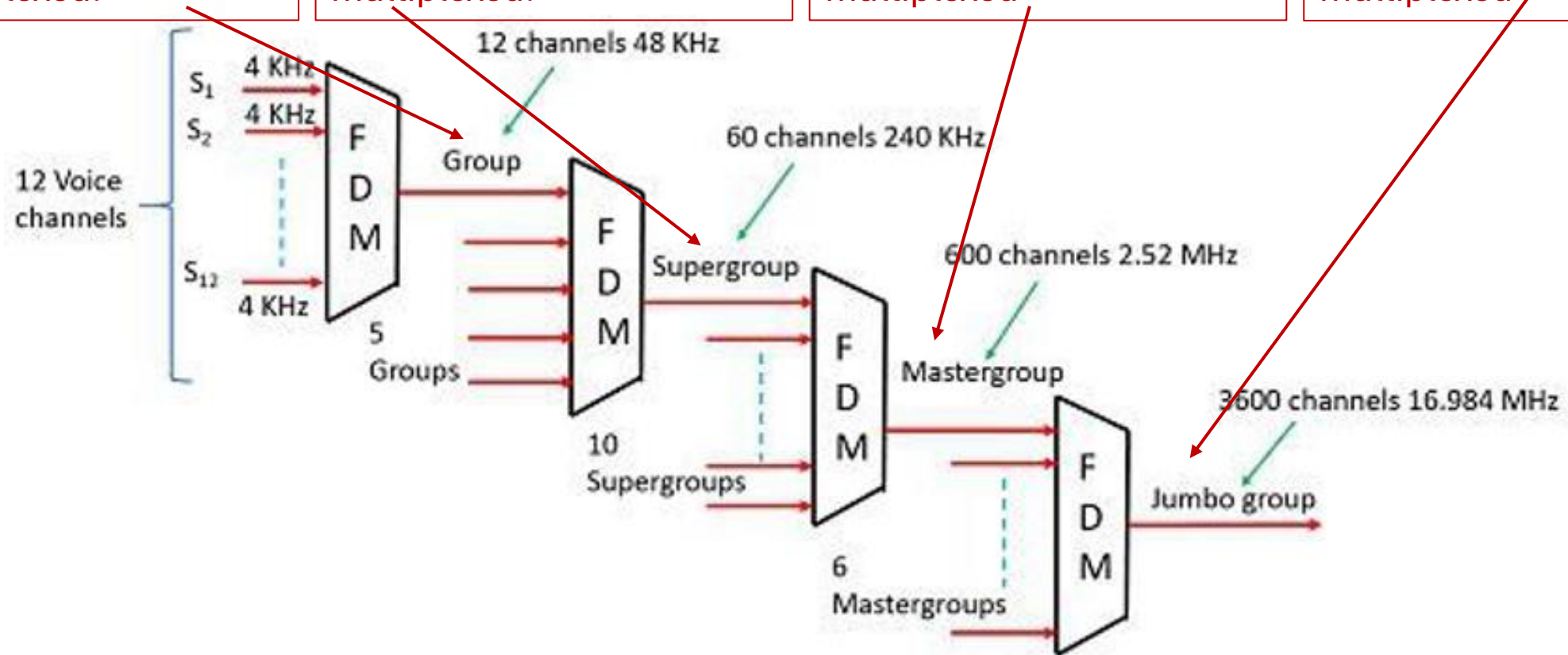
FDMA HIERARCHY IN TELEPHONY

Level 1: Basic group in which 12 voice channels are multiplexed.

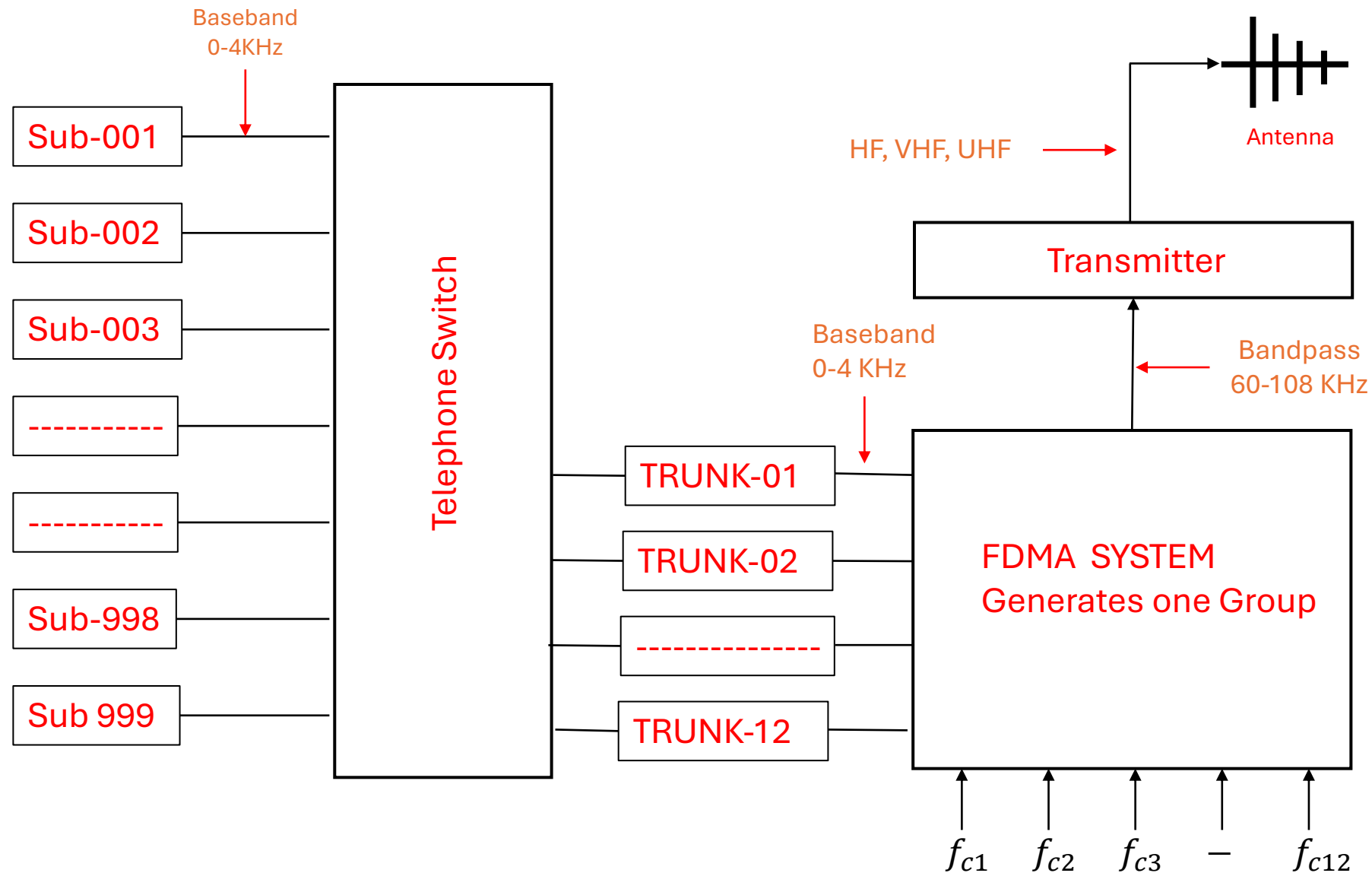
Level 2: Super group in which 5 basic groups are multiplexed.

