Communication Networks and Switching

Course Code: ETU07402

Lecture 03

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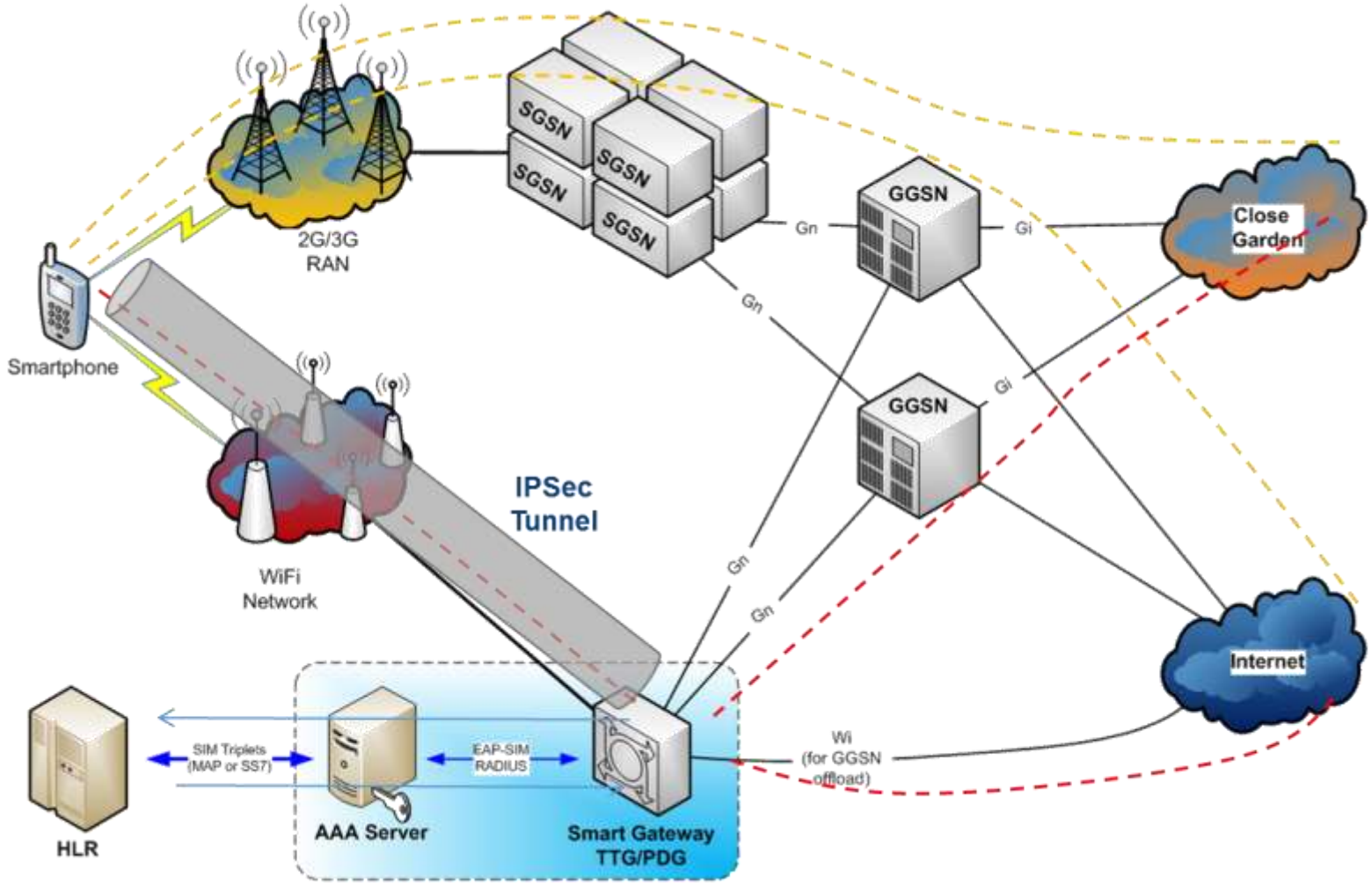
Electronics & Telecommunication Engineering

Signalling Techniques in Switching Systems

Lecture 03


2G/3G
RAN
SGSN
SGSN
SGSN
SGSN
Gn
GGSN
Gi
Close
Garden
Gn
Smartphone
GGSN
Gi
IPSec
Tunnel
WiFi
Network
Gn
Gn
Internet
Wi
(for GGSN
offload)
SIM Triplets
(MAP or SS7)
EAP-SIM
RADIUS
HLR
AAA Server
Smart Gateway
TTG/PDG

Switching Signaling Basics

Part I

Switching Signaling Basics

- 3.1. Introduction & Definitions
  - 3.1.1. Functions of Signaling
  - 3.1.2. Signaling Techniques
  - 3.1.3. In - Band Signaling
  - 3.1.3. Voice Frequency Signaling
  - 3.1.5. Out - of - Band Signaling
  - 3.1.6. Intra-exchange Signaling
  - 3.1.7. Intra-exchange Signaling

3.1. Introduction - Signaling----Definitions

Signalling: Is the dialog language for the communication between various parts of the telecom network. (ZTE)

"Is the dialog language for the communication between various parts of the telecom network". (*web proForum Tutorials*, www.iec.org)

"The exchange of information between call components required to provide and maintain service."

(*Examples*) *Dialing digits, providing dial tone, accessing voice mail, sending a call waiting tone, *69, etc.*

3.1. Introduction - Signaling----Definitions..

Signaling: The process of generating and exchanging information among components of a telecommunication system to establish, monitor or release connections and to control related network and system operations’’

Signaling systems: link the variety of switching systems, transmission systems and subscriber equipment’s in a telecommunication System to facilitate the network to function as a whole.

3.1.1. Functions of Signaling

- **Supervisory Signaling:** Provides information on line or circuit condition.
  - It [signaling] informs a switch whether a circuit (internal to switch) or a trunk (external to switch) is busy or idle; a called party is off-hook or on-hook…"
- **Some supervisory signals:**
  - Request for service - **off-hook**
  - Ready to receive address - **dial tone**

3.1.1. Functions of Signaling…..

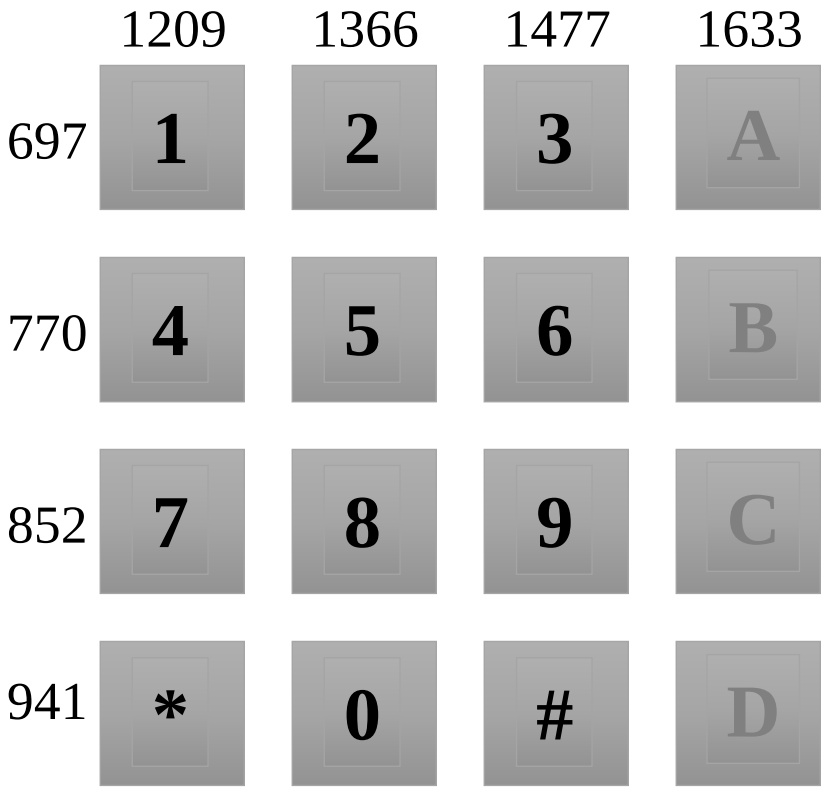
- Call alerting - **ringing**
- Call termination - **on-hook**
- Request for operator - **hook-switch flash**
- Called party station ringing - **ring back**
- Network/called station busy - **busy tone**

- **Address Signaling:** Directs and routes a telephone call to the called subscriber
  - *When more than one switch involved in the call setup, signaling is required between switches (interregister switching)*

3.1.1. Functions of Signaling…..

- **DTMF Signaling (Dual Tone Multi Frequency)**

This is a telecommunication signaling system using the ***voice-frequency*** band over telephone lines between telephone equipment and other communications devices and switching centers. Wikipedia



3.1.1. Functions of Signaling….

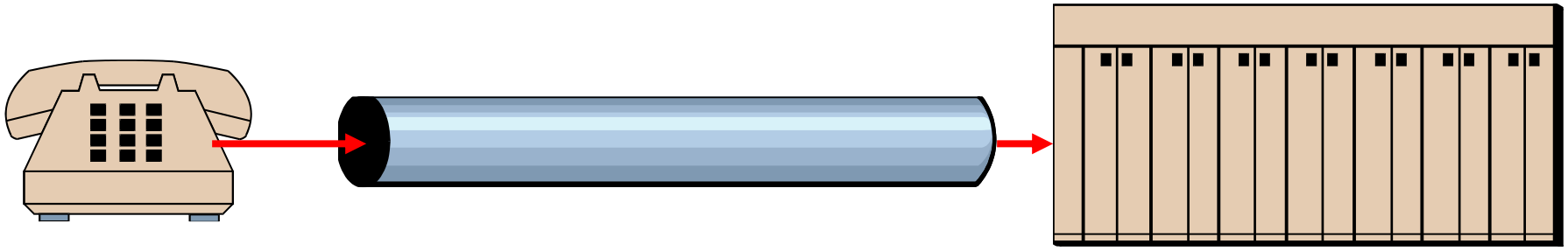
- **Call-Progress Signaling (Audible - Visible):** Categorized by audio/visual signals sent in a forward and backward direction.
  - **Forward Direction: A signal sent to your phone which tells it to ring**
  - **Backward Signaling:**
    - Ringback - The distant telephone you are calling is ringing
    - Busyback - The called line is busy
    - ATB - All Trunks Are Busy (*sometimes a voice announcement is used*)
    - Loud Warble - Telephone is off hook

3.1.2. Signaling Techniques

- In band signaling
- Out-of-band signaling
- Common Channel Signaling (CCS)
- E&M signaling
- Multi frequency (MF) signaling

3.1.3. In - Band Signaling

- Signaling path = voice path
- Voice path clogged with signaling
- Busy calls, congestion, and “ring-no-answers” result in 20-35% of incomplete calls
- Slower call setup due to channel sharing



In-band

- SF Signaling (2600 Hz)
- MF Signaling
- DTMF Signaling

Out-of-band

- DC Current (on-/off-hook
- Dial pulses (10 pps)
- 20 Hz Ringing voltage

Figure 3.1: In-channel signaling

3.1.3. Voice Frequency Signaling

Advantage of In-band

- Control Signals can be sent to every part voice can reach
- Disadvantage of in-Band
- In-Band Voice Frequency signaling must be protected against false operation by speech
- Disadvantage of out-Band
- very narrow bandwidth available
- **voice frequency Signalling Schemes** suffer from limited Bandwidth

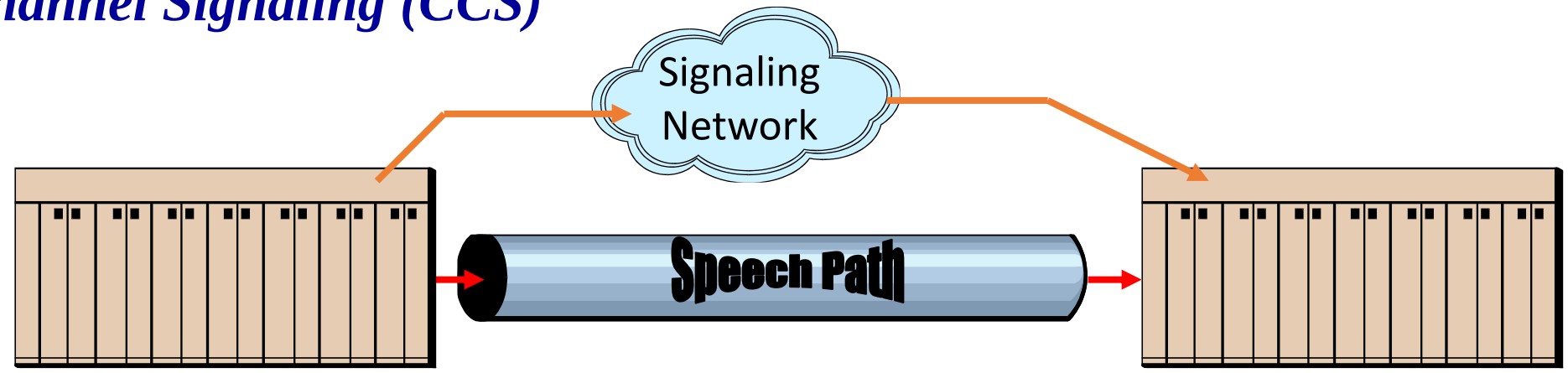
3.1.3. Voice Frequency Signaling

Disadvantage of Inband

- More possibility of speech signals imitating control signals. This problem can be reduced using suitable guard circuit.
- The inland signal may ‘spill-over’ from one link to the another and causes error in that signalling system.

