# Protocol Technology

## Common Channel Signaling System 7 (SS7)

## Part 1

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- Here you can find some additional information to SS7
- Slides 14 (the internal structure of the MTP-2 message), 15, 20, 23-24 and 29 are just for your information, not part of the material

# Channel Associated Signaling - CAS

- Signaling: set-up and release of connections between two subscribers
- Signals were carried by the same circuit ( subscriber line, trunk) that carried the speech during the call
  - Subscriber Signaling – between subscriber and his local exchange
- Not possible to send signaling messages in the absence of a call

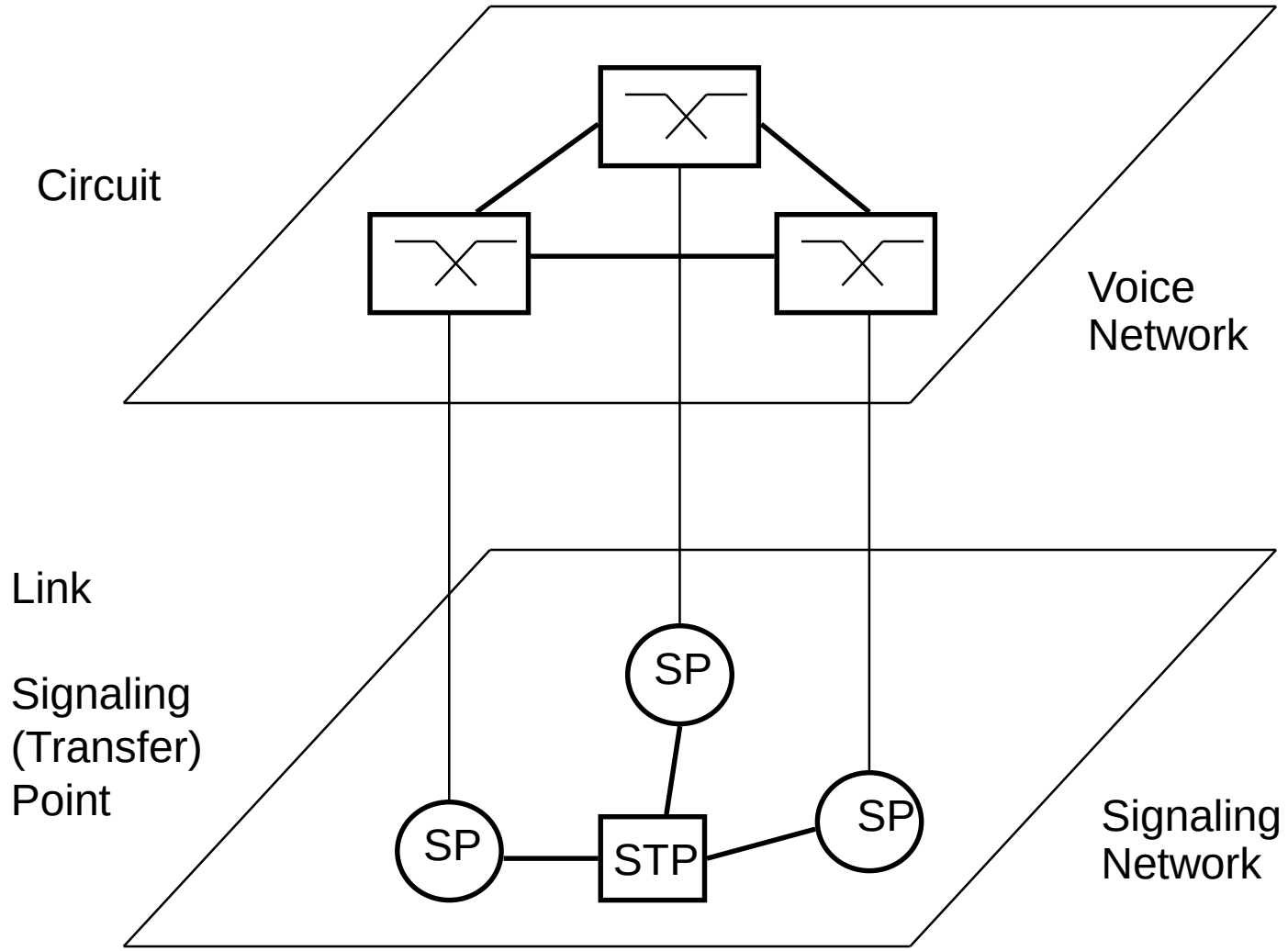
# Common Channel Signaling - CCS

- CCS
  - Signaling does not have to go along the same path as speech
  - Abbreviated as CCS7, CCS#7, SS7 or simply C7
  - Modular in design protocol architecture
  - Non call related signaling possible