Level 3: Master group in which 10 supergroups are multiplexed.

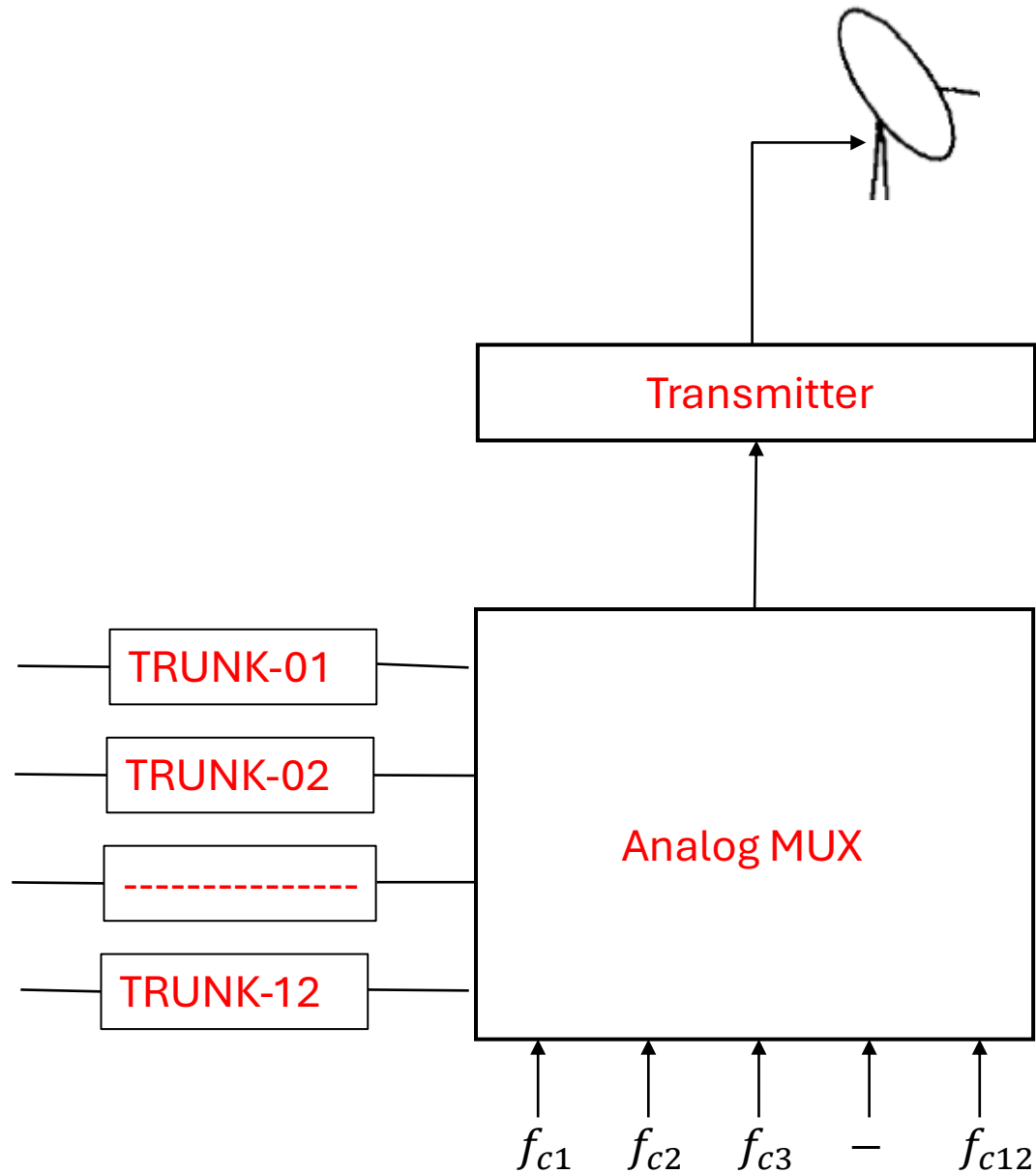
Level 4: Jumbo group in which 6 master groups are multiplexed.