3.1.5. Out - of - Band Signaling

- Signaling path done on a separate channel
- Voice path dedicated only to voice
- Much faster call setup and knockdown
- Led to SS7 and AIN
- ***Common Channel Signaling (CCS)***



Dedicated data link between systems

- Trunk group associated
- Trunk group disassociated

3.1.5. Out - of - Band Signaling…

- *One signaling path needed per trunk group*
- *Faster and simpler to transfer information between control processors*
- *No possibility of interference with speech path*
- *The requirement of line splits are not necessary to avoid signal limitation.*
- *Signals and speech is transmitted simultaneously without disturbing the conversation.*
- *Signaling can't be accessed by customer*
  - *Value-added services of a signaling control point*
  - *Shared processing for small offices*
  - *Allows centralized decision making (flow mgmt)*
  - *Permits Advanced Intelligent Network (AIN) services*

3.1.5. Out - of - Band Signaling…

Disadvantages

- *CCS links can be a single point of failure*
- *No inherent testing of speech path by call setup signaling*
- *CCS response time is critical*
- *Very narrow bandwidth is available for signalling.*
- *Filtering circuits are needed to handle the signalling bands.*
- *More dependent on the transmission system.*

3.1.6. Intra-exchange Signaling

- **Intra-exchange Signalling** is the exchange of control information, i.e. call setup, call supervision ad call termination within telephone exchange/switch. There are three types of intra-exchange signalling
  - ***Supervision signals*** *also known as line signals communicate events that occur on the telephone lines, such as on-hook and off-hook.*
  - ***Address Signals*** *are referred as selection signal, digits, or register signals communicate the called subscriber number.*
  - ***Tones and announcements****, eg. Ringing-tone and busy-tone communicate the status of the called subscriber.*

3.1.6. Intra-exchange Signaling…

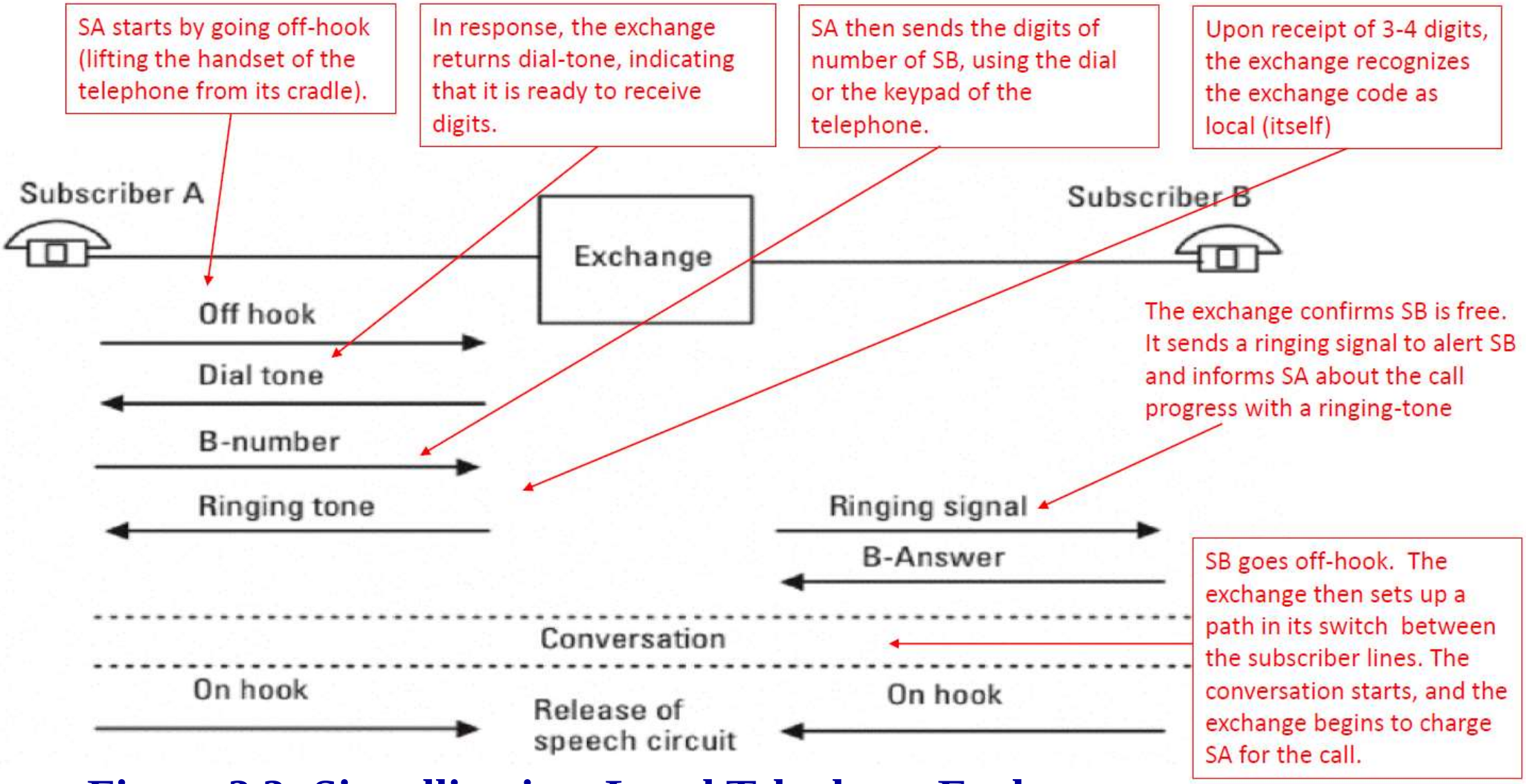


Figure 3.3: Signalling in a Local Telephone Exchange

3.1.6. Intra-exchange Signaling…

- **Call Processing - Local Call**
  - *Detect off-hook condition*
  - *Send dial-tone to calling station*
  - *Collect dialed digits*
  - *Translate digits to a called number*
  - *Route call*
  - *Prepare connection between stations*
  - *Send ring voltage to called station / ring-back tone to calling station*
  - *Detect off-hook by called station and cut-through the call*
  - *Detect disconnect and terminate call*

3.1.7. Intra-exchange Signaling

- **Inter-exchange Signalling** is the exchange of control information, ie call setup, call supervision ad call termination within telephone exchange/switch
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3.1.7. Intra-exchange Signaling…

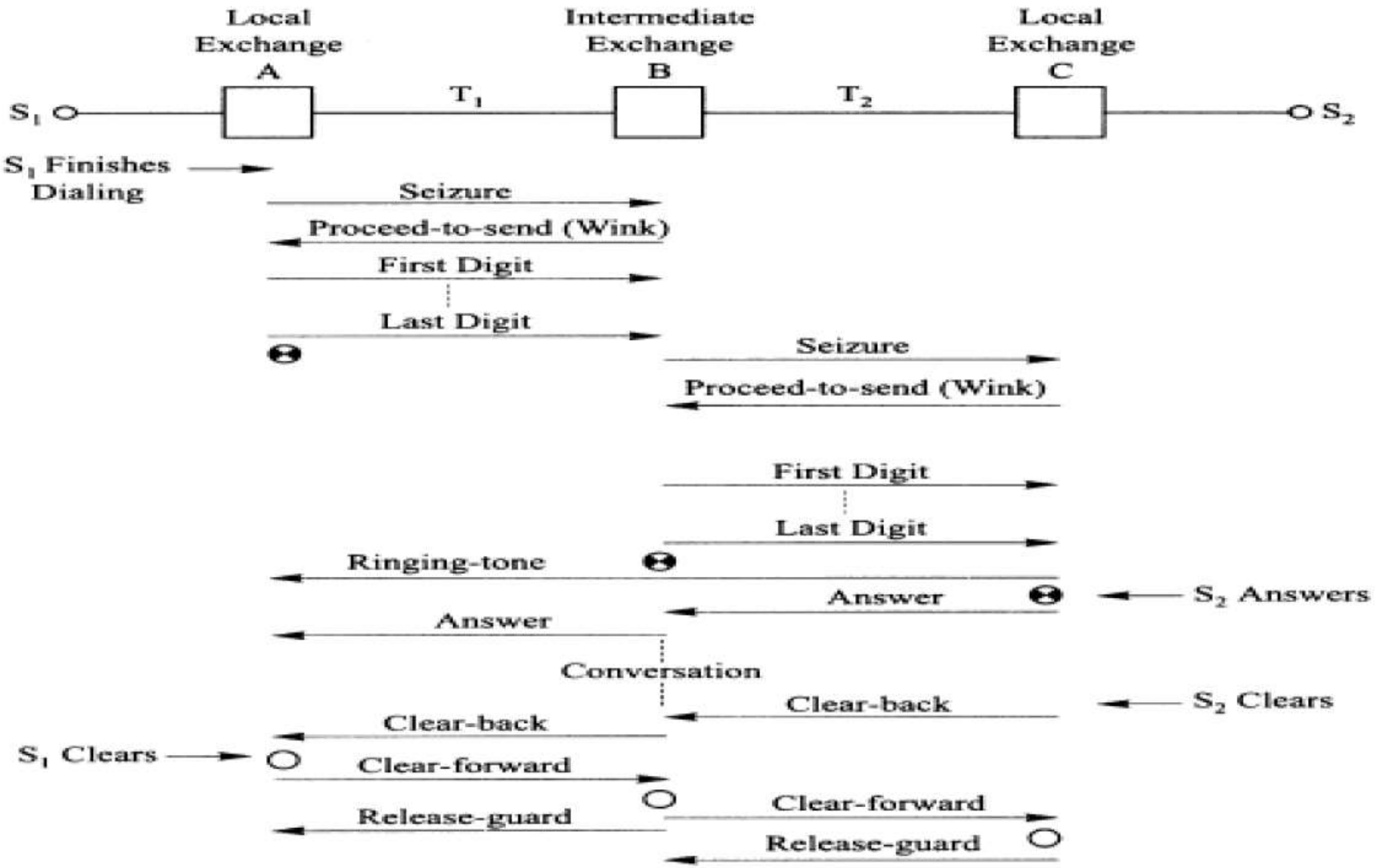


Figure 3.4: Signalling During a Transit Call

3.1.7. Intra-exchange Signaling…

- **Billable minutes:** The duration (counted in minutes) for which the reporting Service Provider (SP) is entitled to bill the customers. if the reporting SP offers any free-of-charge minutes to its customers, the free-of-charge traffic should be reported as part of the "billable minutes“
- "**Conversation minutes"** The duration (counted in minutes) measured by the reporting SP in which conversation can take place between the calling and called parties. A "conversation minutes" represent one minute of "conversation time“

3.1.7. Intra-exchange Signaling…

- **Conversation time**" is defined in the relevant ITU-T Recommendation to be the interval that elapses between.
  - The moment when the reply condition (answer signal in the backward direction) is detected at the point where the recording of the call duration takes places, and
  - The moment when the clear forward condition (Clear Forward signal) is detected at the same point.

Signaling Technique

Classifications

Part II

3.2: Signaling Technique Classifications

- 3.2.Signaling Technique Classifications
- 3.3. In Channel Signaling
- 3.3. Common Channel Signaling
  - 3.3.1. CCS Message Formats
  - 3.3.2. CCS Network
  - 3.3.3. CCS Classification
  - 3.3.3. Advantages of CCS
  - 3.3.5. Disadvantages of CCS…
  - 3.3.6. Comparison of Inchannel and CCS Signaling Techniques

3.2.Signaling Technique Classifications

- The signaling are classified as follows
  - Internal signaling of an exchange,
  - Signaling between exchanges
  - Signaling between an exchange and subscriber.

Thus a signaling system must be compatible with the switching systems.

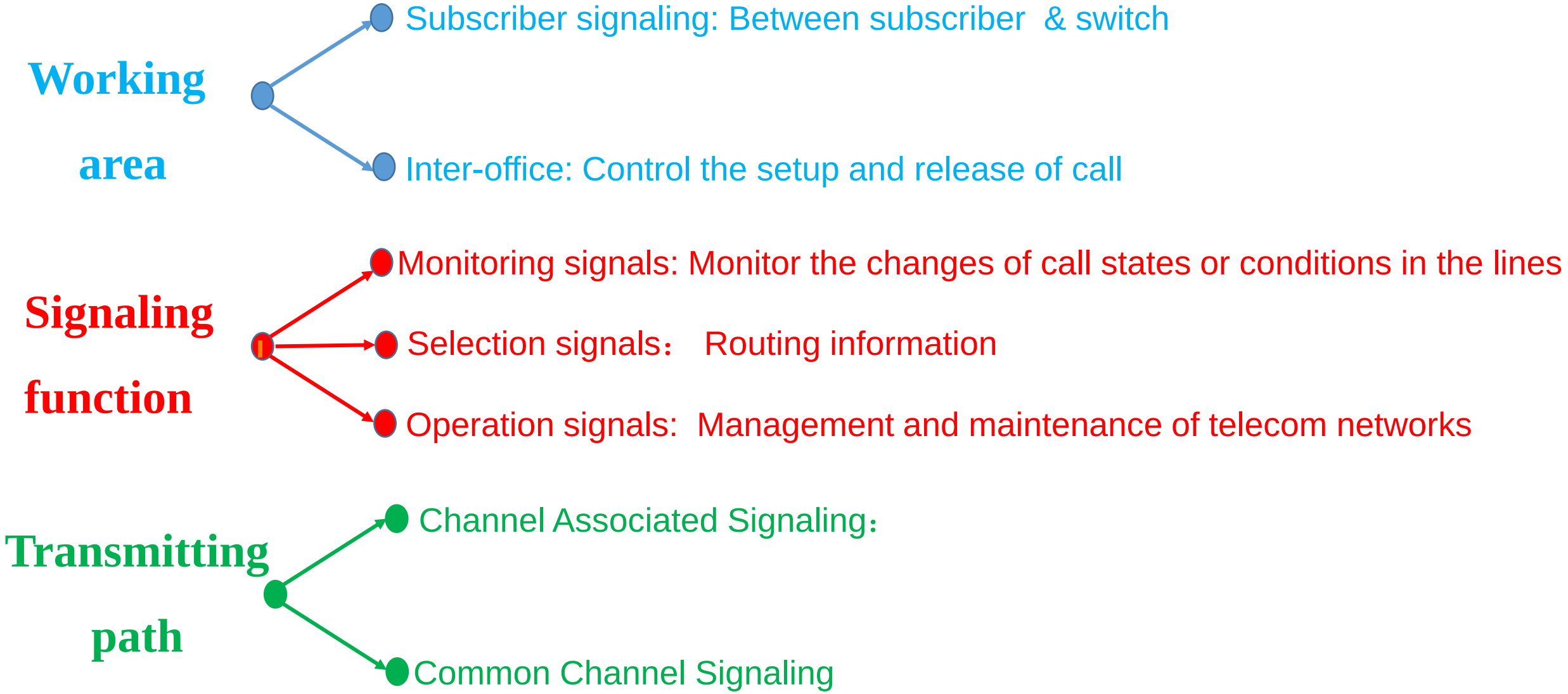
- **Forms of signaling**: information transmitted between subscribers, and between switching centers including
  - **Supervisory signals or line signals**. Signals necessary to initiate a call setup and to supervise it, once it has been established. (subscriber loop signaling).

