Power Control

- Design issues making it desirable to include dynamic power control in a cellular system
  - Received power must be sufficiently above the background noise for effective communication
  - Desirable to minimize power in the transmitted signal from the mobile
    - Reduce cochannel interference, alleviate health concerns, save battery power
  - In SS systems using CDMA, it's desirable to equalize the received power level from all mobile units at the BS

Types of Power Control

- *Open-loop power control*
  - *Depends solely on mobile unit*
  - *No feedback from BS*
  - *Not as accurate as closed-loop, but can react quicker to fluctuations in signal strength*
- *Closed-loop power control*
  - *Adjusts signal strength in reverse channel based on metric of performance*
  - *BS makes power adjustment decision and communicates to mobile on control channel*

Traffic Engineering

- *Ideally, available channels would equal number of subscribers active at one time*
- *In practice, not feasible to have capacity handle all possible load*
- *For N simultaneous user capacity and L subscribers*
  - *L < N – nonblocking system*
  - *L > N – blocking system*

Traffic Intensity

- Load presented to a system:

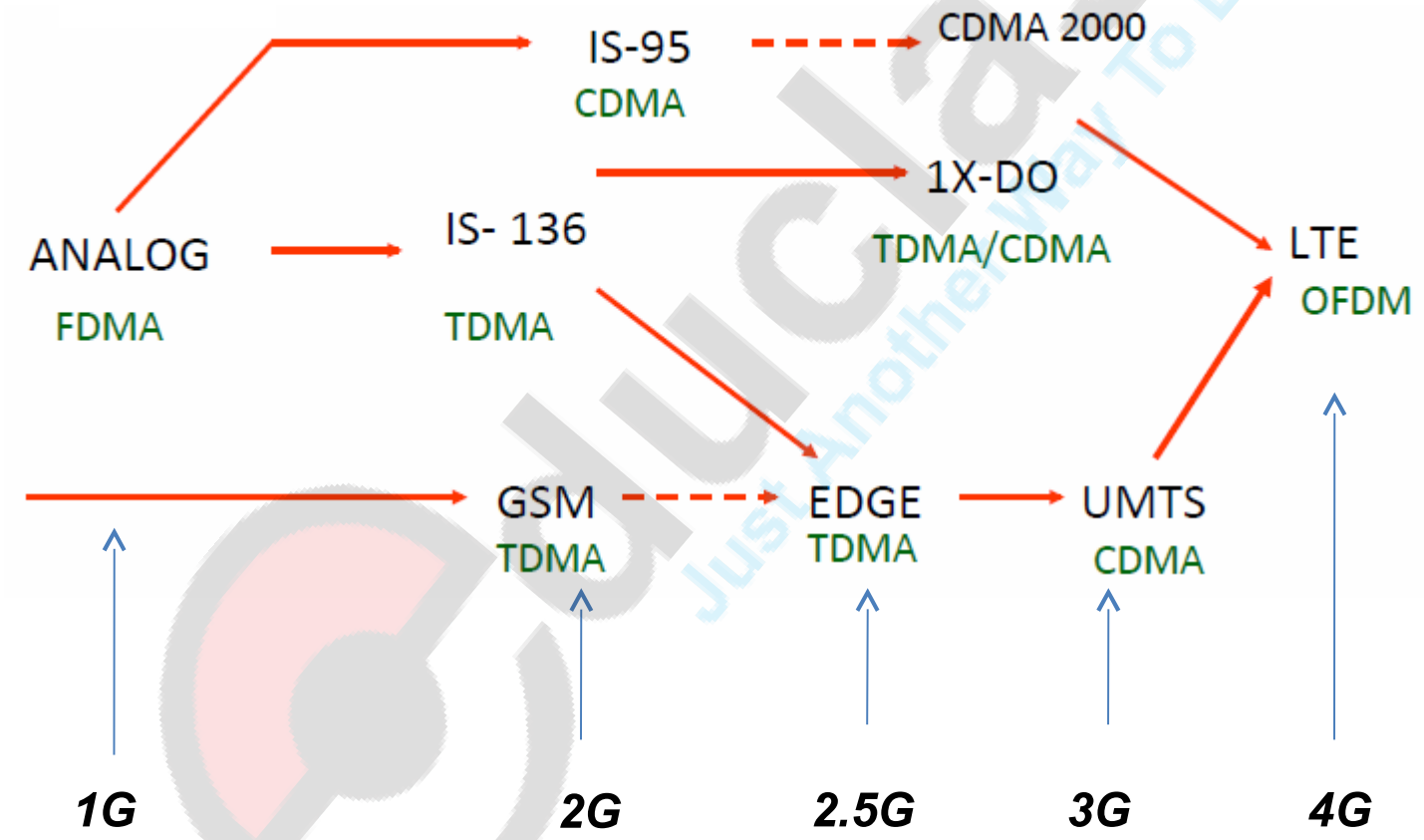
$$A = h\lambda$$

  - λ = mean rate of calls attempted per unit time
  - h = mean holding time per successful call
  - A = average number of calls arriving during average holding period, for normalized λ

Factors that Determine the Nature of the Traffic Model

- *Manner in which blocked calls are handled*
  - *Lost calls delayed (LCD) – blocked calls put in a queue awaiting a free channel*
  - *Blocked calls rejected and dropped*
    - *Lost calls cleared (LCC) – user waits before another attempt*
    - *Lost calls held (LCH) – user repeatedly attempts calling*
- *Number of traffic sources*
  - *Whether number of users is assumed to be finite or infinite*

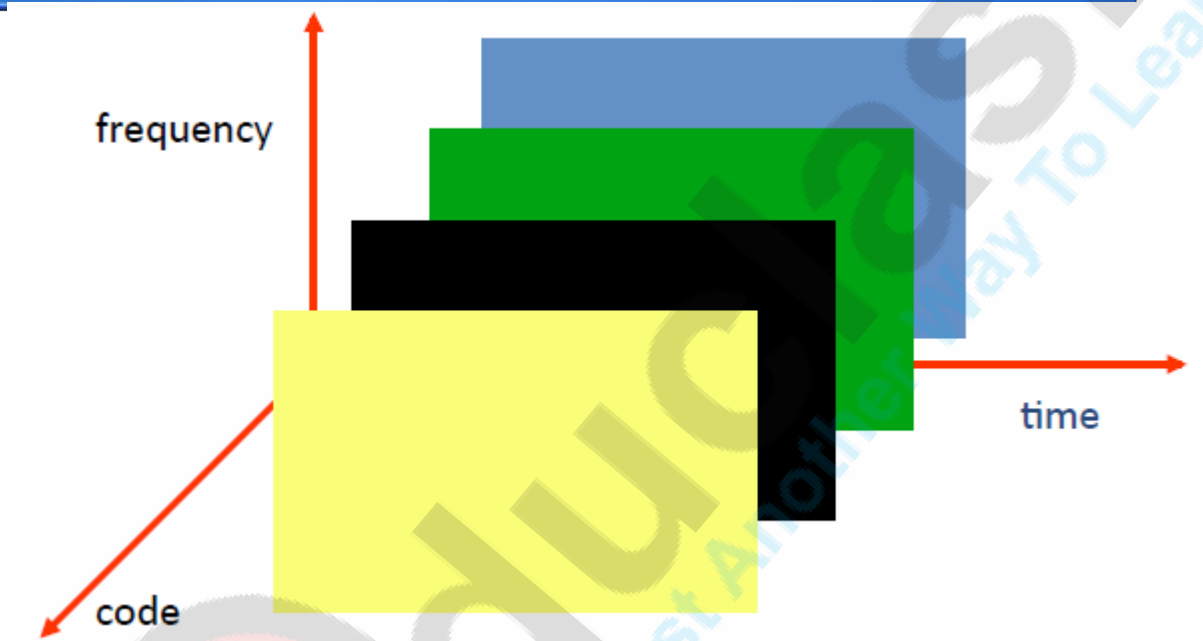
Evolution of Cellular Networks



The Multiple Access Problem

- *The base stations need to serve many mobile terminals at the same time (both downlink and uplink)*
- *All mobiles in the cell need to transmit to the base station*
- *Interference among different senders and receivers*
- *So we need multiple access scheme*

