ISDN User Part - ISUP

✔ **ISUP - ISDN User Part**
  › **ISUP/TUP brief comparison**
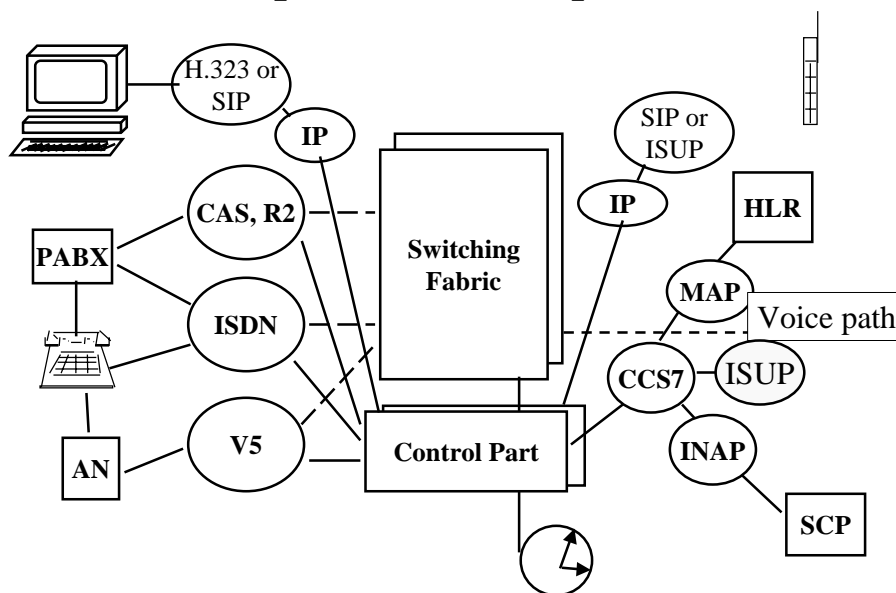 › **ISUP additional features**

✔ **Interworking of signaling systems**

ISUP is an international and national network signaling system for
- *call setup,*
- *supervision and*
- *release.*

In addition it supports a wide range of ISDN supplementary services.

Course scope - lecture scope

ISUP - ISDN User Part milestones

- **TUP was specified before DSS1 ISDN user signaling during 1980's.**

- **ISUP2 specification was released after DSS 1.**

- **ISUP2 deployment in Finland started 1994.**

- **Changeover from TUP to ISUP is well under way internationally.**

- **In network core development path is CAS -> TUP ->ISUP.**

- **If TUP is already deployed, changing to ISUP is relatively easy by a software upgrade in exchanges, because MTP-infra is already in place.**

- **Development under way in ISUP:**

  - **ETSI is adding charging information messages into ISUP.**

  - **IETF (SIGTRAN) is specifying ISUP over IP**

Why does the ISDN need ISUP instead of TUP?

Limitations of TUP compared to ISUP:

DSS 1 terminal compatibility information can not be transported in TUP,

User-to-User information is not specified in TUP signaling messages

ISDN Suspend/Resume is not supported in TUP,

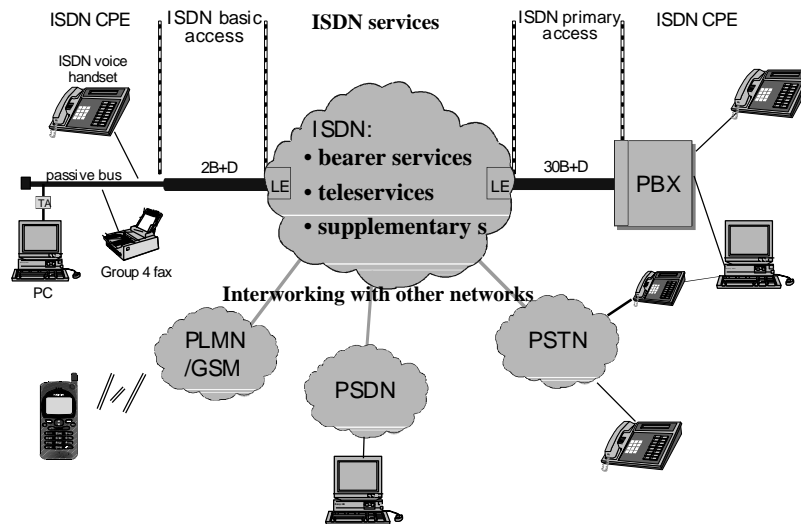**TUP does not support all (Euro-)ISDN supplementary services - call waiting, call hold ...**

