FACULTY OF ENGINEERING & TECHNOLOGY

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Topics Covered

Multiple Access Techniques
Frequency division multiple-access (FDMA)
Time division multiple-access (TDMA)

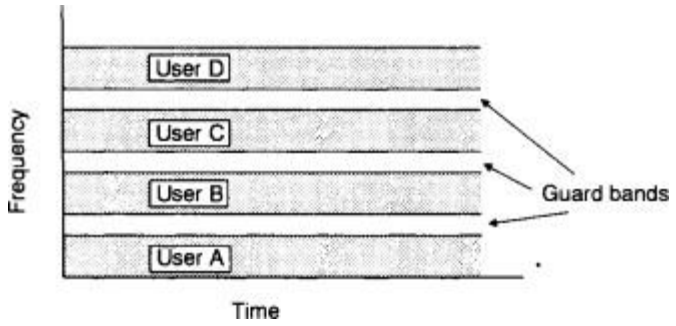
Multiple Access Techniques

In wireless communication systems, it is often desirable to allow the subscriber to send information simultaneously from the mobile station to the base station while receiving information from the base station to the mobile station.
A cellular system divides any given area into cells where a mobile unit in each cell communicates with a base station. The main aim in the cellular system design is to be able to **increase the capacity of the channel**, i.e., to handle as many calls as possible in a given bandwidth with a sufficient level of quality of service.

There are several different ways to allow access to the channel. These includes mainly the following −
Frequency division multiple-access (FDMA)
Time division multiple-access (TDMA)
Code division multiple-access (CDMA)
Space division multiple access (SDMA)

Frequency division multiple-access (FDMA)

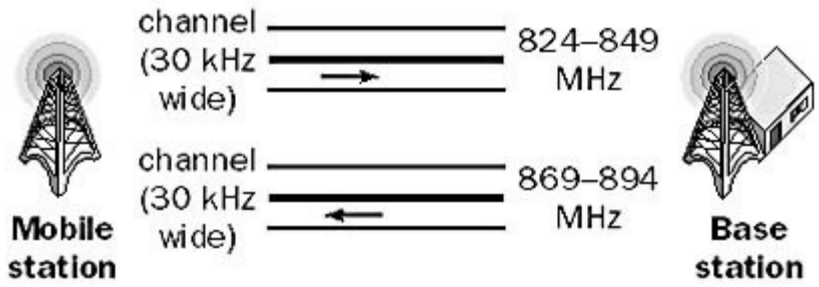
FDMA is the basic technology for advanced mobile phone services. The features of FDMA are as follows.
FDMA allots a different sub-band of frequency to each different user to access the network.
If FDMA is not in use, the channel is left idle instead of allotting to the other users.
FDMA is implemented in Narrowband systems and it is less complex than TDMA.
Tight filtering is done here to reduce adjacent channel interference.
The base station BS and mobile station MS, transmit and receive simultaneously and continuously in FDMA.



How FDMA works?

FDMA is implemented at the media access control (MAC) layer of the data-link layer in the Open Systems Interconnection (OSI) reference model for networking protocol stacks. FDMA is based on the frequency-division multiplexing (FDM) technique used in wireless networking. In FDMA, the user is assigned a specific frequency band in the electromagnetic spectrum, and during a call that user is the only one who has the right to access the specific band. In the AMPS cellular phone system, these frequency bands are allocated from the electromagnetic spectrum as follows:
Transmission by mobile station: 824 MHz to 849 MHz
Transmission by base station: 869 MHz to 894 MHz

Two different frequency bands are used to allow full-duplex communication between base and mobile stations. Both of these bands are then divided into discrete channels that are 30 kHz wide in bandwidth.



Frequency Division Multiple Access (FDMA)

Time division multiple-access (TDMA)

In the cases where continuous transmission is not required, there TDMA is used instead of FDMA. The features of TDMA include the following.

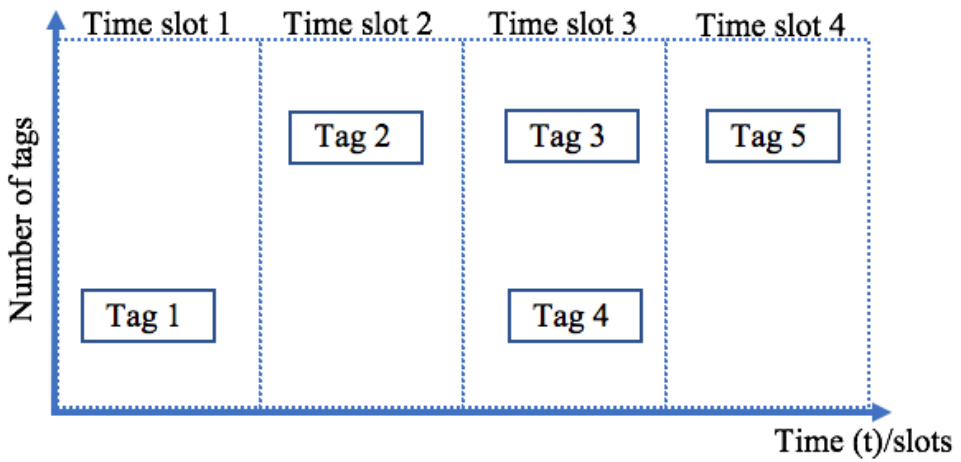
TDMA shares a single carrier frequency with several users where each users makes use of non-overlapping time slots.

Data transmission in TDMA is not continuous, but occurs in bursts. Hence handsoff process is simpler.

TDMA uses different time slots for transmission and reception thus duplexers are not required.

TDMA has an advantage that is possibl allocate different numbers of time slots frame to different users.

Bandwidth can be supplied on demand different users by concatenating or reassigning time slot based on priority.



Advantages of TDMA

TDMA can easily adapt to the transmission of data as well as voice communication.
It has the ability to carry 64 kbps to 120 Mbps of data rates.
No interference from simultaneous transmission.
TDMA is the cost-effective technology to convert an analogue system to digital.
Share a single carrier frequency with multiple users
Mobile assisted handoff possible
TDMA provides the user with extended battery life since transmitting the only portion of the time during conversations
Flexible bit rate
No frequency guard band required
No need of a precise narrowband filter
TDMA separates users according to time ensures that there will be no interference from the simultaneous transmission.

Disadvantages of TDMA

It is subjected to multipath distortion. A signal coming from a tower and receive to handset might come from any one of several directions so on the road signal bounced off several different buildings before arriving which can cause interference.
Network and spectrum planning is intensive.
Too few users result in ideal channels rural versus urban environment.
High synchronization overhead.
Frequency/slot allocation is to be complex in TDMA.
Equalization was necessary for high data rates.
Demands high peak power on the uplink in transient mode.
Signal processing is required for matched filtering and correlation detection.