

Communication Networks 2



Signaling (Mobile)

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2020

Channel Associated Signaling

- Channel Associated Signaling: voice (user data) path not separated from call control (signaling) path
 - Same path is used both for voice and signal transmission
- Originally: analogue systems
 - In the voice band (300-3400 Hz) itself – in-band signaling
 - Outside the voice band – out-of-band signaling
 - E.g. DC component, special signaling frequency (3850 Hz)
- Later: digital voice lines (PCM)
 - Signaling bits in a signaling channel associated to the voice line (PCM signaling channel) – out-of-band signaling

Channel Associated Signaling

- Advantages:
 - simple
 - relation between signal and voice channel is obvious
- Disadvantages:
 - limited signaling transfer capability
 - signal transfer is not protected
 - different signaling for different services
- No non-call-related signaling possible

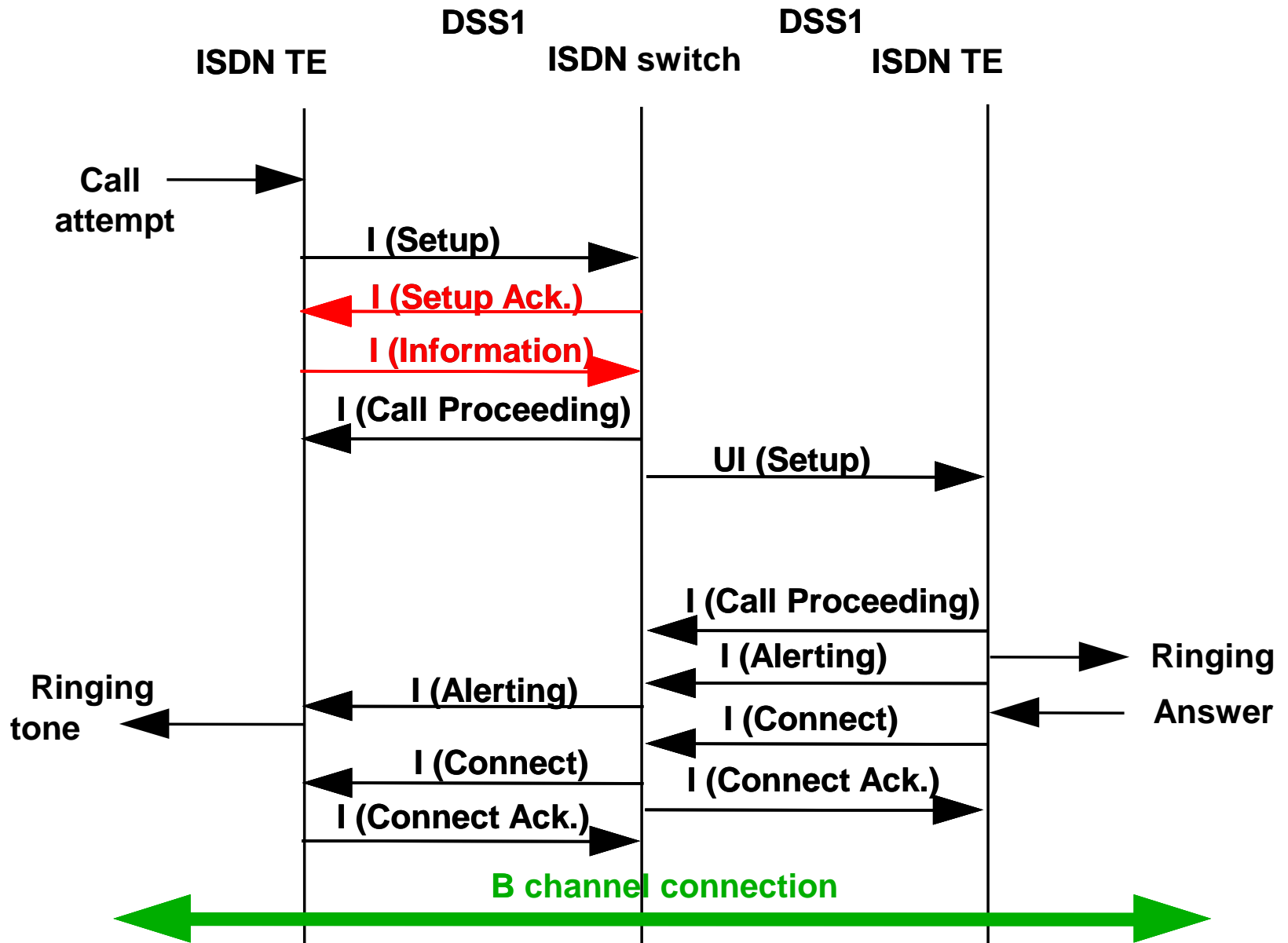
Common Channel Signaling Systems

- ❑ Digital signals on a dedicated signaling channel that is independent from the voice channel
- ❑ Idea: not to occupy a voice channel for several, short (~100 byte) signals
- ❑ Advantages:
 - better utilisation of voice circuits
 - more complicated signals possible: lot of services can be controlled
 - signal transfer can be more protected than voice transfer
 - internal (e.g. management) messages possible
 - **non-voice-related (e.g. data base query) signals possible (!!!!!)**
- ❑ Disadvantages:
 - separated signaling network → plus cost
 - more complicated functioning of switches, etc.
 - voice path to be established separately – should be checked (call continuity check)
- ❑ More advantages