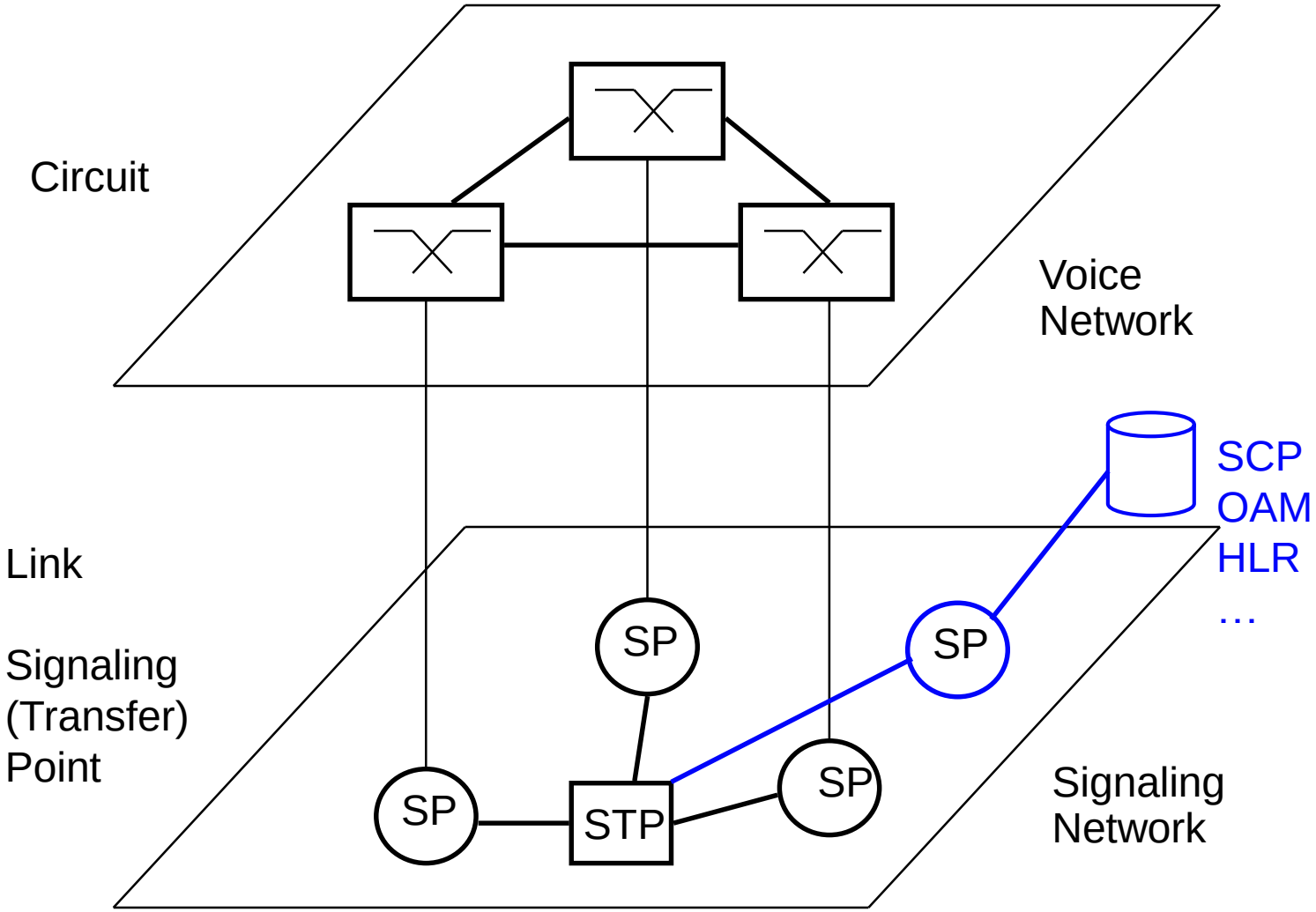
# Common Channel Signaling Systems

- Digital signals on a voice circuit independent network
- One signaling link serves the need of several voice circuits
- Disadvantages:
  - additional subnetwork → plus cost
  - more complicated switches
  - explicit continuity check needed
- Advantages:
  - better voice circuit utilisation
  - complex messages: several services/features can be controlled by one system
  - stronger protection than for voice transmission
  - call-independent messages possible
    - data base query
    - SMS
    - operation and mainteneance messages

# CCSS


Circuit
Voice
Network
Link
Signaling
(Transfer)
Point
SP
SP
STP
SP
Signaling
Network

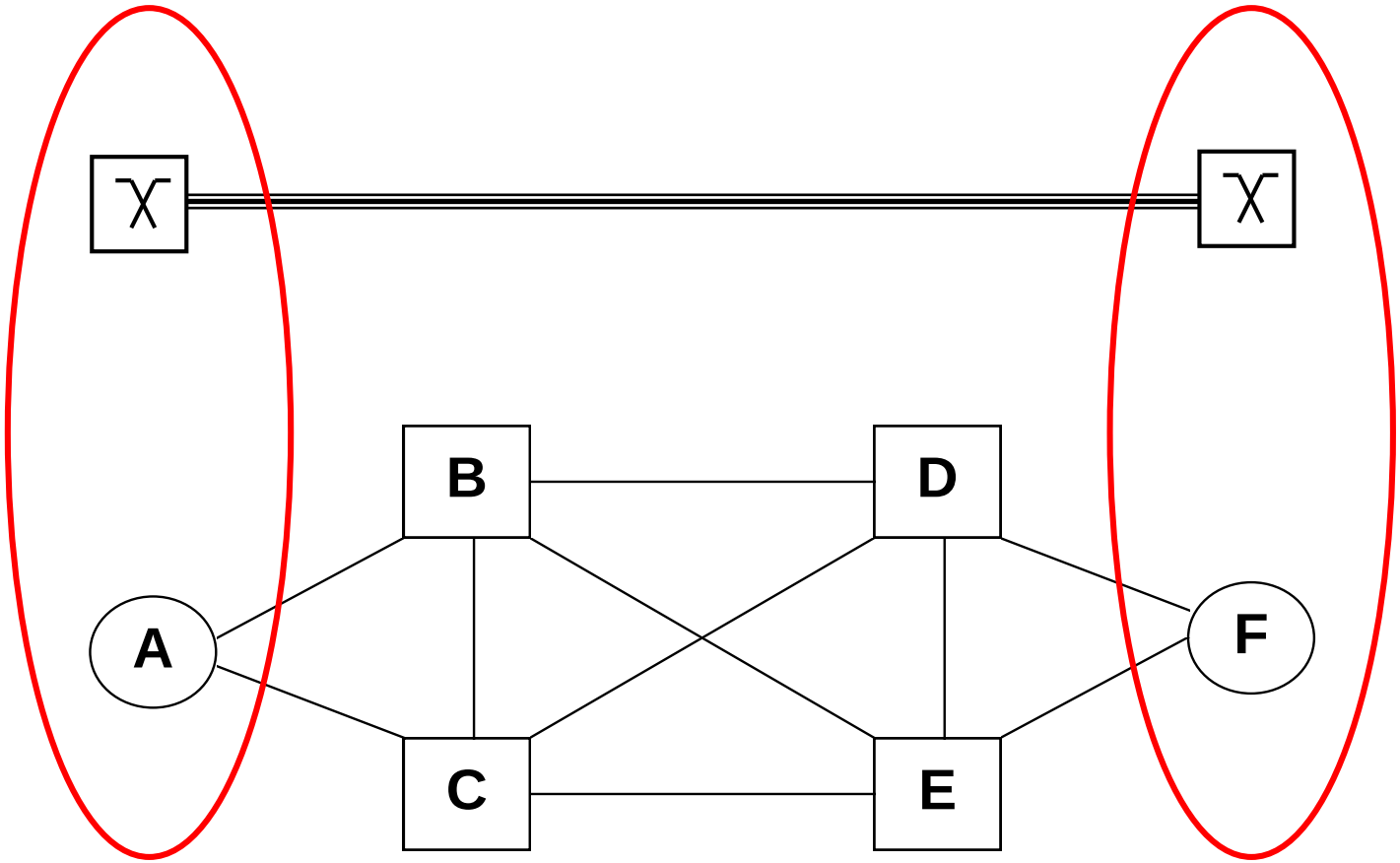
# CCSS


Circuit
Voice
Network
SCP
OAM
HLR
…
Link
Signaling
(Transfer)
Point
SP
SP
SP
SP
STP
Signaling
Network