In TUP release is non-symmetric / in ISDN it is symmetric
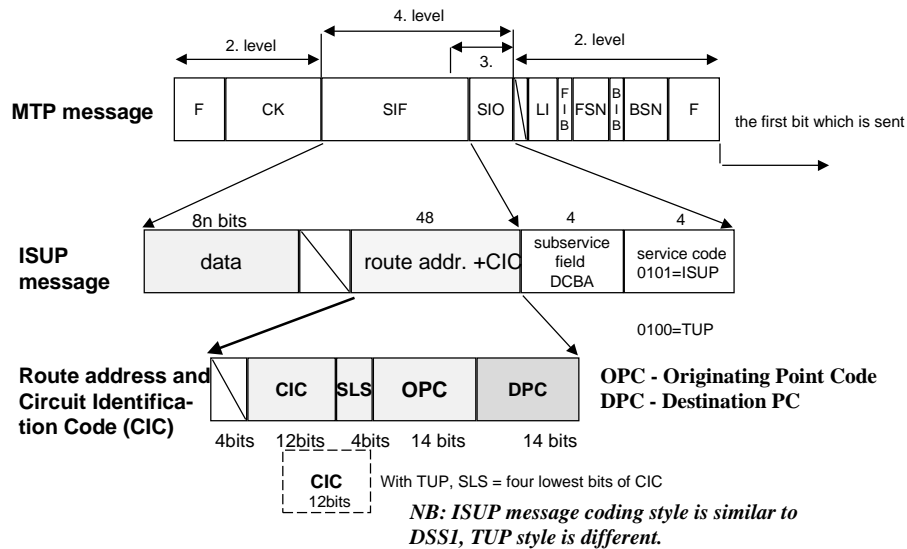
Bearer services supported by ISUP are

- ✔ **speech**
- ✔ **64 kbit/s unrestricted (= transparent 64kbit/s)**
- ✔ **3.1 and 7 kHz audio**
- ✔ **alternate speech / 64 kbit/s unrestricted**
- ✔ **alternate 64 kbit/s unrestricted / speech**

  2 x 64 kbit/s unrestricted

  384 kbit/s unrestricted

  1536 kbit/s unrestricted

  1920 kbit/s unrestricted

In the future ISUP offers extenstions compared   to TUP, but competition from the Internet is tough!

ISDN basic structures

ISDN CPE

ISDN basic access

ISDN services

ISDN primary access

ISDN CPE

ISDN voice handset

passive bus

TA

PC

Group 4 fax

2B+D

LE

ISDN:
- **bearer services**
- **teleservices**
- **supplementary s**

LE

30B+D

PBX

Interworking with other networks

PLMN /GSM

PSDN

PSTN

Basic structure of an ISUP message

MTP message: F | CK | SIF | SIO | LI | FIB | FSN | BIB | BSN | F — the first bit which is sent

2. level, 4. level, 3., 2. level

ISUP message:
- 8n bits: data
- 48: route addr. +CIC
- 4: subservice field DCBA
- 4: service code 0101=ISUP

0100=TUP

Route address and Circuit Identification Code (CIC):
CIC | SLS | OPC | DPC

4bits | 12bits | 4bits | 14 bits | 14 bits

CIC 12bits

With TUP, SLS = four lowest bits of CIC

OPC - Originating Point Code
DPC - Destination PC

NB: ISUP message coding style is similar to DSS1, TUP style is different.

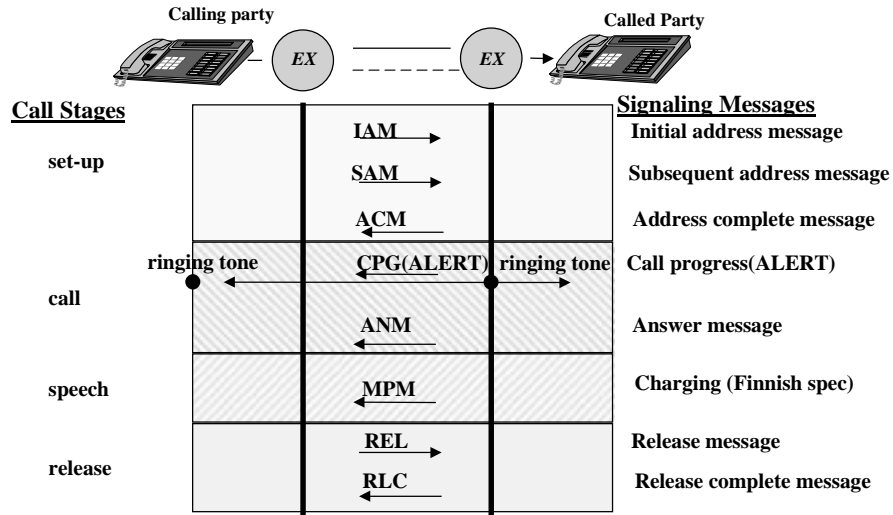## *Call identification is based on a compulsory CIC and an optional (logical) call reference*

