Communication Networks

VITMAB06

Signaling

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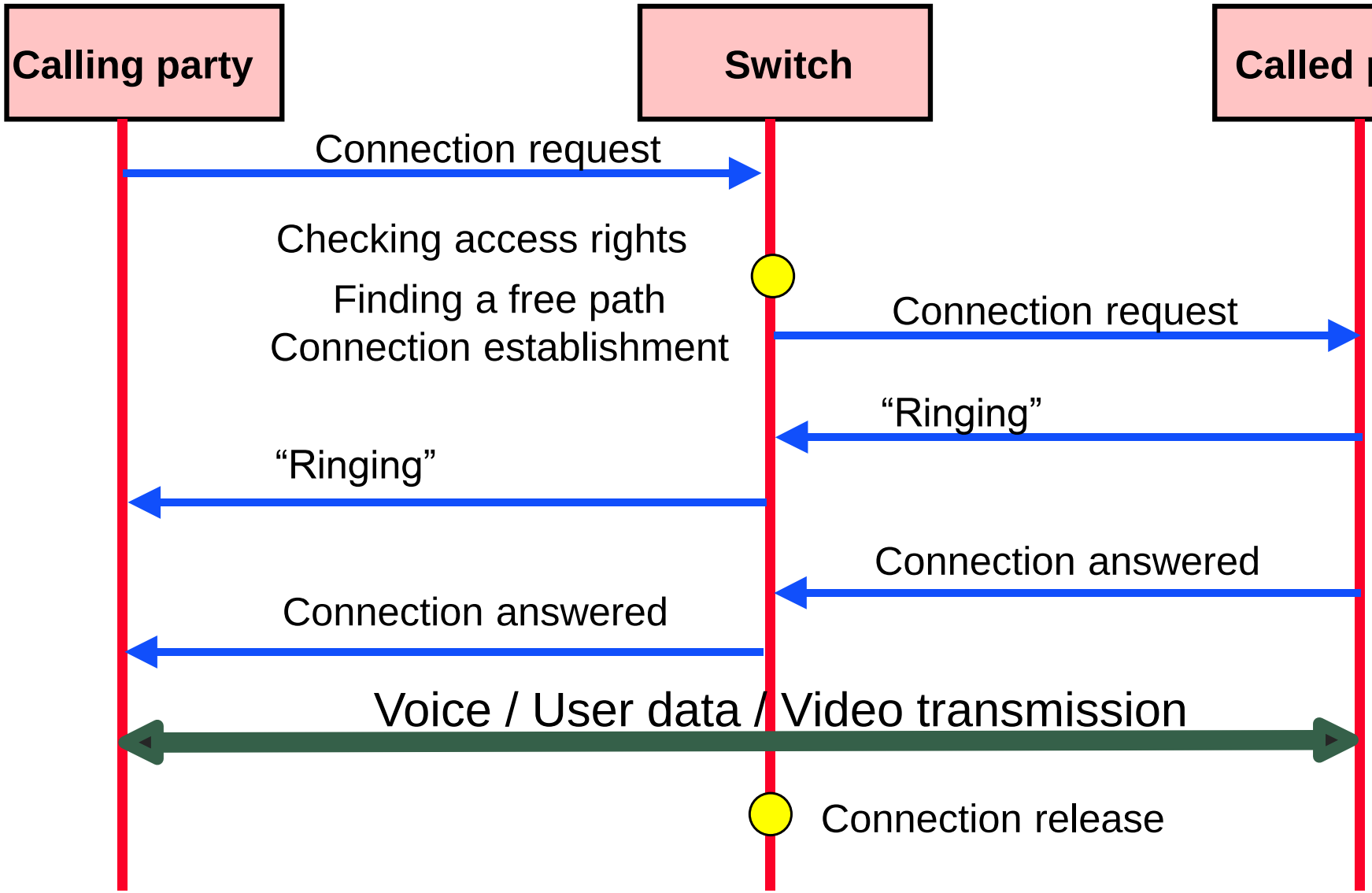
Signaling needs

- Why do we need signaling?
  - Communication between terminals and network nodes
  - Call / Connection / Session control

Signaling needs



- Conn. Request:
  - Type of connection
  - Called pty’s ID (tel. number, SIP URI, IP address, etc.)
- “Ringing”: Alerting
- Conn. Release:
  - Typically, any of the parties may initiate
  - Release/Release complete signals

Overview of signaling systems

- Signaling systems may be (according to their place in the network)
  - Subscriber signaling systems: between a terminal and a switch (User-network interface, UNI)
  - Network signaling systems: between switches and/or other network elements (Network-to-Network Interface, NNI)
- Encoding of signals may be
  - Analog (e.g. voice frequency signal – e.g. DTMF)
  - Digital message (similar to the protocol messages in computer networks)
- Connection with voice path
  - Channel Associated Signaling
  - Common Channel Signaling, CCS (independent from voice path)