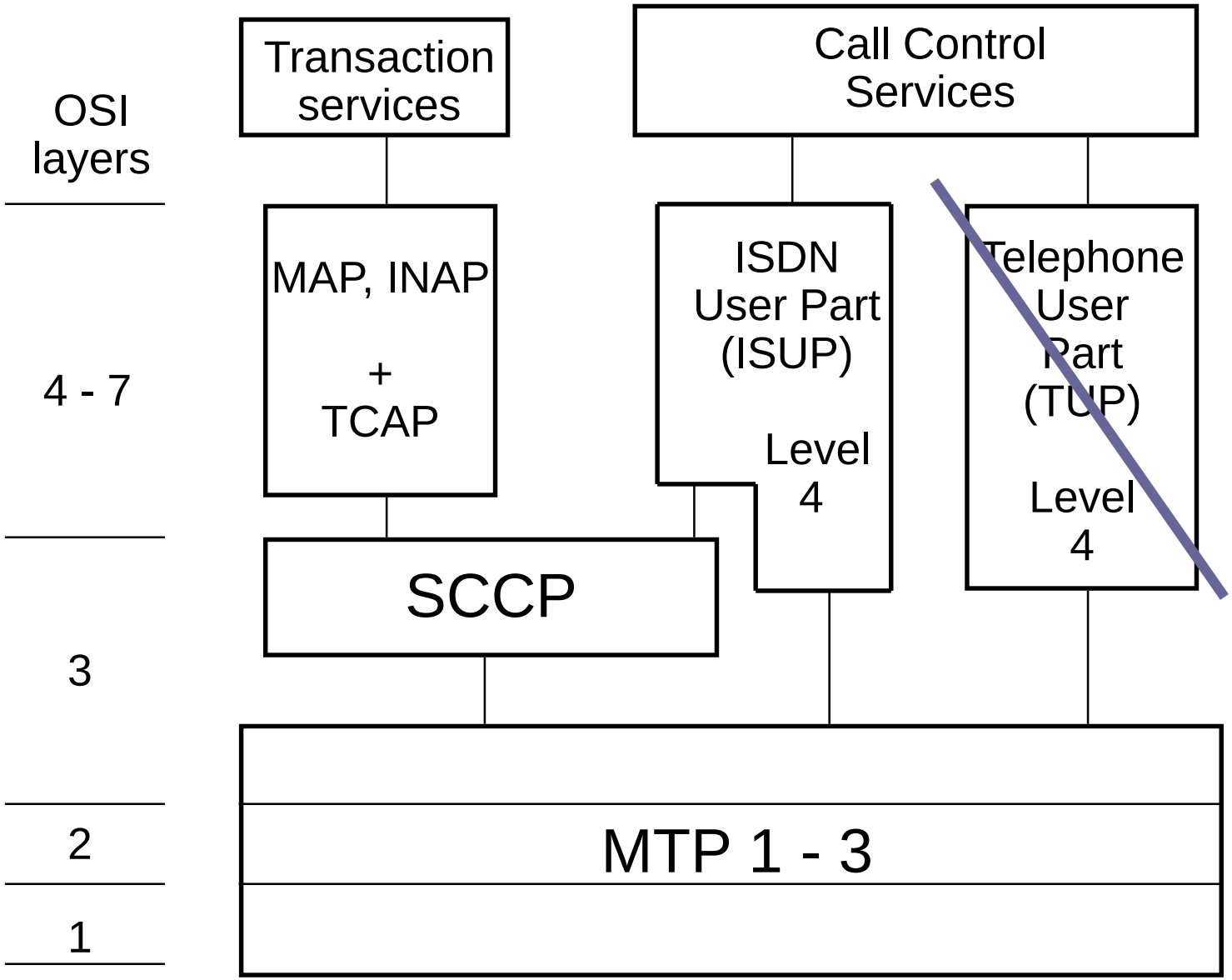
# Connection Types

- Associated connection
  - Same path for link and circuit
    - different, dedicated time slots
    - different, dedicated cables
- Quasi-associated connection
  - Different paths

# CCSS7 Subnetwork



# CCSS7 Protocol Architecture



# SS7 Protocol Layers

Signaling System 7 was introduced by AT&T in 1975 and approved by worldwide standard bodies in 1980.

SS7 basic functions are as follows

**MTP** (Message Transfer Part) - Provides a reliable transfer and delivery of signaling information in a signaling network.

**TUP** (Telephone User Part) - Provides the transport of call set-up information between two signaling points only for voice services.

**ISUP** (ISDN User Part) - Provides the transport of call set-up information between two signaling points.

**SCCP** (Signaling Connection Control Point) - Provides additional routing capabilities via SubSystem Numbers (SSNs). It also offers the capability of routing based on dialed digits or global title translation.

**TCAP** (Transaction Capability Application Part) - Provides the capability of transferring non-circuit-related information between signaling points.

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**SCTP** (Streams Control Transmission Protocol) - Provides generic transport for SCN signaling .

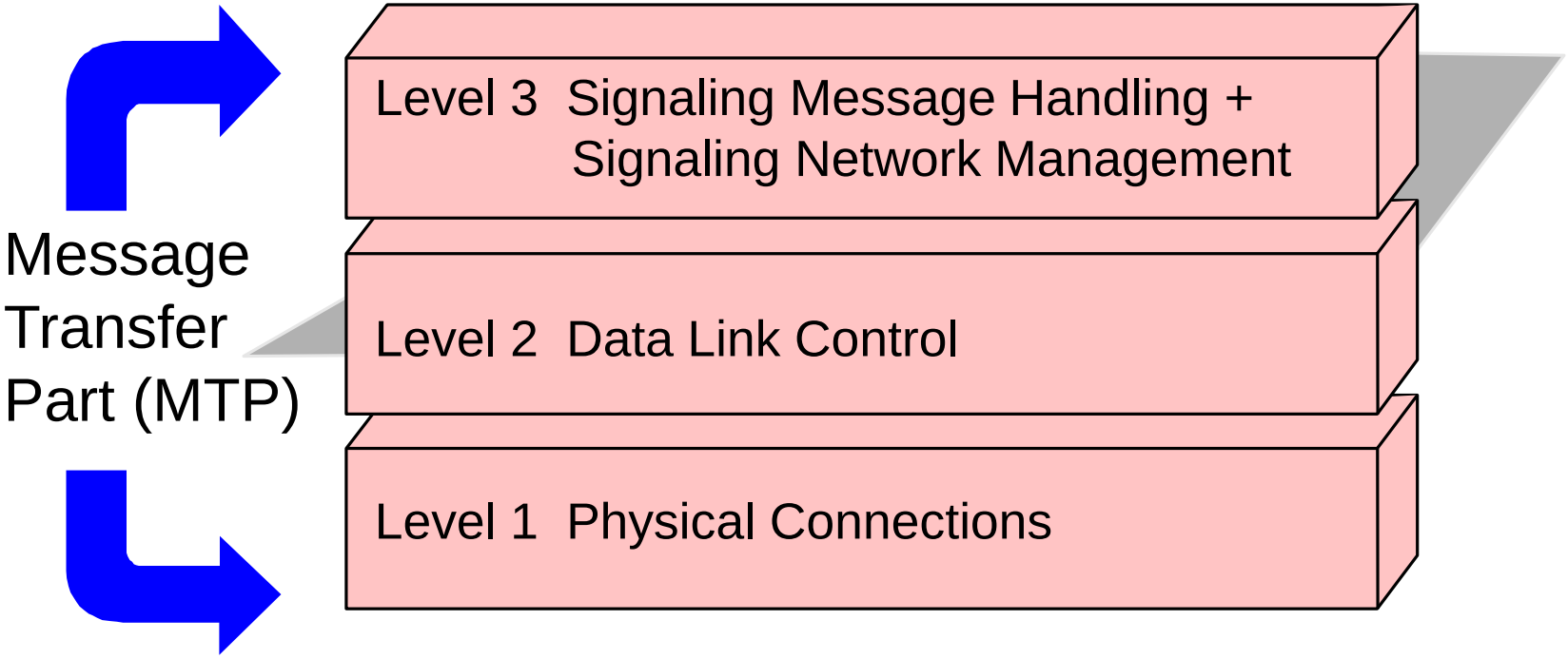
**M2PA** (MTP 2 Peer-to-peer Adaptation Layer) - Enables SS7 links replacement over IP.