- ✔ **Call reference is recommended only for national use.**

- ✔ **n x 64kbit/s connections are always built using consecutive timeslots, thus one CIC is enough.**

- ✔ **n x 64kbit/s -connection is identified using the smallest CIC among the time-slots.**

- ✔ **CIC binds the call channel and signaling together. One can not exist without the other --> one result is that in IN a special standardised Basic Call State Model is needed. The BCSM is used track the state of the resources in an SSP (service switching point) while an SCP (service control point) processes additional features.**

- ✔ **Binding to CIC is also an issue when Interworking with IP Telephony systems.**
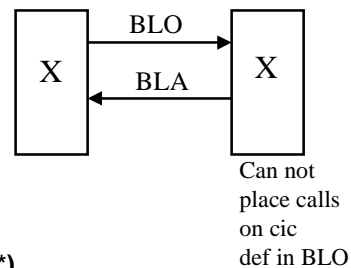
A successful ISUP call
(calling subscriber initiates release)

Calling party   **Called Party**

EX   EX

Call Stages   **Signaling Messages**

set-up
- IAM →   **Initial address message**
- SAM →   **Subsequent address message**
- ACM ←   **Address complete message**

ringing tone ← CPG(ALERT) ringing tone →   **Call progress(ALERT)**

call
- ANM ←   **Answer message**

speech
- MPM ←   **Charging (Finnish spec)**

release
- REL →   **Release message**
- RLC ←   **Release complete message**

ISUP circuit supervision messages --> circuits and 2M connections can be taken into use and from use in a managed way.

RSC Reset circuit
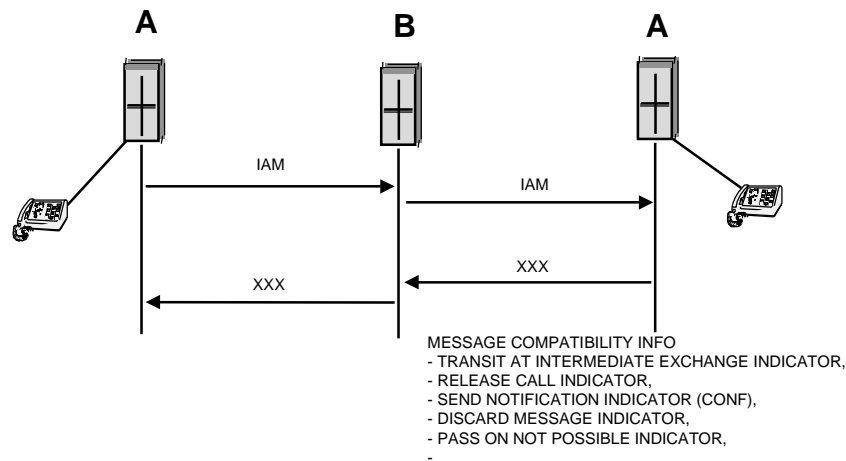**BLO** Blocking
BLA Blocking acknowledgement
UBL Unblocking
UBA Unblocking acknowledgement

X → BLO → X
X ← BLA ← X

Can not place calls on cic def in BLO

EHL End-of-hold (*)
EHA End-of-hold acknowledgement (*)
OLM Overload (*)
UCIC Unequipped circuit identification code (*)

(*) For national use

Forward COMPATIBILITY is ensured from 1992 release

A   **B**   **A**

IAM →   IAM →

← XXX   ← XXX

MESSAGE COMPATIBILITY INFO
- TRANSIT AT INTERMEDIATE EXCHANGE INDICATOR,
- RELEASE CALL INDICATOR,
- SEND NOTIFICATION INDICATOR (CONF),
- DISCARD MESSAGE INDICATOR,
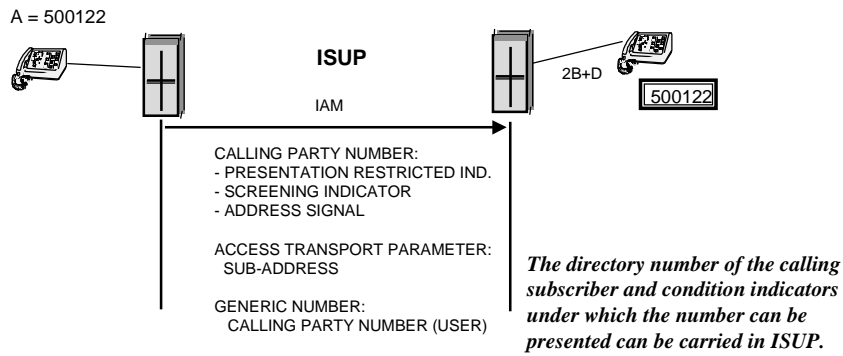- PASS ON NOT POSSIBLE INDICATOR,
-...