3.2.Signaling Technique Classifications

- **Signals or register signals Information transfer related to call setup**. (Dialed code which indicates required routing. Others information's are signals route information, terminal information, register control signals, acknowledgement signals, status of called terminal.
- **Management signals or interregister signaling**: used to convey information or control between exchanges, also referred as inter exchange signaling. This signaling involves remote switching of private circuits, routing plans, modification of routing plans, traffic over load, priority of the call, class of service etc.

3.2.Signaling Classifications

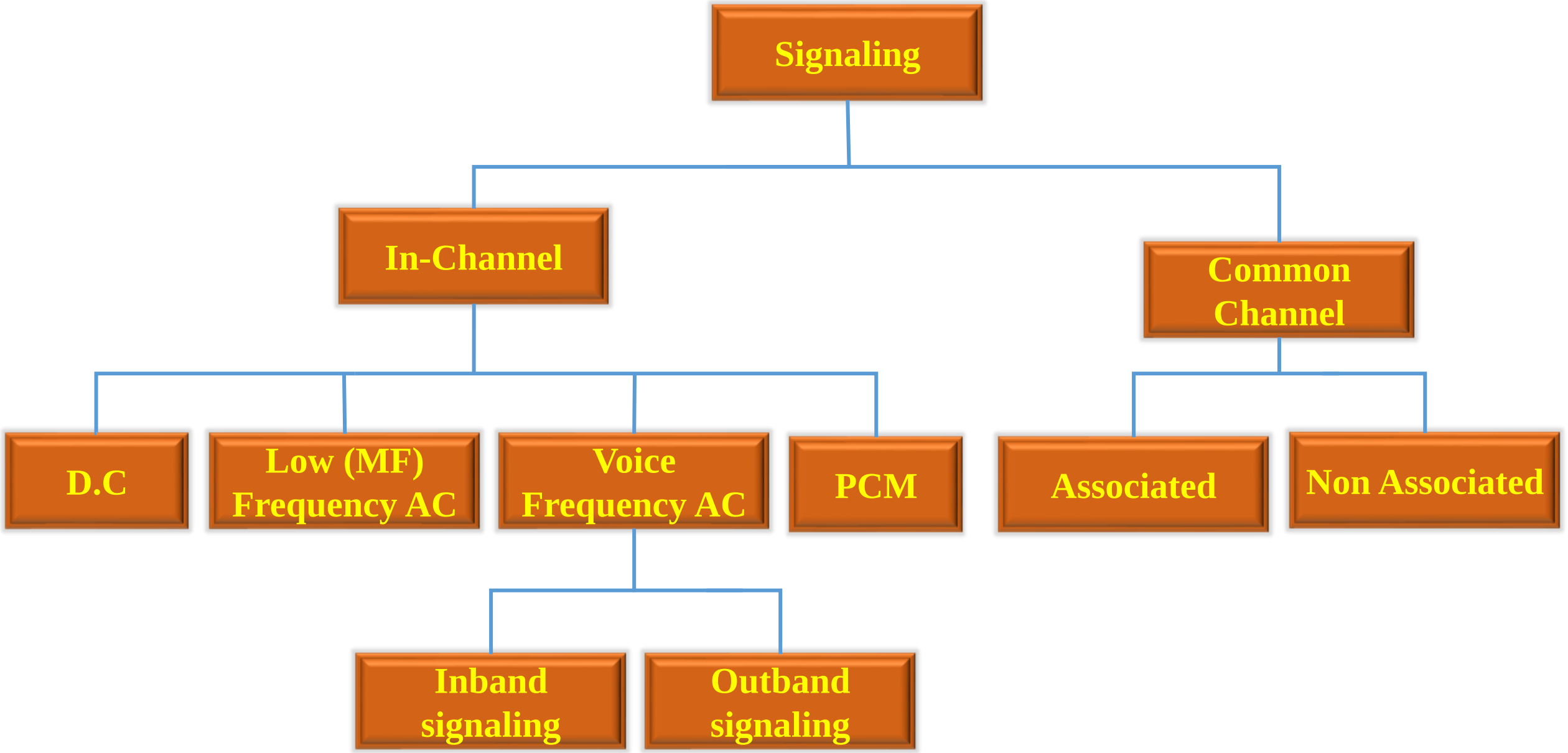
Signaling for Switching Systems can be classified in three Main category



3.2.1. Classifications

- **Signaling technique is classified into**
  - In channel signaling/per trunk signaling (PTS)
  - Common channel signaling (CCS)
- **In channel signaling/per trunk signaling (PTS):** uses the same channel to carry voice/data and control signals to carry out the path setup for speech or data transfer
- **Common Channel Signaling (CCS)**: uses a separate common channel for passing control signals. It couples the signals for a large number of calls together and send them on a separate signaling channel
  - The Inchannel signaling is classified further into four categories

3.2.2. Signaling Technique Classification



3.3. In Channel Signaling

- **In Channel Signaling:** Uses same path for control signals and data/speech
  - **Loop disconnect – dc signaling:-**Aimed at interrupting D.C path of the subscriber's loop for a specified number of short periods to indicate dialed number dialed. This is called loop-disconnect (or rotary) signaling.
  - **Multi frequency (mf) – ac signaling**:- Sends out frequency based tones instead of electrical impulses. This is called a dial tone multi frequency (DTMF).
  - **Voice frequency (vf)** – ac signaling:-signaling frequencies are chosen within the range of base band of telephone channel,
  - **PCM signaling**: Signaling and speech are sampled, coded and transmitted within the frame of PCM channels.

3.3. Common Channel Signaling

Common Channel Signaling (CCS): or Common Channel Interoffice Signaling (CCIS), Uses a separate channel from the data/Voice, and, more specifically, where that signaling channel controls multiple data channels...

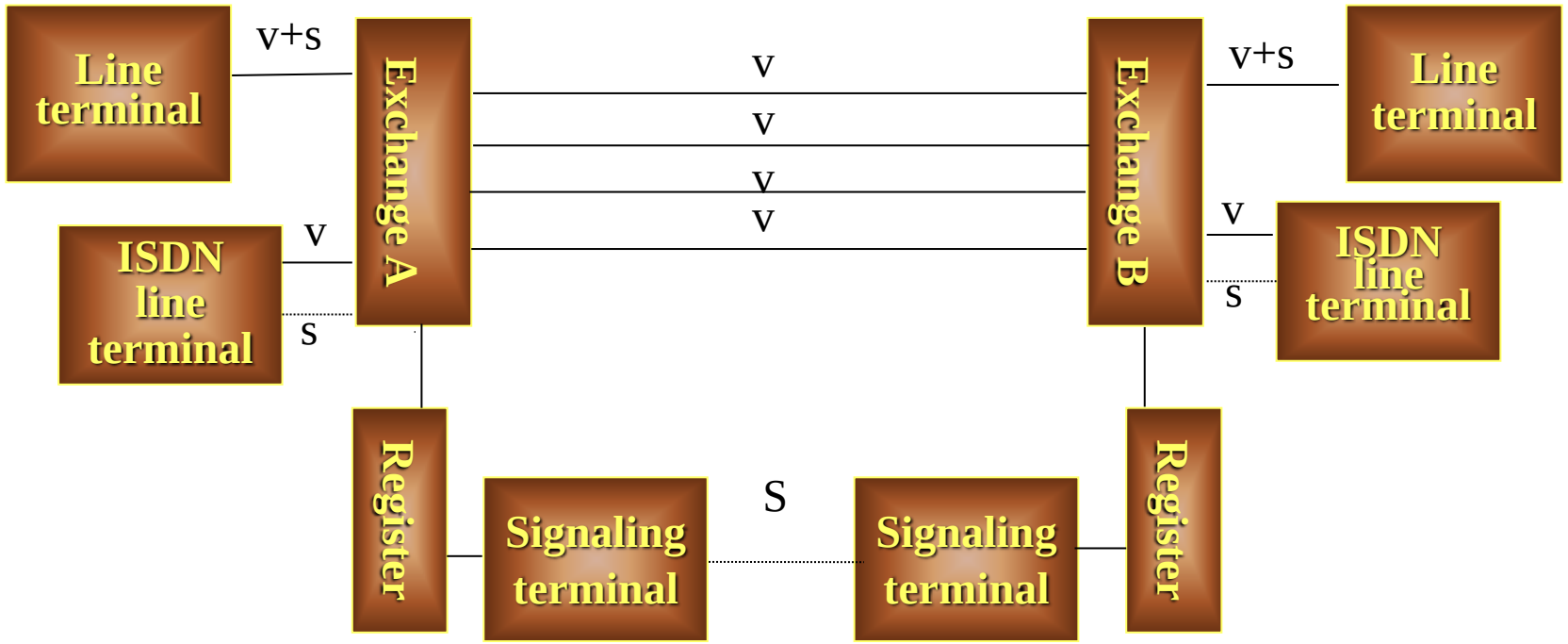


Figure 3.6 Common Channel Signaling System

3.3.1. CCS Message Formats

- In CCS information Message is transferred as signaling units, which is of varying length with one or more fixed length.
- A signaling unit is divided into a number of fields
- The fields (units) may be address, centralized service message, acknowledgement, synchronization or idle, management message etc.
- The signaling information includes
  - Routing,
  - Addressing digits,
  - Inter exchange information,
  - Routing status to the originating exchange maintenance request/details etc.

3.3.1. CCS Message Formats.....

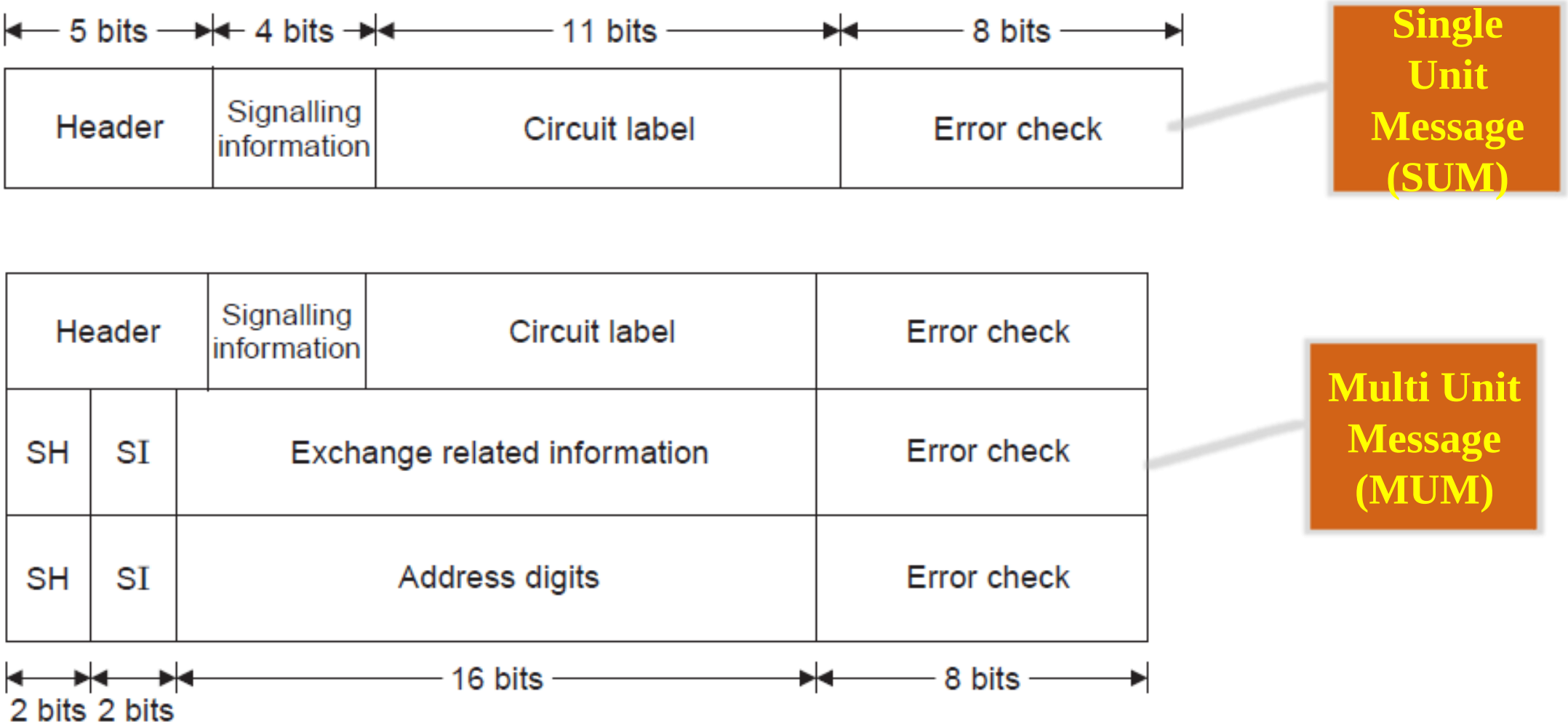


Figure 3.7: Basic CCS Message Formats.