**M2UA** (MTP 2 User Adaptation Layer) - Enables SS7 back-hauling from remote end-points over IP.

**M3UA** (MTP 3 User Adaptation Layer) - Enables SS7 User Parts (e.g. ISUP and SCCP) to run over IP.

**SUA** (SCCP User Adaptation Layer) - Enables SS7 Application Parts (e.g. TCAP) to run over IP.

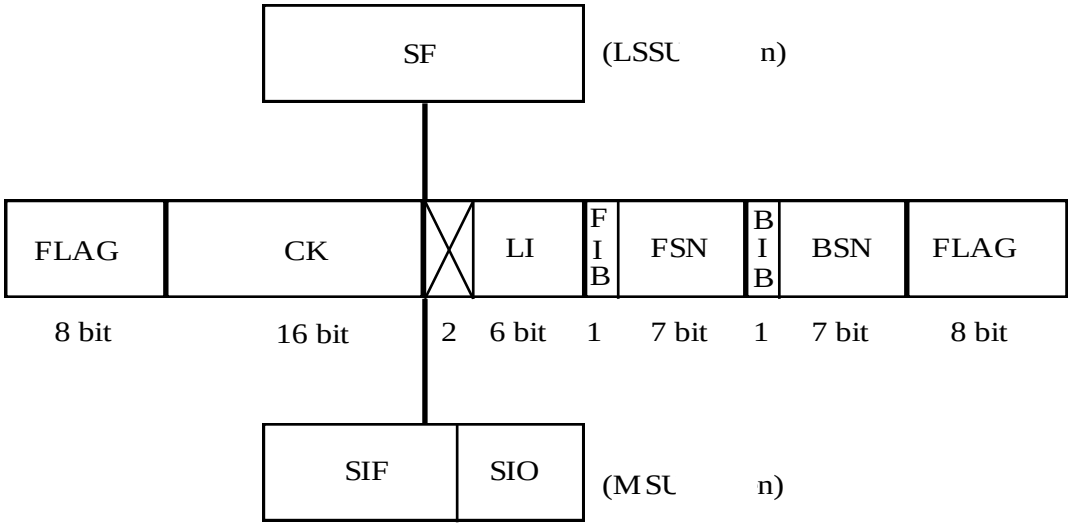
# MTP levels of CCSS7



# Message Transfer Part (MTP)

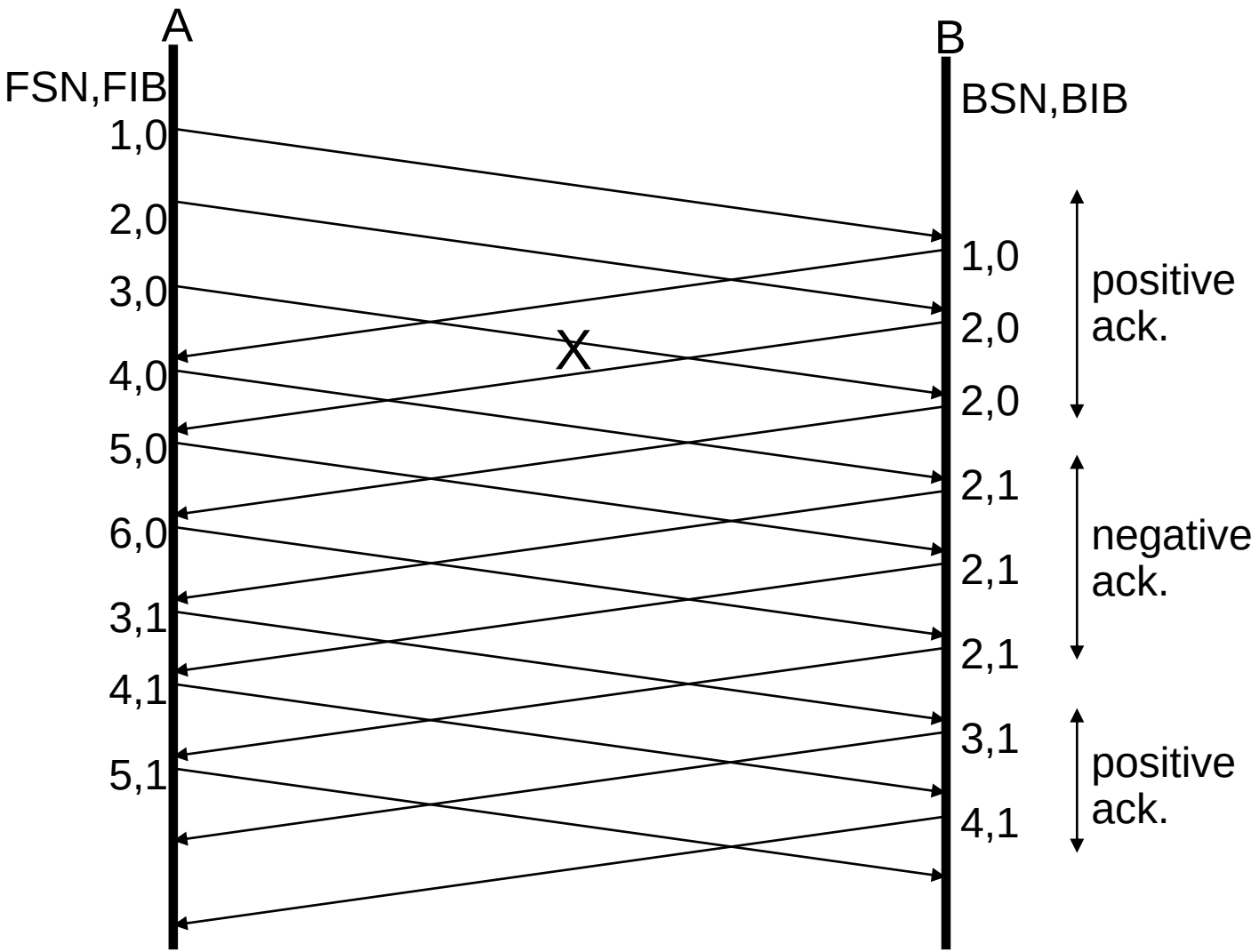
- **Level 1 Physical Connections** : Defines the physical, electrical, and functional characteristics of the digital signaling link. Defined physical interfaces include, DS1 (1.544 Mbps), **E1 (2.048 Mbps),** V.35 (64 kbps),DS0 (64 kbps), and DS0A (56 kbps).
- **Level 2 Data Link Control** : Defines the functions and procedures to ensure that messages are reliably transmitted across a signaling link. They implement flow control, message sequence validation, and error checking. When an error occurs on a signaling link, the messages are retransmitted.
  - Framing
  - Error detection and correction
  - Different message types

# MTP-2 Message Structure




- Flag: 01111110 + bit stuffing
- FSN/BSN: Forward/Backward Sequence Number
- FIB/BIB: Forward/Backward Indicator Bit
- LI: Length Indicator
- CK: Checksum
- FISU: Fill-In Signal Unit
- LSSU: Link Status Signal Unit
- MSU: Message Signal Unit
- SIF: Service Information Field („Address” + Message)
- SIO: Service Information Octet

