B O2 - Mobile Networks
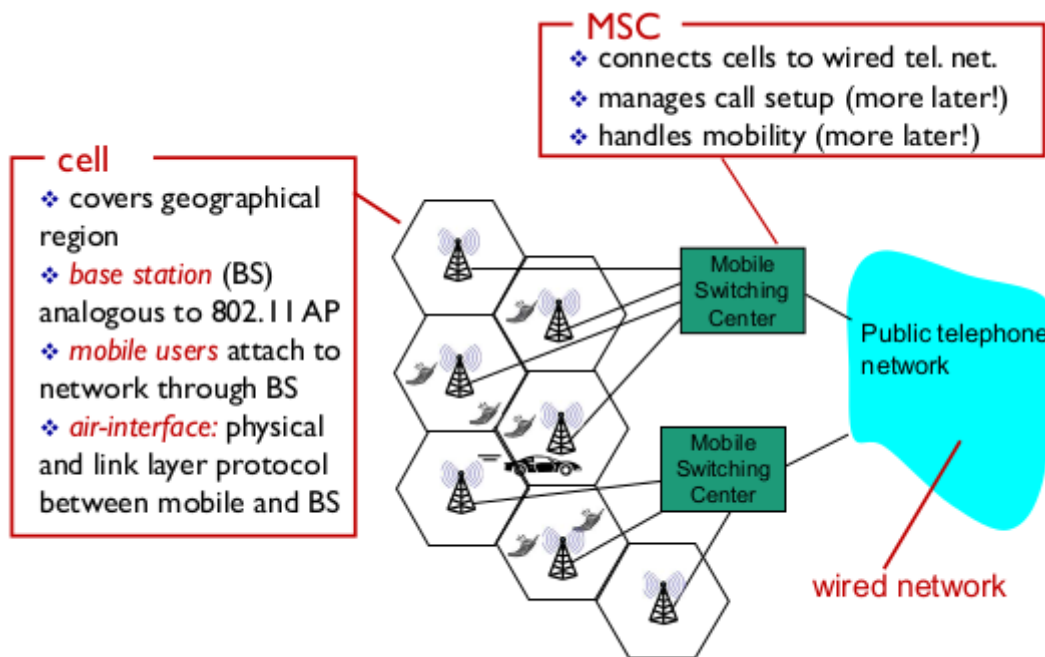
- Wireless: communication over wireless link (hops,user devices, BS)
- Mobility: handling the mobile user who canges point of attachment to network, mobile phone operators provide connection service allowing you to move, identity, authentication (if id user € their registry), of course billing
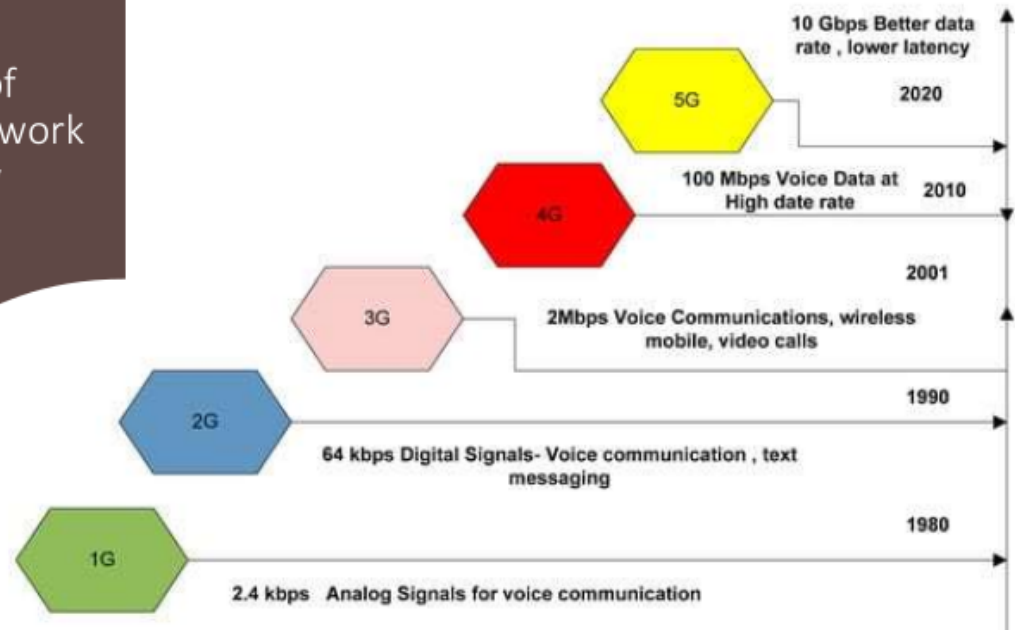
Cellular Network Architecture Components:

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- MSC other features:
    - can hadle multiple cell
    - hidden frame
    - manage the handoff
    - some as gateway to public telefone network
    - identity, auth, trace devices, billing, trace time user connection

Evolution of mobile network technologies

Evolution of mobile network technology

- 10 Gbps Better data rate, lower latency — 5G — 2020
- 100 Mbps Voice Data at High date rate — 4G — 2010
- 2001
- 2Mbps Voice Communications, wireless mobile, video calls — 3G
- 1990
- 64 kbps Digital Signals- Voice communication, text messaging — 2G
- 1980
- 2.4 kbps Analog Signals for voice communication — 1G

- 1G:

    - 1st gen
    - communication over analog signals
    - frequency
    - multiplexing:
        - method by which multiple (analog or digital) signals are combined into one signal over a shared medium
    - no digital signal

- 2G:

    - GSM
    - voice communication
    - digital signals
    - text messaging (SMS success wasn't expected)

- 3G:

    - 1st revolution
    - data communication and anternet connection
    - high data rate

- 4G:

    - extension of 3G architecture

- 5G:

- 5G have (also in 4G really) software engineering principles (microservices, virtualisation, impact of data centers)
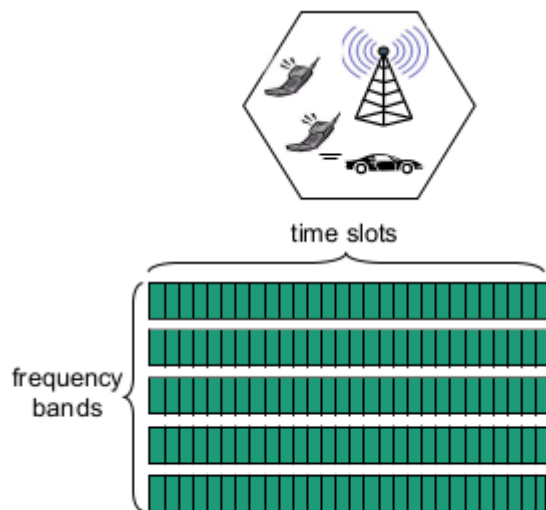- low latency

Cellular netwoks: the first hop

- two techniques for sharing mobile to BS radio spectrum
-
> ● Frequency/Time DIVISION MULTIPLE ACCESS

1. **combined FDMA/TDMA:**
   - divide spectrum in frequency channels, divide each channel into time slots
   - informal:
     - each frequency band is divided in time slots
     - assign each intersection to a device