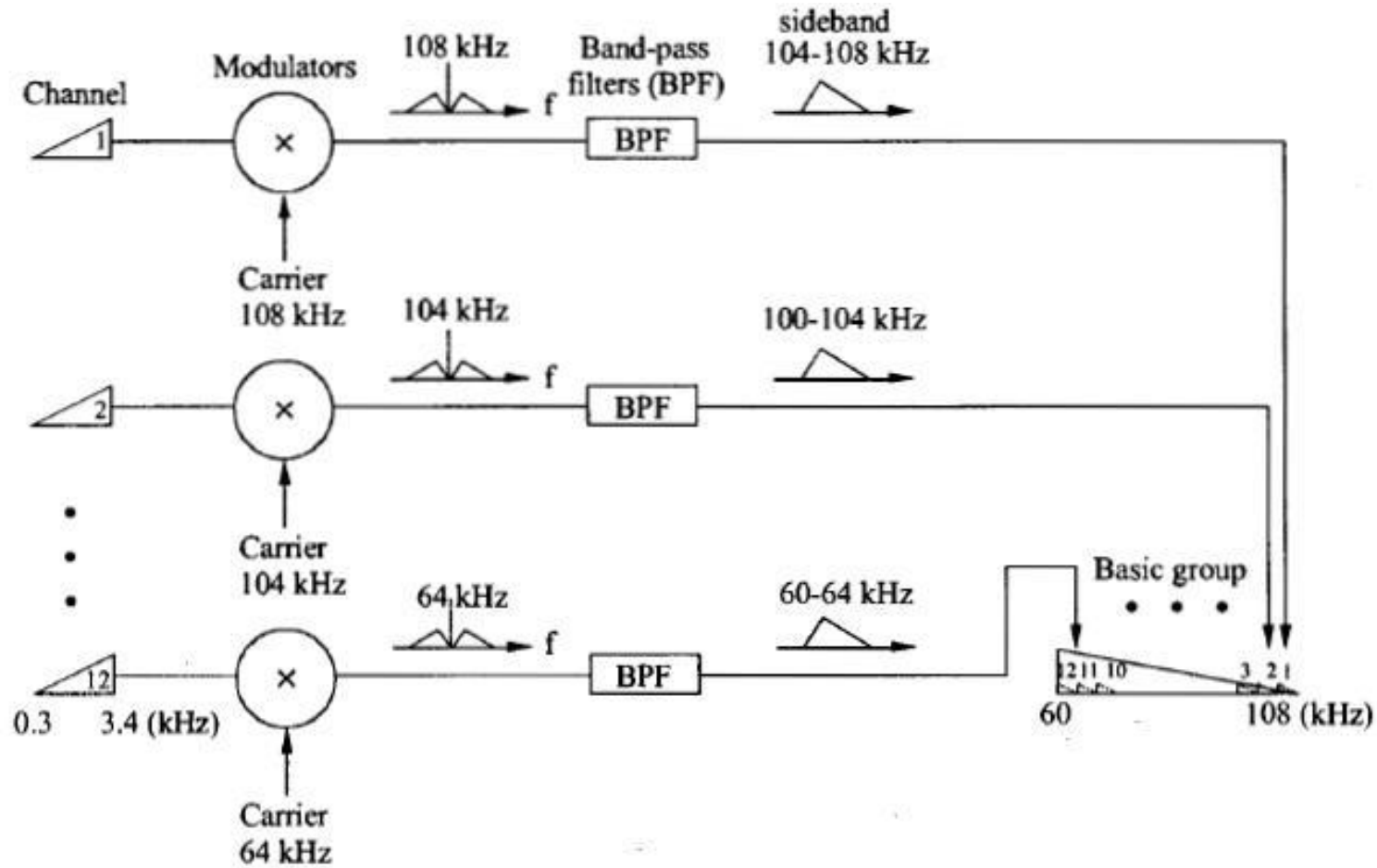
FDM IN ANALOGUE TERRESTRIAL RADIO SYSTEM