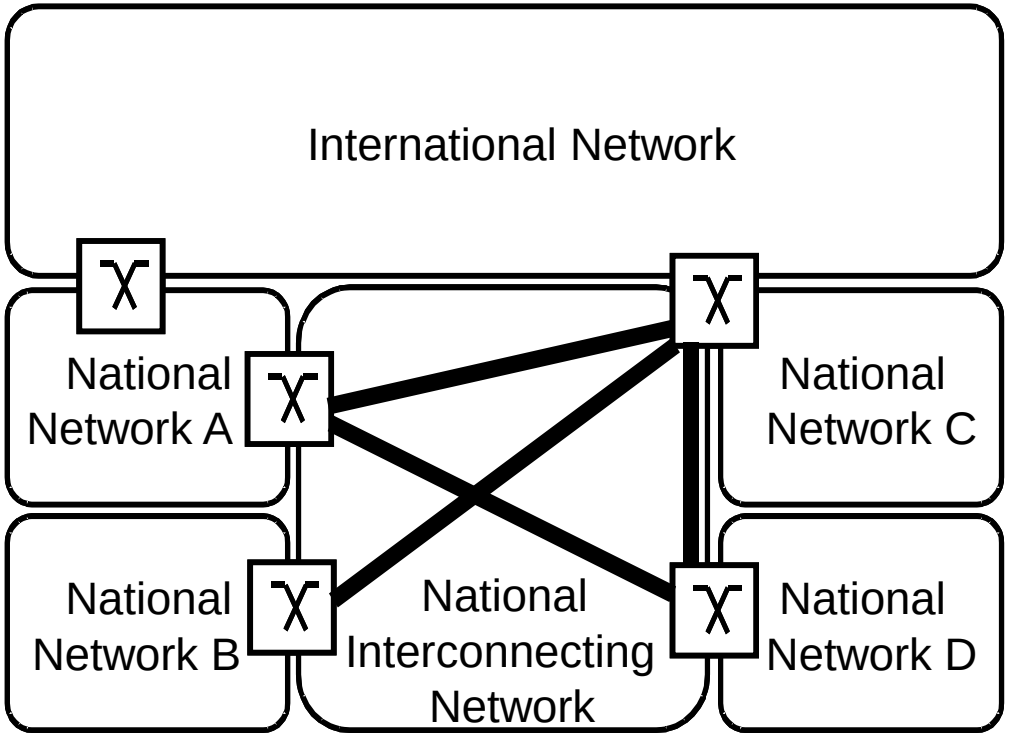
# MTP-2 – Basic Error Correction



# Message Transfer Part (MTP)

- **Level 3**
  - **Signaling Message Handling**: Provides message routing between signaling points in a SS7 network.
  - **Signaling Network Management:** Monitors state of the signaling network + performs reconfiguration when necessary

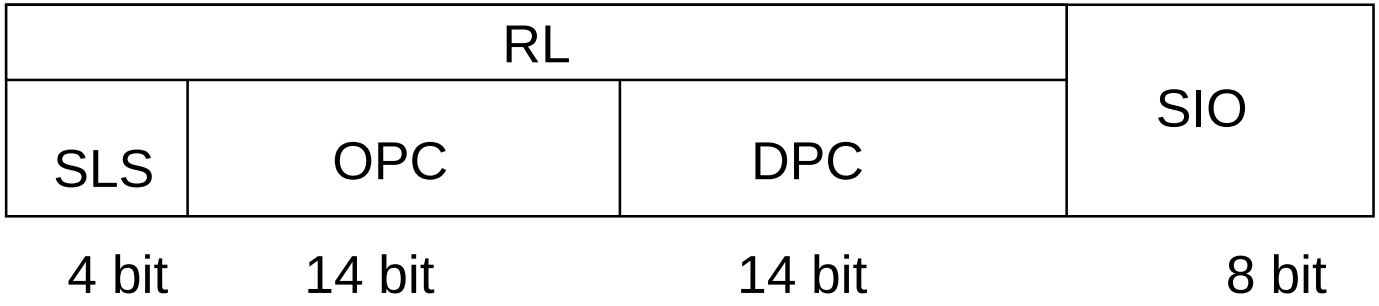
# Signaling Networks, Signaling Point Codes




Signaling Point Code – 14 bit

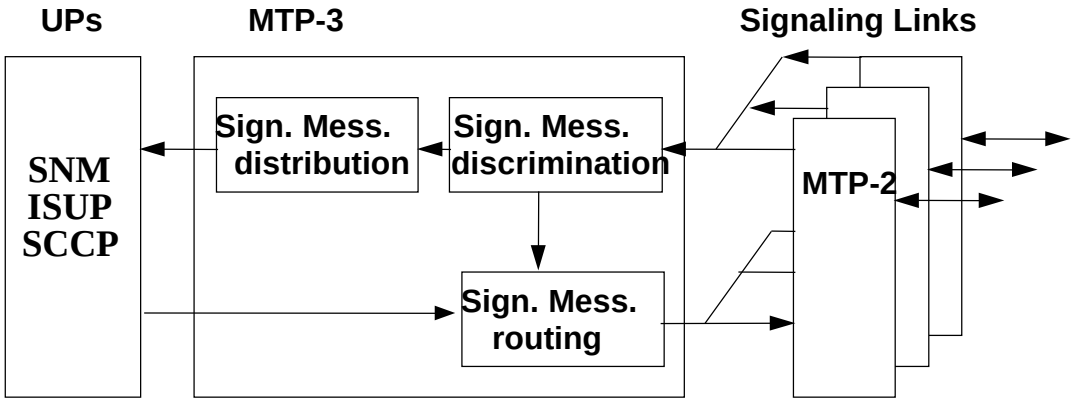
ISPC = Zone Code + Area/Network Code + Signaling Point Identifier
NISPC
NSPC