ISUP message coding supports ISUP software upgrades - old and new version can talk to each other!

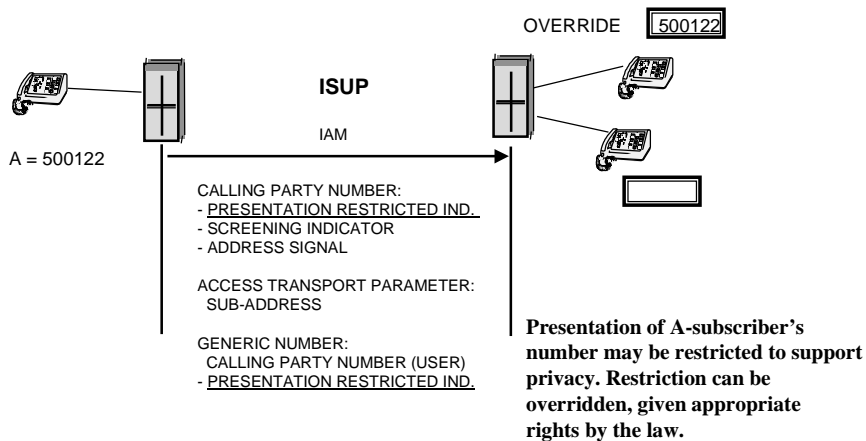# *Version compatibility rules: the following should not be changed:*

✔ Protocol procedures, messages, information elements, coding, except to correct an error in the protocol.

✔ Semantics of existing info elements.

✔ Formatting and coding rules

✔ Adding new parameters into mandatory part of Messages, Optional part can be extended.

✔ Order of information items in an Information Element of variable length, new items can be added to the end of the IE.

✔ Information item value ="all 0" == non-significant value.

+ **Fall-back and other compatibility procedures.**

Rules apply from ISUP'92.

Calling Line Identification Presentation - CLIP - is a supplementary service supported by ISUP
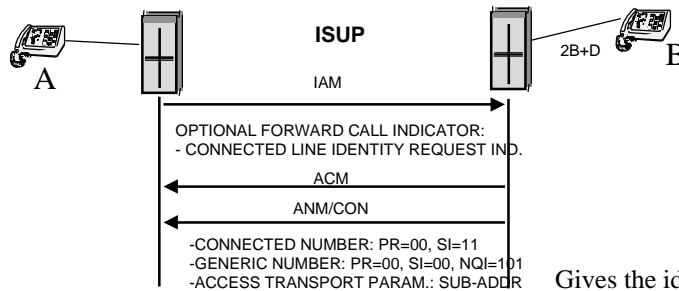
A = 500122

ISUP

IAM

2B+D

500122

CALLING PARTY NUMBER:
- PRESENTATION RESTRICTED IND.
- SCREENING INDICATOR
- ADDRESS SIGNAL

ACCESS TRANSPORT PARAMETER:
 SUB-ADDRESS

GENERIC NUMBER:
   CALLING PARTY NUMBER (USER)

The directory number of the calling subscriber and condition indicators under which the number can be presented can be carried in ISUP.

Calling Line Identification Presentation Restriction - CLIR - is a pair to CLIP

OVERRIDE   500122

ISUP

IAM

A = 500122

CALLING PARTY NUMBER:
- <u>PRESENTATION RESTRICTED IND.</u>
- SCREENING INDICATOR
- ADDRESS SIGNAL

ACCESS TRANSPORT PARAMETER:
 SUB-ADDRESS

GENERIC NUMBER:
   CALLING PARTY NUMBER (USER)
- <u>PRESENTATION RESTRICTED IND.</u>

Presentation of A-subscriber's number may be restricted to support privacy. Restriction can be overridden, given appropriate rights by the law.

Connected Line Identification Presentation -COLP - is a mirror image to CLIP

500122

B = 500122

ISUP

2B+D

A

B

IAM

OPTIONAL FORWARD CALL INDICATOR:
- CONNECTED LINE IDENTITY REQUEST IND.

