

# OVERVIEW OF SS7

Notes prepared for EEDG/CE 6345

by

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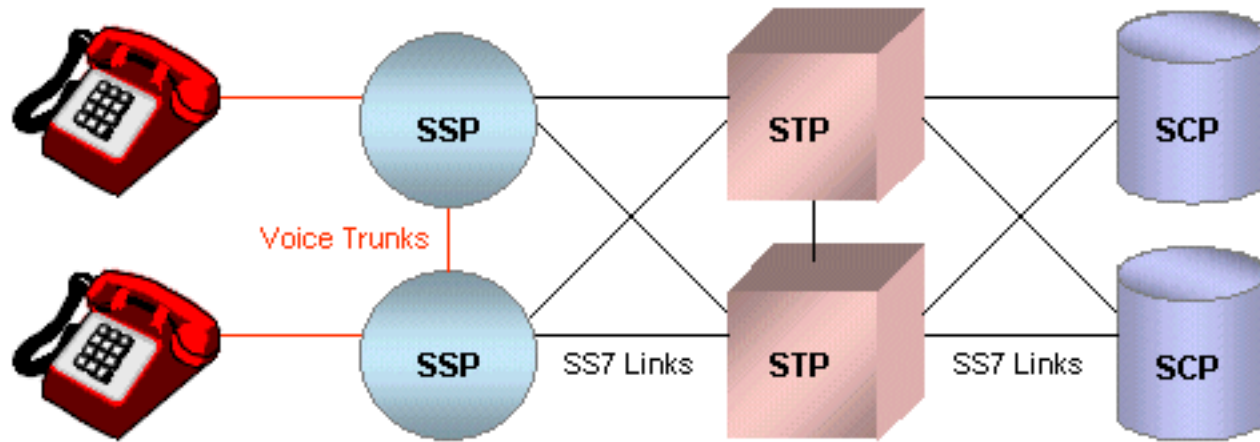
## COMMON CHANNEL SIGNALING SYSTEM NO. 7

- An international standard for exchange of information on call setup, call routing and control in the PSTN
  - ▷ Standardized by the ITU-T
    - North American variant standardized by ANSI and Bellcore
  - ▷ The SS7 network enables enhanced services such as:
    - Call setup, management and teardown
    - CallerID, call forwarding, 3-way calling, ...
    - Toll-free (800/888) and toll (900) services
    - Wireless roaming
    - Wireless subscriber authentication
  - ▷ SS7 information travels over a separate network
    - Message-based packet network
    - SS7 signaling links are dedicated channels, separate from voice channels

## SS7 ARCHITECTURE

- SS7 signaling links are DS0 bidirectional channels
  - ▷ SS7 signaling is out-of-band, meaning that a signaling link is not in a voice channel
  - ▷ Out-of-band signaling enables:
    - Faster call setup than would be possible with in-band signaling using multifrequency tones
    - Support for intelligent network features such as database systems
- Types of SS7 signaling points:
  - ▷ Service Switching Points (**SSP**'s)
  - ▷ Signal Transfer Points (**STP**'s)
  - ▷ Service Control Points (**SCP**'s)
- Addressing and routing
  - ▷ Signaling points are addressed by unique point codes
  - ▷ Message routing uses the source and destination point codes and routing tables at each signaling point