# MTP-3 Addressing

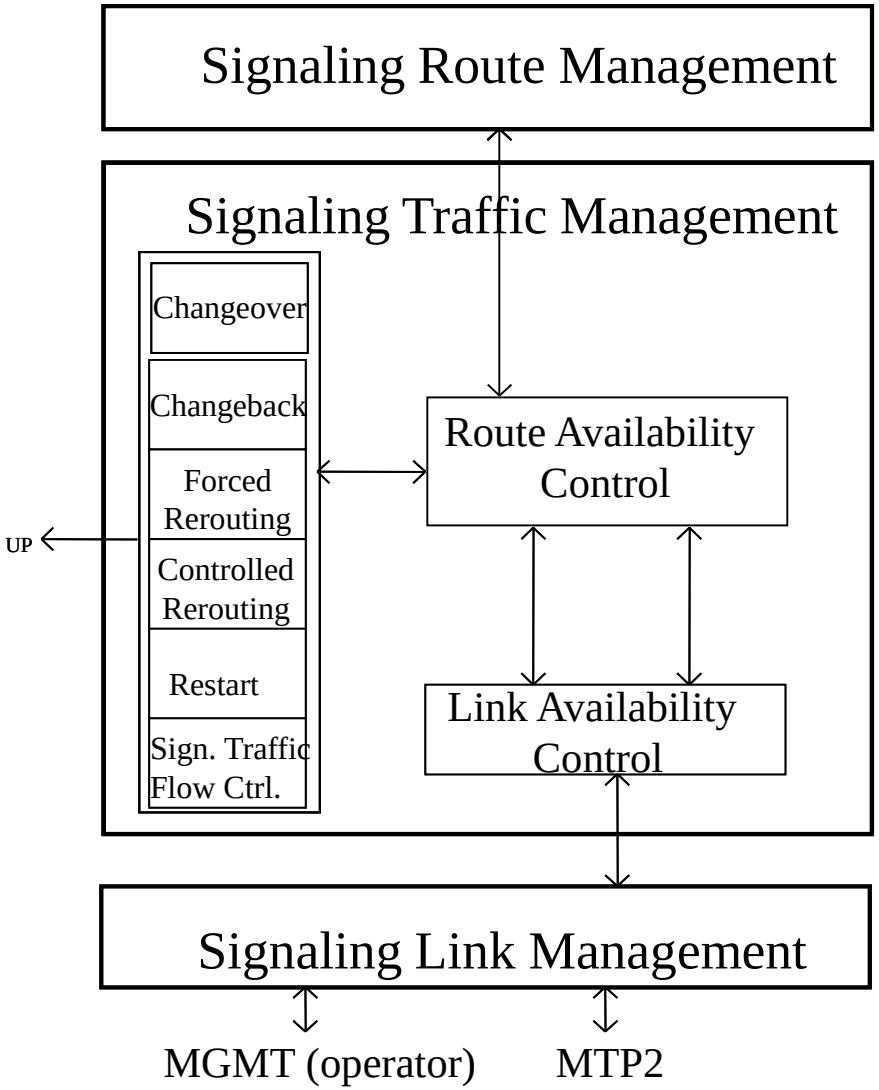



- RL – Routing Label
  - OPC, DPC – Originating Point Code, Destination Point Code –
  - SLS – Signaling Link Selection
- SIO – Service Indicator Octet = Network Indicator (NI) + Service Indicator (SI)

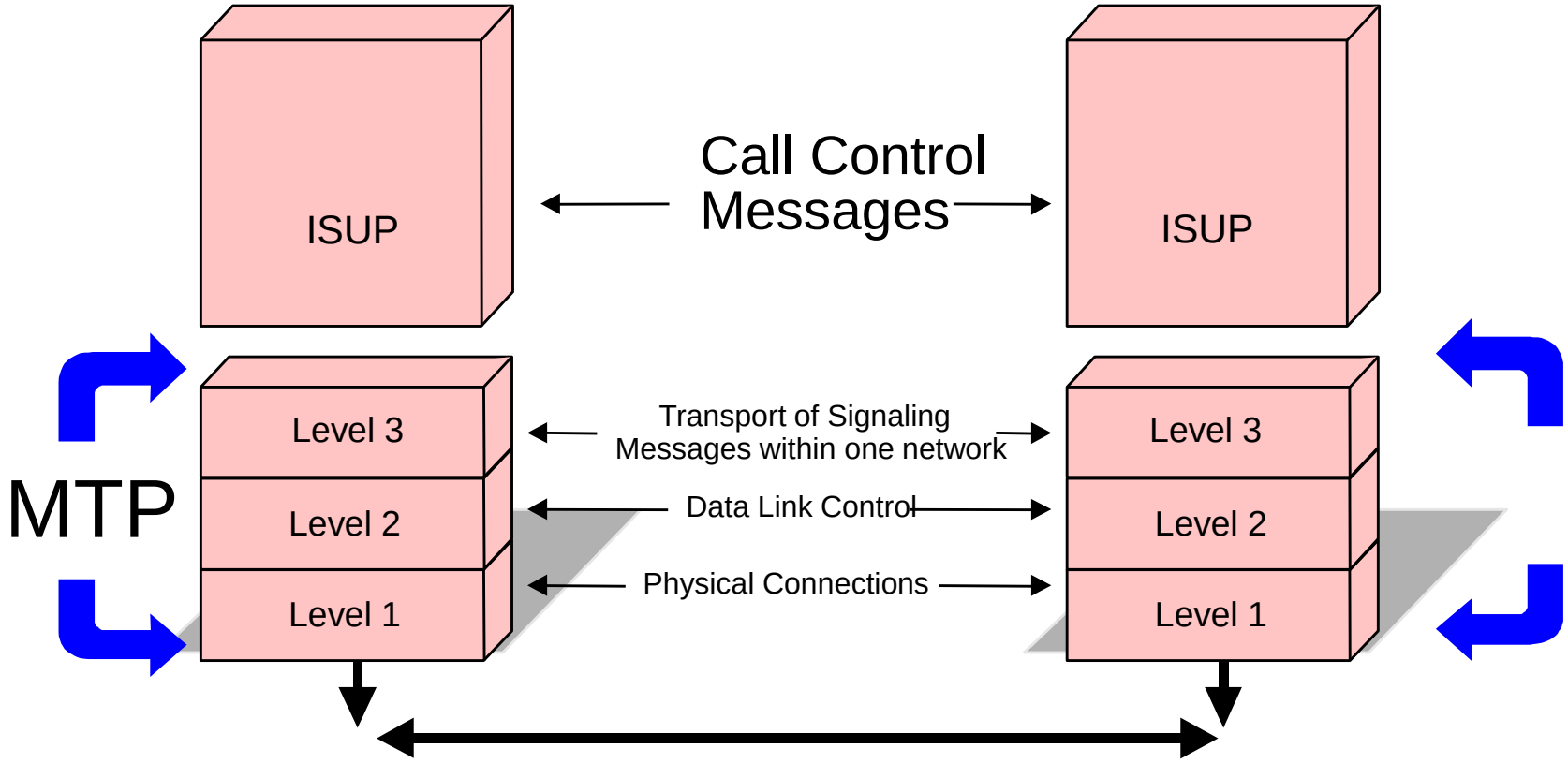
# MTP-3 Signaling Message Handling



# MTP-3 Signaling Network Management



# Protocol stack for fixed networks in CCSS7

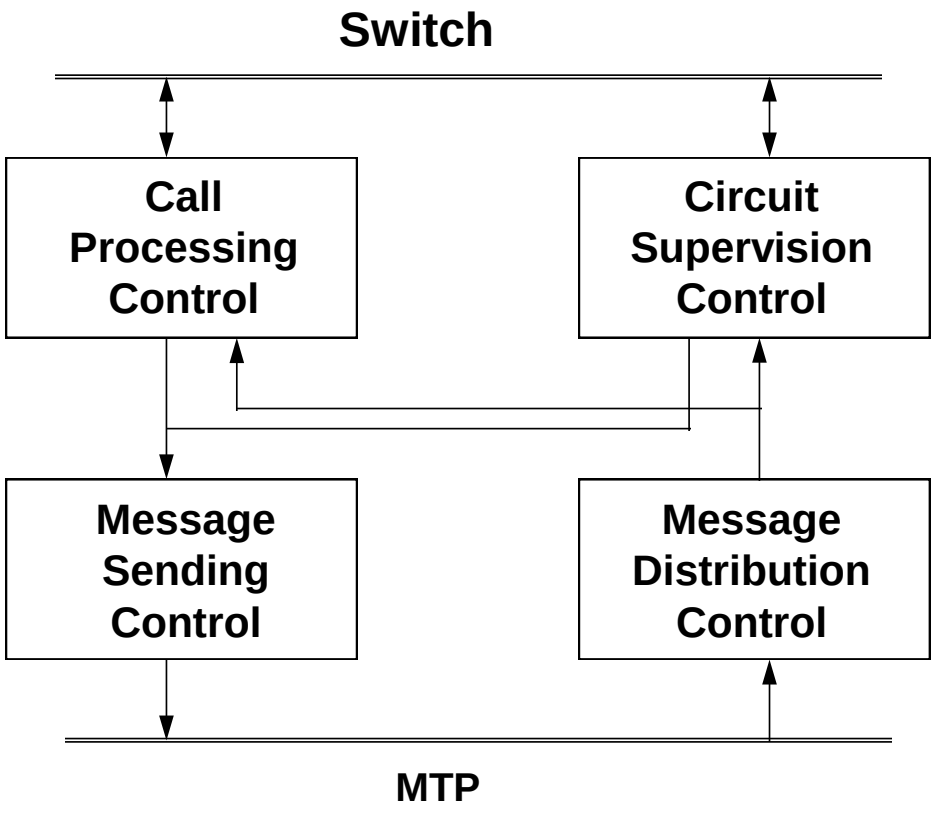



MTP – Message Transfer Part

# User Parts

- Telephone User Part (TUP)
  - Defines the international telephone call control signaling functions for basic call setup and release. Withdrawn.
- Data User Part (DUP)
  - Defines data transfer control. Obsolete.
- ISDN User Part (ISUP)
  - Defines the protocol used to setup, manage, and release trunk circuits that carry voice and data + ISDN Supplementary Services
    - Call Control
    - Circuit Supervision