ACM

ANM/CON

-CONNECTED NUMBER: PR=00, SI=11
-GENERIC NUMBER: PR=00, SI=00, NQI=101
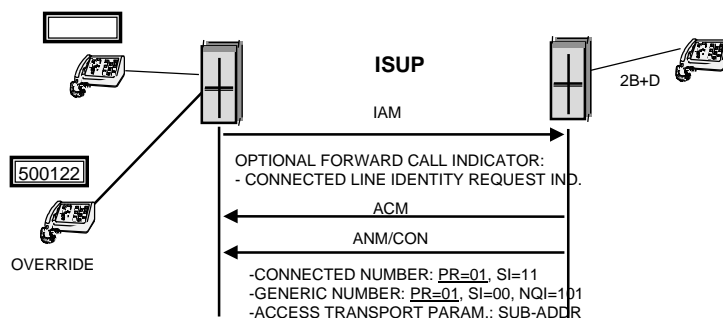-ACCESS TRANSPORT PARAM.: SUB-ADDR

PR = 00, presentation allowed
SI = 11, network provided
SI = 00, user provided not verified
NQI = 101, additional connected nbr.

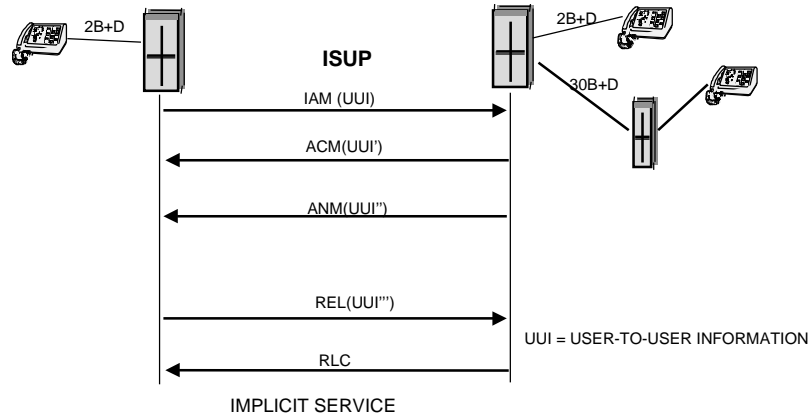Gives the identity of B to A. NB: due to supplementary services B may be different from dialled nr

---

Connected Line Identification Presentation Restriction - COLR - is the pair to COLP

B = 500122

ISUP

2B+D

IAM

500122

OPTIONAL FORWARD CALL INDICATOR:
- CONNECTED LINE IDENTITY REQUEST IND.

ACM

ANM/CON

OVERRIDE

-CONNECTED NUMBER: PR=01, SI=11
-GENERIC NUMBER: PR=01, SI=00, NQI=101
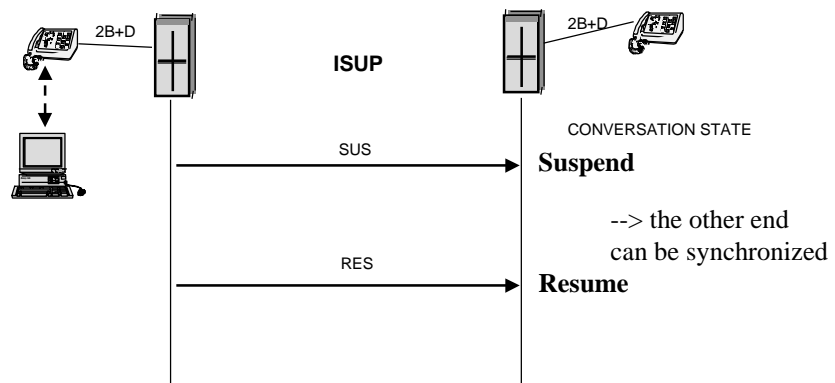-ACCESS TRANSPORT PARAM.: SUB-ADDR

PR = 01, presentation restricted
SI = 11, network provided
SI = 00, user provided not verified
NQI = 101, additional connected nbr.

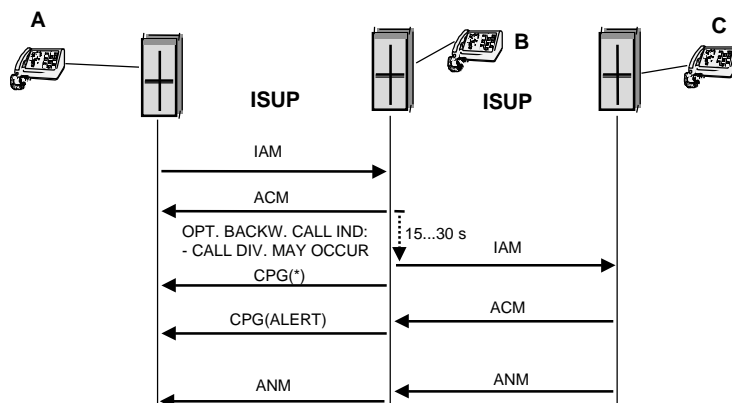*User to User Signalling 1 - UUS1 - allows transpor-*
ting user provided information over CCS7 network

2B+D

ISUP

2B+D

30B+D

IAM (UUI)

ACM(UUI')

ANM(UUI")

REL(UUI"')

UUI = USER-TO-USER INFORMATION

RLC

IMPLICIT SERVICE

Terminal Portability (TP) - ISDN allows interrupting a call and
resuming it even from a different phone or phone line..