3.3.2. CCS Network

- CCS network improved the performance of the existing network and established a platform for the introduction of new facilities.
- The CCS network links increases the speed of long distance call connect timings and reduces the cost compared to the Inchannel SF/MF signaling.
- There are two types CCS network nodes.
  - Signal transfer Points (STP)
  - Signal control Points (SCP).
- These nodes are interconnected by signaling links..

3.3.3. CCS Classification

- CCS may be implemented in three ways.
  - Channel Associated mode
  - Channel Non-Associated mode
  - Quasi-Associated mode
- **Channel Associated mode**: there is a direct link between two exchanges where signaling path passes through the same set of switches as does the payload/speech.

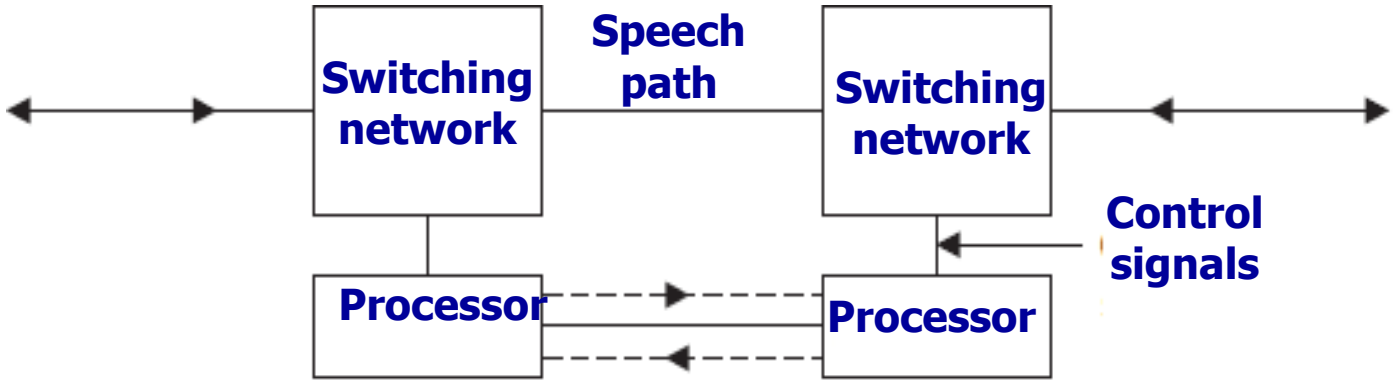


Fig. 3.8: Channel Associated signaling

3.3.3. CCS Classification....

- **Channel Non-Associated mode**: there are separate control of the networks from the switching Nodes. In multi-exchange network, signal message passing through several intermediate nodes.

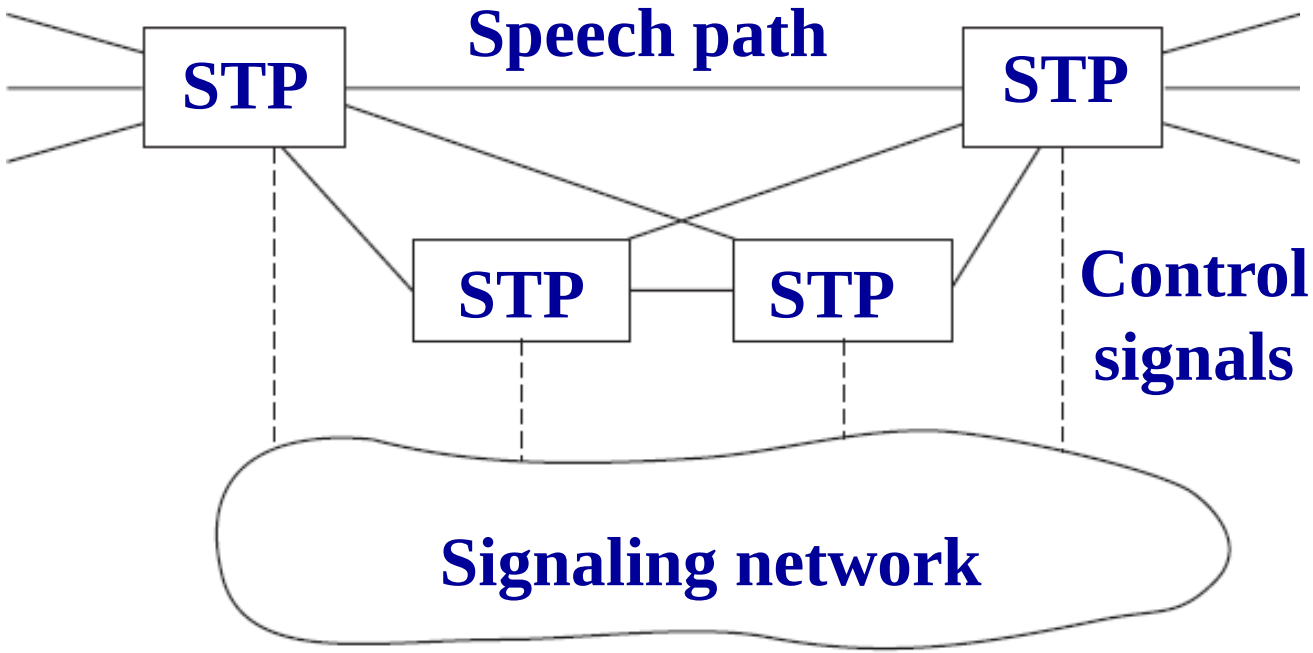


Fig. 3.9: Non-associated signaling

3.3.3. CCS Classification....

- **Quasi-Associated mode**: Signaling messages are routed through one intermediate node for short distance communication.(simplified paths between exchanges).

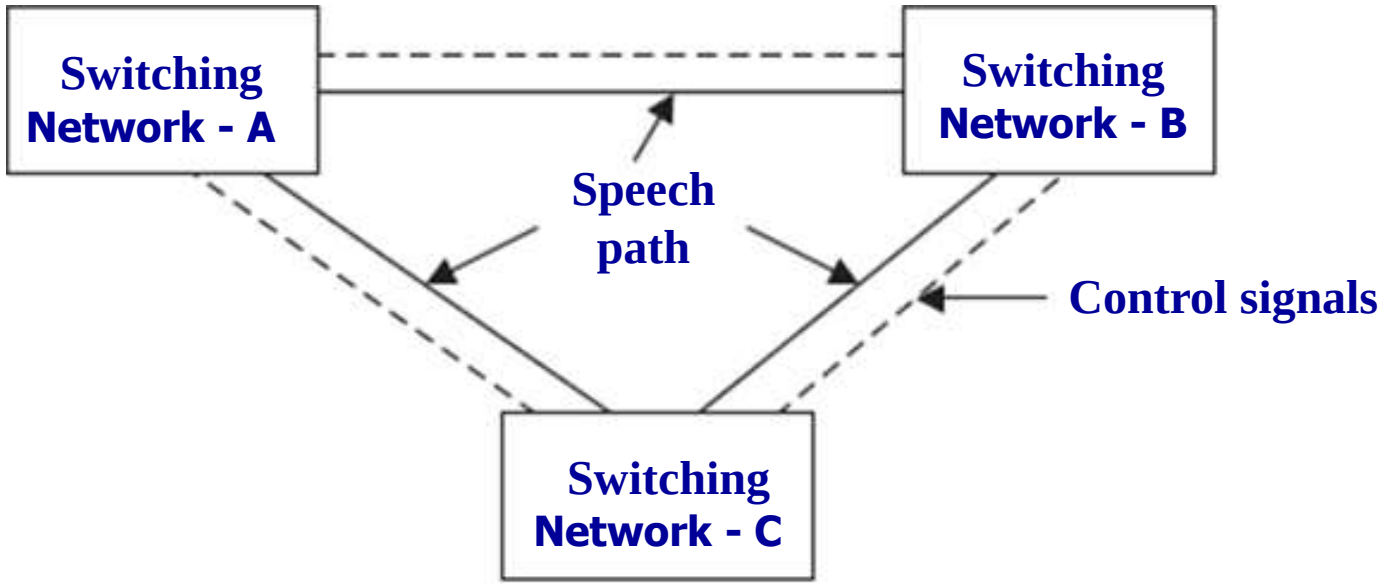


Fig. 3.10: Quasi-associated signaling

3.3.3. Advantages of CCS

- For each associated trunk group, only one set of signaling facility is required.
- Provides efficient routing procedure.
- Allows signaling at any time in the entire call duration, not only at the beginning.
- Provides acceptable quality for network related signaling tones
- There is no chance of mutual interference and the error rate is very low.
- With a huge signal capacity, it can hold dozens or even hundreds of different kinds of signals, thus providing more new services.
- With a great flexibility, Provides more new services simply by modifying software.
- Line signaling device is not needed any more at any trunk station, which shall greatly reduce investment costs.

3.3.3. Advantages of CCS…

- Since line signaling is no longer needed, trunk devices can be used both in calls from A to B, and in calls from B to A. In such bi-directional working modes, even less circuits are required than when trunk circuits are respectively used in single call directions.
- When a call is being set up, signals related to this call can be sent. In this way, the subscriber can change the already setup connections. For example, the subscriber can transfer one call to another place, or request a third party to join the present connections.
- Information can be exchanged between processor at high speed. Hence to allows maintenance or network management.

3.3.5. Disadvantages of CCS…

- More over heads due to, in an established circuit, the signaling information are stored, processed and then forwarded to next node.
- Thus, a high degree of reliability is required for the common channel.
- The integrity of speech path is not assured. Since signaling information is not actually sent over speech paths in CCS,
- The error rate of the common channel signaling system must be very low.
- Its reliability must be much high, because once the data link fails, all related calls between the two related switches shall be affected.
- Bi-directional trunk working modes exist conflict of seizure (A Sudden Disorder).
- Compatibility problem in mult-vendor environment. *The SS7 systems that every transnational corporation produces are having some problems in compatibleness.*

3.3.6. Comparison of Inchannel and CCS Signaling Techniques

SN	IN-CHANNEL	COMMON CHANNEL
1	Trunks must be held during signaling	Trunks are not required for signaling
2	Signal repertoire is limited	Extensive signal are repertoire is possible
3	Interference between voice and Control Signal may occur	No Interference since the channels are physically separate
4	Signaling equipment is required for every trunk and hence is expensive	Only one equipment is required for a whole group of trunks making CCS much cheaper
5	There is potential for misuse by customer who can generate signals to mimic signaling	Control channel is un-accessible to users
6	Signaling is relatively slow	Signaling is significantly faster
7	Speech circuit reliability is assured	There is no automatic test of the speech circuit
8	It is difficult to add or change a signal since all trunks must be altered	Signals can be added or altered at any time due to separate signaling channel
9	it is difficult to handle signaling during the speech period	Signaling can be handled at any time due to the separate signaling channel

Signaling System 7

Part III

3.5: Signaling System 7

- 3.5.1. The Goal of Signaling System 7
- 3.5.2. Purpose of SS7 network
- 3.5.3. Features of SS7
- 3.5.3. SS7 Network Architecture
- 3.5.5. SS7 Signaling Link Types
- 3.5.6. Protocol Architecture of SS7
- 3.5.7. SS7 Signaling units
- 3.5.8. SS7 Signaling units – Common Fields
- 3.5.9. SS7 Call Flow - Common Case
- 3.5.10. Basic Call Setup with ISUP

3.5. Introduction to Signaling System 7

- **Signaling System 7 (SS7)** Is a Global standard (Architecture) for telecommunication defined by ITU-T for preforming out-of-band singling in support of the call-establishment, billing, routing, and information-exchange functions of the PSTN.
- SS7 identifies functions to be performed by signaling-system network and a protocol to enable their performance.(*web proForum Tutorials, www.iec.org*)

3.5.1. The Goal of Signaling System 7

- **The Goal of SS7:** Suggests Internationally standardized CCS system with general applications fields to enable digital communication networks (SPC switches) work efficiently. Furthermore, such networks can provide sequential (Forming or characterized by a sequence) and highly reliable transmission with no loss and no repetition.

3.5.2. Purpose of SS7 network

- SS7 is a prerequisite for introduction of
  - Internal control and network intelligence essential to an ISDN
  - Intelligent Network (IN)
  - Personal Communication Systems (PCS) for personalized services (voice, data, image and video) that can be accessed regardless of location, network and time
- To access remote database to lookup
- Increased revenue generation, additional call charging capabilities (Bundles etc.)

3.5.2. Purpose of SS7 network..

- Enables quick and efficient call setup and teardown across the network
- Full use of the channel for the talk
- Enhanced call features (forwarding, name/number display and conference
- Rerouting of network by using automatic protection switching services
- Uses packet Switching concept hence, capable of preventing the misrouted calls, duplication of call requests and lost packets

3.5.3. Features of SS7

- standardized by the ITU.
- suitable for any transmission medium i.e., can be operated over both terrestrial and satellite links.
- optimized to work with digital SPC exchanges utilizing 64 kbps digital channels, it is suitable for operation over analog channels.
- suitable for various services such as Voice, text, data, images and video.
- Transport mechanism is application independent
- High performance and flexibility
- High reliability for message transfer
- Faster, efficient in the call setup and teardown process

3.5.3. SS7 Network Architecture

The SS7 network is built out of the following three essential components, interconnected by signaling link:

- **Signal Switching Points (SSP's)** are Telephone switches (end offices or tandems) equipped with SS7 - capable software and terminating signaling links. they are generally originate, terminate, or switch calls.