DSS1

- Digital Subscriber System 1
 - User (subscriber) signaling for ISDN terminals (TE – Terminal Equipment)
- 2B+D
 - Signals in the D channel
 - The D channel is common for 2 B channels

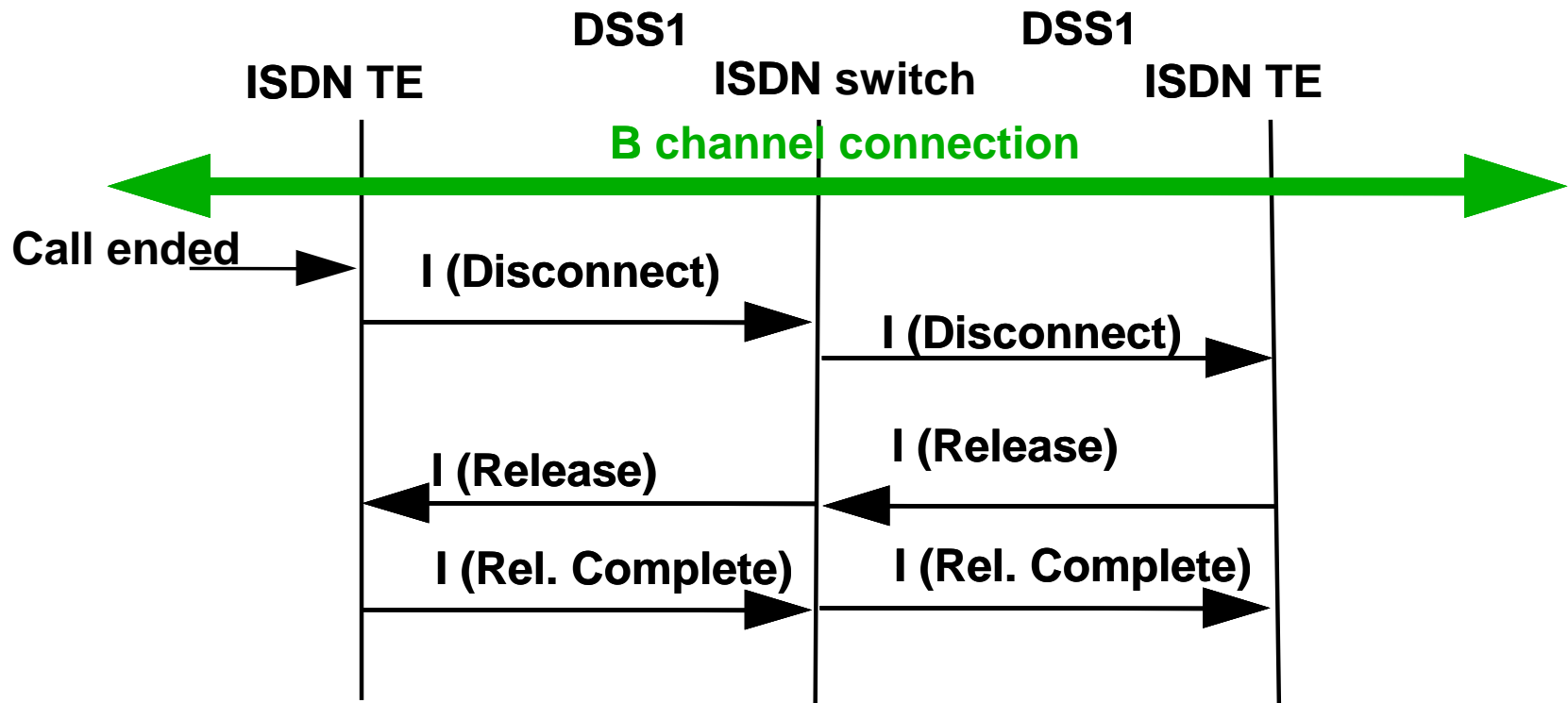
DSS1 call establishment



DSS1 call establishment

- Setup
 - Type of call
 - Typically the dialed number
- Setup Ack + Information
 - Only when Setup does not contain the dialed number
 - Dialing starts after call initiation, e.g. ISDN phones, faxes
 - An Information message can carry 1 digit – as many Information messages are transmitted as is the number of digits in the telephony number