2B+D

ISUP

2B+D

CONVERSATION STATE

SUS   **Suspend**

--> the other end
can be synchronized

RES   **Resume**

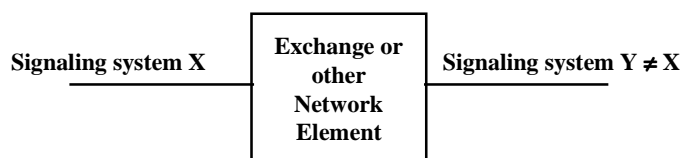## Call Forwarding No Reply - CFNR - automatically forwards an incoming call to C-number

```
A                                    B                          C

            ISUP                         ISUP

                    IAM
        ──────────────────────►
                    ACM
        ◄──────────────────────
        OPT. BACKW. CALL IND:      │15...30 s
        - CALL DIV. MAY OCCUR      │         IAM
                    CPG(*)         ▼  ──────────────────────►
        ◄──────────────────────
                  CPG(ALERT)                 ACM
        ◄──────────────────────     ◄──────────────────────
                    ANM                      ANM
        ◄──────────────────────     ◄──────────────────────
```
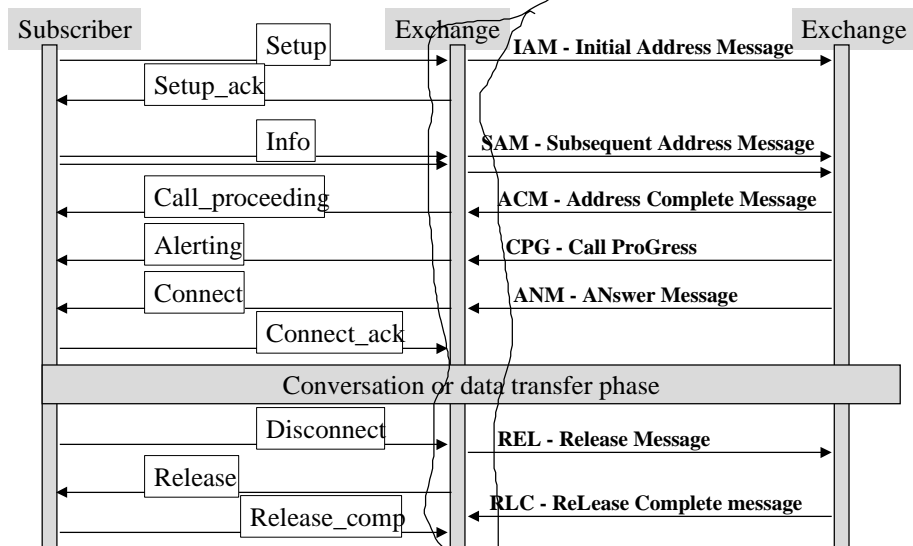
(*) CALL DIV. INFO, REDIR. NBR., GENERIC NOTIF.

Signaling interworking occurs in an exchange if two legs of the call are managed using different signaling systems

```
                        ┌──────────────┐
Signaling system X      │ Exchange or  │    Signaling system Y ≠ X
─────────────────────── │    other     │ ───────────────────────
                        │   Network    │
                        │   Element    │
                        └──────────────┘
```

✔ **Interworking of signalling systems**

✔ **Also we talk about signaling interworking if two peer exchanges are manufactured by different vendors (interworking of different implementations)**
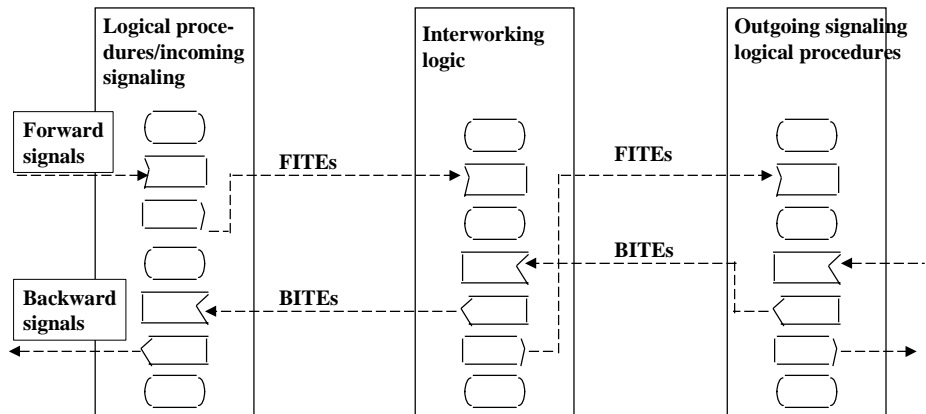
✔ **cmp. compatibility**

