Networking technologies and applications

SCCP & TCAP

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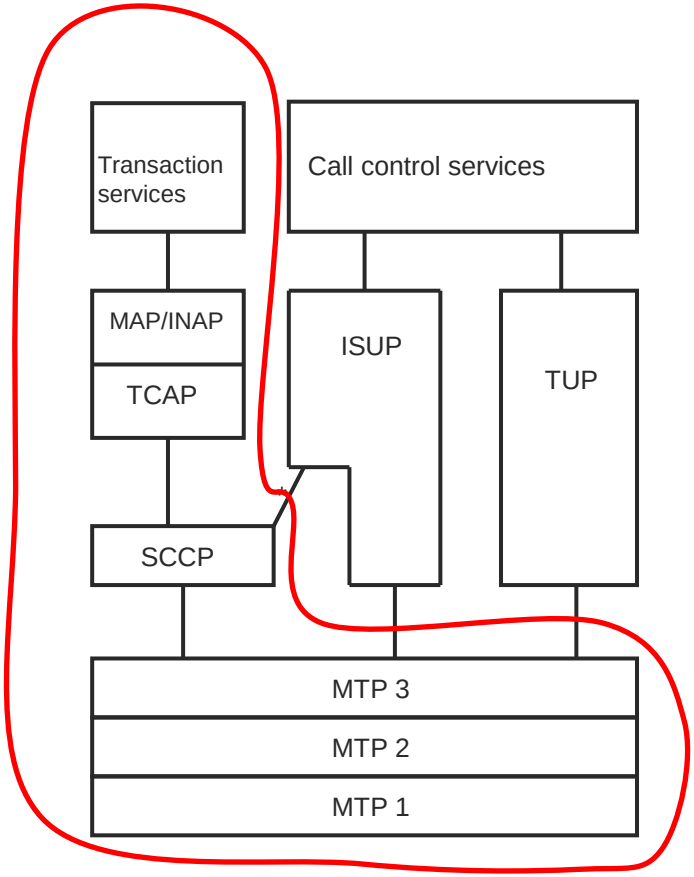
2015

