ITA0321 - MOBILE COMPUTING

FOR

5G TECHNOLOGY

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1) List of all multiple access technique used for wireless communication. Do a neat diagram comparison b/w TDMA, FDMA and CDMA.

TDMA (time Division Multiple Access):

Time Slot Allocation: Each user is assigned a specific time slot for transmission. This means that users take turns using the same frequency channel.

Synchronization:

Requires precise synchronization between the transmitter and receiver to ensure that users transmit in their designated time slots without overlap.

Efficiency:

can be inefficient if users do not utilize their time slots fully, leading to wasted bandwidth.

Scalability:

Limited scalability, as the number of user increases, the time slots become shorter, which can lead to increased latency & reduced quality.

Usecase:

Commonly in GSM n/w, where voice calls are time sensitive and can be effectively.

FDMA:

frequency division multiple Access:

Frequency allocation:

Each user is assigned a unique frequency band for Communication. This allows simultaneous transmission without interface.

Guard bands:

requires guard band b/w frequency channel to prevent interface, which leaad to inefficient use of spectrum.

Simpliaty:

simpler to implement than TDMA & CDMA, does not need synchronisation.

Limitations:

The no. of users is limited by available frequency bands, fewer users can be accomdated.

Usecase:

used in analog cellular systems & some satellite communications, where frequency bands are too wide.

CDMA :
Code division multiple access :

Spreading codes :

each user is assigned a unique spreading code, allowing muetiple users to transmit simultaneously.

Interference :

Uses advanced signal processing techniques to manage interference, making it robust in high density environment.

Capacity

High capacity due to the ability to support many users simultaneously.

Increased by using more sophisticated coding techniques.

Complexity

=> More Complex than TDMA & FDMA, requiring sophisticated coding techniques.

=> H/W, S/W for encoding & decoding signals

Usecase

=> widely used in 3G n/w

eg: CDMA 2000, WCDMA and is suitable for both voice & data services.

Feature	TDMA	FDMA	CDMA
Principle	time Slots	frequency bands	unique codes.
Synchronisation	required	not required	not required
Scalability	limited by time slot	by available frequency	highly scalable
Complexity	moderate	Low	high.
Latency	Can introduce delays	generally low	Low but can ↑ with users.
App	GSM, D-AMPS	Analog cellular system.	CDMA2000, WCDMA, UMTS
Interference	Minimal	without guard bands possible	Managed through code

2) uses of new modulation:

1. over to EDGE:

Enhanced data rates for GSM evolution is EDGE is technology that enhances the data transmission capabilities of existing GSM & GPRS networks. It is often referred to as a 2.5G technology, acting a bridge b/w 2G & 3G n/w.

purpose:

It provides higher data rates & improved capacity for mobile data services, enabling users to access the internet.

2. New modulation Techniques:

8PSK modulation:

EDGE employs 8PSK (8 phase shift keying) modulation, which allows for the transmission of three bits of data per symbol.

Impact on throughput:

=> use of 8PSK significantly enhance n/w throughput, allowing for faster data transmission.

=> uses apps like web browsing, video streaming & online gaming.

Protocol Enhancement:

Error Correction:

Edge incorporates advanced error correction techniques, such as turbo coding.

Data Compression:

The technology also utilizes data compression.

packet data optimisation:

These protocol enhancement facilitat more efficient handling of packet data.

Seamless Integration with existing features:

No core n/w:

-> does not req modification.

-> minimise costs

-> Smooth transition.

BSS upgrades:

-> while core network remains unchanged, the base station subsystem (BSS) requires upgrades to BSC.

Backward compatibility:

=> Support for legacy devices: EDGE is designed to be backward compatible with existing GSM & GPRS services.

-> This means that user with EDGE capable devices can still communicate.

Increased capacity & Throughput:

improved modulation & protocol enhancements results in dramatically increased throughput and capacity gains.

This allows operates to offer more data services to users, accomodating the growing demand for mobile internet access.

Market position & competing advantage:

By implementing EDGE, operators can enhance their service offerings without the need for a complete overhaul of their existing infrastructure.

Challenges & consideration:

→ limited data rate in high traffic.

→ device compatibility.

ASPECT	DETAILS
definition	Enhances GSM / GPRS data.
purpose	Higher data rates.
modulation	8PSK / 3bits / Symbol, upto 384 kbps
Throughput	Significantly improved data transmission
protocol Enhancement	Turbo coding & data compression
Core n/w changes	No change required
BSS upgrade	S/W upgrades to BSC & BTS
Backward Compatibility	Supports legacy GSM devices
Capacity	Increased throughput & user density.
Spectrum utilisation	efficient use of available Spectrum.
Market positioning	Cost - effective enhancement
Transition to 3G	Brideges to 3G technologies
Challenges.	High traffic limitation.