DSS1 / ISUP -interworking

Subscriber	Exchange		Exchange

Setup → **IAM - Initial Address Message** →

Setup_ack ←

Info → **SAM - Subsequent Address Message** →

Call_proceeding ← **ACM - Address Complete Message** ←

Alerting ← **CPG - Call ProGress** ←

Connect ← **ANM - ANswer Message** ←

Connect_ack →

Conversation or data transfer phase

Disconnect → **REL - Release Message** →

Release ←

Release_comp → **RLC - ReLease Complete message** ←

Each signaling system has its own set of signals of information elements -> in interworking almost always some info is lost.

- To ensure smooth interworking, functioning need to be carefully specified. If we have *n* signaling systems, there are n^2 interworking cases!

- Standardization bodies use two methods for the specification of interworking:

    - *For Channel Associated signaling*: event based FITE/BITE -method.

    - *For message based signaling*: layer oriented method.
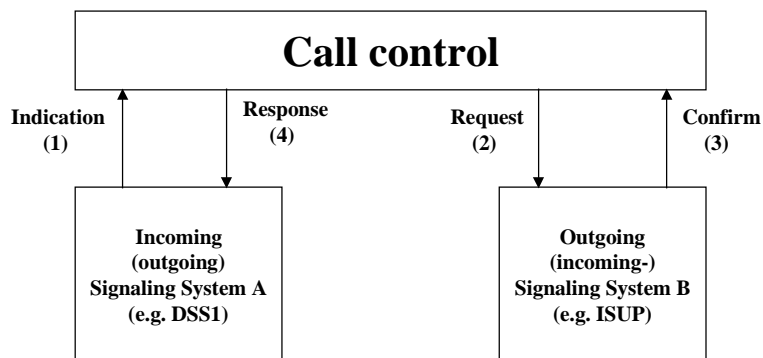
Event based interworking specification method

FITE - Forward Interworking Telephone Event ⎤
BITE - Backward Interworking Telephone Event ⎦ · **Between signaling systems.**
SPITE - Switching Processing Interface Telephone Event - internal to an exchange.

| Logical proce-dures/incoming signaling | Interworking logic | Outgoing signaling logical procedures |

Forward signals

FITEs   **FITEs**

BITEs

Backward signals

BITEs

Incoming and outgoing signaling systems are analyzed only to the extent necessary for the specification of interworking. Logic is given using SDL.
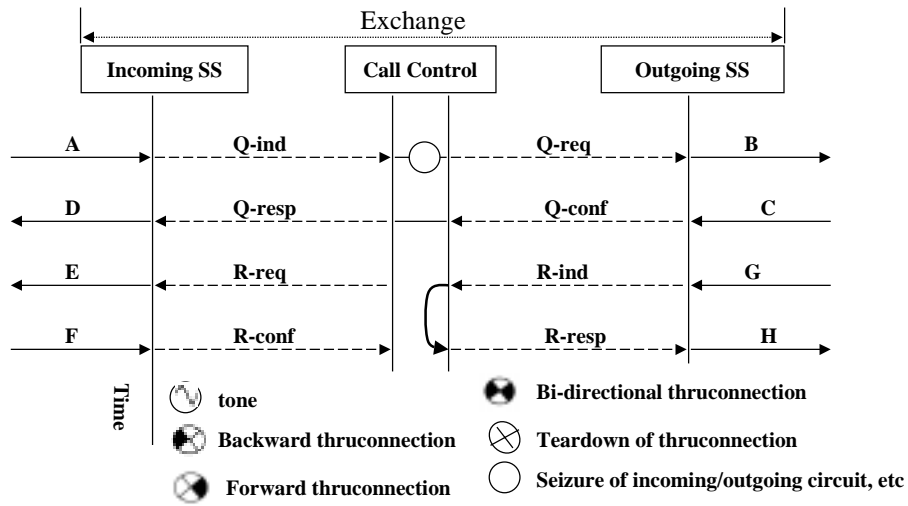