SSP Symbol

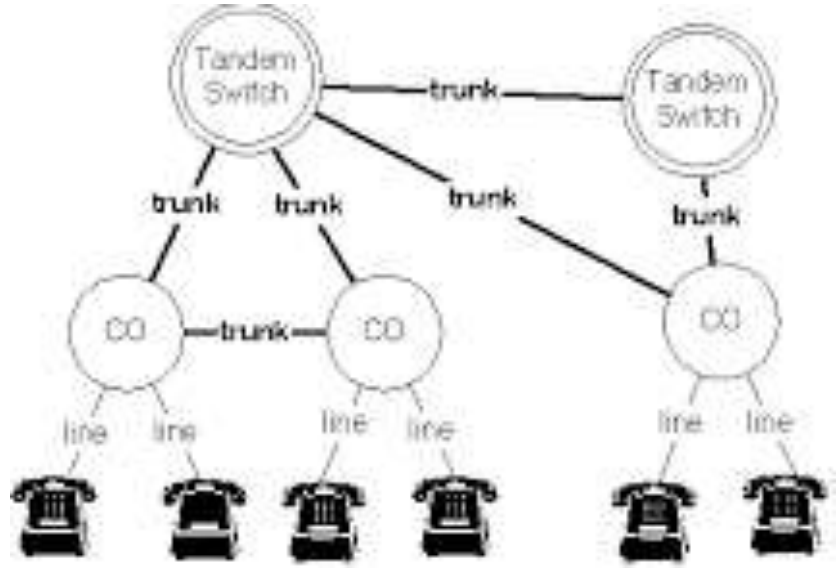
3.5.3. SS7 Network Architecture

- **Take Note**

- **Tandem Switch** is a telephone central office switch that links telco end offices together and does not connect to the customer directly. Also called a "Class 4 switch" or "TDM switch,"

- Configured to route traffic amongst themselves or to other switches for such purposes as capitalizing on preferential rates, etc.

- It is computer that is specialized for TDM-based, circuit-switched telephone calls.



T1/E1//STM-1/PCM/SS7

Media Gateway

3.5.3. SS7 Network Architecture…

- **Signal Transfer Points (STPs)** are the packet switches of the SS7 network. They receive and routes incoming singling messages towards the proper destination. Also they perform specialized routing functions.
- STP May Performs **Global Title Translation (GTT):** a procedure by which the destination Signaling Point (SP) is determined from digit present in the signaling message.
- Acts as a "fire wall" to screen SS7 messages exchanged with other networks
- Eliminating the need for direct links between SPs.

STP Symbol

STP pair Symbol

3.5.3. SS7 Network Architecture ..

- **Signal Control Points (SCP's)** are databases that provide information necessary for advanced call processing capabilities.
- An **SCP** sends a response to the originating **SSP** containing the routing number(s) associated with the dialed number. An alternate routing number may be used by the SSP if the prime number is busy or the call is unanswered within a specified time.

SCP Symbol

SCP pair Symbol

- SCP's and STP's are deployed in mated pair configurations in separate physical locations to ensure network Services Reliability and Availability

3.5.3. SS7 Network Architecture …

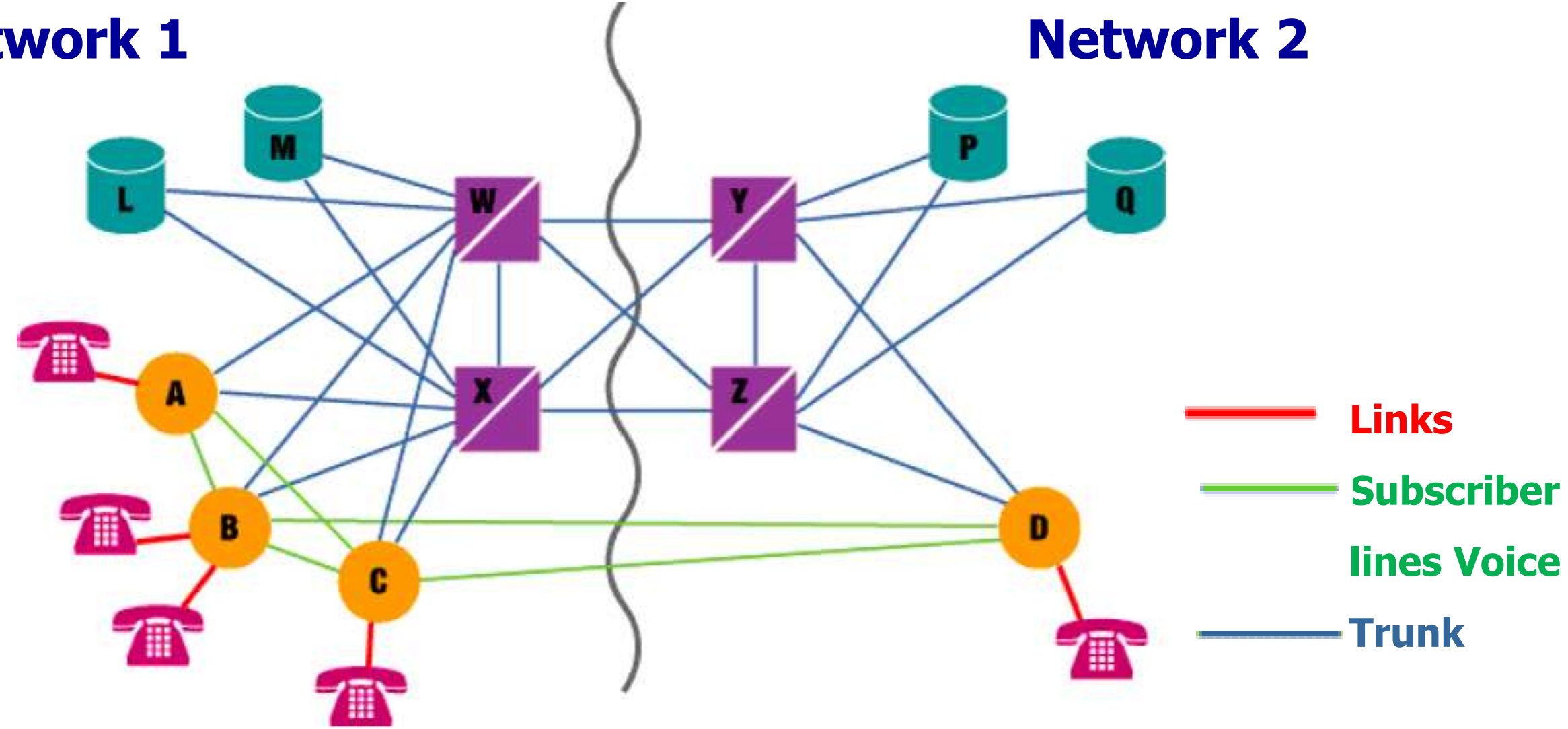


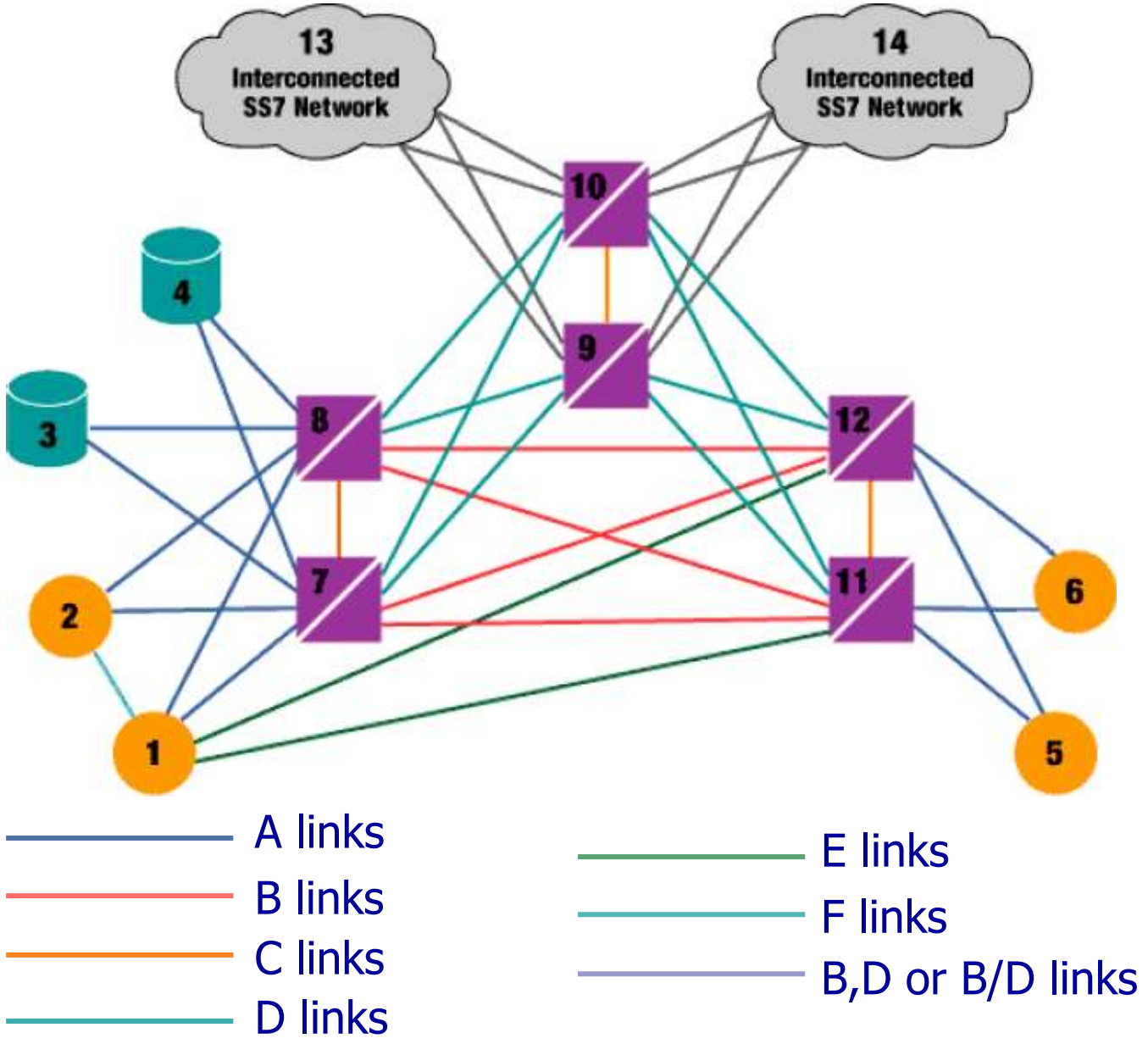
Figure 3.11: Typical SS7 Signaling Architecture

3.5.3. SS7 Network Architecture…

- **Mated pair of STPs** W & X and Y & Z they are referred as mated pairs they are redundant they perform identification functions.
- Each SSP has two links (or sets of links), one to each STP of a mated pair. All SS7 signaling to the rest of the world is sent out of these links. Because the STPs of a mated pair are redundant, messages sent over either link (to either STP) will be treated equivalently
- The STPs of a matched pair are joined by a link (or set of links)
- **Quad**. Two mated pairs of STPs interconnected by four links (or set of links)
- Matched pairs of SCPs. SCPs are usually deployed in pairs

3.5.5. SS7 Signaling Link Types

SS7 signaling link types are Characterized according to their use in the signaling network. Virtually all links are identical i.e. 56kbps or 64kbps bidirectional data links that support the same lower layers of the protocol



3.5.5. SS7 Signaling Link Types…

- **A links Link (Signaling):** interconnect an STP and either an SSP or SCPA stand for "**Access**".
- **B (Bridge) links**: Connects one STP to another STP. 'B' links, or D links interconnecting two mated pairs of STPs are referred as B/D links.
- **C (Cross) links:** Interconnect mated STPs. They are used to enhance the reliability of the signaling network in instances where one or several links are unavailable

3.5.5. SS7 Signaling Link Types…

- **D links (Diagonal) Q**uad of links interconnecting mated pairs of STPs at different hierarchical levels referred as either B,D or B/D links.
- **E links (Extended)** provide an alternate signaling path if an SSP's home STP can not be reached via an A link. E' links provide backup connectivity to the SS7 network.
- **F (Fully Associated)** Links connect two signaling end points. F links allow associated signaling only. They are not commonly deployed between networks. their use are within the discretion of the network Provide

3.5.6. SS7 Protocol Architecture

- SS7 protocol hardware and software functions are divided into functional abstractions called 'levels'. SS7 Protocol is layered
- The SS7 uses a four layer protocol stack that loosely maps OSI Model.
- The bottom three layers are meant for communication transmission of the messages.
- These three levels are referred to as the Message transfer part (MTP).
- MTP provides a reliable service for routing messages across SS7 network.
- The upper portion or the fourth layer of the stack performs the data processing function.