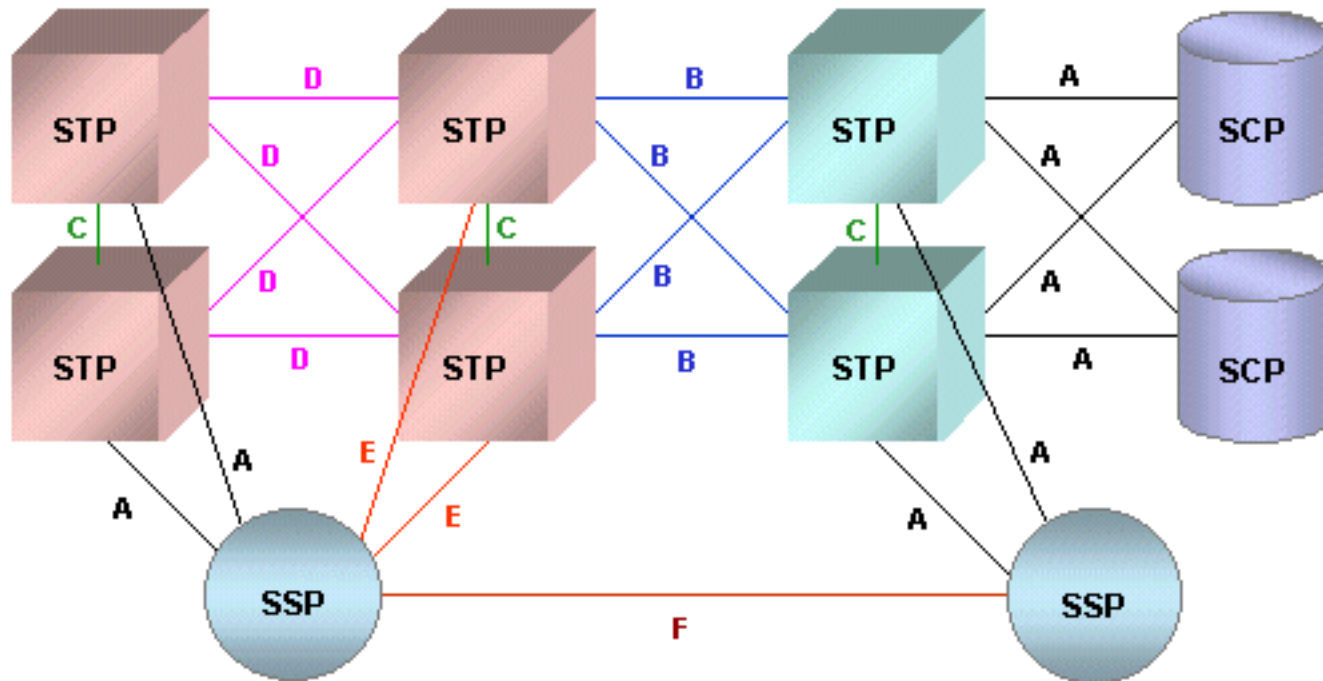
# SS7 ARCHITECTURE



## SS7 SIGNALING POINTS

- Service Switching Points (**SSP**'s)
  - ▷ SSP's are PSTN switches that originate or terminate calls, or route calls to other switches (tandem switches)
  - ▷ SSP's exchange SS7 messages to set up, manage and release voice circuits
- Service Control Points (**SCP**'s)
  - ▷ SCP's are database servers that respond to requests from SSP's for call routing information
- Signal Transfer Points (**STP**'s)
  - ▷ STP's are packet switches that serve as routers in the SS7 network
  - ▷ Incoming SS7 messages are switched to outgoing links based on routing information contained in the messages (*not* just based on the destination numbers)