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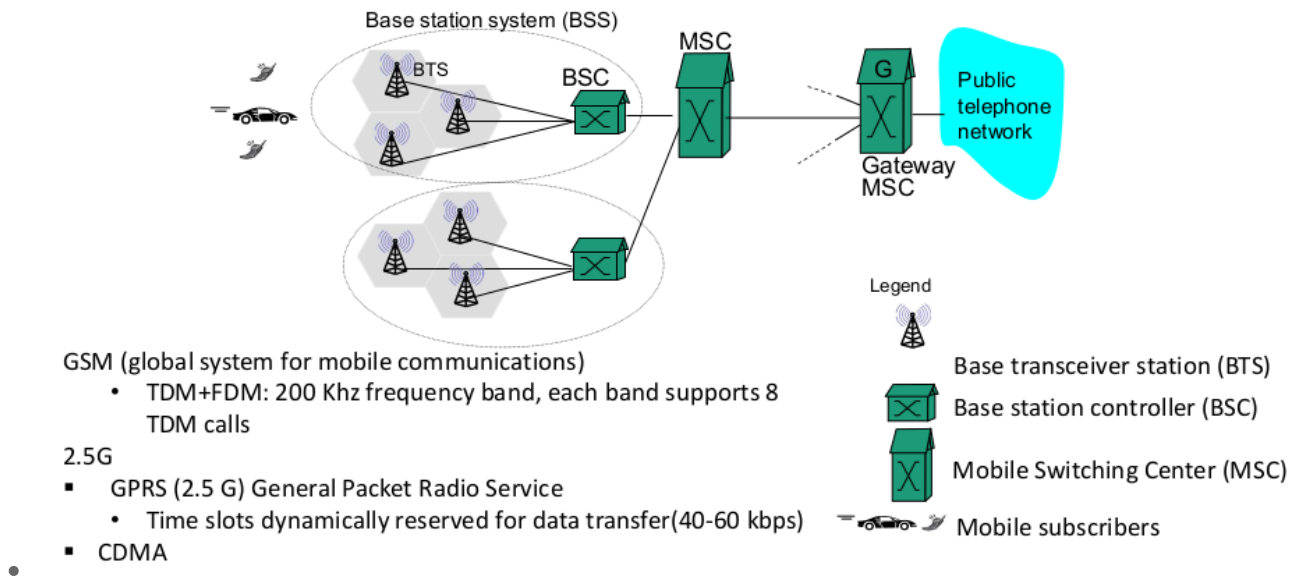1. **CDMA**: Code Division Multiple Access:
   - division by codes: sequences of bits
   - partitioning the code space
   - code is negotiated before by BS according to decision provided by functions of the architecture (multiple codes)
   - specific code for each node transmitting
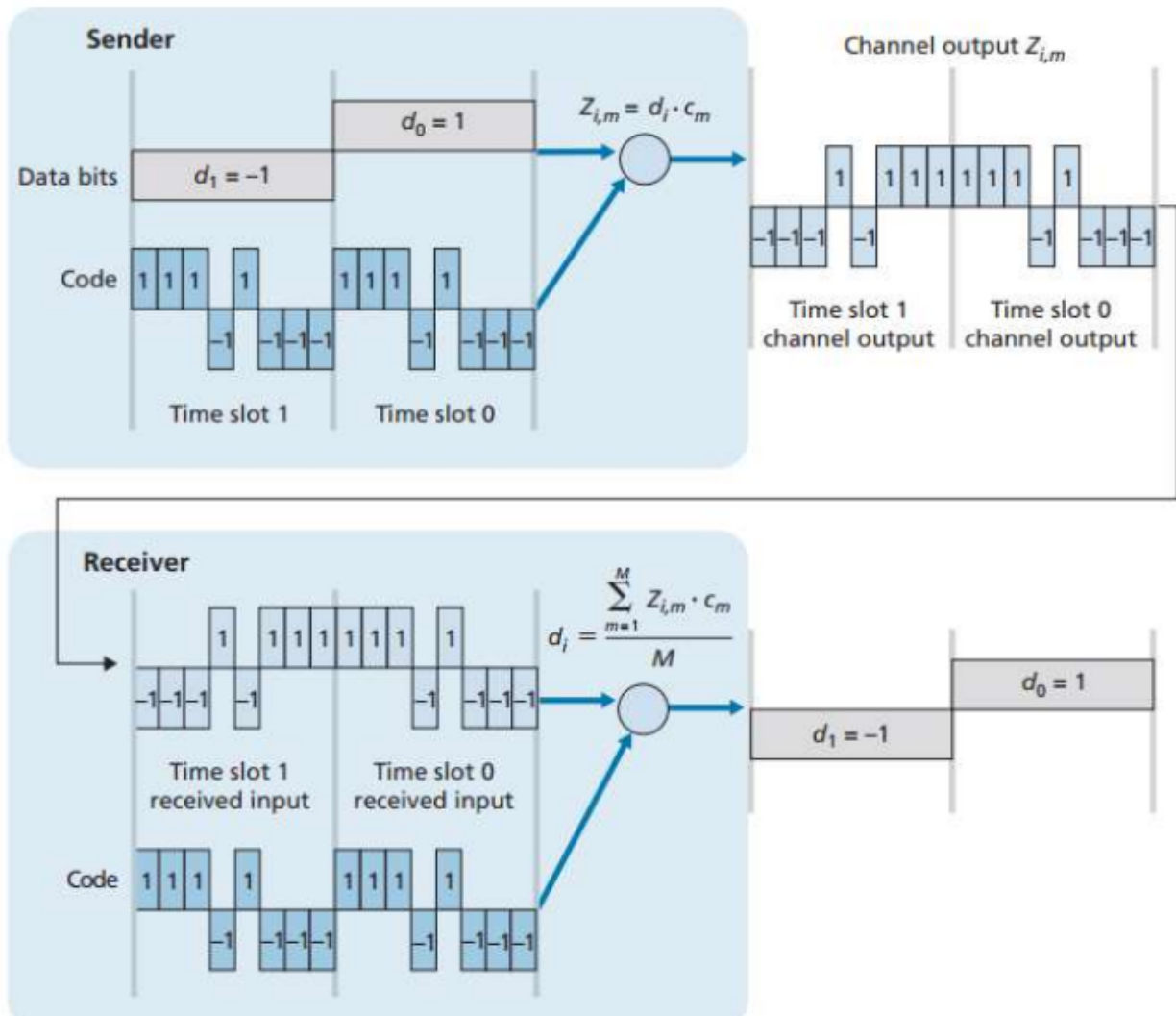
-
- Sendig station send d1 and d0, so Z= di * Cm is the output of the station
- Receiving station decode signal and reconstruct appling di
- simple situation, real scenario has multiple trnsmitters and 1 receiver
- since receiver knows code used from transmitting, is amble to reconstruct original signal
 - even if the sum of many singals send