Subscriber signaling - Analog

Channel Associated signals

- Classification on frequency used:
  - DC: closing of local loop: ringing tone request
  - Almost DC: periodical cutting of local loop: dialled number transmission („PULSE mode", 66ms+33ms)
  - Under voice band: ringing 25 Hz (15-68 Hz, USA 20 Hz, Eu. typically 25 Hz, 40-150V (!) AC)
  - In voice band *(in-band signaling)*
    - subscriber → switch: DTMF (Dual Tone MultiFrequency)
      - sum of two sinusoid signals

F (Hz)	1209	1336	1477	1633
697	1	2	3	A
770	4	5	6	B
852	7	8	9	C
941	*	0	#	D

    - switch → subscriber: dial tone, ringing tone, busy signal, etc. (mainly for humans, not for machines)
  - Over vioce band: tariff pulses (12-16 kHz)
    - payphones

Digital Subscriber System No. 1 (DSS1)

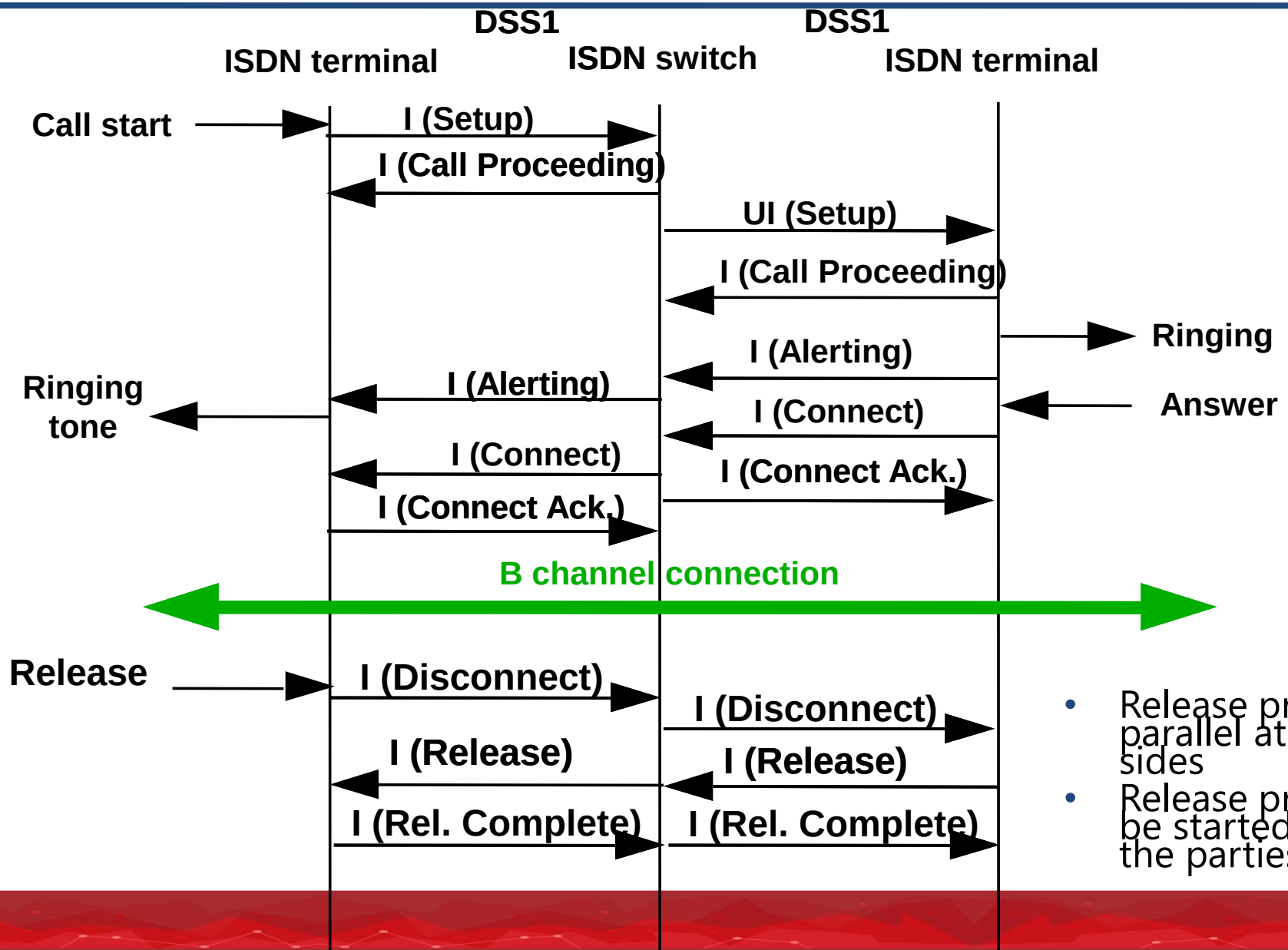
- Signaling system for ISDN subscriber loop - (2B+D)
  - Common Channel Signaling
  - 3 layers