# ISUP Functional Blocks



# ISUP Message Structure

**CIC**
Circuit Identification Code (12 bit + 4 spare)
**Message type code**
Type
**Mandatory fixed part**
Parameter A
Parameter ...
Parameter F
**Mandatory variable part**
Pointer to parameter M
Pointer to parameter ...
Pointer to parameter P
Pointer to start of optional part

Length indicator of parameter M

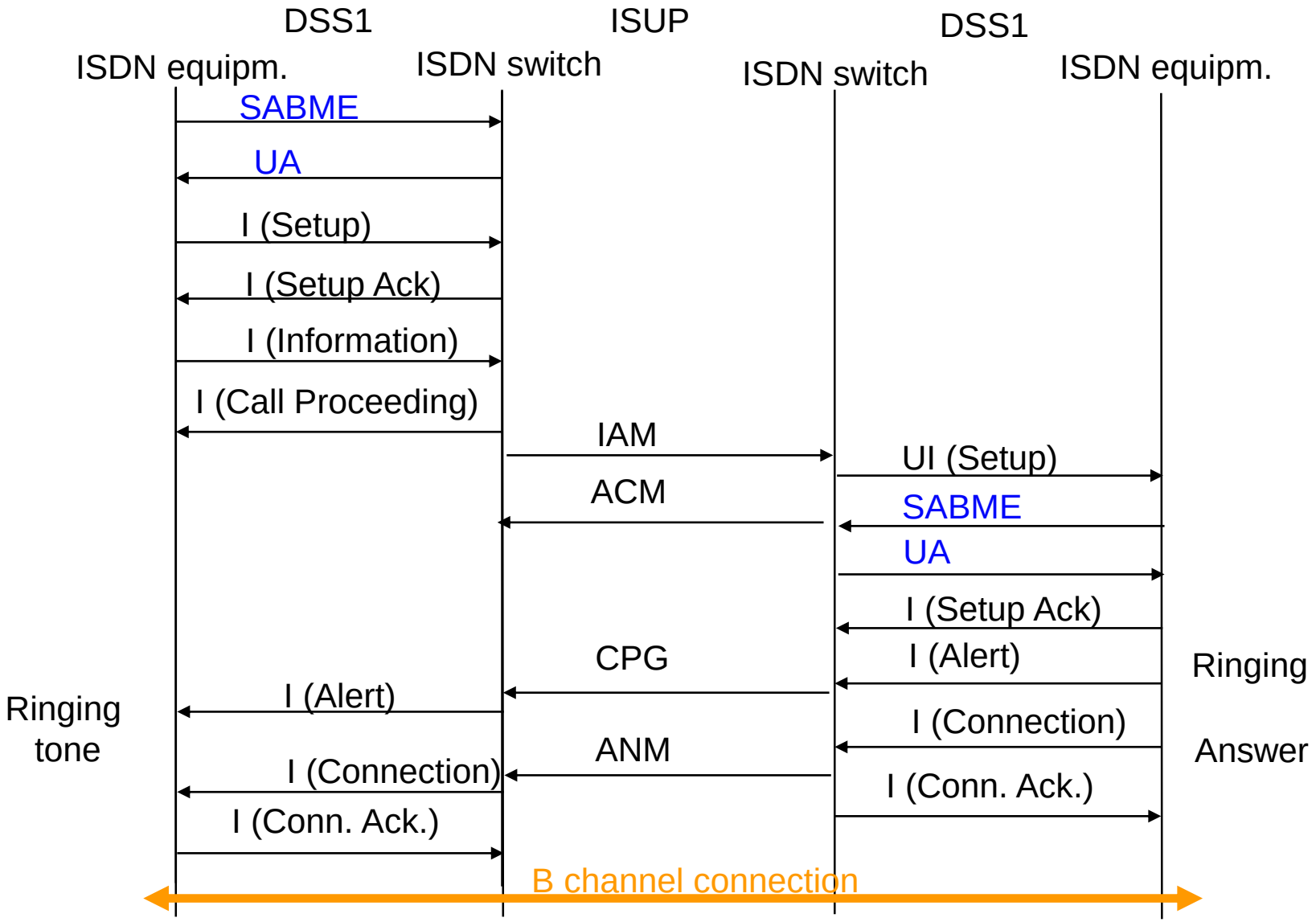
Parameter M
...
Length indicator of parameter P

Parameter P
**Optional part**
Parameter name=X
Length indicator of parameter X

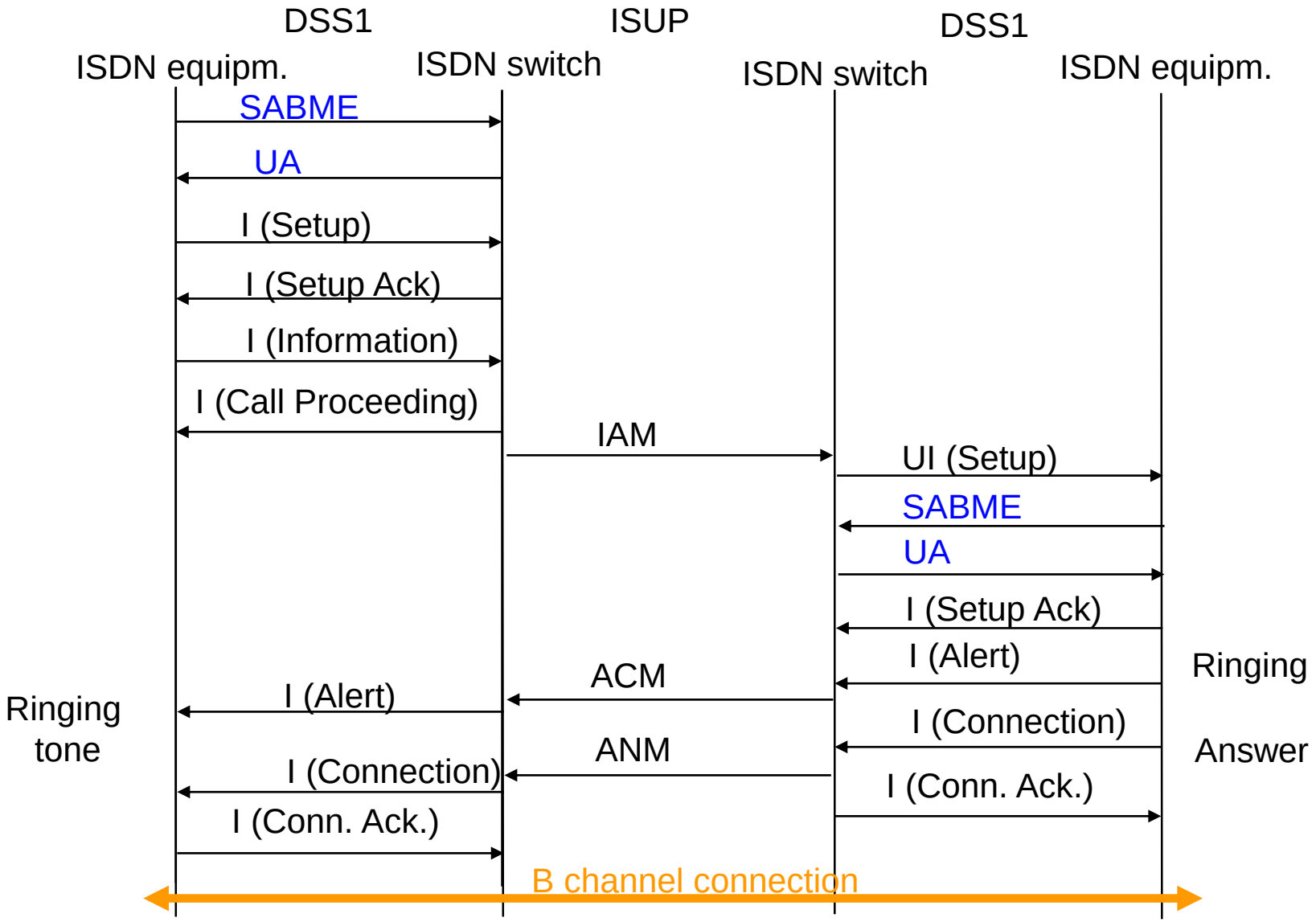
Parameter X
...
Parameter name=Z
Length indicator of parameter Z