3.5.6. SS7 Protocol Architecture…

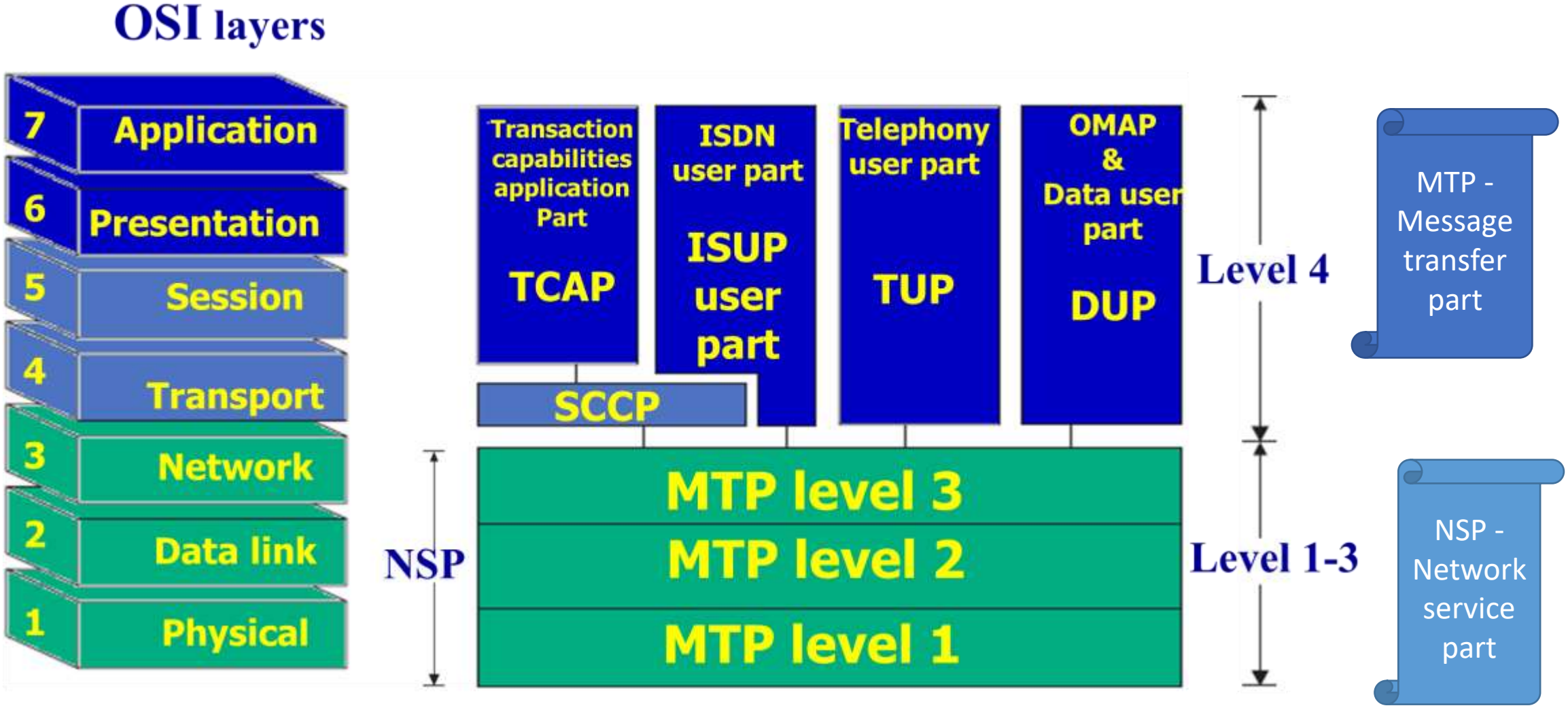


Figure 3.12:OSI and SS7 protocol architecture.

3.5.6. SS7 Protocol Architecture..

- **MTP level 1:** Defines the physical, electrical and functional characteristics of the digital signaling link.
  - uses time slot of a 2 Mbit/s PCM system or time slot 24 of a 1.5 Mbit/s system (E–1 (2048 kb/s, 3264 kb/s channels)
- **MTP level 2**: Provides link layer functionality, ensures the two end points of a signaling link can reliably exchange signaling messages. It incorporate capabilities such as error checking, flow control, and sequence checking.
- **MTP level 3**: Equivalent to OSI network layer, provides network layer functionality.
  - Its functions includes node addressing, routing alternate routing and congestion

3.5.6. SS7 Protocol Architecture…

- **Signaling Connection Control Part (SCCP)** provides connectionless and connection-oriented network services.
  - SCCP and MTP together are referred to as Network Service Part (NSP).
  - SCCP provides two major functions that are lacking in the MTP.
    - ✓It has the capability to address applications within a signaling point.
    - ✓Incremental routing using a capability called Global Title Translation (GTT)

3.5.6. SS7 Protocol Architecture…

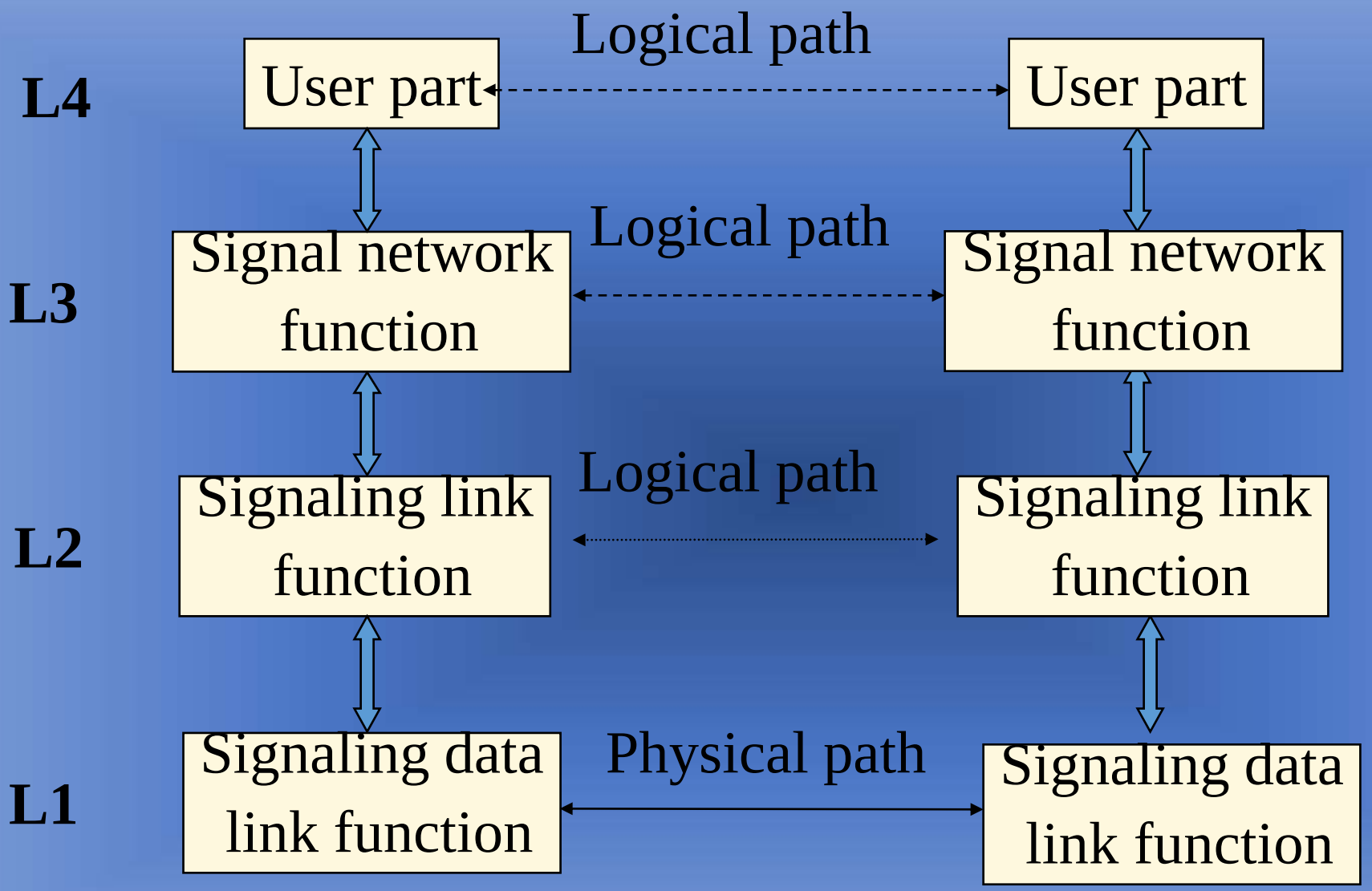
- **Take Note:**
  - GTT frees originating signaling points from the burden of having to know every potential destination to which they might have to route a message.
  - GTT selects the correct destination to which the message should be routed.
  - GTT effectively centralizes the problem and places it in a node (the STP) that has been designed to perform this function.

3.5.6. SS7 Protocol Architecture…

- **Signaling Connection Control Part (SCCP)** provides connectionless
- **Transaction Comptabilities Application Part (TCAP)** defines the message and protocol used to communicate between application in nodes. used for Database services i.e. IAN services (repeat dialing and call return).
- **Telephone Use Part (TUP)** is an analog protocol that performs basic telephone call connect and disconnect. Such as establishment, maintenance, and termination of telephone calls.

3.5.6. SS7 Protocol Architecture…

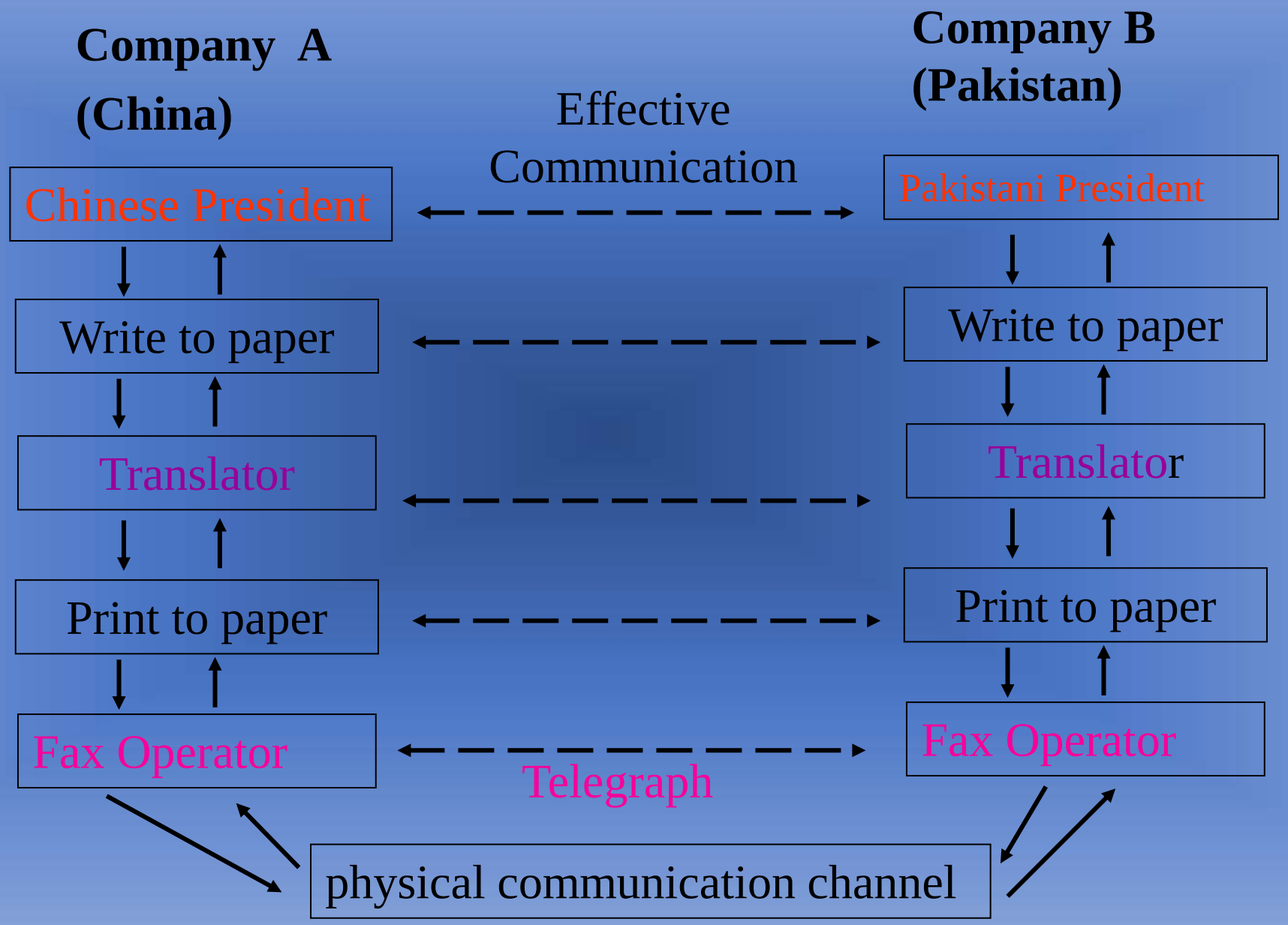
- **ISUP (ISDN User Part):** Supports basic telephone call connect/disconnect between end offices. ISUP was derived from TUP, but supports ISDN and intelligent networking functions.
- **DUP (Data User part):** Defines the necessary call control, and facility registration and cancellation related elements for international common channel signaling by use of SS7 for circuit-switched data transmission services.
- **Operations, Maintenance and Administration part (OMAP):**Defines messages and protocol designed to assist administrators of the SS7 network.