3rd layer
LAPD
physical layer

- 1. Physical layer: ISDN D channel
- 2. LAPD: Link Access Procedure on D channel
  - framing
  - error-free signal transfer between a terminal equipment (TE) and a switch (NT – Network Termination)
    - connection-oriented
- 3. DSS1 3rd layer: call control

DSS1 example: call establishment + release

You don't need to learn for exam



- Release processes: in parallel at the two sides
- Release process can be started by any of the parties

DSS1 vs SIP

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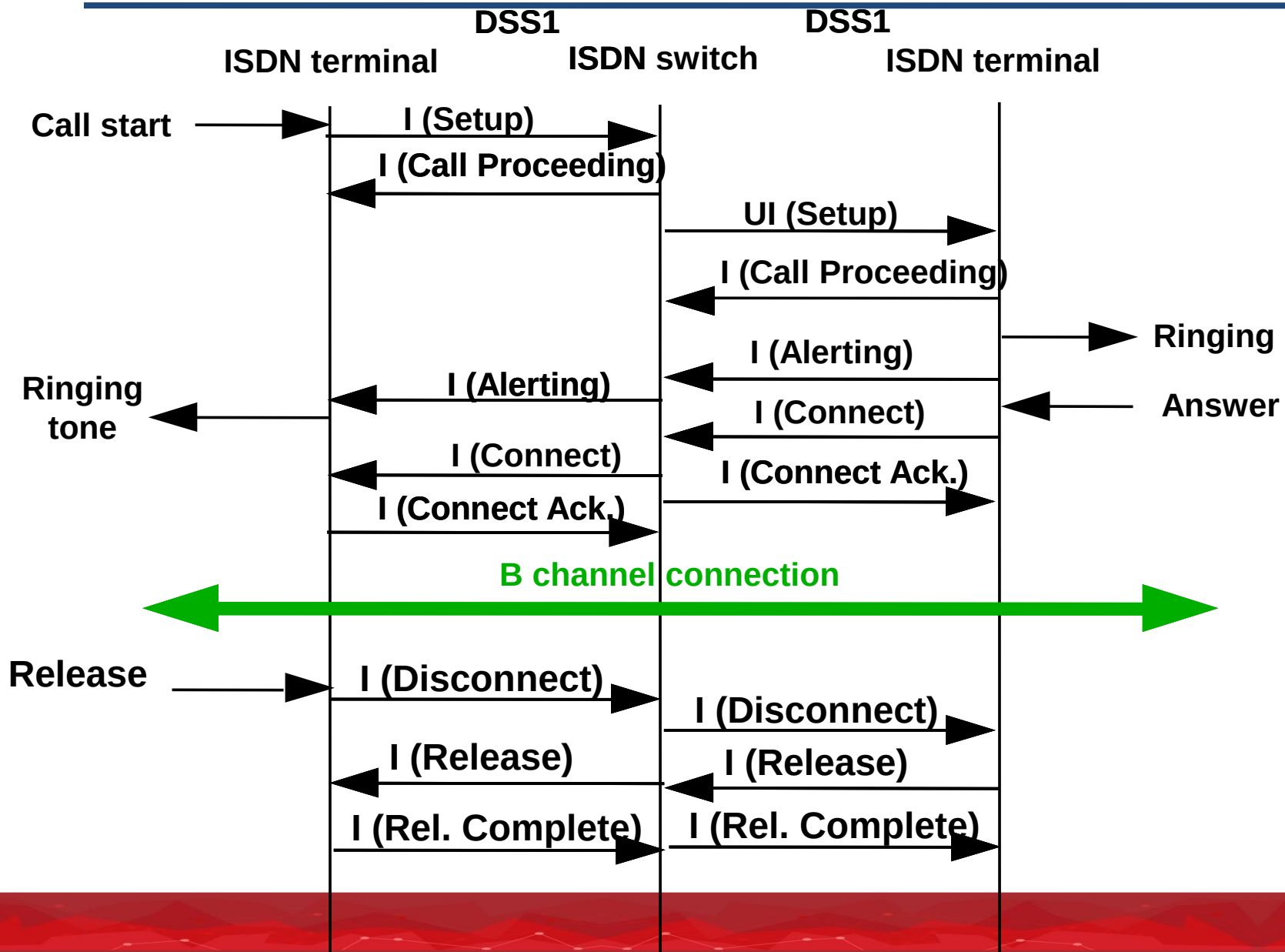
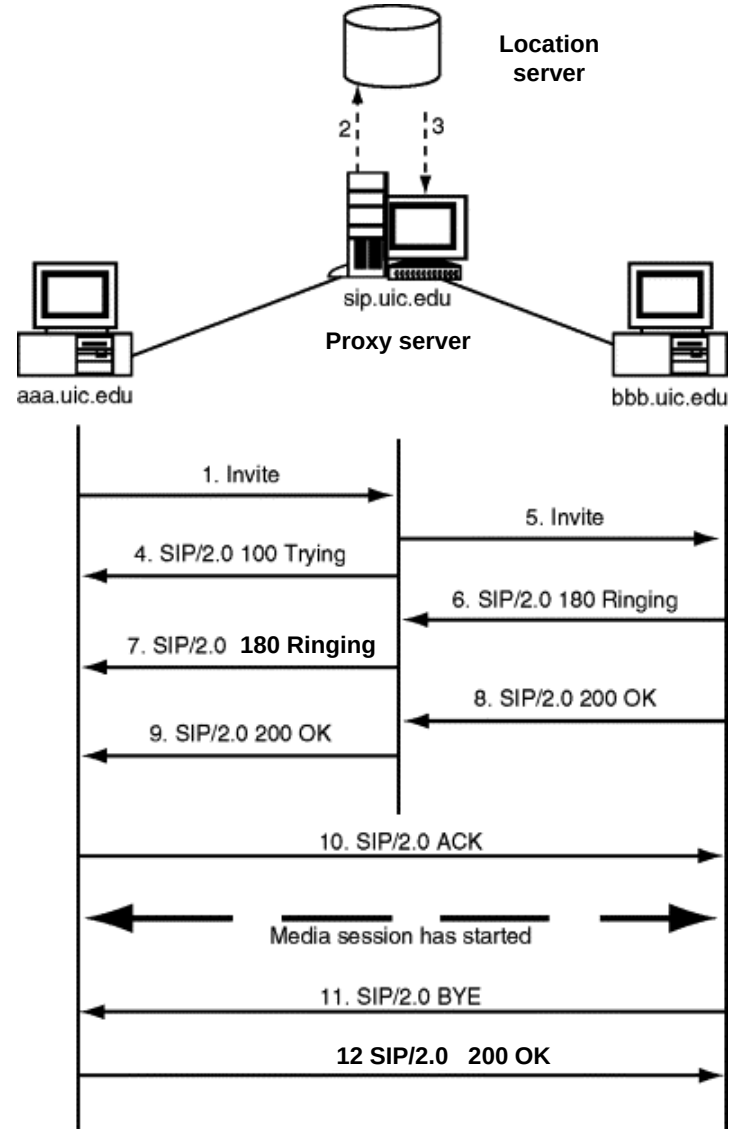




