Common Channel signaling
Switching Networks

- Long distance transmission is typically done over a network of switched nodes
- Nodes not concerned with content of data
- End devices are stations
  - Computer, terminal, phone, etc.
- A collection of nodes and connections is a communications network
- Data routed by being switched from node to node
Circuit Switching

• Dedicated communication path between two stations

• Three phases
  — Establish
  — Transfer
  — Disconnect

• Must have switching capacity and channel capacity to establish connection

• Must have intelligence to work out routing
Telecomms Components

- **Subscriber**
  - Devices attached to network

- **Subscriber line**
  - Local Loop
  - Subscriber loop
  - Connection to network
  - Few km up to few tens of km

- **Exchange**
  - Switching centers
  - End office - supports subscribers

- **Trunks**
  - Branches between exchanges
  - Multiplexed
Circuit Establishment

- a: Two end offices connected to the same intermediate exchange.
- b: One end office connected to the intermediate exchange.
- c: One end office connected to the intermediate exchange.
- d: One end office connected to the intermediate exchange.
Circuit Switch Elements

- Control Unit
- Digital Switch
- Full-duplex lines to attached devices
- Network Interface
Circuit Switching Concepts

- Digital Switch
  - Provide transparent signal path between devices
- Network Interface
- Control Unit
  - Establish connections
    - Generally on demand
    - Handle and acknowledge requests
    - Determine if destination is free
    - Construct path
  - Maintain connection
  - Disconnect
Blocking or Non-blocking

• Blocking
  — A network is unable to connect stations because all paths are in use
  — A blocking network allows this
  — Used on voice systems
    • Short duration calls

• Non-blocking
  — Permits all stations to connect (in pairs) at once
  — Used for some data connections
Multistage Switch

- Reduced number of crosspoints
- More than one path through network
  - Increased reliability
- More complex control
- May be blocking
Three Stage Space Division Switch
Time Division Switching

- Modern digital systems rely on intelligent control of space and time division elements
- Use digital time division techniques to set up and maintain virtual circuits
- Partition low speed bit stream into pieces that share higher speed stream
Control Signaling Functions

- Audible communication with subscriber
- Transmission of dialed number
- Call can not be completed indication
- Call ended indication
- Signal to ring phone
- Billing info
- Equipment and trunk status info
- Diagnostic info
- Control of specialist equipment
Control Signal Sequence

- Both phones on hook
- Subscriber lifts receiver (off hook)
- End office switch signaled
- Switch responds with dial tone
- Caller dials number
- If target not busy, send ringer signal to target subscriber
- Feedback to caller
  - Ringing tone, engaged tone, unobtainable
- Target accepts call by lifting receiver
- Switch terminates ringing signal and ringing tone
- Switch establishes connection
- Connection release when Source subscriber hangs up
Switch to Switch Signaling

- Subscribers connected to different switches
- Originating switch seizes interswitch trunk
- Send off hook signal on trunk, requesting digit register at target switch (for address)
- Terminating switch sends off hook followed by on hook (wink) to show register ready
- Originating switch sends address
Location of Signaling

- Subscriber to network
  - Depends on subscriber device and switch

- Within network
  - Management of subscriber calls and network
  - More complex
In Channel Signaling

• Use same channel for signaling and call
  — Requires no additional transmission facilities

• Inband
  — Uses same frequencies as voice signal
  — Can go anywhere a voice signal can
  — Impossible to set up a call on a faulty speech path

• Out of band
  — Voice signals do not use full 4kHz bandwidth
  — Narrow signal band within 4kHz used for control
  — Can be sent whether or not voice signals are present
  — Need extra electronics
  — Slower signal rate (narrow bandwidth)
Drawbacks of In Channel Signaling

- Limited transfer rate
- Delay between entering address (dialing) and connection
- Overcome by use of common channel signaling
Common Channel Signaling

- Control signals carried over paths independent of voice channel
- One control signal channel can carry signals for a number of subscriber channels
- Common control channel for these subscriber lines
- Associated Mode
  - Common channel closely tracks interswitch trunks
- Disassociated Mode
  - Additional nodes (signal transfer points)
  - Effectively two separate networks
Common v. In Channel Signaling

(a) Inchannel

(b) Common channel

CCIS SIG: Common-channel interoffice signaling equipment
SIG: Per-trunk signaling equipment
Common Channel Signaling Modes

(a) Associated

(b) Disassociated

Signaling links
Speech links
Switching point (speech)
Switching point (signal transfer point)
Signaling System Number 7

- SS7
- Common channel signaling scheme
- ISDN
- Optimized for 64k digital channel network
- Call control, remote control, management and maintenance
- Reliable means of transfer of info in sequence
- Will operate over analog and below 64k
- Point to point terrestrial and satellite links
SS7
Signaling Network Elements

- **Signaling point (SP)**
  - Any point in the network capable of handling SS7 control message

- **Signal transfer point (STP)**
  - A signaling point capable of routing control messages

- **Control plane**
  - Responsible for establishing and managing connections

- **Information plane**
  - Once a connection is set up, info is transferred in the information plane
Signaling Network Structures

• STP capacities
  — Number of signaling links that can be handled
  — Message transfer time
  — Throughput capacity

• Network performance
  — Number of SPs
  — Signaling delays

• Availability and reliability
  — Ability of network to provide services in the face of STP failures