L4
L3
L2
L1
User part
Logical path
User part
Signal network function
Logical path
Signal network function
Signaling link function
Logical path
Signaling link function
Signaling data link function
Physical path
Signaling data link function

Example

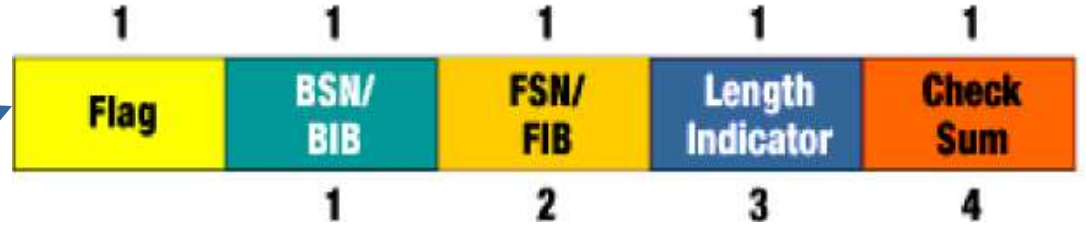
President of a Chinese company is communicating with the Principal of DIT , however neither speaks the other's language. Each employs an English translator and the translated messages are sent by the Fax operator over physical communication channel. Thus, they are communicating with each other through five layers below them

Example


Company A
(China)
Company B
(Pakistan)
Effective
Communication
Chinese President
Pakistani President
Write to paper
Write to paper
Translator
Translator
Print to paper
Print to paper
Fax Operator
Fax Operator
Telegraph
physical communication channel

3.5.7. SS7 Signaling units

- Signaling information is passed over the signaling link in messages, which are called signal units (SUs). The SU is based on the high level data link control (HDLC) protocol.
- Three types of SUs are defined in the SS7 protocol
  - Fill-in signal unit (FISU)
  - Line status signal unit (LSSU)
  - Message signal unit (MSU)



3.5.8. SS7 Signaling units – Common Fields

- **The following are the common fields used in all the signalling units**
  - **Flag:** The flag indicates the beginning of a new signal unit and implies the end of the previous signal unit (if any).
  - **Backward Sequence Number (BSN). U**sed to acknowledge the receipt of signal units by the remote signalling point.
  - **Backward Indicator Bit (BIB):** A negative acknowledgement is indicated by inverting the BIB bit, which remains unchanged for all subsequent positive acknowledgement.

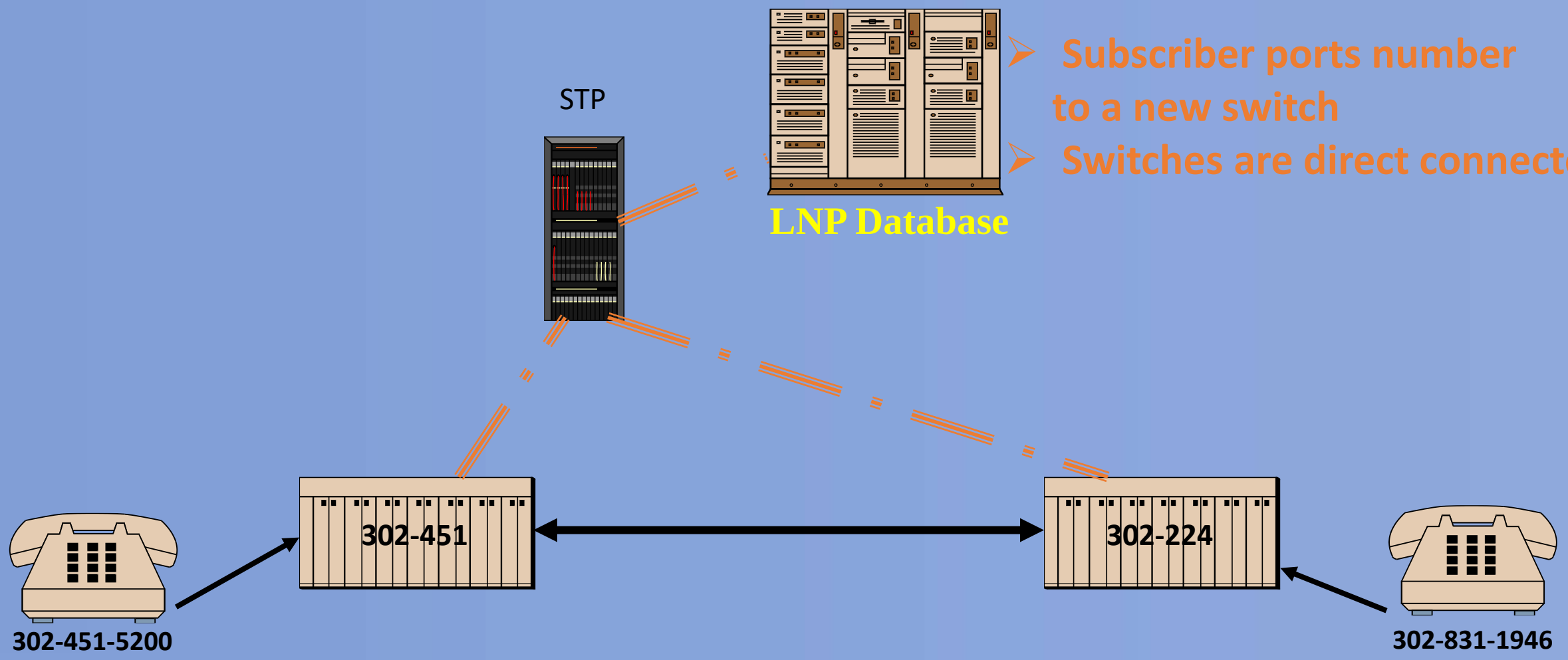
3.5.8. SS7 Signaling units – Common Fields

- **Forward Sequence Number (FSN)** contains the sequence number of the signal unit and identifies the SU uniquely using modulo 128 count.
- **and Forward Indicator Bit (FIB)** is used in error recovery like the BIB.
- Cyclic Redundancy Check (CRC) is 16bit field used to detect and correct data transmission errors.
- Length Indicator (LI) it is an 8 bit bytes serves both as a check on the integrity of the SU and as a means of discrimination between different types of SUS at level2.

3.5.8. SS7 Signaling units – Common Fields…

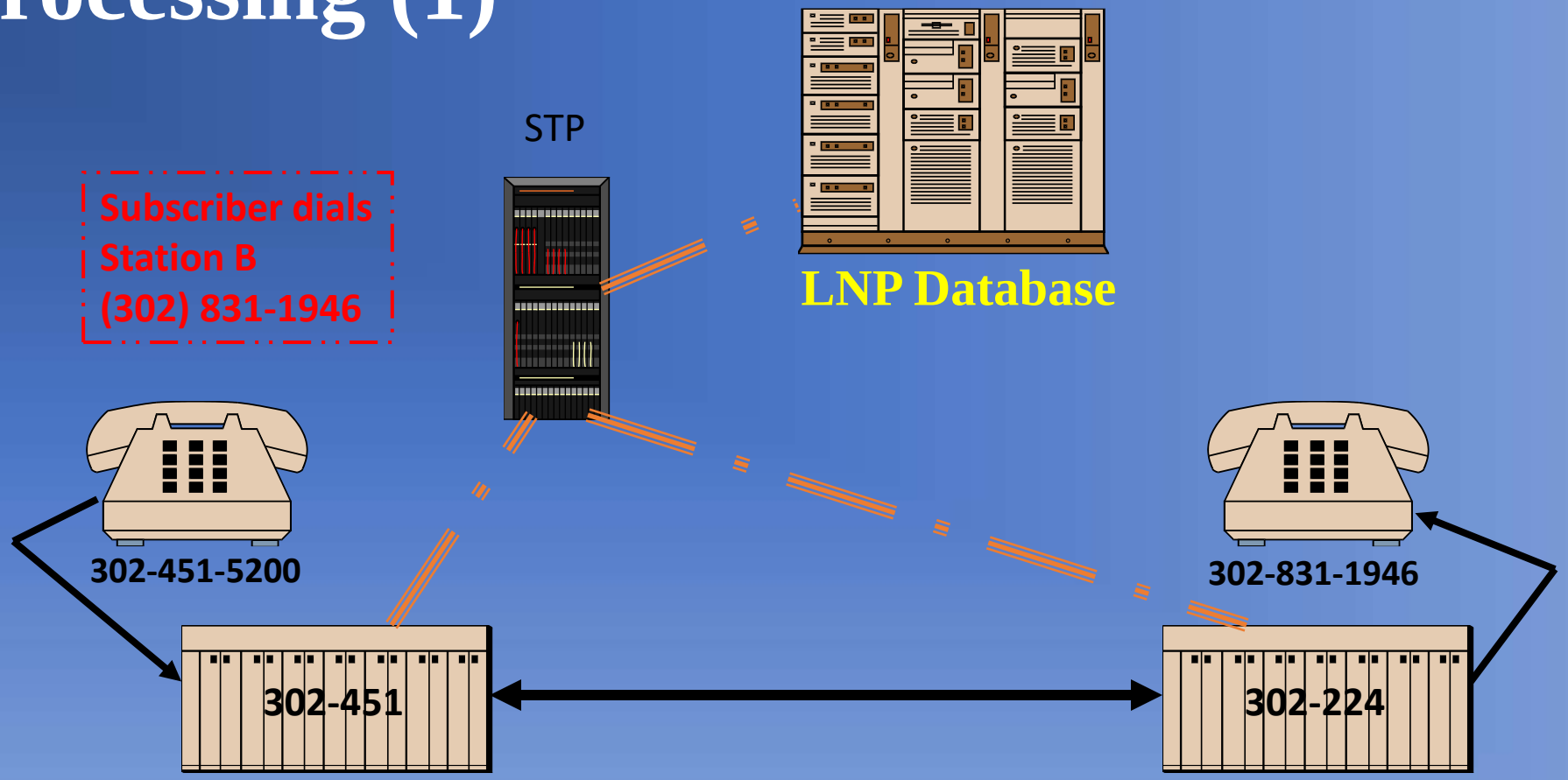
- **Service information octet (SIO)** it indicates the user part according to the message (e.g., telephone, data or ISDN).
- **Signalling Information Field (SIF)** may consist of upto 272 octets, it contains the information to be transmitted. The SIF in an MSU contains the routing label and signalling information.

3.5.9. SS7 Call Flow - Common Case



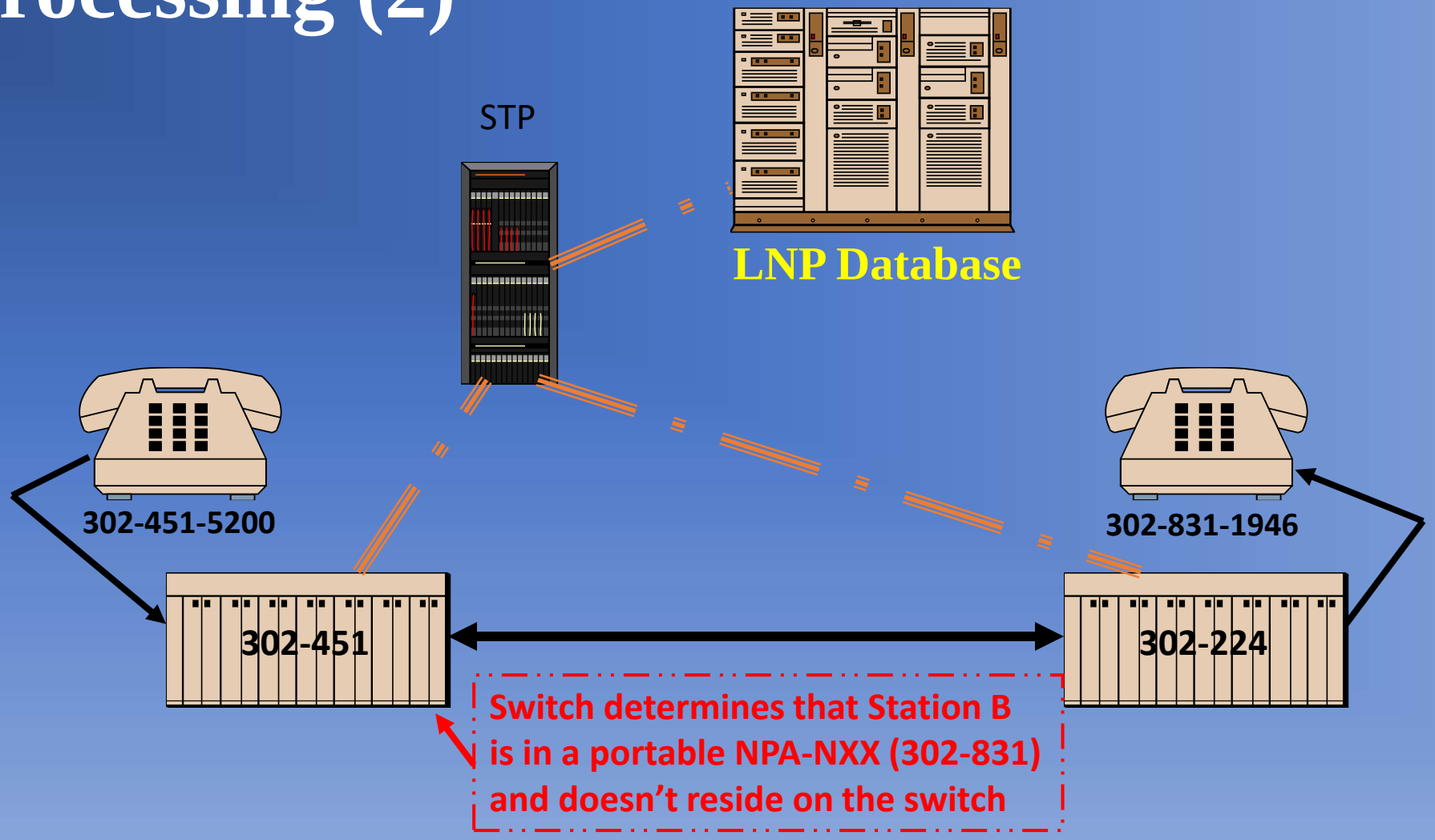
3.5.8. SS7 Call Flow - Common Case

Call Processing (1)