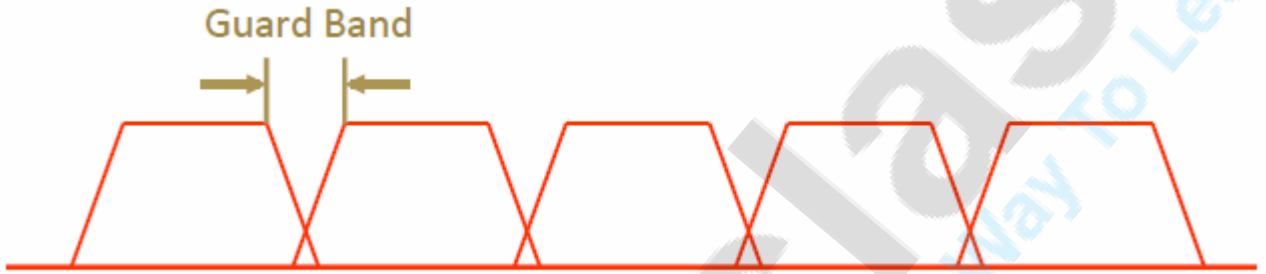
Multiple Access Schemes



3 orthogonal Schemes:

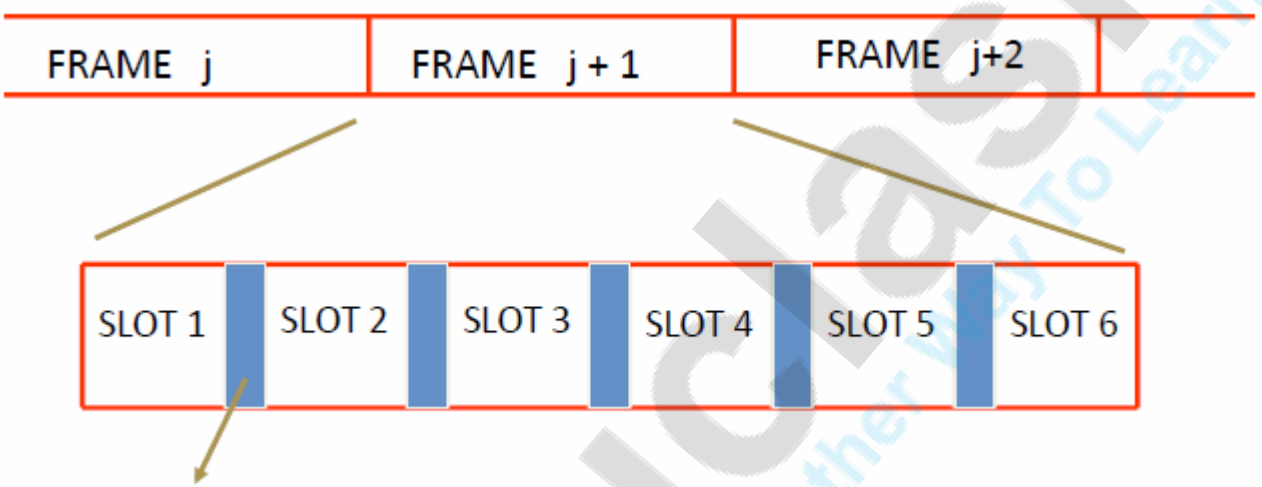
Frequency Division Multiple Access (FDMA)
Time Division Multiple Access (TDMA)
Code Division Multiple Access (CDMA)

Frequency Division Multiple Access



- *Each mobile is assigned a separate frequency channel for the duration of the call*
- *Sufficient guard band is required to prevent adjacent channel interference*
- *Usually, mobile terminals will have one downlink frequency band and one uplink frequency band*
- *Different cellular network protocols use different frequencies*