SS7 Protocols

- For call control: ISUP
- For other control: SCCP/TCAP/MAP



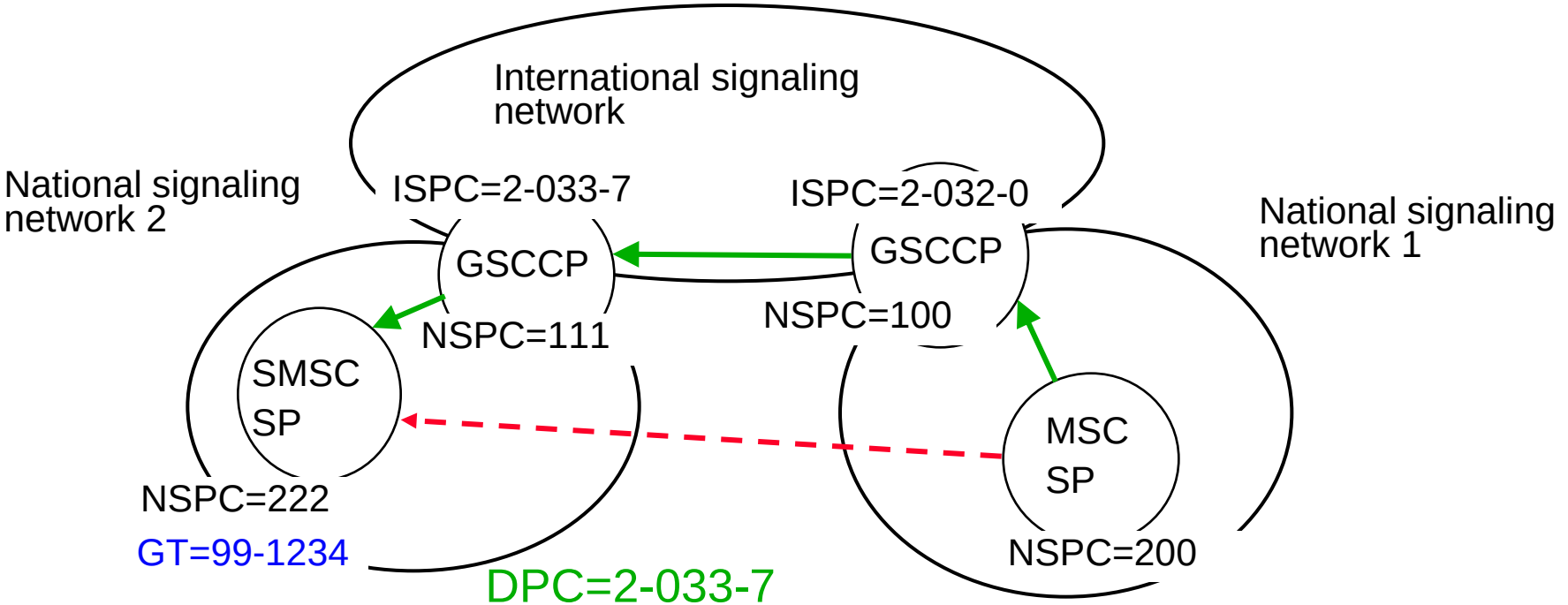
SCCP

- SCCP: Signalling Connection Control Part
- Main problem: 14 bits long Point Codes used in MTP-3 are not suitable for every SP to have a globally unique address
  - Not a problem in ISDN, because there trunk lines are to be controlled, and two ends of every trunk line belong always to the same network
  - ISDN: if in a call more than one trunks are used: several, independent signalling connections
  - A signalling 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.:
    - SMS always to home network's SMS Centre
    - Home network's HLR must get temporary telephone number (MSRN) from the serving MSC/VLR to terminate a call
- So elements of different networks must communicate…

SCCP

- Solution: use non-SS7 addresses
  - Global titles (GT)
  - Most typically: telephone numbers (E.164 numbers)
  - To each network element that may be reached from an other network (e.g. SMS Centre, HLR, MSC/VLR, etc.) a „telephone number” is assigned
- SCCP translates between the global and the local (MTP-3 DPC/OPC) addresses