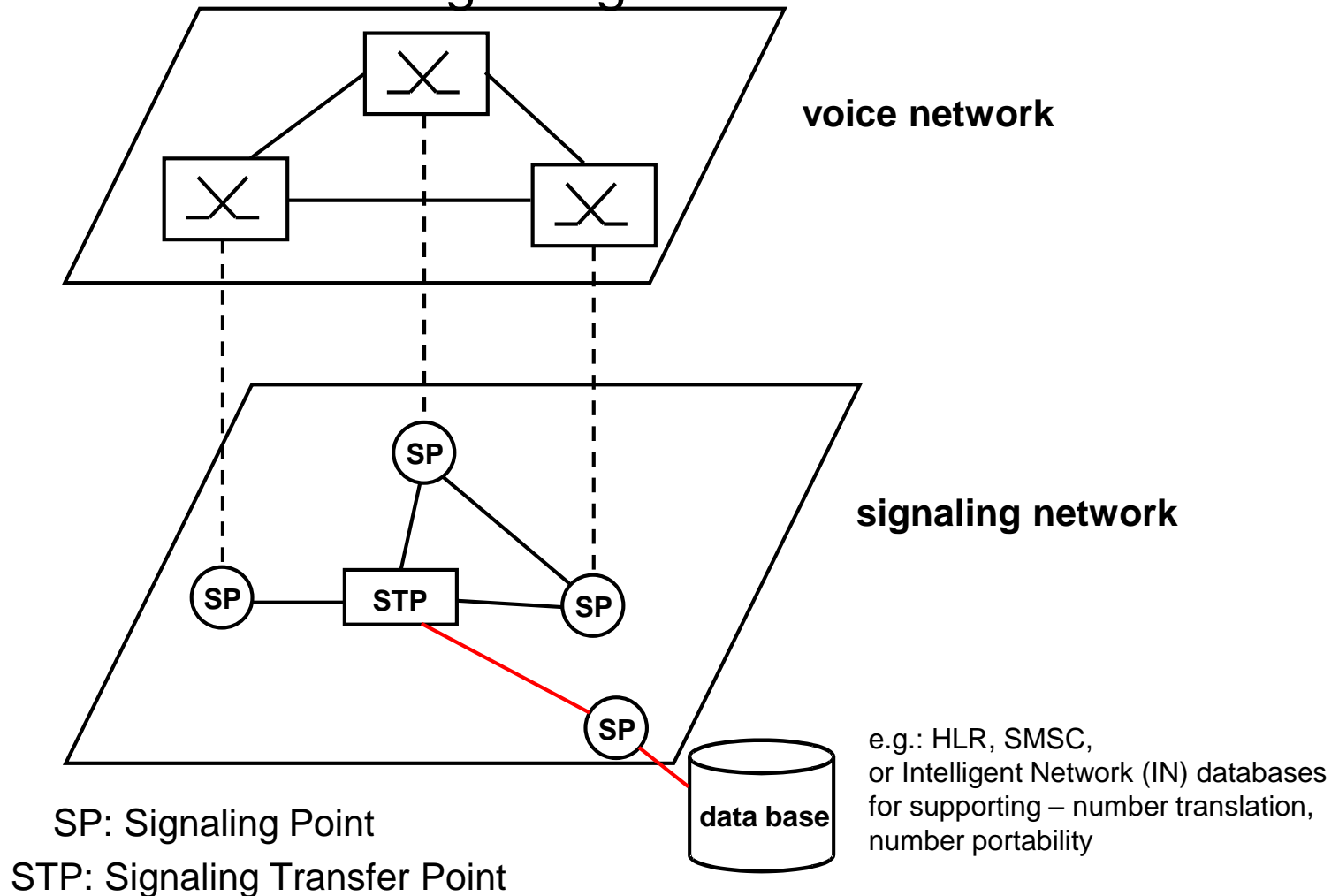
DSS1 call release



- Release can be initiated caller or called party
- Release acknowledgements are parallel on the two sides
 - Relative order of these messages can be anything

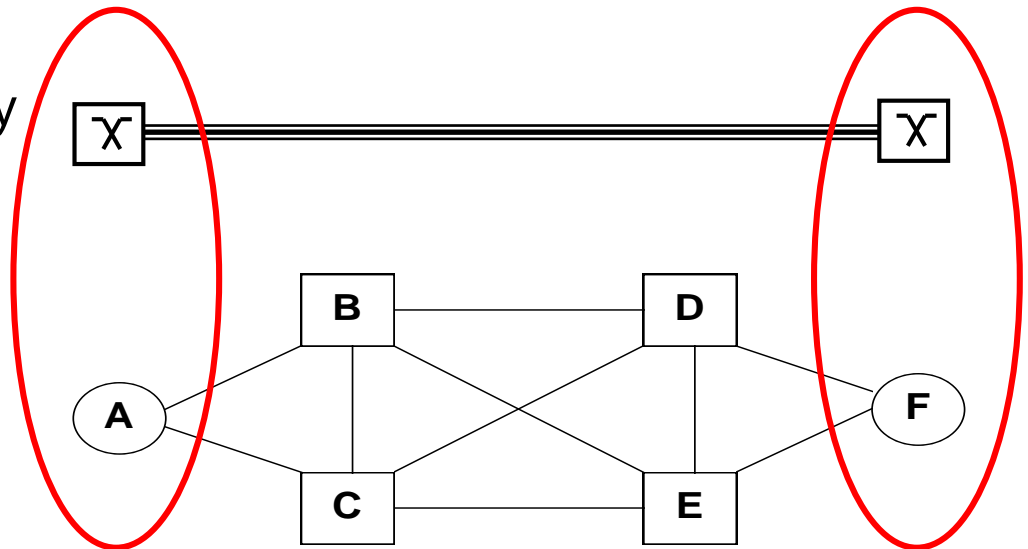
(Common Channel) Signaling System 7 (SS7)