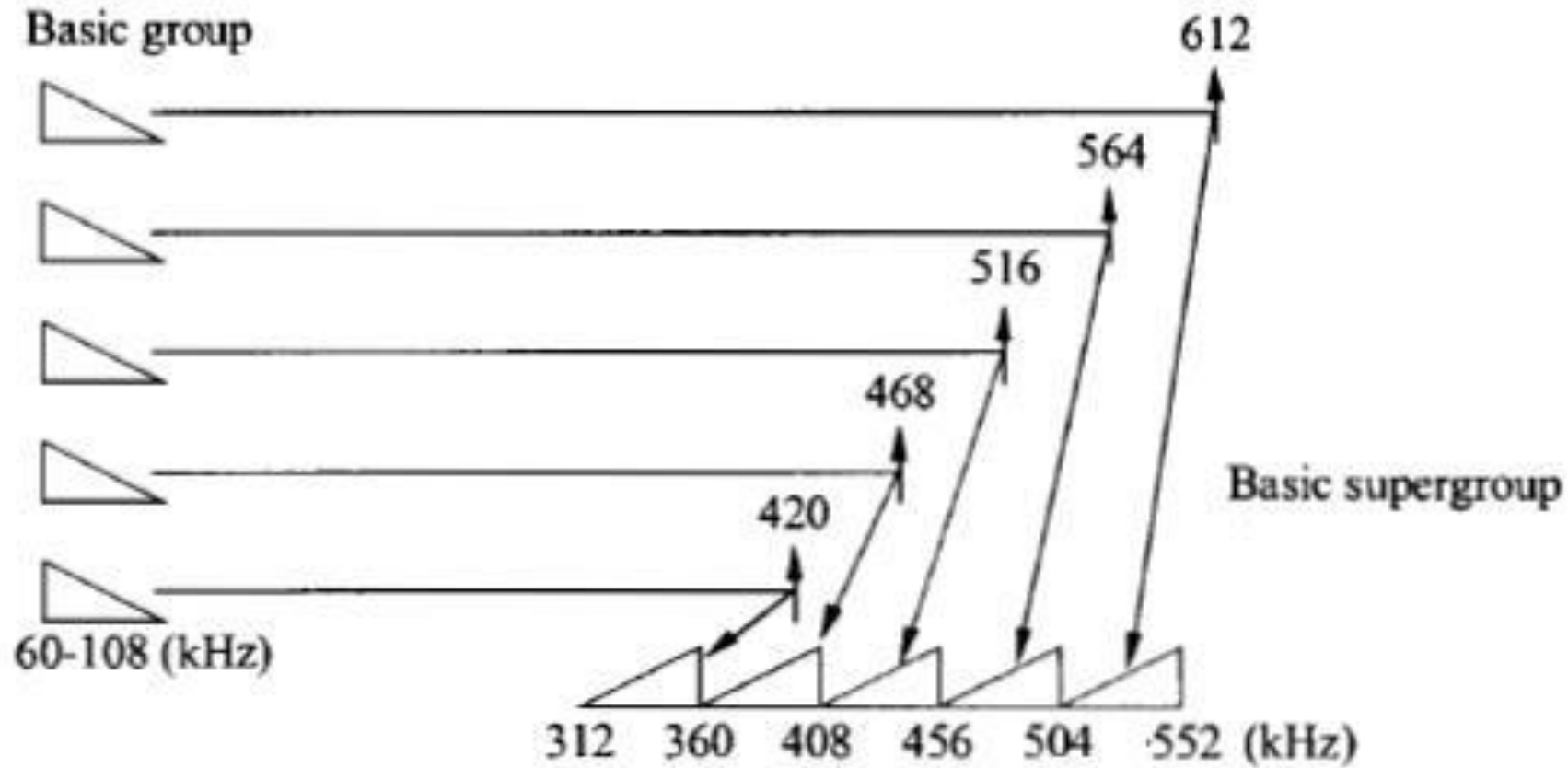
FDM IN ANALOGUE SATELLITE SYSTEM



FORMATION OF A BASIC GROUP IN FDMA TELEPHONY



FDMA – FORMATION OF A SUPERGROUP



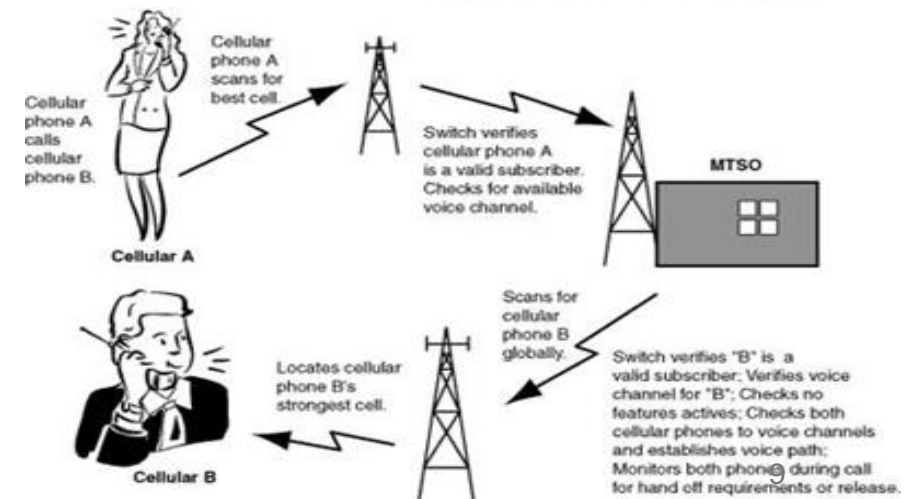
FDMA IN CORDLESS TELEPHONES

EEEN 462 – ANALOGUE COMMUNICATION

Tuesday, November 12, 2024

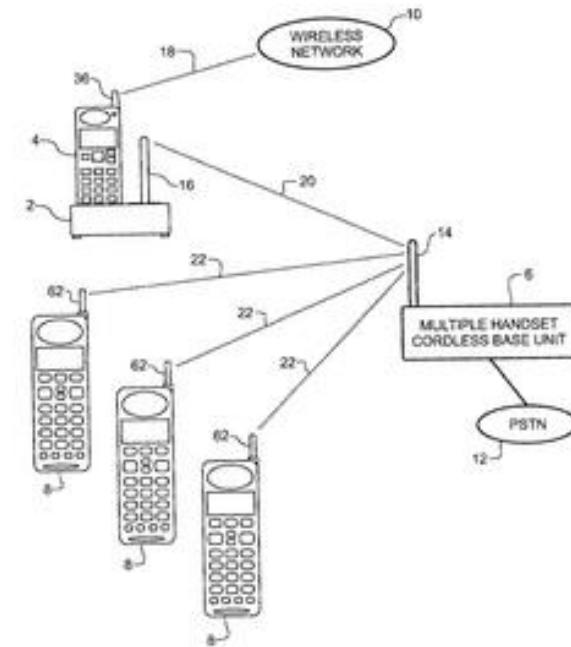
PERSONAL COMMUNICATION SERVICES

1. **Personal Communication Services (PCS)** refers to a wide variety of wireless access and personal mobility services provided through a small terminal with the goal of facilitating communication at any time, any location and any form.
2. There are basically two types of Personal Communication Services:
 - a) **Low-tier Telecommunication Systems** which includes:
 - a) Cordless Telephone 1 and 2 (CT1 and CT2)
 - b) Digital Enhanced Cordless Telephone (DECT)
 - c) Personal Access Communication Systems (PACS)
 - d) Personal Handy Phone System (PHS)
 - b) **High-tier cellular communication systems** including:
 - a) Global System for Mobile Communication (GSM)
 - b) Personal Digital Cellular (PDC)
 - c) IS-95 CDMA, WCDMA, IMT2000