SCCP Global Title Translation - Case Study: SMS transfer



DPC=222
OPC=111
NI=10(NSPC)
GT=99-1234

DPC=2-033-7
OPC=2-032-0
NI=00(ISPC)
GT=99-1234

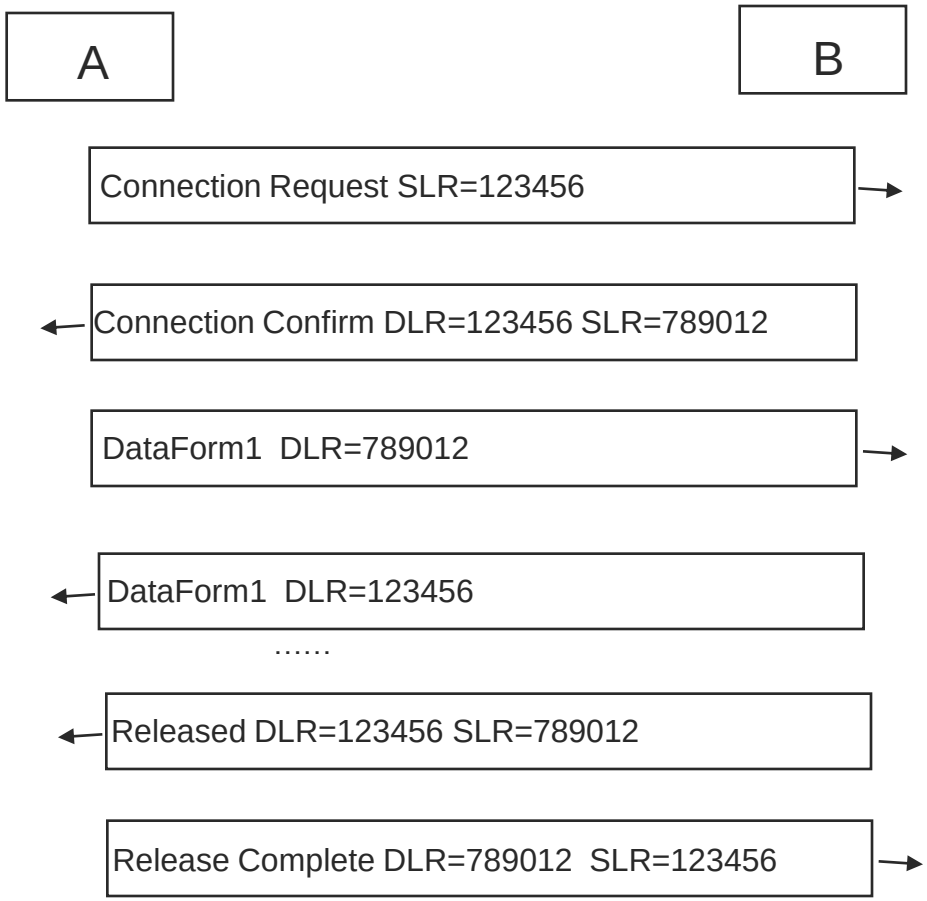
DPC=100
OPC=200
NI=01(NSPC)
GT=99-1234

SCCP Classes, Subsystems

- SCCP provides 3 different services to higher layer:
  - Class0: connectionless, messages sent independently
  - Class1: connectionless, messages between two SPs sent on the same path – order of the message is kept
  - Class2: connection-oriented:
    - signalling connection establishment,
    - data transfer
    - signalling connection release
- Subsystems

SSN (Hex)	Subsystem
00	SSN not known or not available
01	SCCP management
02	Reserved
03	ISUP
04	OMAP
05	MAP
06	HLR
07	VLR
08	MSC
09	EIR
0A	AuC
FE	BSSAP

SCCP Connection



- SLR, DLR: Logical connection identifiers
- Source/Destination Local Reference

TCAP

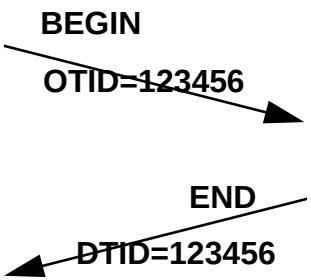
- TCAP: Transaction Capabilities Application Part
  - SCCP provides only the transparent signal transfer
- TCAP supports the query-response data base transactions
  - e.g.: matches the response with the query
  - a transaction may contain several operations – management of operations within a transaction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

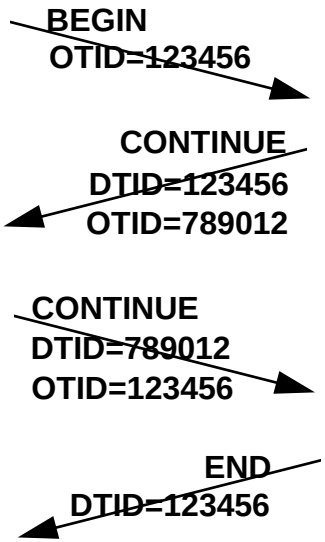
TCAP

- Structure of a TCAP message:
  - Transaction Portion
  - Dialogue Portion
  - Component Portion

Transaction Portion

- Identifies the transaction
  - OTID/DTID
    - Originating/Destination Transaction Identifier
- Describes where we are in the transaction (Phase of the transaction)
  - Message Type
    - BEGIN, END, CONTINUE, ABORT





Dialogue Portion

- Optional
- Only if version of TCAP and/or type of TCAP user protocol (MAP, INAP, …) can be different
  - E.g.: if several different network elements communicate over the link
- Even in this case, only the first TCAP messages contain Dialogue Portion

Component Portion

- Identifies the OPERATION within the transaction
  - Invoke ID
    - Each OPERATION invocation in a transaction must have different Invoke ID
- Phase of the OPERATION
  - Invoke
  - Return Result Not Last
  - Return Result Last
  - Return Error
  - Reject
- OPERATION code
- Parameters

TCAP & ASN.1

- TCAP messages are defined in ASN.1
- TCAP messages endoded by BER
- Also for all TCAP User protocol (MAP, INAP, …)

- Remote Operation Call

- To specify OPERATION, ERROR:
  - macros in ASN.1

OPERATION macro

```
name_of_operation OPERATION
    ARGUMENT
        list of parameters at invocation
    RESULT
        list of parameters at return
    ERRORS {
        list of error types may occur
        during operation execution
    } ::= localValue operation_code
```

- Result, Errors: optional

ERROR macro

```
error_type_name ERROR
   PARAMETER
      optional further information
::= localValue error_code
```

- Parameter: optional

OPERATION example

```
checkIMEI OPERATION
    ARGUMENT
        imei OCTET STRING (SIZE (3..8))
    RESULT
        equipmentStatus ENUMERATED {
                whiteListed (0),
                blackListed (1),
                greyListed (2)}
    ERRORS {
        systemFailure, dataMissing,
        unexpectedDataValue, unknownEquipment }
::= localValue 43
```

ERROR examples

```
systemFailure ERROR
   PARAMETER
      networkResource ENUMERATED{
            plmn  (0),
            hlr         (1),
            ....
            }
::= localValue 34

dataMissing ERROR
::= localValue 35
```