- ❑ Common channel signaling system in core network
- ❑ Separate voice and signaling networks



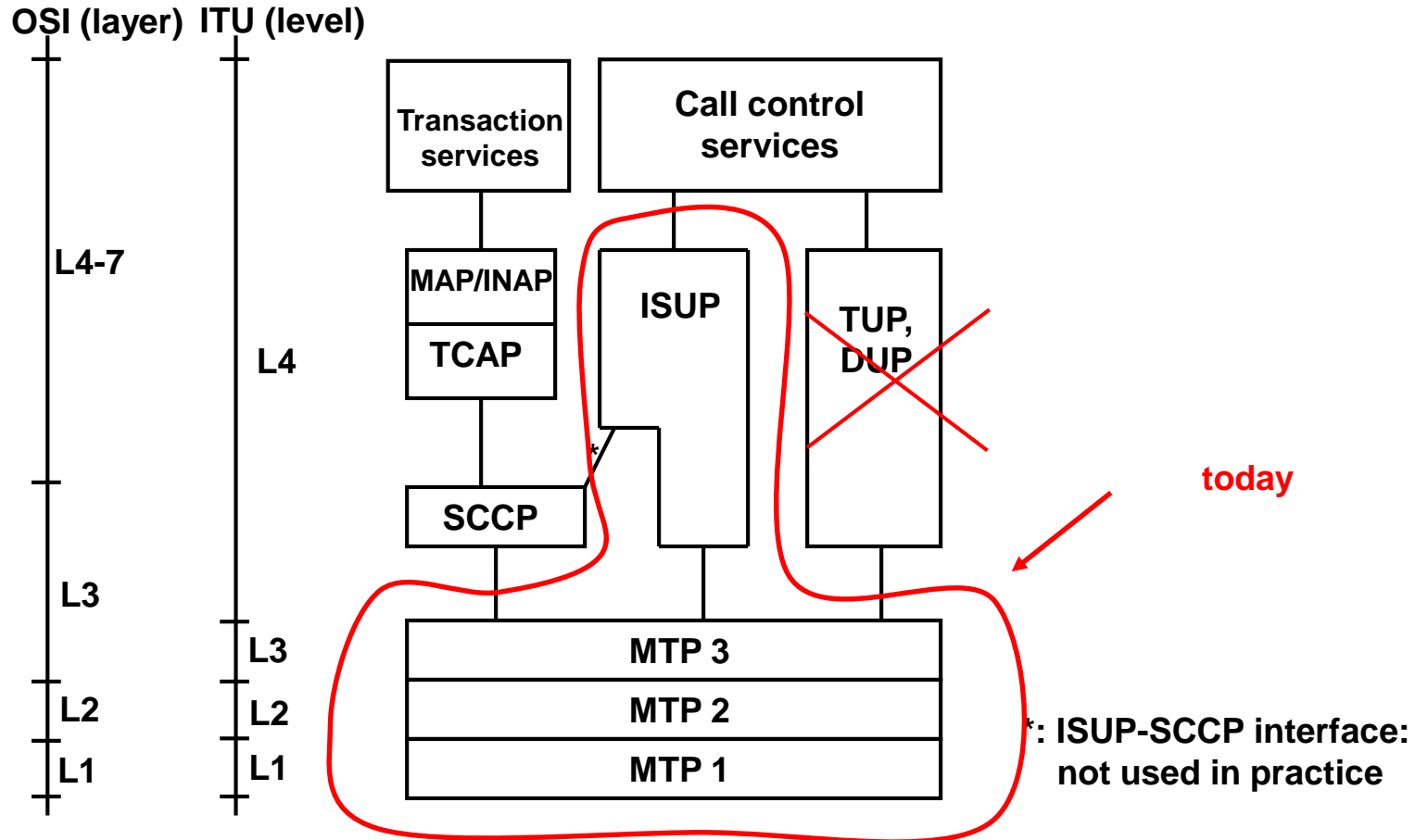
Connection Types

- Associated connection – rare exceptions for very low traffic
 - Same path for link and circuit
 - different, dedicated time slots
 - different, dedicated cables
- Quasi-associated connection – typical case
 - Different paths
 - Lot of redundancy
 - “6 sub-network”



SS7

- “Red” protocols are used for call control (establishment, release)
 - Both in fixed and in mobile networks