Signaling in Core Network

Channel Associated Signaling

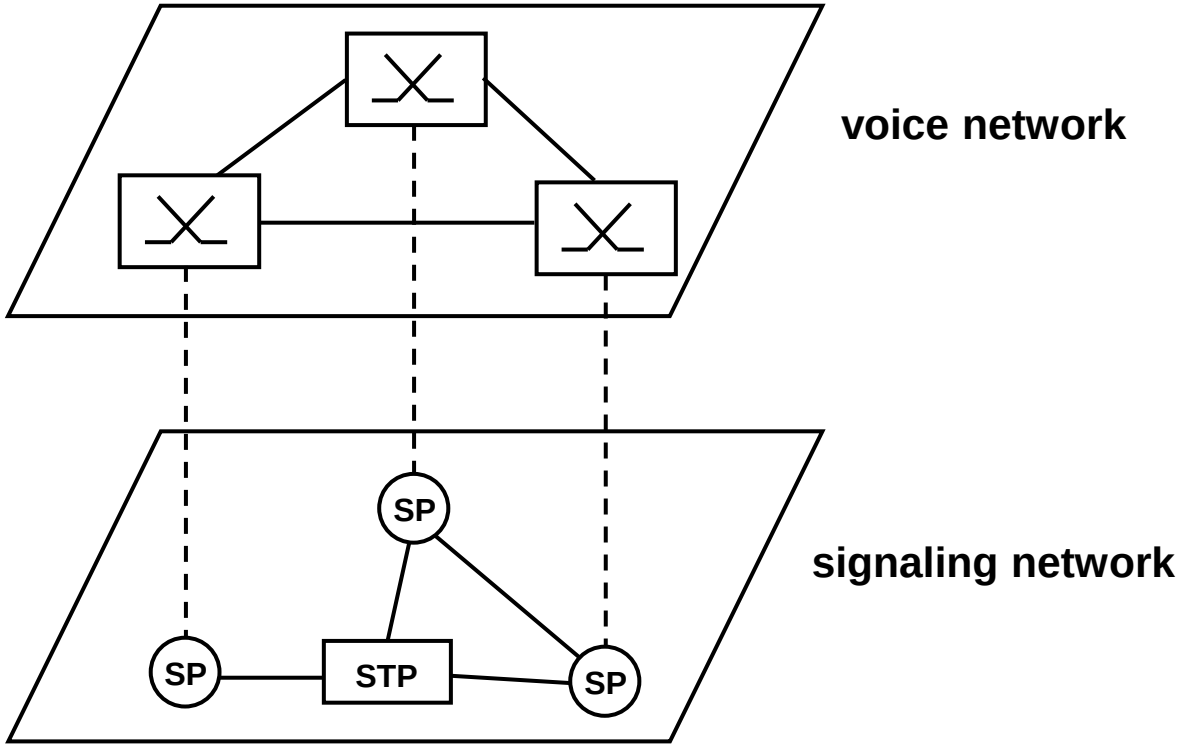
- Originally: in analogue systems
  - In a signaling frequency associated to the voice channel (in the GAP – 3850 Hz) – out-of-band signaling
- Later: digital
  - Signaling bits in a signaling channel associated to the voice line (PCM signaling channel) – out-of-band signaling
- Advantages:
  - simple
  - 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 signal