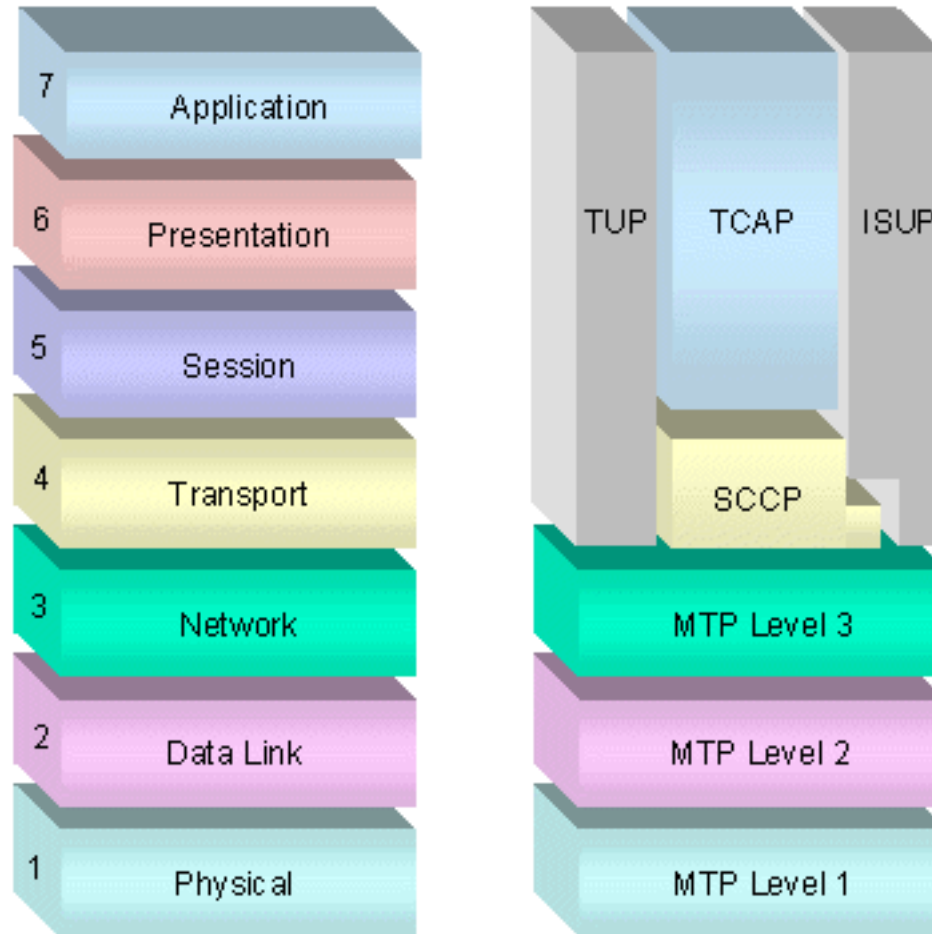
# SS7 SIGNALING LINKS



## TYPES OF SS7 SIGNALING LINKS

- A (access) link
  - ▷ Connects end nodes to STP's
- B (bridge) link
  - ▷ Interconnects primary STP's from different networks
- C (cross) link
  - ▷ Connects STP's performing identical functions into a mated pair
- D (diagonal) link
  - ▷ Interconnects secondary STP's
- E (extended) link
  - ▷ Connects an SSP to a secondary STP; alternate access link
- F (fully associated) link
  - ▷ Interconnects two end nodes

# SS7 PROTOCOL STACK



## SS7 MESSAGE TRANSFER PART (MTP)

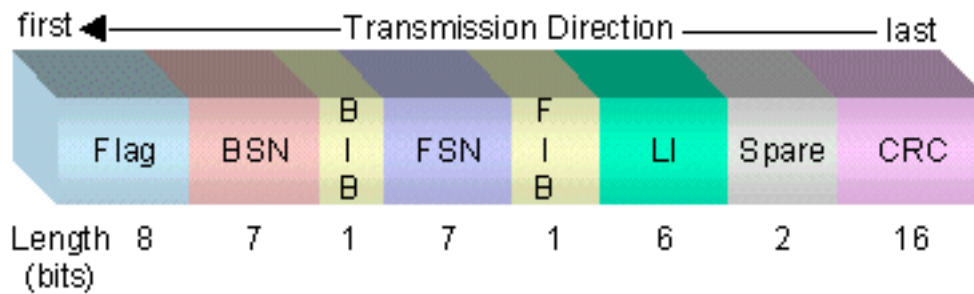
- MTP Level 1
  - ▷ Physical and electrical interfaces of SS7 digital signaling links
    - E-1 (2048 kb/s), DS-1 (1544 kb/s), DS-0 (64 kb/s), V.35 (64 kb/s), DS-0A (56 kb/s)
- MTP Level 2
  - ▷ Handles message transmission over a physical link
    - Includes flow control, packet sequencing, error detection, retransmission
- MTP Level 3
  - ▷ Handles message routing between SSP's
    - Provides congestion control

## SS7 TRANSPORT AND HIGHER LAYERS

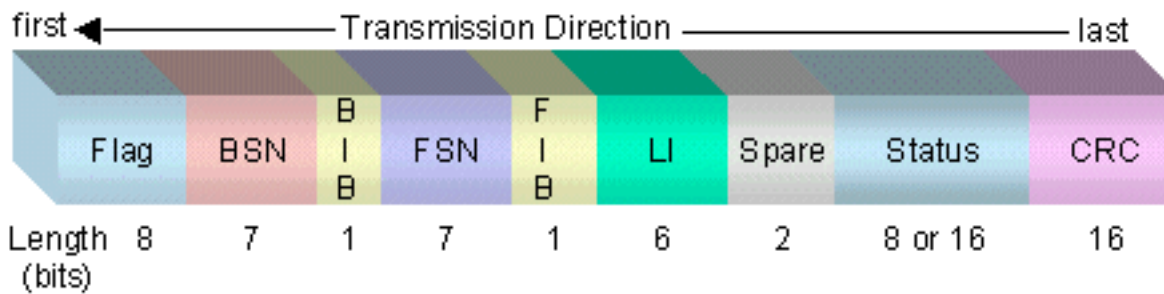
- Telephone User Part (TUP)
  - ▷ Analog call circuit setup/teardown
- ISDN User Part (ISUP)
  - ▷ Setup, management & release of trunk circuits
- Signaling Connection Control Part (SCCP)
  - ▷ Transport layer for TCAP-based services such as 800/888 numbers, wireless roaming, etc.
    - Provides subsystem numbers (like port numbers in TCP/UDP), which enable addressing to specific applications at destination signaling points
- Transaction Capabilities Application Part (TCAP)
  - ▷ Used for SCP-SSP communications concerning routing of 800/888/900 calls, to encapsulate Mobile Application Part (MAP) messages containing customer profile information for roving mobile subscribers, and for calling-card calls