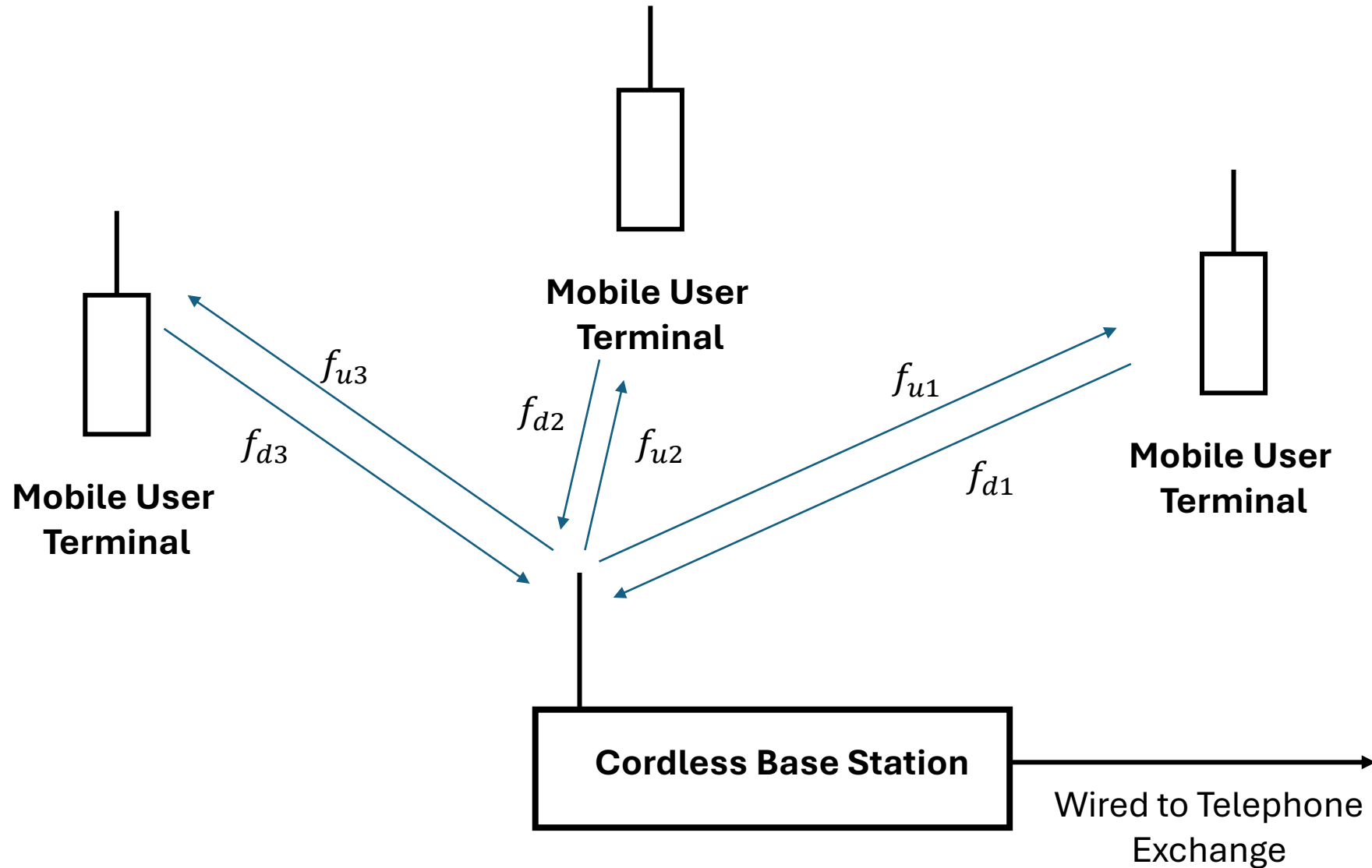


CORDLESS TELEPHONE

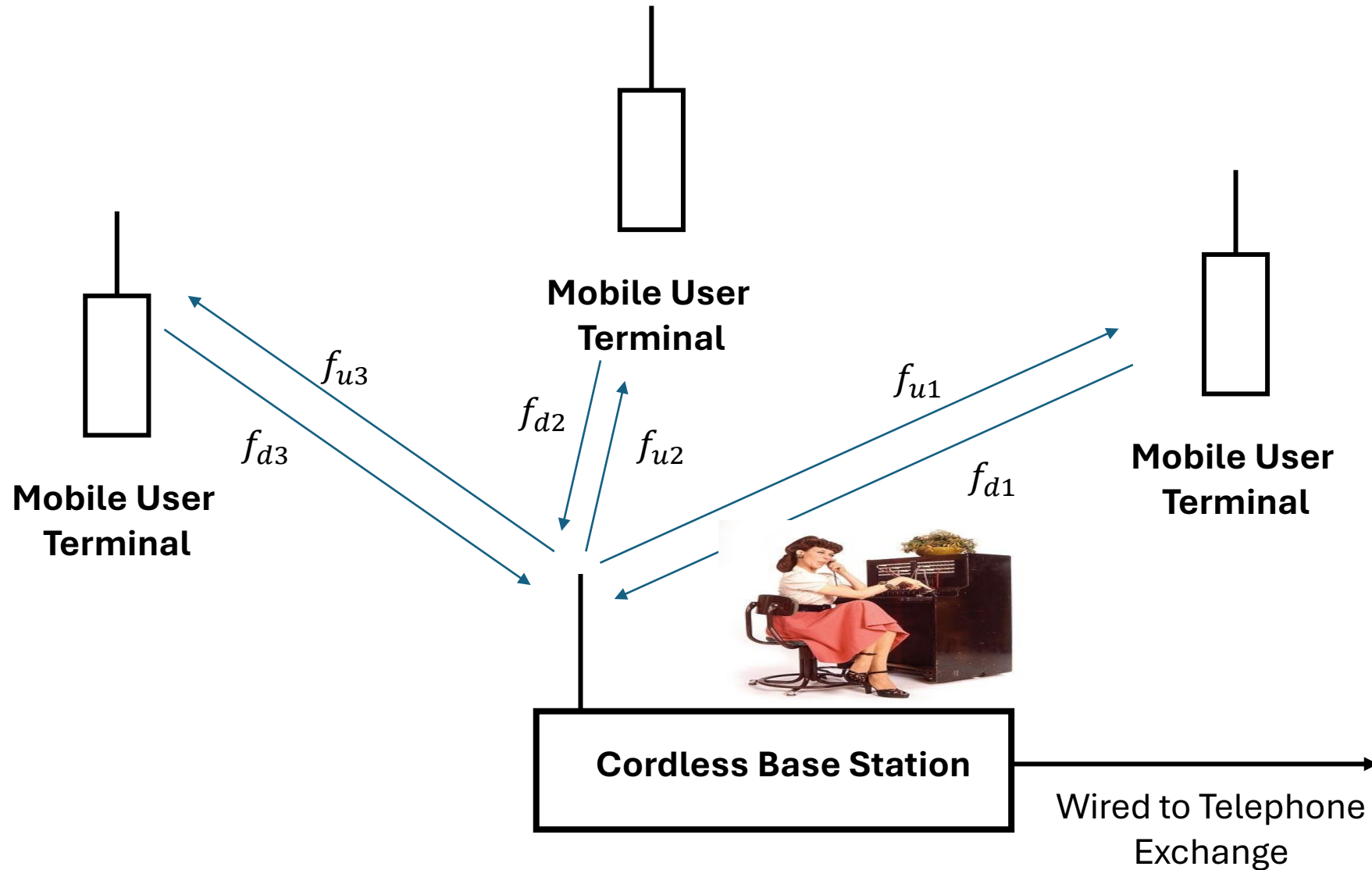
1. **A cordless telephone** uses a radio link instead of a physical cord to connect the handset to the base station.
2. The mobile handset and the base station are radio transceivers.
3. The first generation of cordless telephones uses analogue techniques and it is known as CT1 (Early 1970s).
4. CT1 has been followed by a digital system known as CT2 (Mid 1980s).
5. Both CT1 and CT2 rely upon the base station to connect the mobile handset to the Public Switched Telephone Network (PSTN).
6. An even more recent system is DECT; this system employs digital cellular technology to provide a wireless telephone service to large PABXs.