Layer oriented interworking specification

Primitives carry the information between layers

Call control

Indication   **Response**   **Request**   **Confirm**
(1)   **(4)**   **(2)**   **(3)**

| Incoming (outgoing) Signaling System A (e.g. DSS1) | Outgoing (incoming-) Signaling System B (e.g. ISUP) |

Numerot ilmaisevat primitiivien järjestystä

Signaling flow is described in more detail:

Exchange

| Incoming SS | Call Control | Outgoing SS |

A — Q-ind → ◯ — Q-req → B

D ← Q-resp — ← Q-conf — C

E ← R-req — ← R-ind — G

F — R-conf → R-resp → H

Time

◯ tone

◼ Backward thruconnection

◼ Forward thruconnection

◼ Bi-directional thruconnection

⊗ Teardown of thruconnection

◯ Seizure of incoming/outgoing circuit, etc

Because SDL is not used, specs is never complete -> vendors take care of the details .

In V5 - PSTN protocol, interworking is specified differently: partially in AN, partially in the exchange

PSTN protocol

AN

| Analogue FE-handling | L3 protocol entity |

National AN -part
- autonomous signaling sequences

V5.x

LE

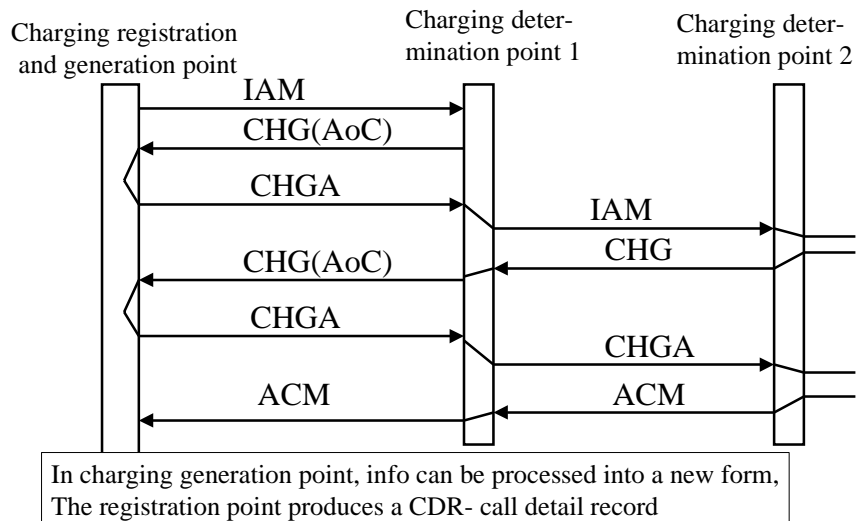| L3 protocol entity | FE-handling | National protocol entity |
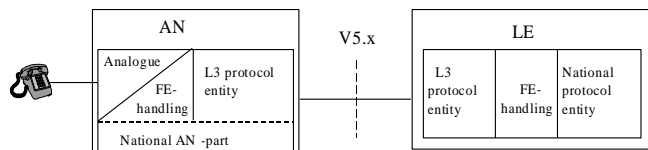
FE - function element primitives
- primitives describe the state of the analogue circuits in AN or in LE describe the interworking with analogue subscriber line signaling

AN takes care of:
- timing and duration of analogue signals
- charge indication frequencies and voltages
- ringing voltage
- autonomous functions specified in national specs

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Ongoing development of ISUP

1. ISDN charging protocol to transport tariff and billing info
   - The Finnish network has traditionally carried charging messages. In most other countries the originating exchange needs to know all tariffs in the world.
   - Reflect the difference between monopoly and competitive markets
   - ETSI is specifying messages between charging points to transport information about additional tariffs on a call by call basis:
     - Final tariff may be composed of many parts
     - tariff info is maintained by the party, who wants to earn the money.
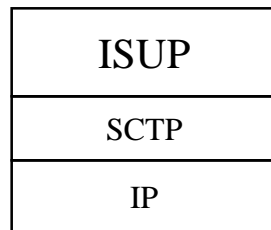   - Makes easier to apply dynamic tariffs.

ISUP2 carries charging info

In charging generation point, info can be processed into a new form,
The registration point produces a CDR- call detail record

ISUP - more ongoing development

2. **ISUP-over-IP for IP-telephony networks**
   - e.g. In Finland in pilot use although the specs
     is not ready
   - SIGTRAN group in IETF

ISUP
SCTP
IP

Signaling Control Transport Protocol
  = transport protocol for e.g. signaling
     modified from TCP
- SCTP/IP replaces MTP + (SCCP)
     (SCCP =?, may survive.)