## SS7 SIGNAL UNITS (MESSAGE FORMATS)

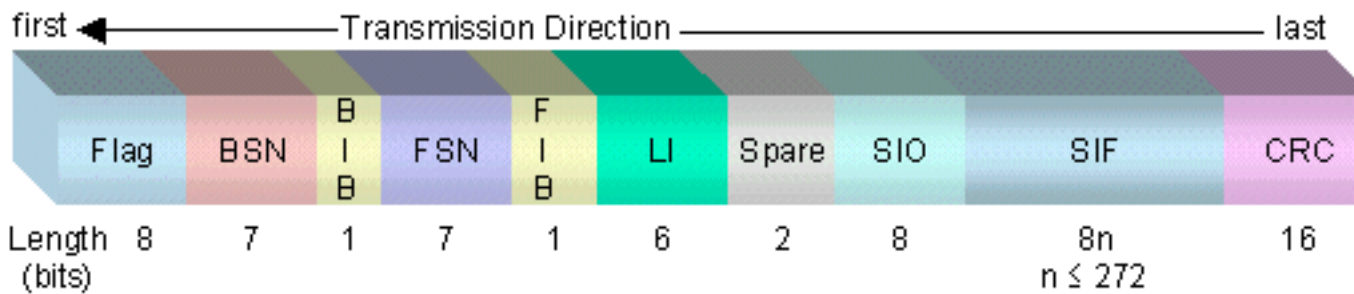
- Fill-in signal units (FISU's)
  - ▷ Transmitted in both directions on a link, without interruption, in the absence of other signal units
  - ▷ Checking of FISU CRC's enables constant monitoring of link quality
- Link status signal units (LSSU's)
  - ▷ Handles message transmission over a physical link
    - Includes flow control, packet sequencing, error detection, retransmission
- Message signal units (MSU's)
  - ▷ Signaling information field (SIF) carries call control, database query/response, network management, network maintenance information
    - Routing label allows the originating SSP to send information to the destination SSP



**Fill-In Signal Unit**



**Link Status Signal Unit**



**Message Signal Unit**

## FIELDS IN SS7 SIGNAL UNITS (1)

- Flag octet 01111110
  - ▷ Indicates the beginning of a signal unit (*i.e.*, a frame)
  - ▷ Runs of 5 or more 1 bits in the data are bit-stuffed with a 0 bit
- Backward sequence number (BSN)  $\in [0, 127]$ 
  - ▷ Indicates the 7-bit serial number of the last signal unit that was correctly received by the sender of the current frame, if the BIB is cleared
- Backward indicator bit (BIB)
  - ▷ If set, indicates that the CRC computed from the last frame received did not match the CRC in the frame (and therefore that there was an error in the frame)
- Forward sequence number (FSN)  $\in [0, 127]$ 
  - ▷ Indicates the 7-bit serial number of the current frame

## FIELDS IN SS7 SIGNAL UNITS (2)

- Forward indicator bit (FIB)
  - ▷ If set, indicates that the sender of the frame is retransmitting information that was not correctly received, starting with the frame with the sequence number indicated in the FSN field
- Length indicator (LI)  $\in [0, 63]$ 
  - ▷ The LI value indicates the number of octets that follow the LI and precede the CRC
  - ▷ If LI = 0, indicates a FISU
  - ▷ If LI  $\in [1, 2]$ , indicates a LSSU
  - ▷ If LI  $\in [3, 63]$ , indicates a MSU with LI octets of data; LI = 63 indicates a message of up to 273 octets
- Cyclic redundancy check (CRC)

## DESIGN DISCUSSION

- Choice of idle channel indicator
  - ▷ Mark idle (constant stream of 1's)
  - ▷ Flag idle (constant stream of flag octets)
  - ▷ Fill-in
  - ▷ None
- Routing path
  - ▷ Determined dynamically by decisions made at each router
  - ▷ Encoded in packet