MULTIPLE HANDSET CORDLESS PHONE

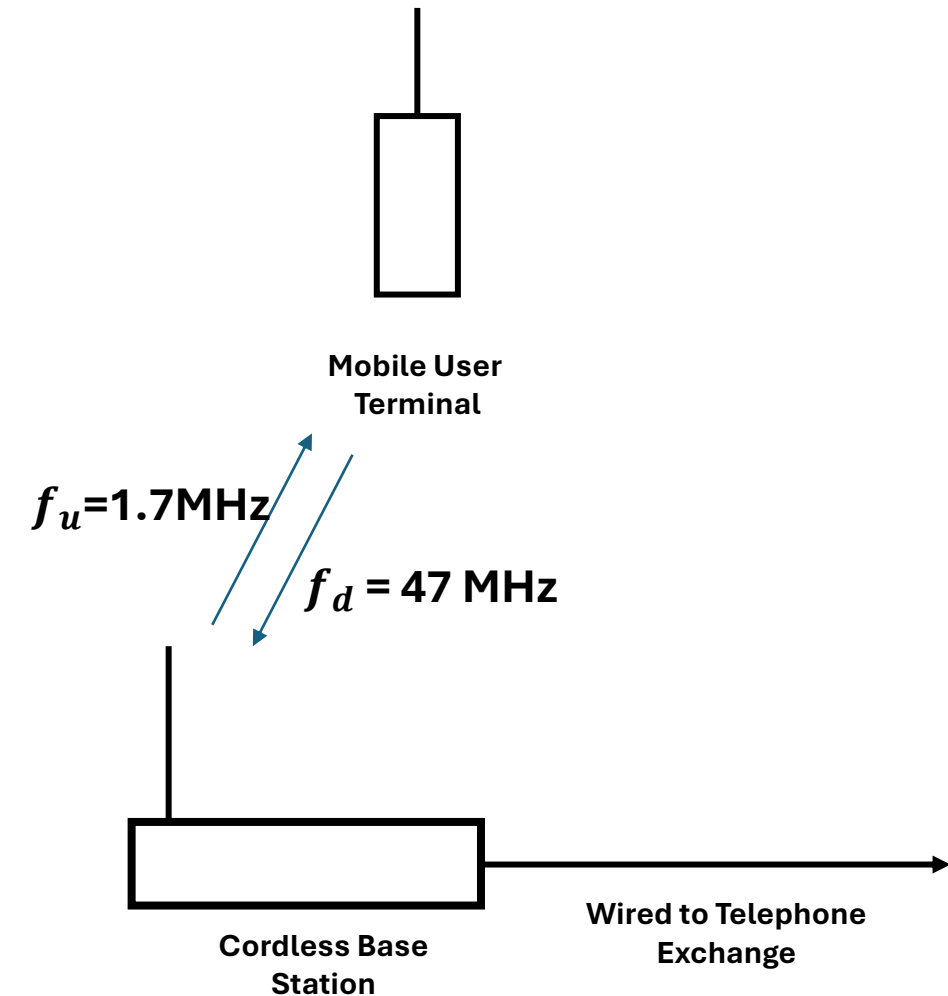


MULTIPLE HANDSET CORDLESS PHONE DID AWAY WITH OPERATOR ASSISTANCE



CT1 CORDLESS TELEPHONE

1. **CT1** were developed at around **1980** to provide for limited mobility of telephone users in the fixed telephone network.
2. CT1 uses two radio frequency bands and analogue technology to provide a **full duplex** speech path between the handset and the cordless base station.
3. The two frequency bands are spaced well apart.
 - a) In the direction **Base Station** to handset the transmit frequency is around **1.7 MHz**, and
 - b) In the direction **Handset** to base **Station** the transmit frequency is around **47 MHz**.

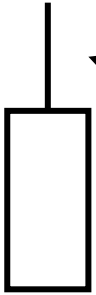


CT1 CORDLESS PHONE

ASSIGNMENT:

What are the official designation of the frequency bands in which the transmit frequencies of the base station and mobile terminals transmit?
(Check <http://www.ca.go.ke>)

Transmits in band
47.45-47.54 MHz



**Mobile User
Terminal**

200m max

Transmits in band
1.642-1.782 MHz



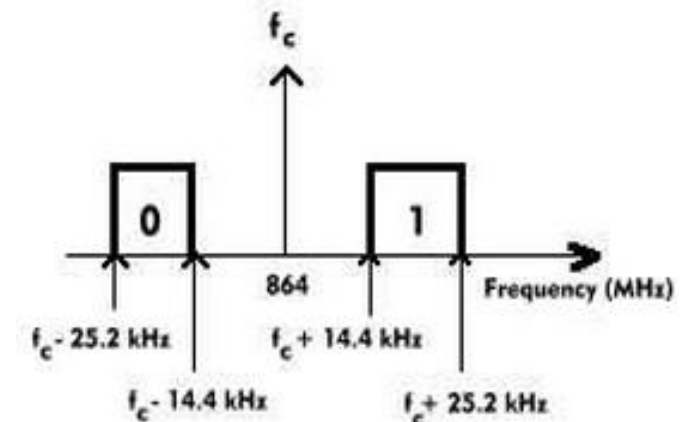
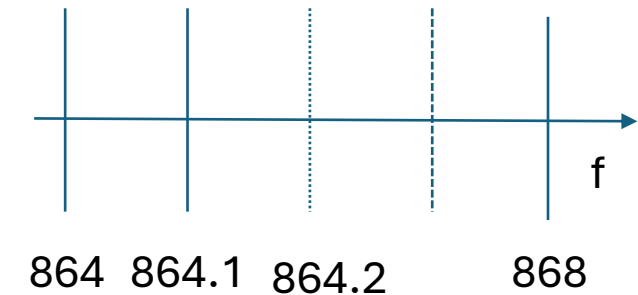
Cordless Base Station

Wired to Telephone
Exchange

CT2 CORDLESS TELEPHONE-DIGITAL

1. CT2, uses a digital speech path in any one of the **forty (40)**, **100 kHz wide RF channels** in the frequency band **864-868 MHz**.
2. Each handset has up to **11 unique identity codes** loaded in at manufacture.
3. This enables each base station to be programmed to recognize up to eight separate handset identities that it is able to deal with simultaneously thus providing PABX function with little risk of privacy invasion.
4. The modulation method that is employed is two-level FSK with frequency deviations of
 - a) **14.4 to 25.2 kHz** above the carrier frequency representing binary 1
 - b) **14.4 to 25.2 kHz** deviation below the carrier frequency indicating binary 0.

$$N = \frac{868 - 864}{0.1} = 40 \text{ Channels}$$



FDMA IN HIGH-TIER COMMUNICATION SYSTEMS

EEEN 462 – ANALOGUE COMMUNICATION

Friday, November 15, 2024

GSM ARCHITECTURE

Base Transceiver Stations (BTS)

Sends and receives radio signals to mobile devices.
Passes signals to the network to route to other terminals.

Mobile Station

- GSM Phone
- SIM card

Mobile Switching Centre

1. Setting up, releasing, and routing calls
2. Routing SMS messages, fax, and conference calls
3. Service billing
4. Interfacing with other networks