Time Division Multiple Access

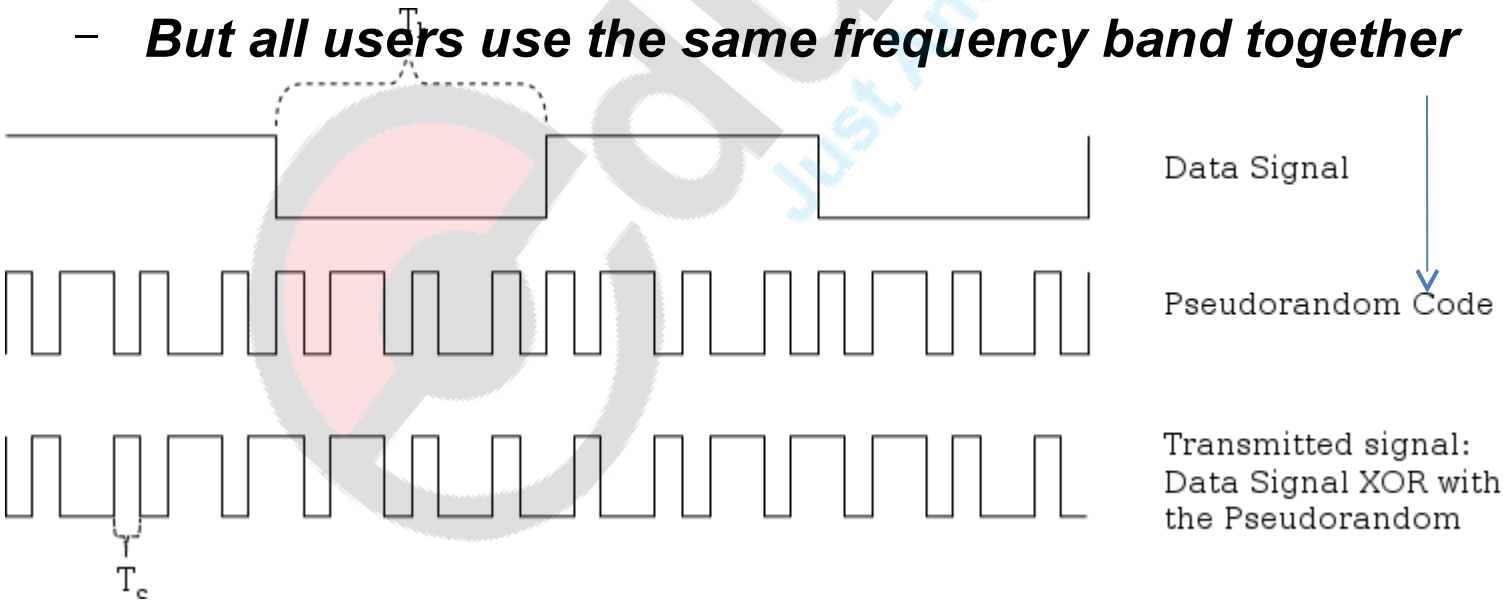


Guard time – signal transmitted by mobile terminals at different locations do no arrive at the base station at the same time

- ***Time is divided into slots and only one mobile terminal transmits during each slot***
- ***Each user is given a specific slot.***

Code Division Multiple Access

- *Use of orthogonal codes to separate different transmissions*
- *Each symbol of bit is transmitted as a larger number of bits using the user specific code – Spreading*
  - *Bandwidth occupied by the signal is much larger than the information transmission rate*
  - *But all users use the same frequency band together*



1G TECHNOLOGY

- *1G refers to the first generation of wireless telephone technology, mobile telecommunications which was first introduced in 1980s and completed in early 1990s.*
- *It's Speed was upto 2.4kbps.*
- *1G network use Analog Signal.*
- *AMPS was first launched in USA in 1G mobile systems.*

1G FIRST GENERATION

DRAWBACKS OF 1G

- Poor Voice Quality
- Poor Battery Life
- Large Phone Size
- No Security
- Limited Capacity
- Poor Handoff Reliability

1G Wireless System

2G TECHNOLOGY

- *2G technology refers to the 2nd generation which is based on GSM standard.*
- *It was launched in Finland in the year 1991.*
- *2G network use digital signals.*
- *It's data speed was upto 64kbps.*

Features Includes:

- ✓ *It enables services such as text messages, picture messages and MMS (multi media message).*
- ✓ *It provides better quality and capacity .*

DRAWBACKS OF 2G

- *2G requires strong digital signals to help mobile phones work. If there is no network coverage in any specific area , digital signals would be weaker.*

- *These systems are unable to handle complex data such as Videos.*

2G Wireless System

2.5G TECHNOLOGY

- *2.5G is a technology between the second (2G) and third (3G) generation of mobile telephony.*
- *2.5G is sometimes described as 2G Cellular Technology combined with GPRS.*

Features Includes:

- ✓ *Phone Calls*
- ✓ *Send/Receive E-mail Messages*
- ✓ *Web Browsing*
- ✓ *Speed : 64-144 kbps*
- ✓ *Camera Phones*
- ✓ *Take a time of 6-9 mins. to download a 3 mins. Mp3 song*

3G TECHNOLOGY

- *3G technology refer to third generation which was introduced in year 2000s.*
- *Data Transmission speed increased from 144kbps- 2Mbps.*
- *Typically called Smart Phones and features increased its bandwidth and data transfer rates to accommodate web-based applications and audio and video files.*

FEATURES OF 3G TECHNOLOGY

- ✓ *Providing Faster Communication*
- ✓ *Send/Receive Large Email Messages*
- ✓ *High Speed Web / More Security*

Video Conferencing / 3D Gaming

- ✓ *TV Streaming/ Mobile TV/ Phone Calls*
- ✓ *Large Capacities and Broadband Capabilities*
- ✓ *11 sec – 1.5 min. time to download a 3 min Mp3 song.*

DRAWBACKS OF 3G TECHNOLOGY

- *Expensive fees for 3G Licenses Services*
- *It was challenge to build the infrastructure for 3G*
- *High Bandwidth Requirement*
- *Expensive 3G Phones.*
- *Large Cell Phones*

4G TECHNOLOGY
(Anytime ,Anywhere)

4G TECHNOLOGY (Anytime ,Anywhere)

- *4G technology refer to or short name of fourth Generation which was started from late 2000s.*
- *Capable of providing 100Mbps – 1Gbps speed.*
- *One of the basic term used to describe 4G is MAGIC.*

MAGIC:

- *Mobile Multimedia*
- *Anytime Anywhere*
- *Global Mobility Support*
- *Integrated Wireless Solution*
- *Customized Personal Services*

Also known as Mobile Broadband Everywhere.

4G (Anytime, Anywhere)

- *The next generations of wireless technology that promises higher data rates and expanded multimedia services.*
- *Capable to provide speed 100Mbps-1Gbps.*
- *High QOS and High Security*
- *Provide any kind of service at any time as per user requirements, anywhere.*

Features Include:

- *More Security*
- *High Speed*
- *High Capacity*
- *Low Cost Per-bit etc.*

DRAWBACKS OF 4G

- *Battery usage is more*
- *Hard to implement*
- *Need complicated hardware*
- *Expensive equipment required to implement next generation network.*

COMPARISON BETWEEN 3G Vs 4G

The basic difference between 3G and 4G is in data transfer and signal quality.

Technology	3G	4G
Data Transfer Rate	3.1 MB/sec	100 MB/sec
Internet Services	Broadband	Ultra Broadband
Mobile - TV Resolution	Low	High
Bandwidth	5-20 MHz	100MHz
Frequency	1.6-2 GHz	2-8 GHz

5G TECHNOLOGY

- *5G technology refer to short name of fifth Generation which was started from late 2010s.*

- *Complete wireless communication with almost no limitations.*

- *It is highly supportable to WWWW (Wireless World Wide Web).*

BENEFITS OF 5G TECHNO

- *High Speed, High Capacity*
- *5G technology providing large broadcasting of data in Gbps .*
- *Multi - Media Newspapers, watch T.V programs with the clarity as to that of an HD Quality.*
- *Faster data transmission that of the previous generations.*
- *Large Phone Memory, Dialing Speed, clarity in Audio/Video.*
- *Support interactive multimedia , voice, streaming video, Internet and other*
- *5G is More Effective and More Attractive.*