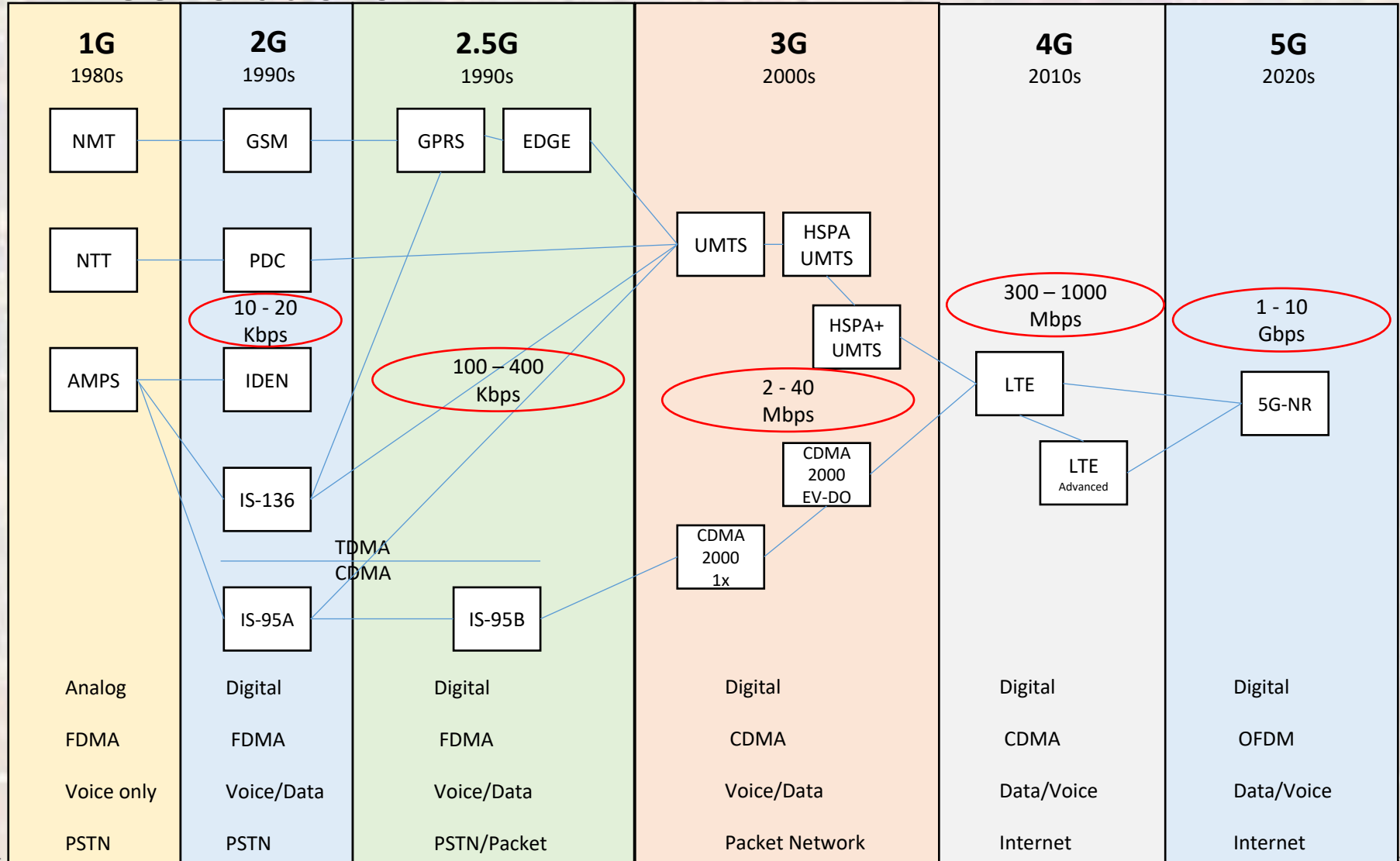


# Cellular Circuit Switched

Last updated 4/18/24

# Cellular - Background

## • Generations

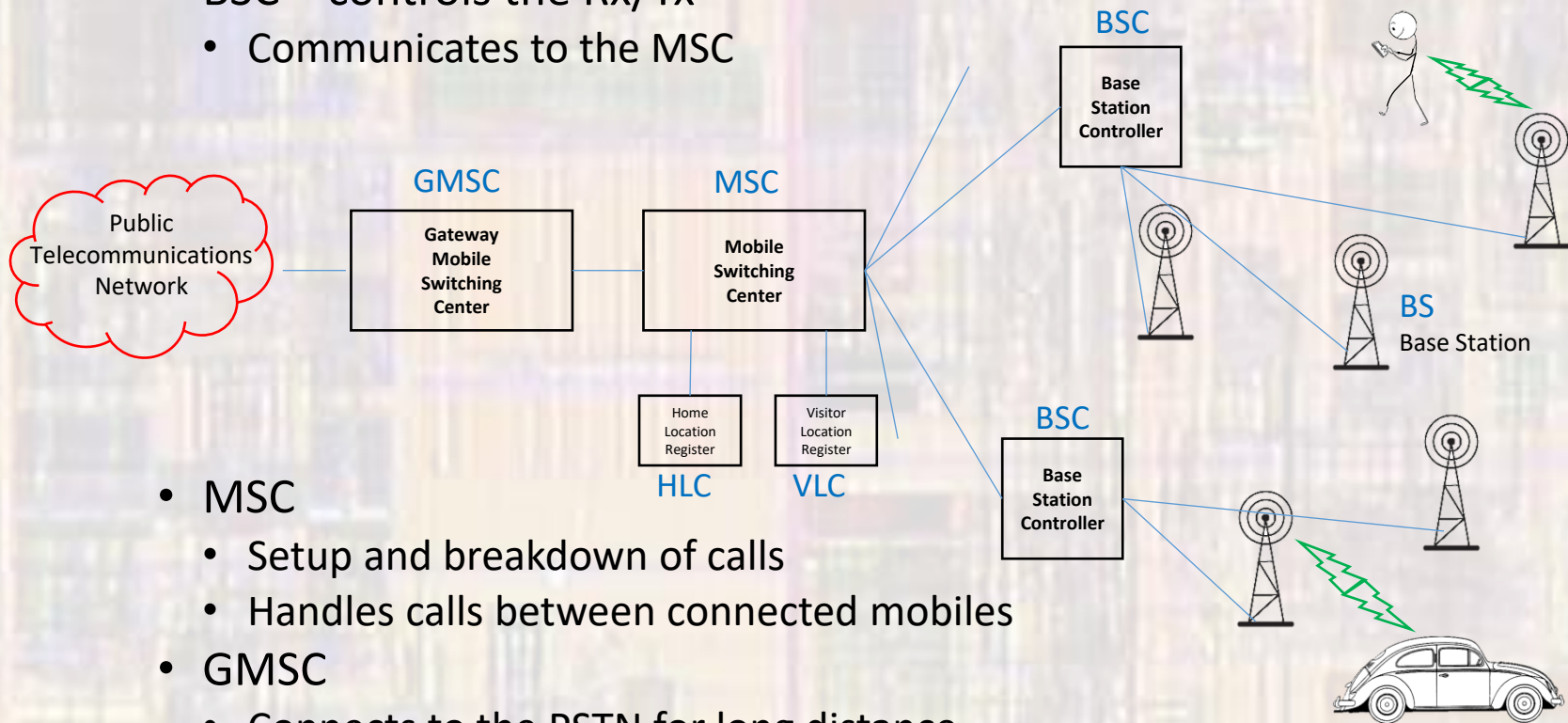


# Cellular – Circuit Switched

- Circuit Switched
  - Operate similarly to the POTS system
  - Dedicated lines(channels) between callers
- AMPS – 1G
  - Advanced Mobile Phone System
  - Analog signals
    - 3KHz voice FM modulated onto a 30KHz channel
    - 832 full-duplex (FDD) channels – 21 reserved for signaling
    - Downlink – 824MHz – 849MHz
    - Uplink – 869MHz – 894MHz
  - Approximately 800 conversations / cell cluster
- GSM – 2G
  - Global System Mobile
  - Digital signals
    - 3.1KHz voice GMSK modulated onto a 200KHz channel
    - Each channel time division multiplexed into 8 timeslots
    - A timeslot is dedicated to a single call
    - Most systems operate in 25Mz bands around 900MHz and 1800MHz
  - Approximately 1000 conversations / cell cluster
  - 14.4Kb/s of data / timeslot

# Cellular – Circuit Switched

- Components
  - BS – Rx/Tx
    - At least 2 channels: Control, Traffic
  - BSC – controls the Rx/Tx
    - Communicates to the MSC