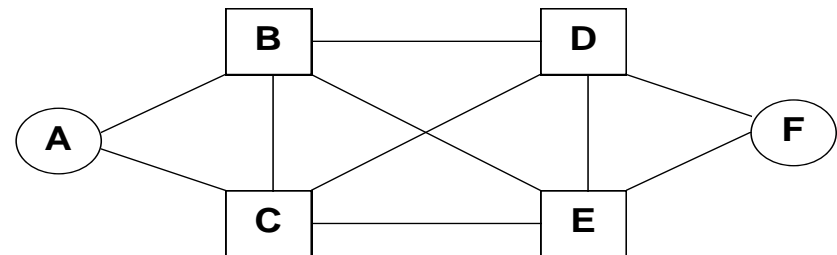
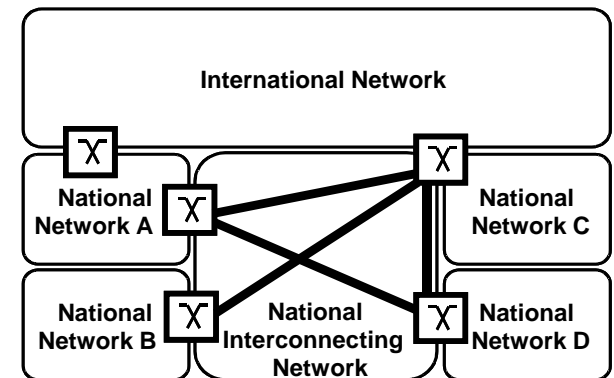
- MTP: Message Transfer Part
- MTP-1: physical level -- 64 kbps digital channel
- MTP-2: framing, error free transmission between neighbouring signaling points
 - 3 types of signaling messages:
 - MSU, Message Signal Unit – carries signals from UPs (e.g. call control)
 - FISU, Fill-In Signal Unit
when no „useful” signal to be sent – empty signal to maintain synchronisation + acknowledgement
 - LSSU, Link Status Signal Unit – used to indicate the status of the link – processed by SNM

- MTP-3: message transfer between any two signaling points within *the same* signaling network (national, national interconnecting, international networks)
 - It is not a restriction in call control
 - Two ends of every voice circuit are always in the same network
 - BUT: problem in mobile control, when inter-network signaling is required (e.g. SMS from abroad, HLR enquiry when a foreigner subscriber is called, etc.: SCCP will be the solution)



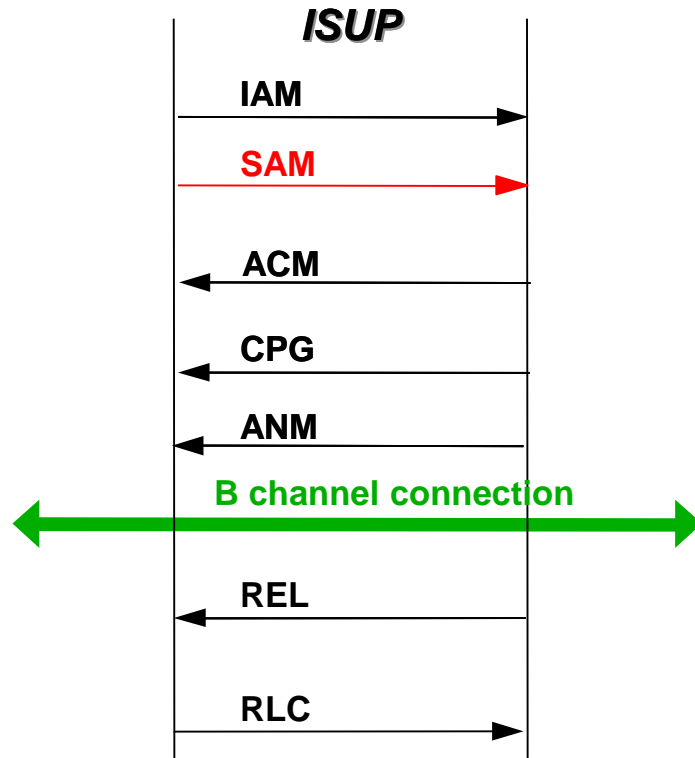
+ Signaling Network Management

- Route reconfiguration on failure
- Route restoration after fixing the failure



- TUP, DUP: Telephony User Part, Data User Part
 - withdrawn → ISUP
- ISUP: ISDN User Part
 - Call control/release messages with a lot of parameters
 - Circuit supervision
 - Voice line management