Operation and Maintenance Centre

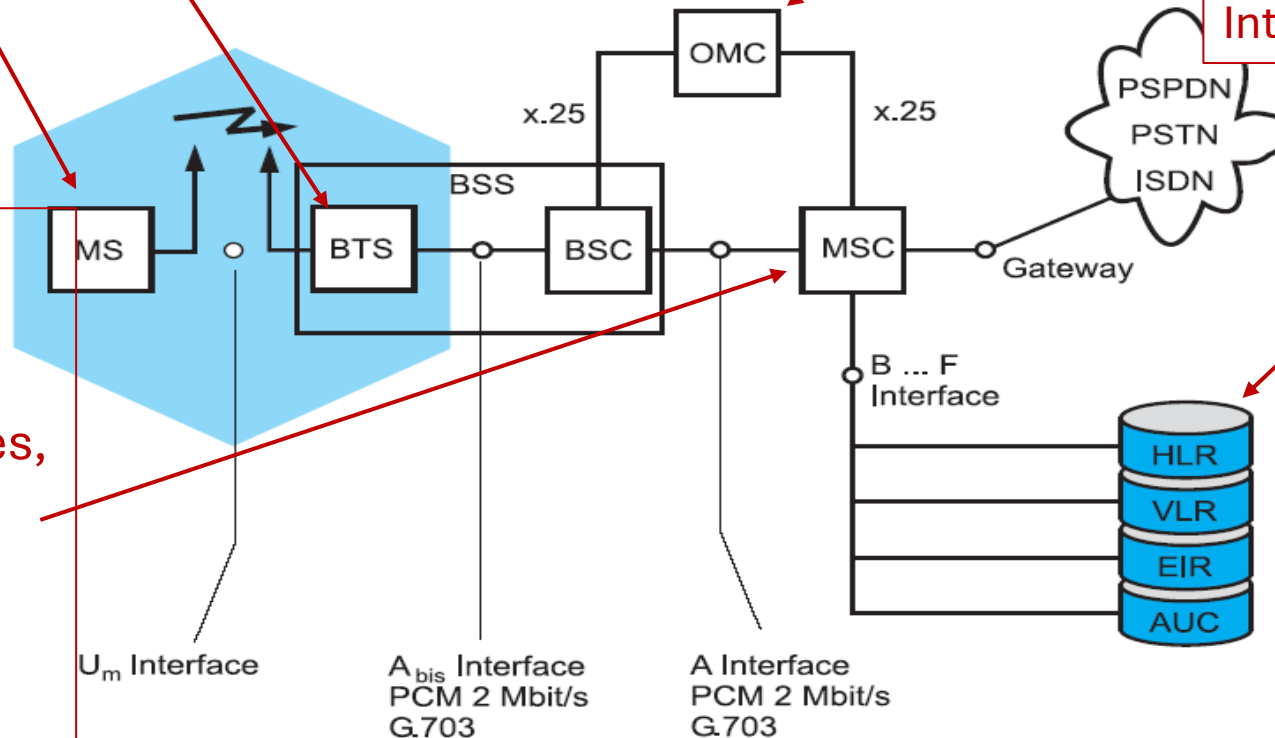
- System updates
- Fault location and clearance

Other Networks

Public Switched Data Nwk
Public Switched Telephone Nwk
Integrated Services Data Nwk