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
- Signal transfer *requirements are different* than that of the voice's
  - Signal: no signal loss allowed; delay (if not toooooo large) and jitter does not matter
  - Voice: strict periodicity but bit errors or even signal loss (if not too many) acceptable
- Advantages:
  - better utilisation of voice circuits
  - more sophisticated signals: lot of services can be controlled
  - signal transfer can be protected more than voice transfer
  - internal (e.g. management) messages possible
  - non-call-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 – may be checked (call continuity control)

Common Channel Signaling Systems

- Separate the voice and signaling into two subnetworks

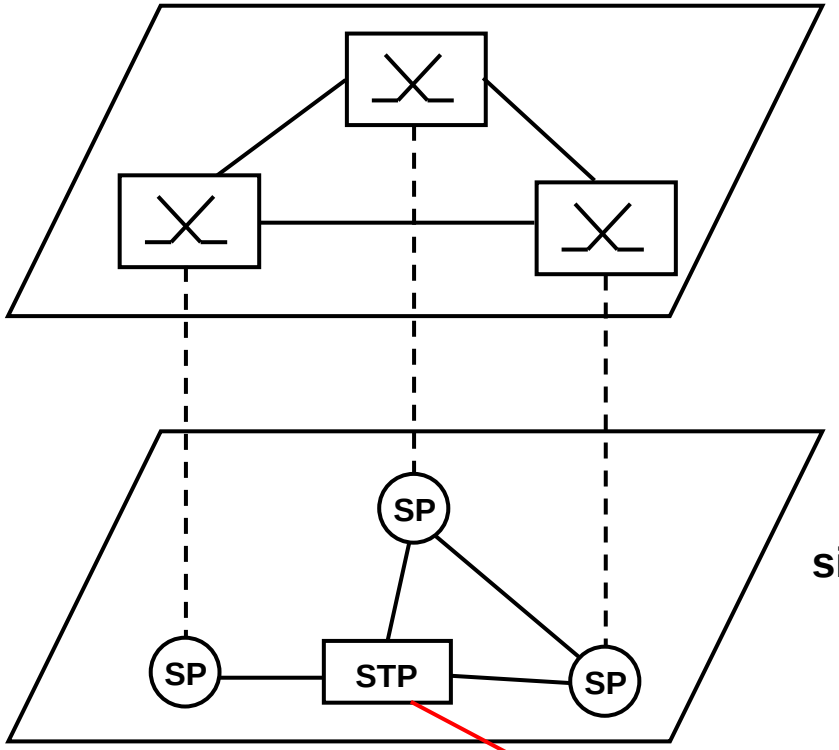


SP: Signaling Point

STP: Signaling Transfer Point

Common Channel Signaling Systems

- Separate the voice and signaling into two subnetworks



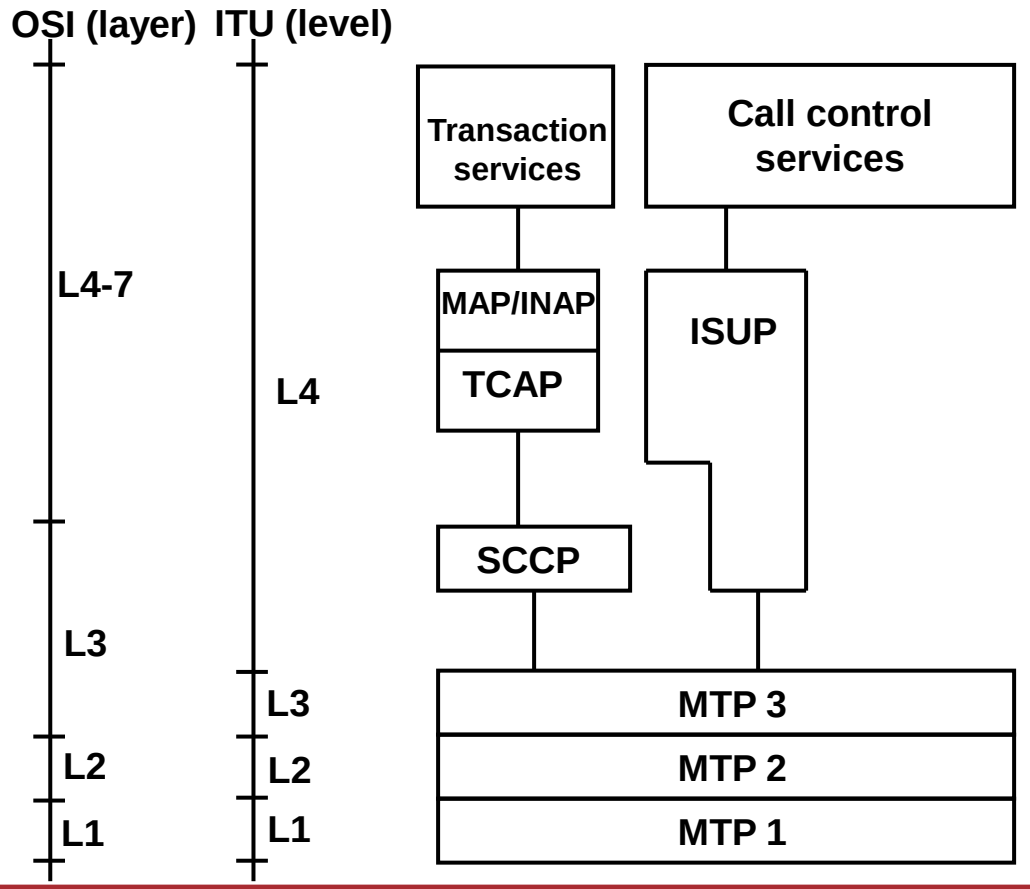
SP: Signaling Point
STP: Signaling Transfer Point