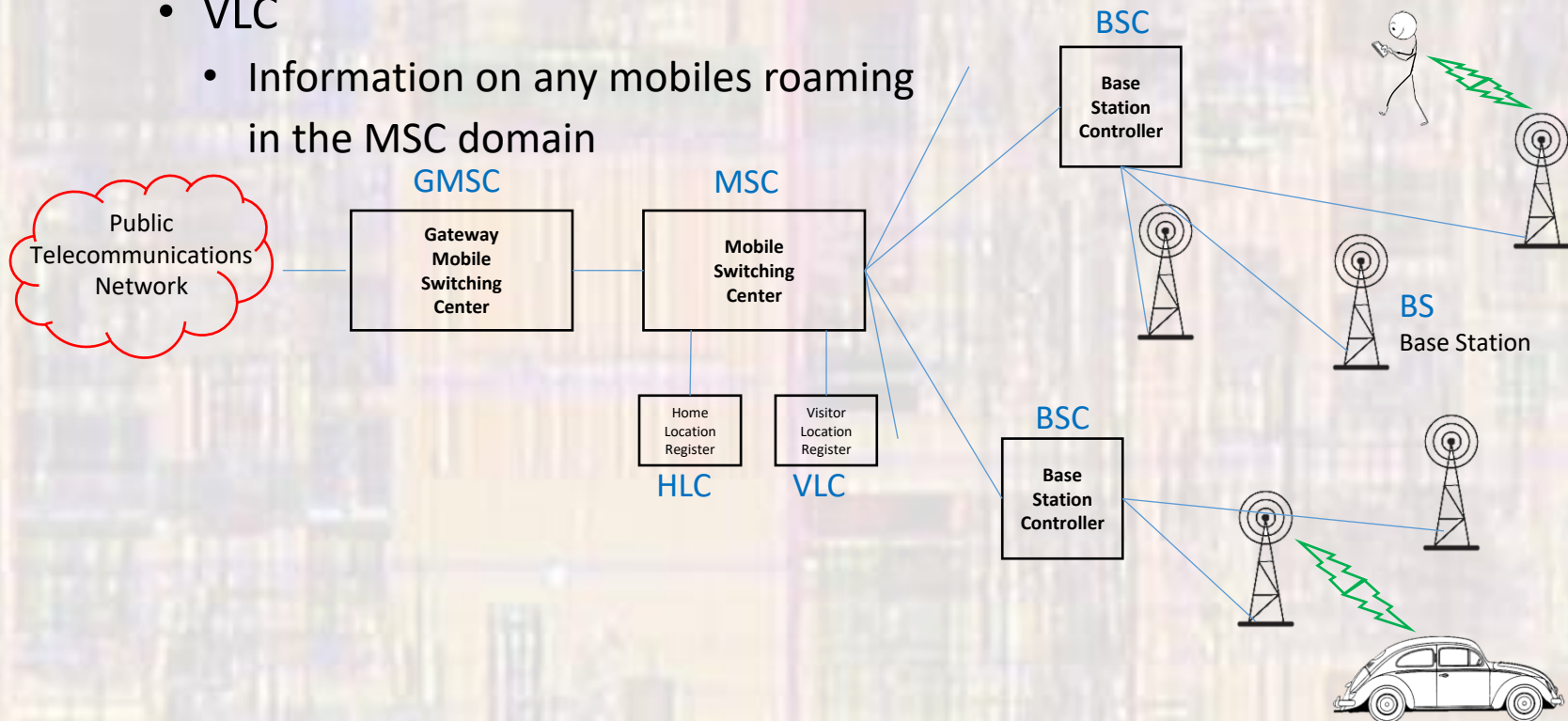


- MSC
  - Setup and breakdown of calls
  - Handles calls between connected mobiles
- GMSC
  - Connects to the PSTN for long distance



# Cellular – Circuit Switched

- Components
  - HLR
    - Billing, services, ... for subscribers
  - VLC
    - Information on any mobiles roaming in the MSC domain



# Cellular – Circuit Switched

- Mobile unit / Cell identification
  - While turned on, the mobile unit periodically scans for forward control channels
    - Selects the strongest (may not be the closest)
    - De-facto selects the cell for communications
  - A hand-shake process 'registers' the mobile unit with the MSC
    - Uses the forward and reverse control channels
    - MSC knows who is in which cells
  - If the mobile unit is moving, this will update as it transfers between cells
  - Mobile unit 'listens' for pages (see later slides)

# Cellular – Circuit Switched

- Mobile unit call initiation
  - Mobile unit checks to see if the forward control channel is idle
  - When idle, the mobile send the desired number to the BSC on the reverse control channel
  - BSC sends the request on to the MSC
  - The MSC then determines which BSC the called unit is operating in
  - The MSC then directs the BSC to send a page to the desired called unit on the forward control channel
  - The called unit detects the page – through its monitoring of the forward control channel – and responds to its BSC/MSC to complete the call
  - The MSC then directs the BSC to assign (via the forward control channel) each mobile to a traffic channel and connects the 2 mobile units to complete the call
    - Each mobile unit will have its own channel depending on cell and co-channel assigned
    - Each mobile unit continues to operate on the control channel
      - Sharing call status and signal strength info with the BSC



# Cellular – Circuit Switched

- Mobile unit call initiation
  - If either of the mobile units is moving – a handoff may be required
    - Signal strength gets weak, and an alternate control channel (different cell) has a stronger signal
  - The moving mobile unit will inform the BSC of a desire to switch control channels (cells)
    - If the change is within a BSC – it can reassign a new traffic channel and inform the MSC
    - If the change crosses BSCs - the MSC assigns the moving unit a new traffic channel in the new BSC/cell
  - The original call continues un-interrupted



# Cellular – Circuit Switched

- Mobile unit call initiation – other conditions
  - Call termination
    - If either unit terminates the call the MTSO informs the other unit and releases the traffic channel
  - No traffic channels free – busy tone provided after some # of attempts
  - Call dropped
    - Signal becomes too weak (and no alternative available)
    - The BSC informs the MTSO that it cannot maintain the traffic channel
    - MTSO terminates the call
  - Out of current system calls
    - GMSC connects to the PSTN to complete the call