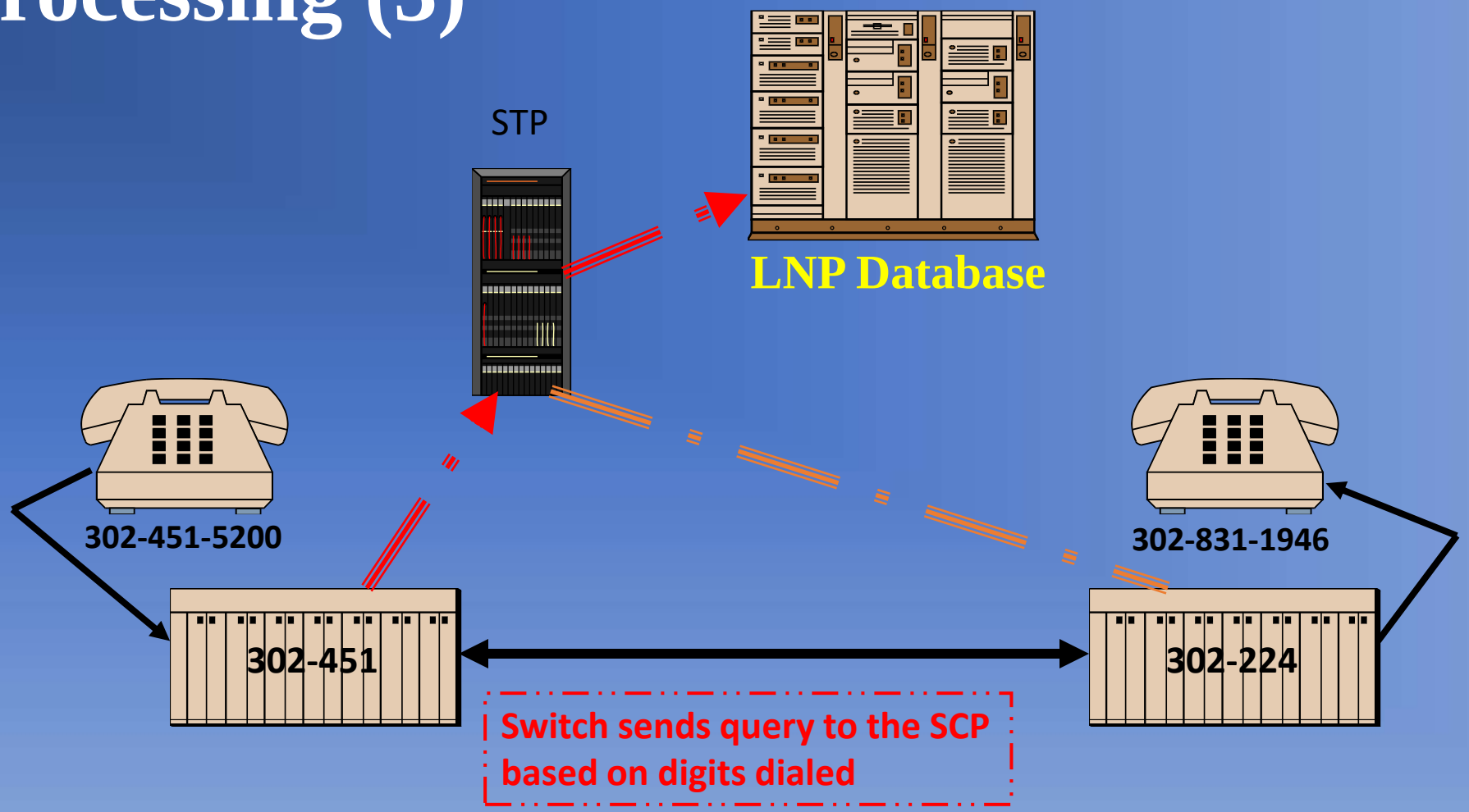
3.5.9. SS7 Call Flow - Common Case

Call Processing (2)



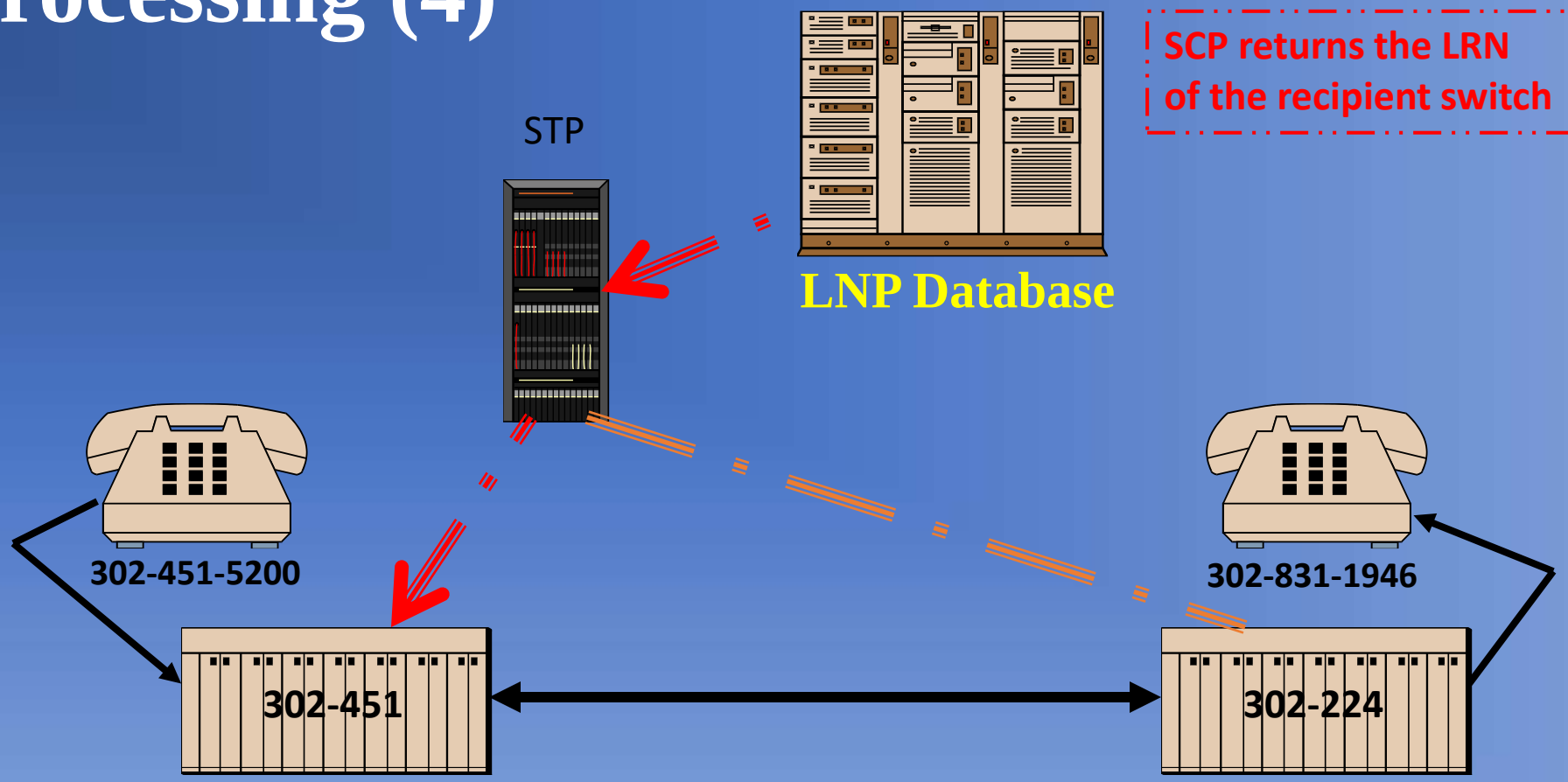
3.5.9. SS7 Call Flow - Common Case

Call Processing (3)



3.5.9. SS7 Call Flow - Common Case

Call Processing (4)



3.5.10. Basic Call Setup with ISUP

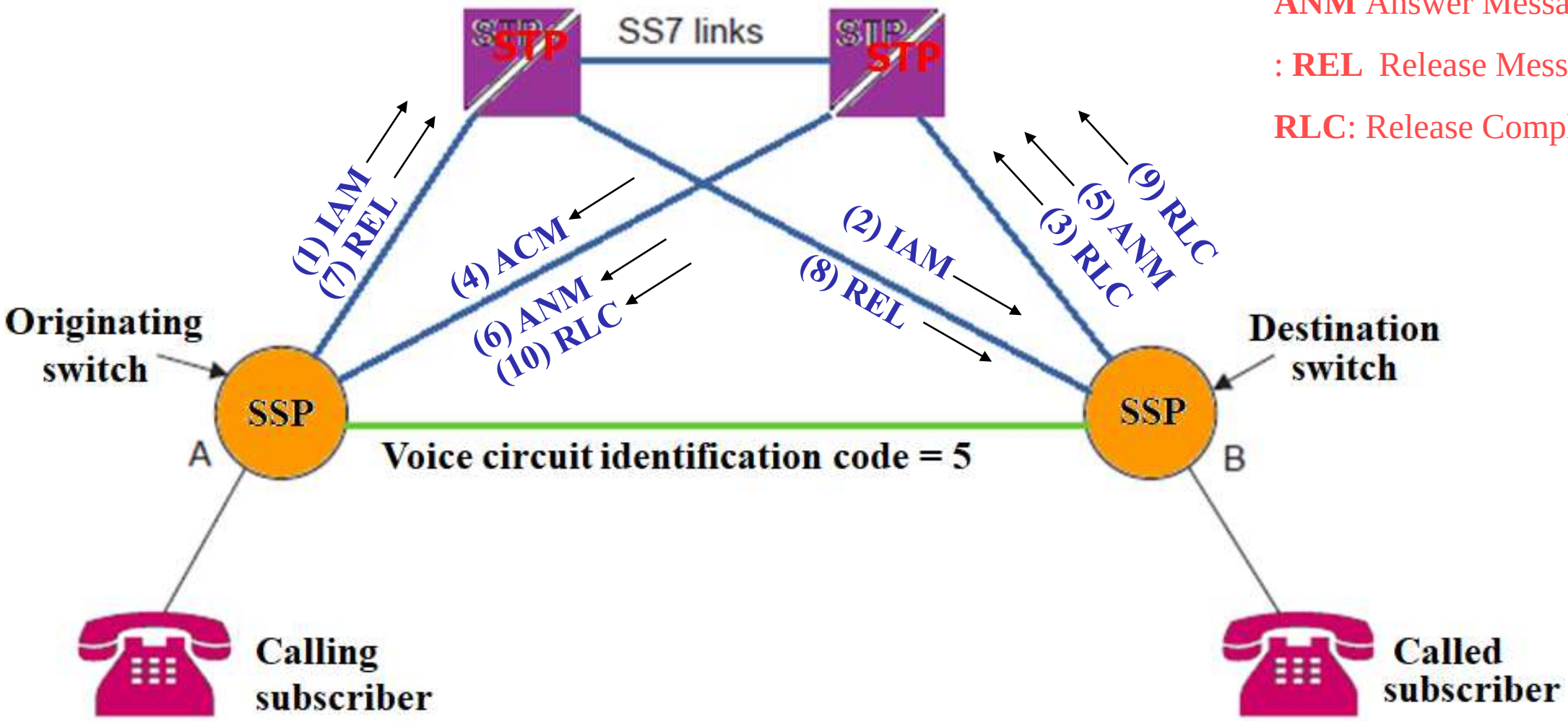
IAM: Initial Address Message

ACM : Address Complete Message

ANM Answer Message

: **REL** Release Message

RLC: Release Complete Message



3.5.10. Basic Call Setup with ISUP…

- When calling subscriber calls a subscriber, the originating SSP transmits an ISUP Initial Address Message (IAM) to reserve an idle trunk from switch A to B. The IAM includes the originating point code, destination point code, calling and called numbers.
- The IAM is routed via the home STP of the originating switch to the destination switch. Same signaling links are used for the full duration of a call unless a link failure forces to change link.
- On reception of IAM by called subscriber (if idle), the destination switch transmits an ISUP Address Complete Message (ACM) to its home STP.

3.5.10. Basic Call Setup with ISUP…

- The destination switch rings the called subscriber and send a ringing tone over the trunk to the originating switch.
- When the called party picks the phone, the destination switch terminates the ringing tone and transmits an ISUP Answer Message (ANM) to the originating switch via its home STP.
- The STP routes the ANM to the originating switch and initiates billing.
- If the calling subscriber hangs up first, SSP (A) sends an ISUP Release Message (REL) to release the trunk circuit between the switches.
- The STP routes REL to the destination switch.

3.5.10. Basic Call Setup with ISUP…

- If the called subscriber hangs up first, the destination switch sends an REL to the originating switch
- Upon receiving REL, the destination switch disconnects the trunk from the called party's line. Then, it transmits an ISUP release complete message (RLC) to the originating switch to acknowledge the release of the trunk circuit.
- When originating switch receives RLC, it terminates billing cycle and sets the trunk state to idle.

End of Lecture 03

Any Questions ?

Thank you Class for your Attention

Reference book

1. Telecommunication Switching Systems and Networks, by Thiagarajan Viswanathan, PHI.
2. Telecommunication Systems Engineering, R. L. Freeman, 4/e, Wiley publication, 2010
3. Telecommunication Switching and Networks. By P. Gnanasivam, New Age International.

3.5.10. Basic Call Setup with ISUP

IAM: Initial Address Message

ACM : Address Complete Message

ANM Answer Message

: **REL** Release Message

RLC: Release Complete Message