Non-call-related signaling possible

e.g.: HLR, SMSC, OAM
IN – number translation, number portability

(CC)SS7

- „The" Common Channel Signaling System: SS7
- (CC)SS7 = (Common Channel) Signaling System No. 7,
- OSI-like architecture:



SS7 protocols

- MTP: Message Transfer Part
  - MTP-1: physical level -- 64 kbps digital channel
  - MTP-2: framing, error free transmission between neighbouring points
  - MTP-3: message transfer between any two signaling points within a signaling network + Signaling Network Management
- ISUP: ISDN User Part
  - call control/release messages with a lot of parameters
  - circuit supervision
- SCCP: Signaling Connection Control Part
  - inter-network signaling
  - used in mobile systems for non-call related signals
- TCAP: Transaction Capabilities Application Part
  - data base transaction control
- MAP: Mobile Application Part
- INAP: Intelligent Network Application Part

DSS1 + ISUP

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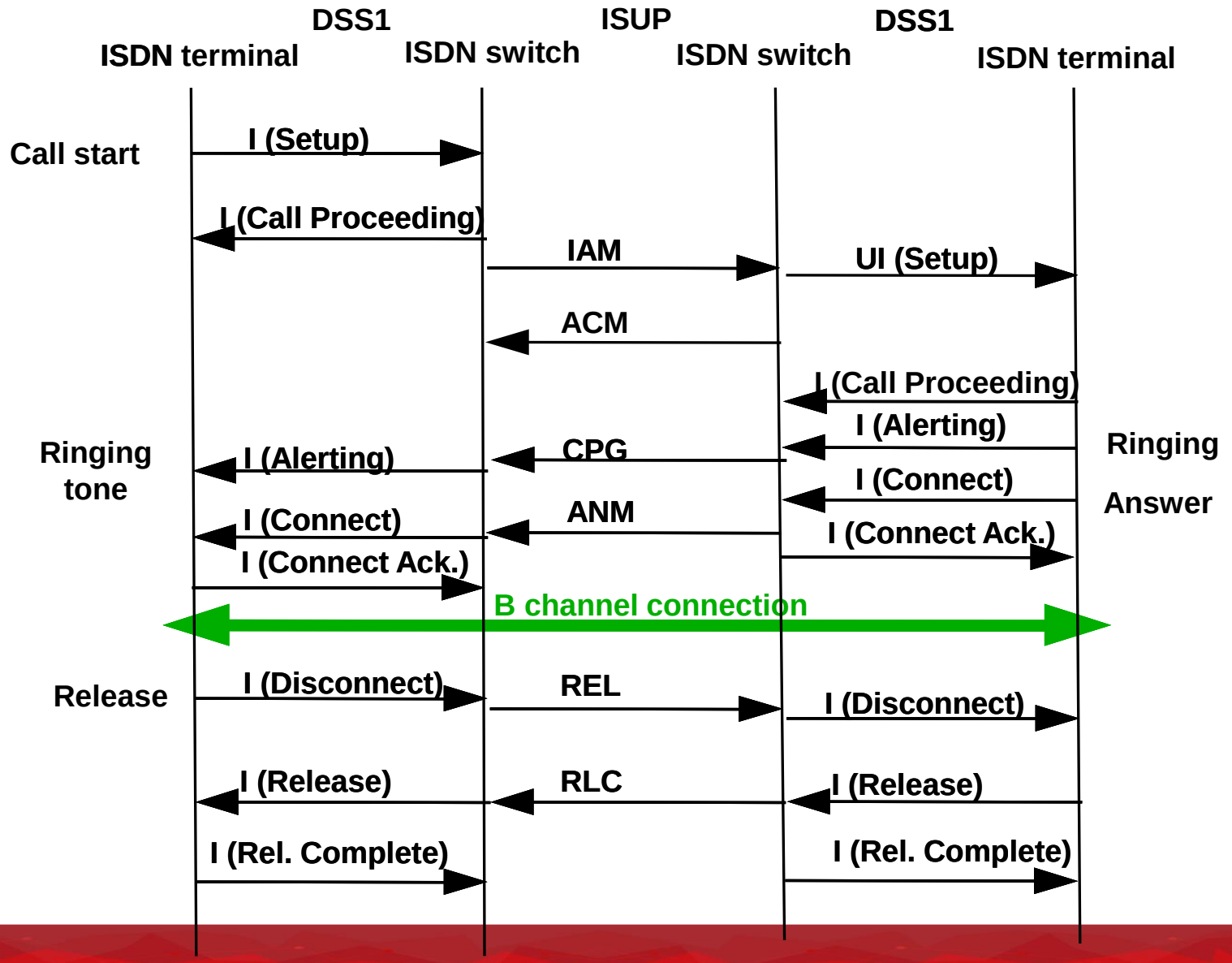