Parameter Z
End of optional parameters

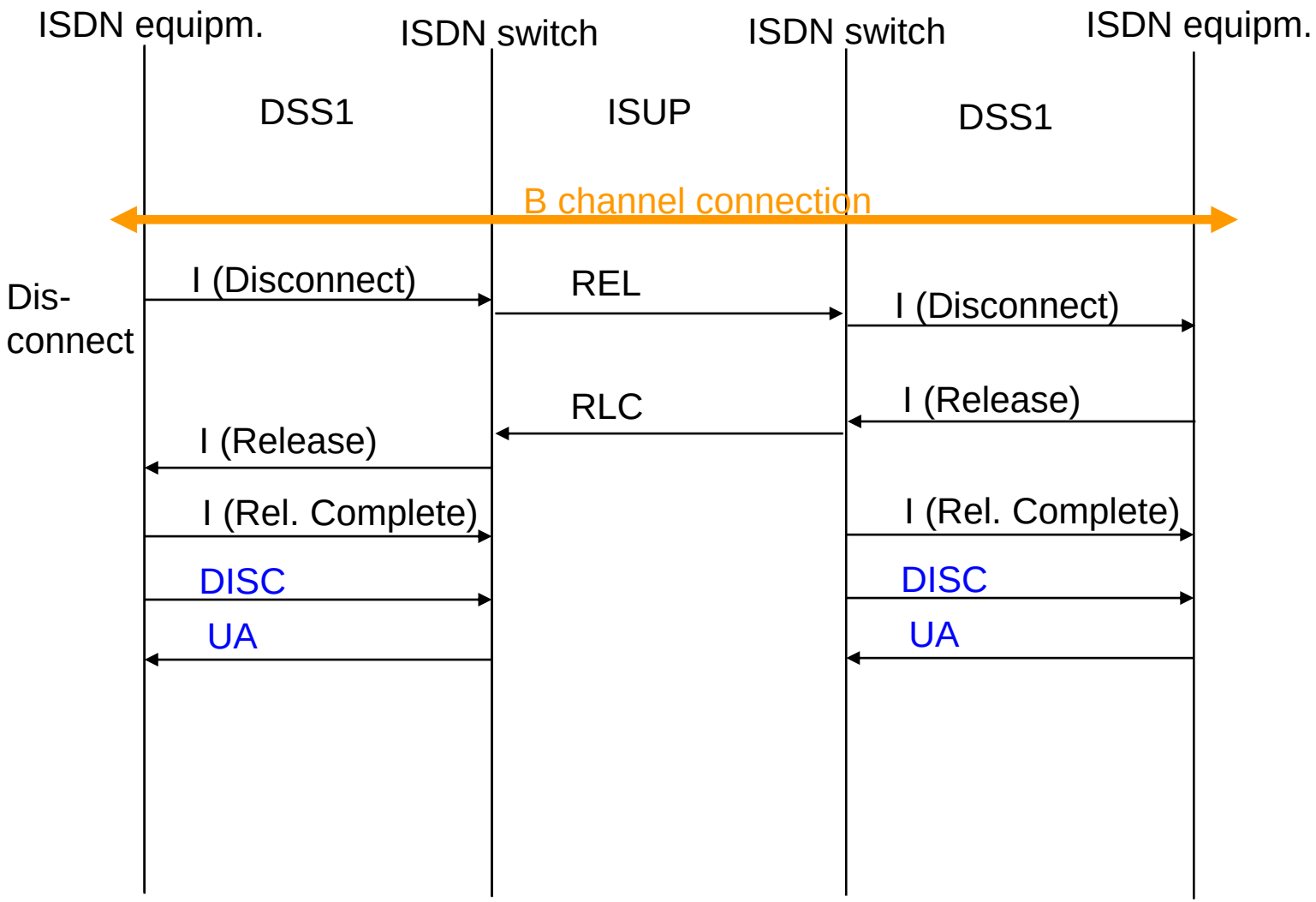
# ISDN call establishment



# ISDN call establishment



# ISDN call release



# ISUP messages

- Initial address message (IAM): contains all necessary information for a switch to establish a connection
- Subsequent Address Message (SAM)
- Address complete message (ACM): acknowledge to IAM; the required circuit is reserved and the “phone is ringing” (ringback tone)
- Call Progress (CPG)
- Answer message (ANM): occurs when the called party picks up the phone
- Release (REL): sent by the switch sensing that the phone hung up
- Release complete (RLC): each exchange that receives REL, sends an RLC message back (this acknowledges receipt of REL)

# IAM parameters

| | |
|---|---|
| Message Type (IAM) | |
| Nature of Connection Indicators<br>• *Satellite Ind.*<br>• *Continuity Ind.*<br>• *Echo Control Device Ind.* | General info |
| Forward Call Indicators<br>• *Nat/Intl Call Ind.*<br>• *End-to-End Method Ind.*<br>• *Interworking Ind.*<br>• *End-to-End Information Ind.*<br>• *ISDN User Part Ind.*<br>• *ISDN User Part Preference Ind.*<br>• *ISDN Access Ind.*<br>• *SCCP Method Ind.*<br>• *Ported Number Translation Ind.*<br>• *Query On Release Attempt Ind.* | Signaling requirements |
| Calling Party's Category | Type of caller |
| Transmission Medium Requirement<br>*(ITU Networks)* | Voice line (B channel) requirements |
| User Service Info<br>*(ANSI Networks)* | |
| Called Party Number | |
| Optional Parms | |