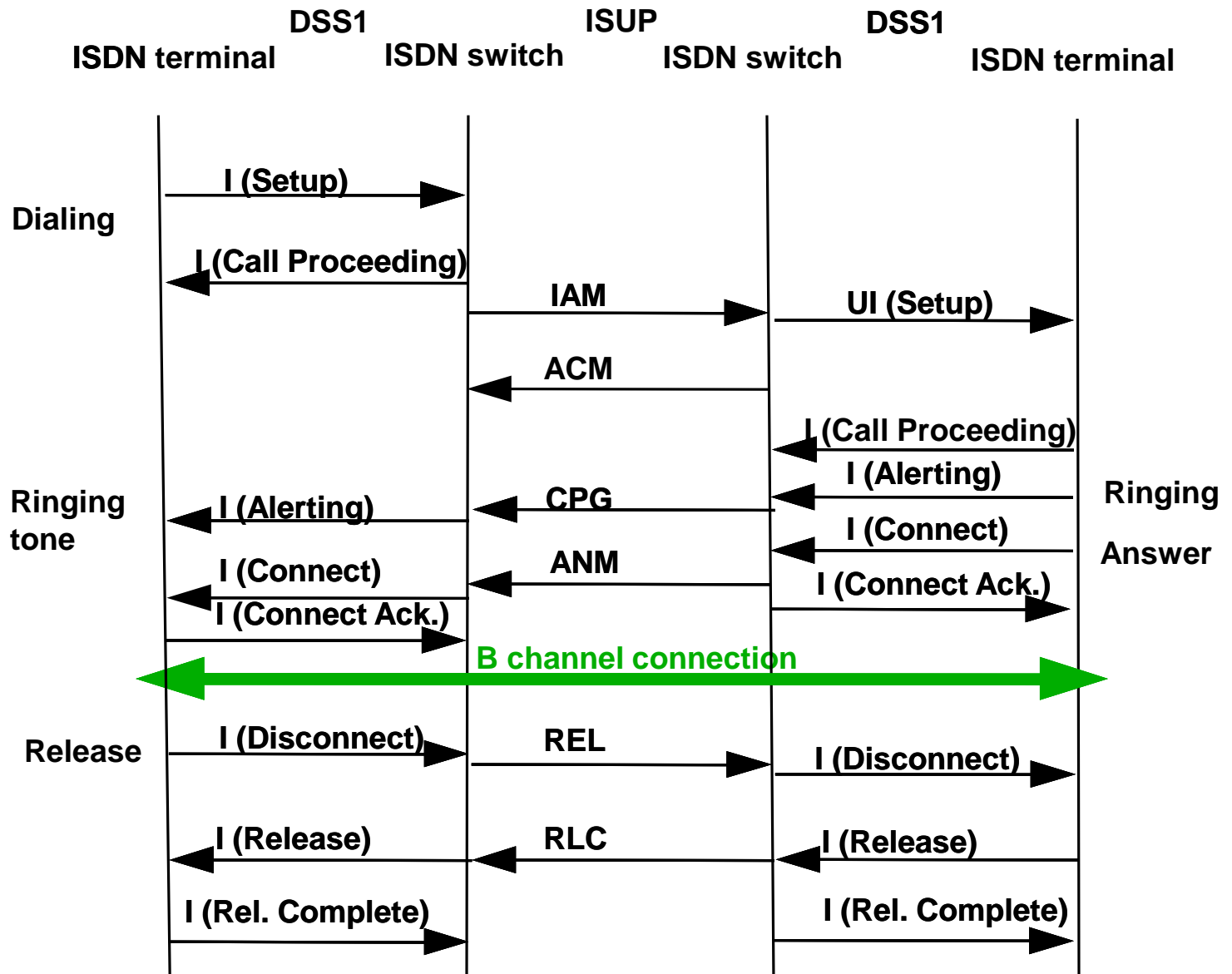
ISUP call establishment/release



IAM: Initial Address Message,
SAM: Subsequent Address Message
(optional, only if IAM does not contain
the dialed number),
ACM: Address Complete

CPG: Call (in) Progress,
ANM: Answer Message
REL: Release
RLC: Release Complete

DSS1 + ISUP



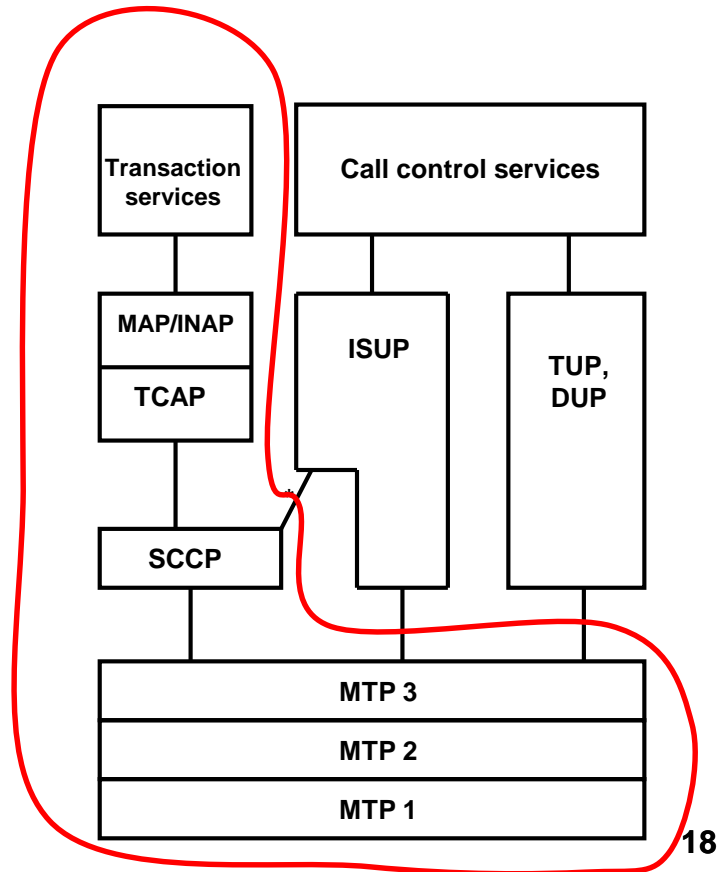
Mobile signaling



- Signaling of GSM is based on the ISDN signaling systems
 - SS7/DSS1
- But, because of mobility, roaming, radio access a lot of new problems to be solved, e.g.:
 - Authentication of subscribers, encryption of signals/voice transmission (ciphering)
 - Mobility Management
 - Management of query/response transactions
 - e.g.: data base query between the MSC and HLR to learn the location of a called mobile subscriber
 - Establishment of a signaling connection between nodes in different signaling networks
 - E.g. in case of roaming