2G(voice) network architecture

2G (voice) network architecture

Base station system (BSS)

GSM (global system for mobile communications)
- TDM+FDM: 200 Khz frequency band, each band supports 8 TDM calls

2.5G
- GPRS (2.5 G) General Packet Radio Service
  - Time slots dynamically reserved for data transfer(40-60 kbps)
- CDMA

Legend

Base transceiver station (BTS)
Base station controller (BSC)
Mobile Switching Center (MSC)
Mobile subscribers

- X : circut switching implementation

- Gateway MSC (Mobile Switching Center):

  - mediate communication mobile ↔ public telefone network

- MSC (Mobile Switching Cenrer):

  - infos of authenticated user, subscribe

- BSC (Base Station Controller):

  - decides on how resources of phisical medium are used/managed
  - control/manage different BS
  - infos about medium devices

- BSS (Base Station System):

  - set of BS
  - awared on wich code is used
  - infos about medium device

3G (voice + data) Network architecture
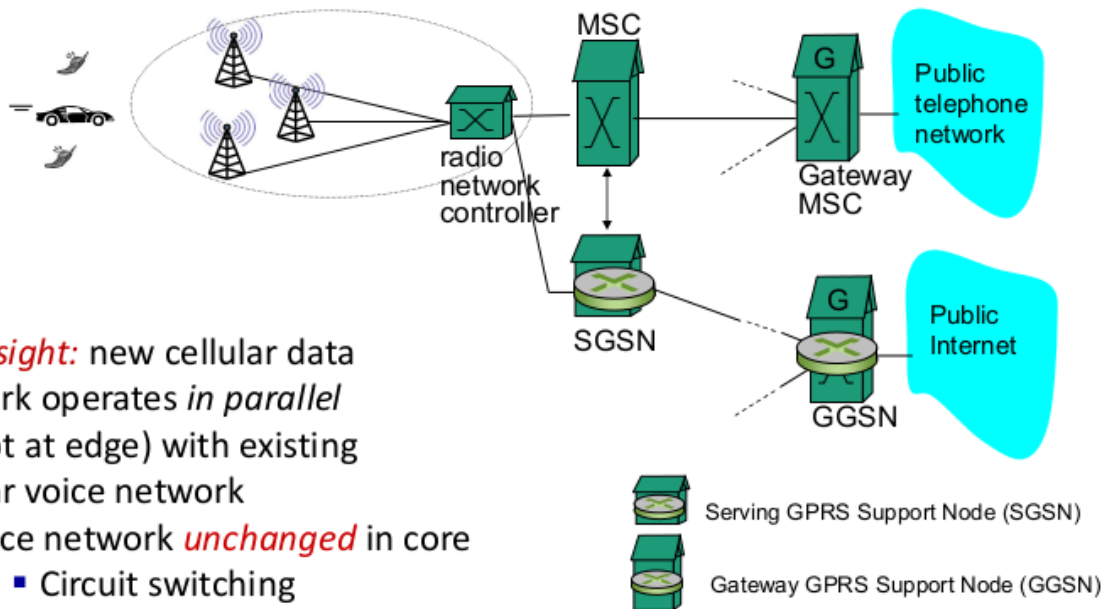
Key insight: new cellular data network operates *in parallel* (except at edge) with existing cellular voice network

- voice network *unchanged* in core
  - Circuit switching
- data network operates in parallel
  - Packet switching

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- Not only voice, also implement connection to core network
- **infrastucture extension, change anything**
- GGSN (Gateway GPRS Support Node) and SGSN (Serving GPRS Support Node) are two core network nodes in 2G GSM and 3G UMTS networks that enable packet-switched mobile internet. GGSN and SGSN were added to GSM networks as part of the GPRS enhancement, and they are used by both GSM and 3G UMTS networks.**
- **Radio Network Controller**:
  - this shit is introduced:
    - circuit switching **to handle datagram and voice**
- Gateway **SGSN**:
  - router, cuz deling with packets
- Gateway **GGSN**:
  - gateway, last router near public internet
- Gateway MSC:
  - parallel branches