IAM: Initial Address Message,
ACM: Address Complete Message
CPG: Call (in) Progress
ANM: Answer Message
REL: Release
RLC: Release Complete

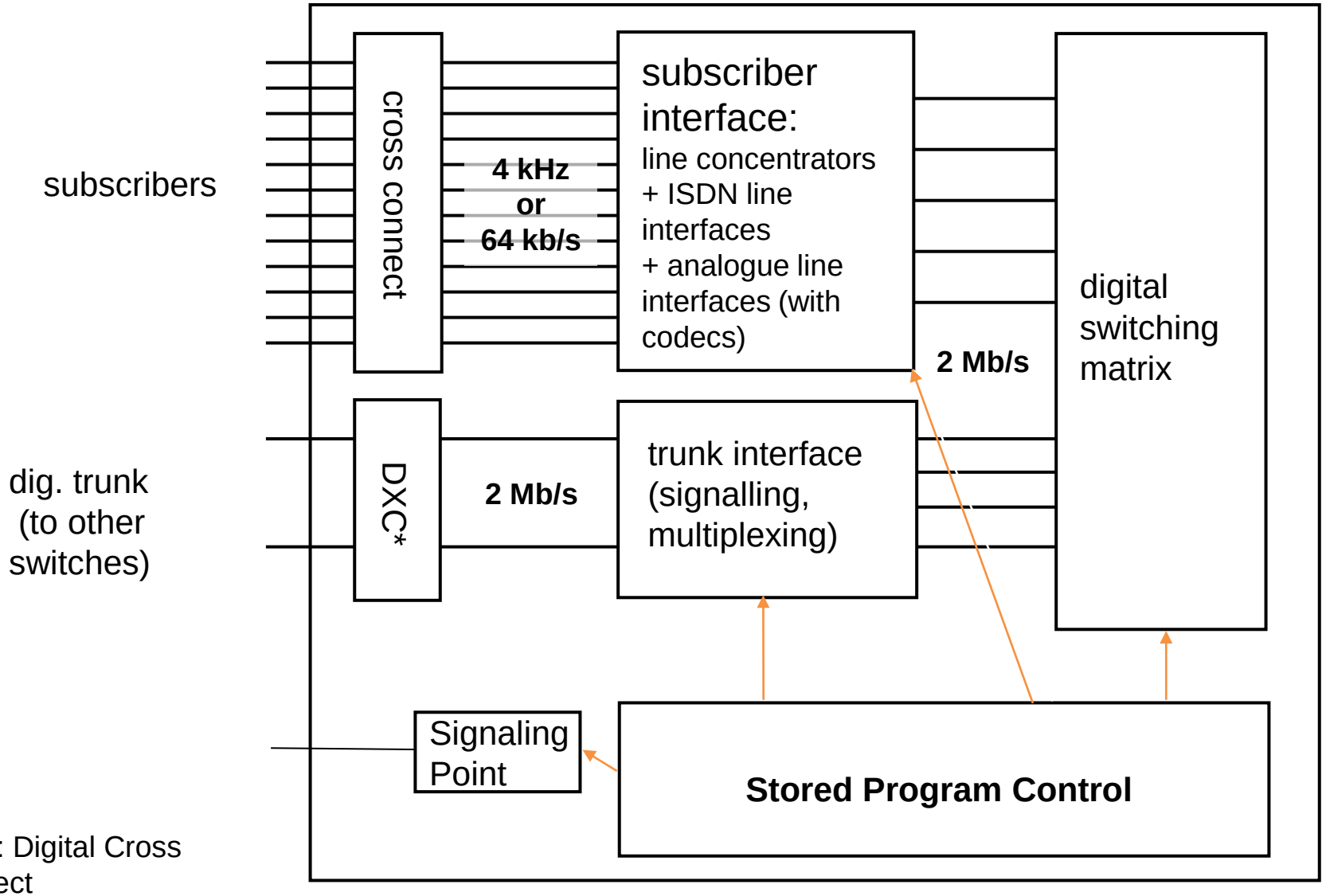
Handling of mobility

- There must be a node where the location info about the subscribers is stored
  - HLR, HSS, Registrar, ….
- During the call establishment this node shall be interrogated
- Temporary identifiers (temporary numbers – MSRN, IP addresses, …) are needed
  - They have ‘address’ function (that is to locate the called pty)
  - Because the public identifiers (e.g. called number) have ‘name’ function (that is to identify the subscriber)