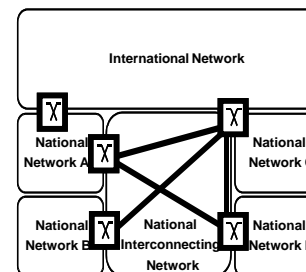
Mobile signaling for controlling

- For management (other than call control) SCCP/TCAP/MAP (INAP) protocols are used
 - E.g. SMS, Mobility Management, Authentication, HLR enquiry to find the called party, etc.

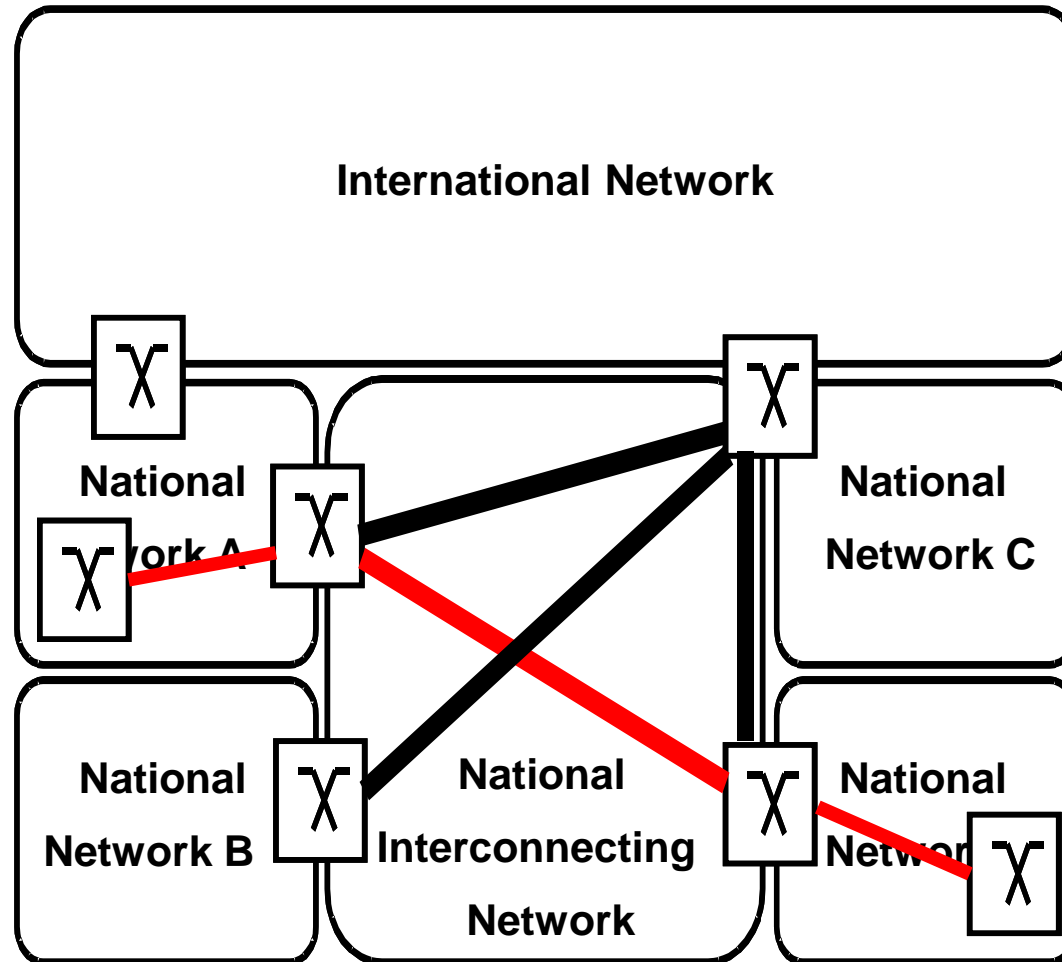


SCCP

- ❑ SCCP: Signaling Connection Control Part
- ❑ Main problem: Signaling Point Codes used in MTP-3 are unique only in a network, and not worldwide
 - not a problem in call control, because there voice circuits are to be controlled, and two ends of every voice circuit belong always to the same network,
 - if in a call more than one trunks are used: several, independent signaling connections
 - a signaling connection may be:
 - ❑ international
 - ❑ in between different operators of the same country (national interconnecting)
 - ❑ inside the network of an operator (national – for historical reasons)
 - But in GSM in case of roaming there is a need of a direct signal exchange between network elements of different operators, e.g.:
 - ❑ SMSC – MSC
 - ❑ HLR – MSC (VLR)