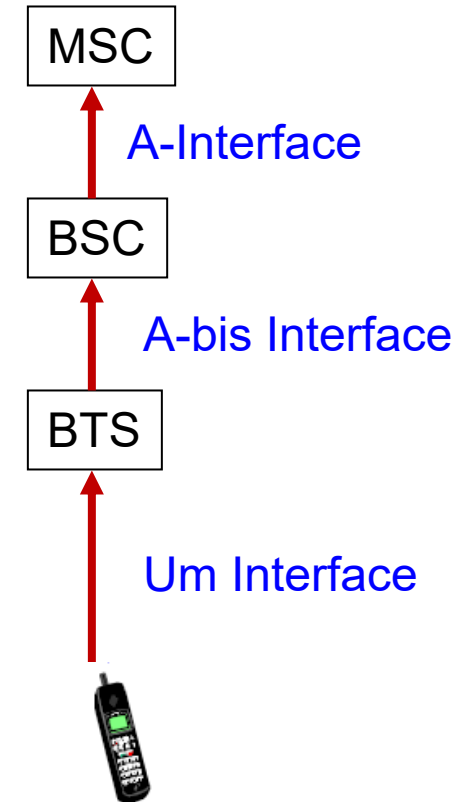
Databases

1. Home Location Register
2. Visitor Location Register
3. Equipment Identity Register
4. Authentication Centre

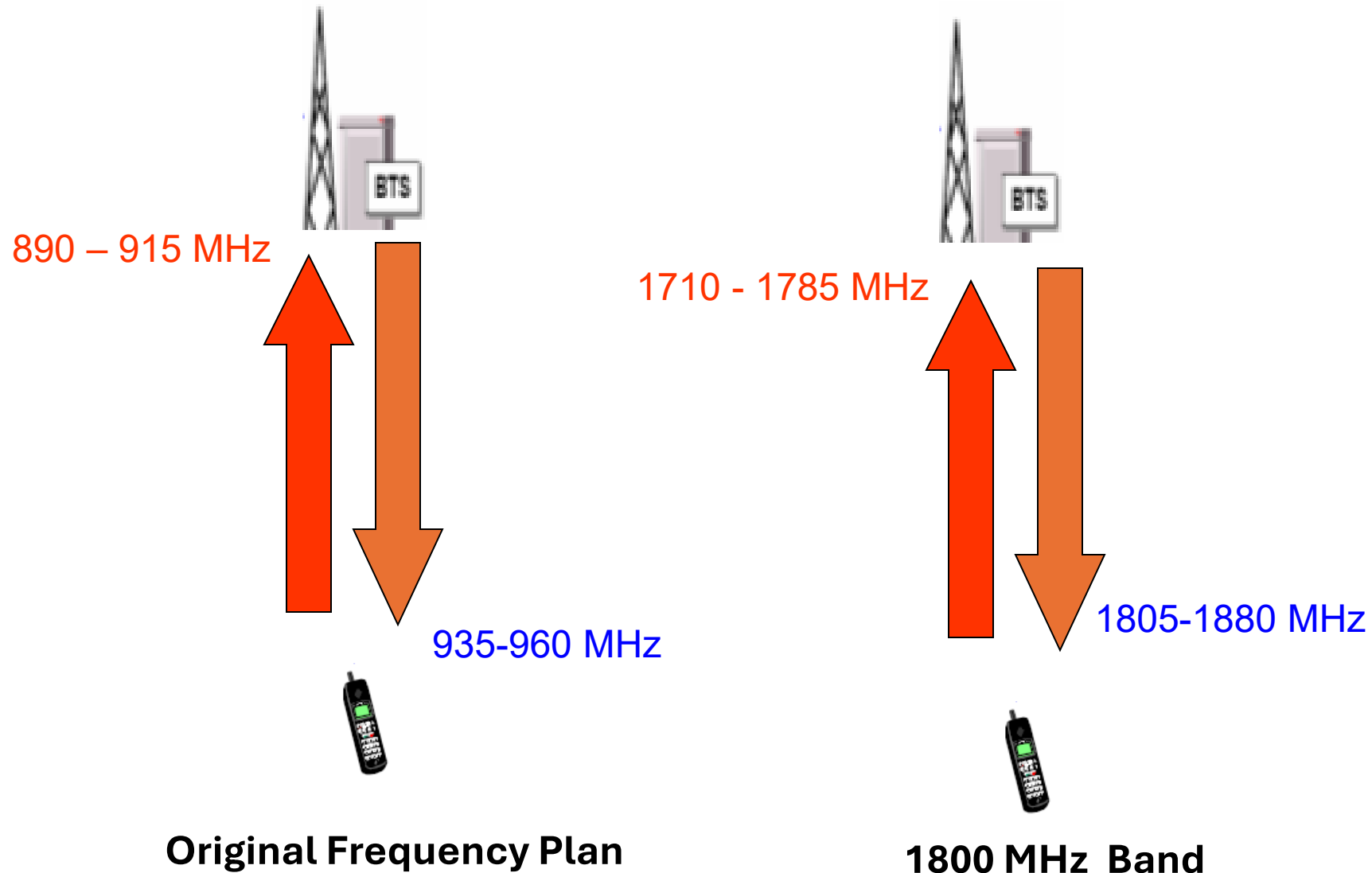


SUMMARY OF GSM INTERFACES

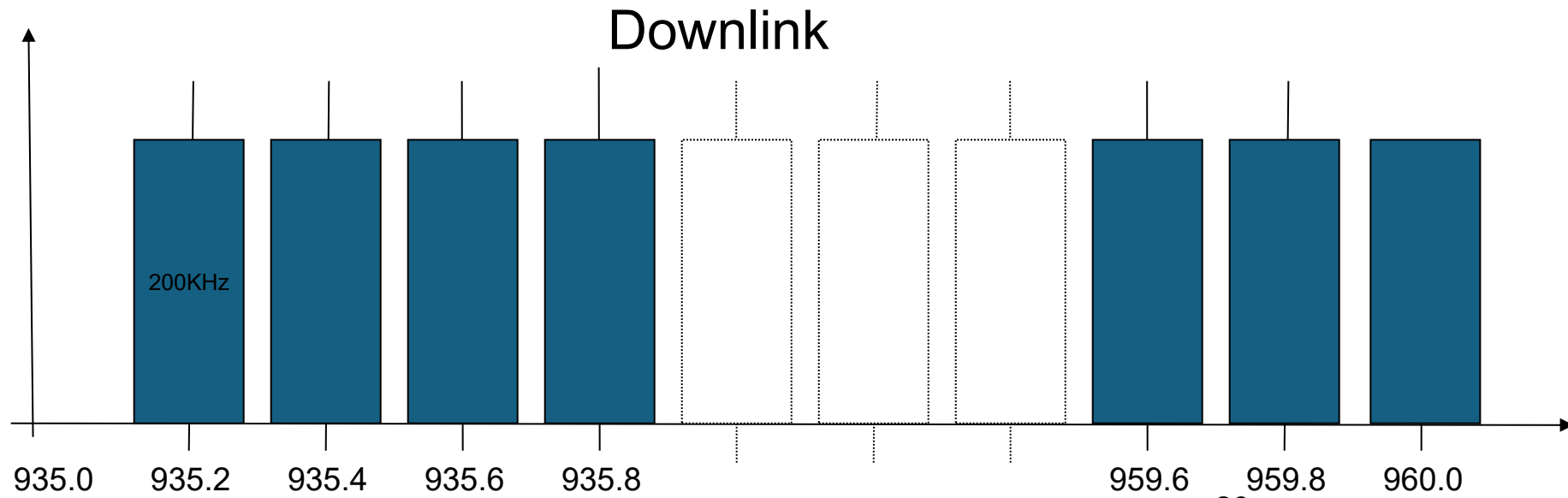
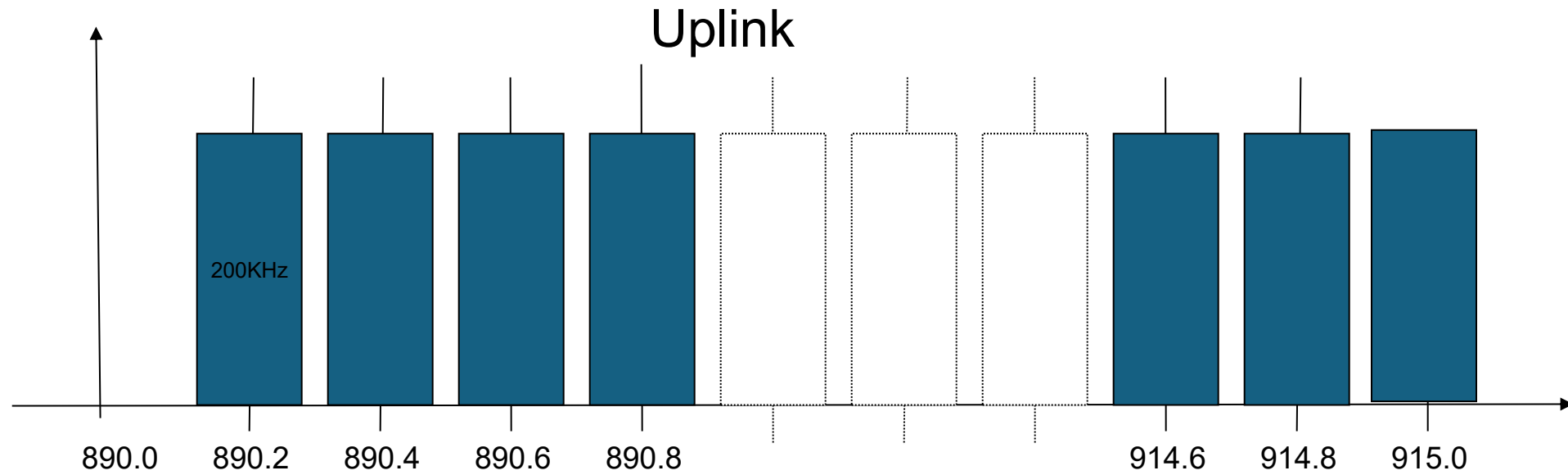
- 1. Um interface:** The "air" or radio interface standard that is used for exchanges between a mobile (ME) and a base station (BTS / BSC).
- 2. Abis interface:** This is a BSS internal interface linking the BSC and a BTS. The Abis interface allows control of the radio equipment and radio frequency allocation in the BTS.
- 3. A interface:** The A interface is used to provide communication between the BSS and the MSC. The interface carries information to enable the channels, timeslots and the like to be allocated to the mobile equipments being serviced by the BSSs.



GSM UM INTERFACE FREQUENCY BANDS



FREQUENCY PLAN FOR GSM 900MHZ UPLINK



900MHZ UM INTERFACE FREQUENCY PLAN

CHANNEL	UPLINK (MHZ)	DOWNLINK (MHZ)
1	890.2±0.1	935.2±0.1
2	890.4±0.1	935.4±0.1
3	890.6±0.1	935.6±0.1
4	890.8±0.1	935.8±0.1
124	914.8±0.1	959.8±0.1

Duplex Frequency = 45MHz

DISADVANTAGES OF FDMA

- 1. Inefficient spectrum use:** FDMA can waste bandwidth due to use guard bands which are used to reduce crosstalk between adjacent channels
- 2. Fixed capacity:** FDMA can't adapt to changing user demand. Bandwidth remains assigned even when the user is not transmitting.
- 3. Doppler effect:** The relative motion of the satellite and the earth station can cause the signal's frequency to shift, which can degrade the signal quality.