Common Channel Signaling

- Can be considered as the first step to separation of the control and user data transmission
  - Later control plane and user plane
- But the separation was not complete since the nodes (switches) were common

Internal Structure of a Digital Switch

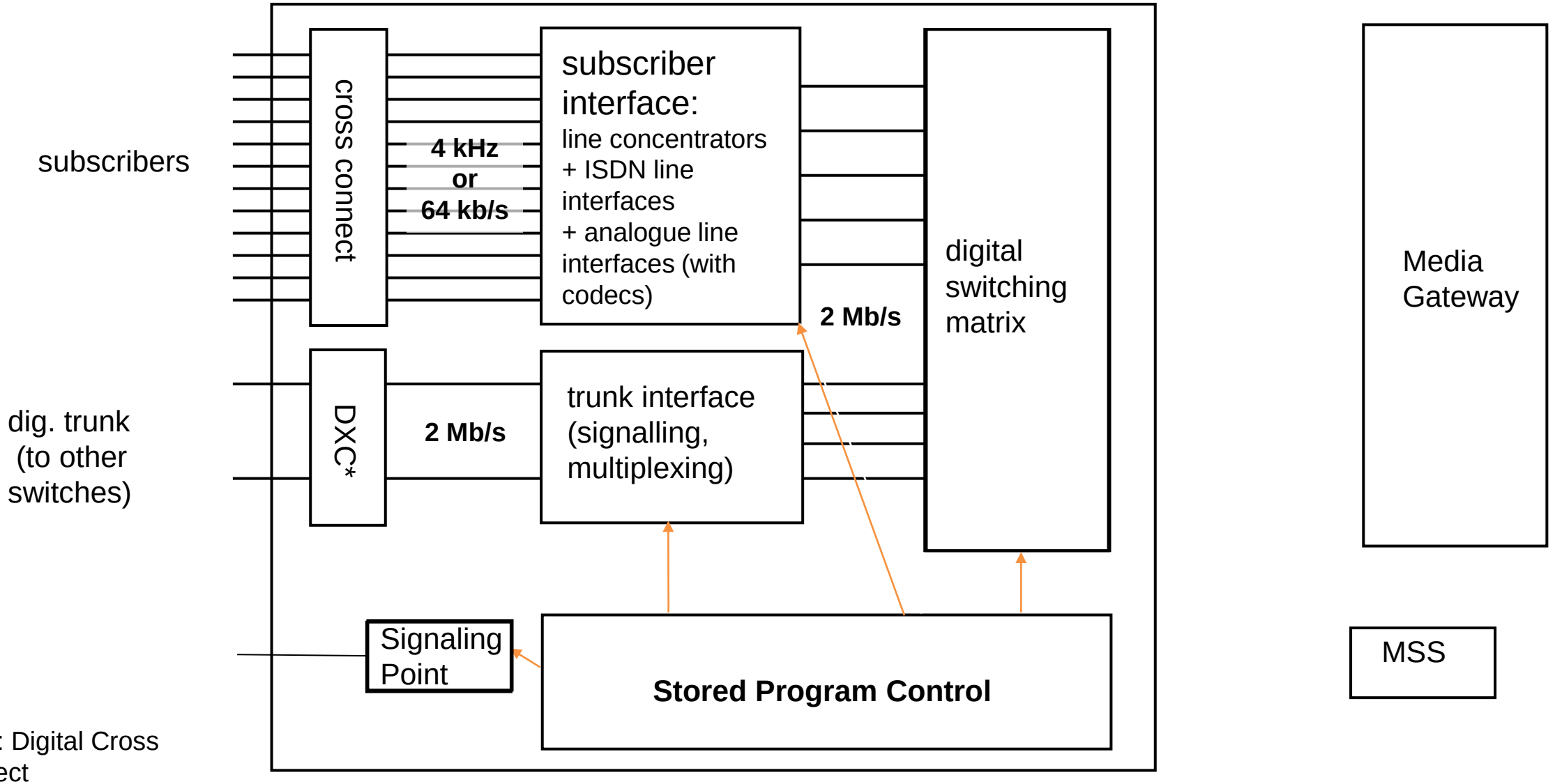


*DXC: Digital Cross Connect

Separation of the tasks of a switch

- Capacity of the computers increased
  - One signaling controlling equipment can control more switches
  - MSC Server [MSS] is responsible for:
    - Signaling (call control)
    - Mobility Management (together with VLR)
- "Switching matrix" -> MGW – Media Gateway
  - responsible for : Transmission of user traffic (voice, data) within core network
  - Get closer to users -> Edge computing
  - Delay for critical services can be reduced

Separation of the tasks of a switch



*DXC: Digital Cross Connect

Control Plane / User Plane