Call in different networks



SCCP

- Solution: Global Titles (global, not SS7-related addresses)
 - Most typically: telephone number
 - A telephone number is assigned to every network element, that may be reached from an other network
- SCCP translates between the global (tel. number) and local (MTP-3 Signaling Point Code) addresses
- 3 different services (SCCP „classes“):
 - connectionless, every signal sent independently (maybe on different route)
 - connectionless, every signal between two particular network elements sent always on the same route (sequence of signals is kept)
 - connection-oriented: connection establishment, data transfer, release phases
 - Used only at A interface for call control

TCAP

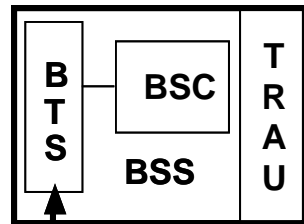
- TCAP: Transaction Capabilities Application Part
 - SCCP provides only transparent signal transfer
- TCAP supports the query-response data base transactions
 - e.g.: matches the response with the query
 - a transaction may contain several operations
 - management of operations within a transaction

MAP/INAP

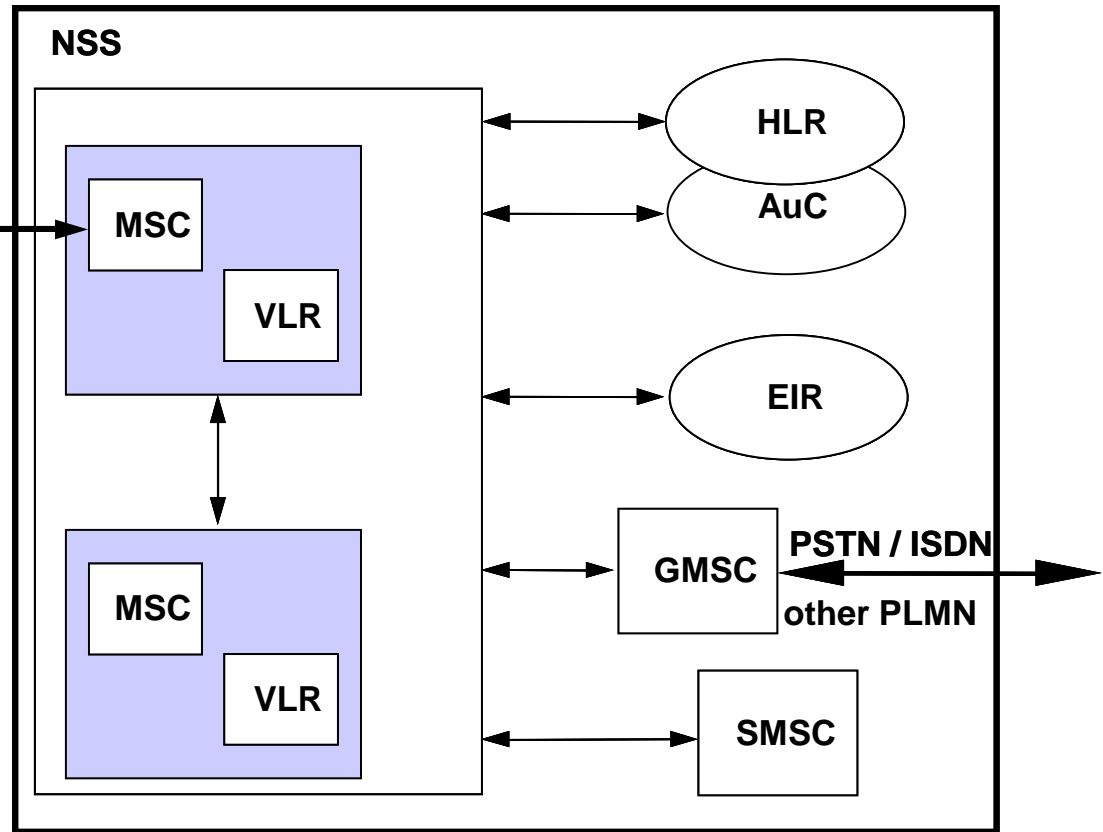
- MAP: Mobile Application Part
 - Management of the communication between the mobile network elements
- INAP: Intelligent Network Application Part
 - E.g.: green/blue or premium rate number translation
 - Number Portability

GSM protocols

A IF:
BSSAP =
BSSMAP + DTAP



Radio IF:
CC
MM
RR



NSS:
MTP + SCCP + TCAP + MAP (control)
MTP + ISUP (call control)

GSM protocols – A Interface

- BSSAP: Base Station Subsystem Application Part = BSSMAP: Base Station Subsystem Management Application Part + DTAP: Direct Transfer Application Part
- BSSMAP:
 - To control between BSS and MSC (frequency allocation to BSS, restart, etc.)
 - Over connectionless SCCP
 - Allocate radio channel to a call
 - Over connection-oriented SCCP
- DTAP:
 - To carry user call control (CC) and mobility management (MM) messages – user messages on a network interface
 - For each call a dedicated connection shall be established between MSC and BSS
 - Over connection-oriented SCCP

GSM protocols – Radio Interface

- CC: Call Control
 - Call establishment and release
 - A version of DSS1
- MM: Mobility Management
 - Location Update
- RR: Radio Resource Management
 - Allocation and synchronisation of radio channels to calls