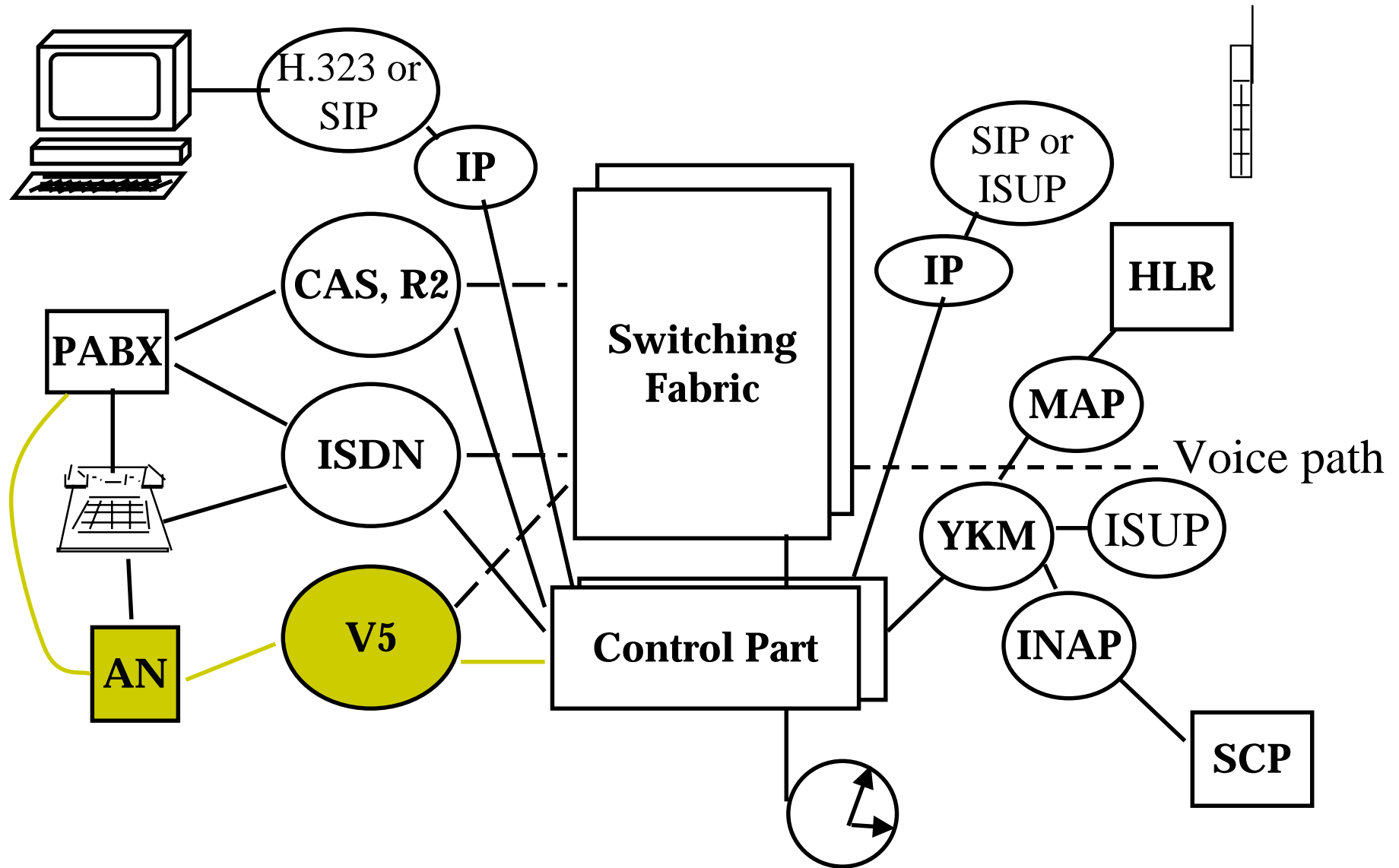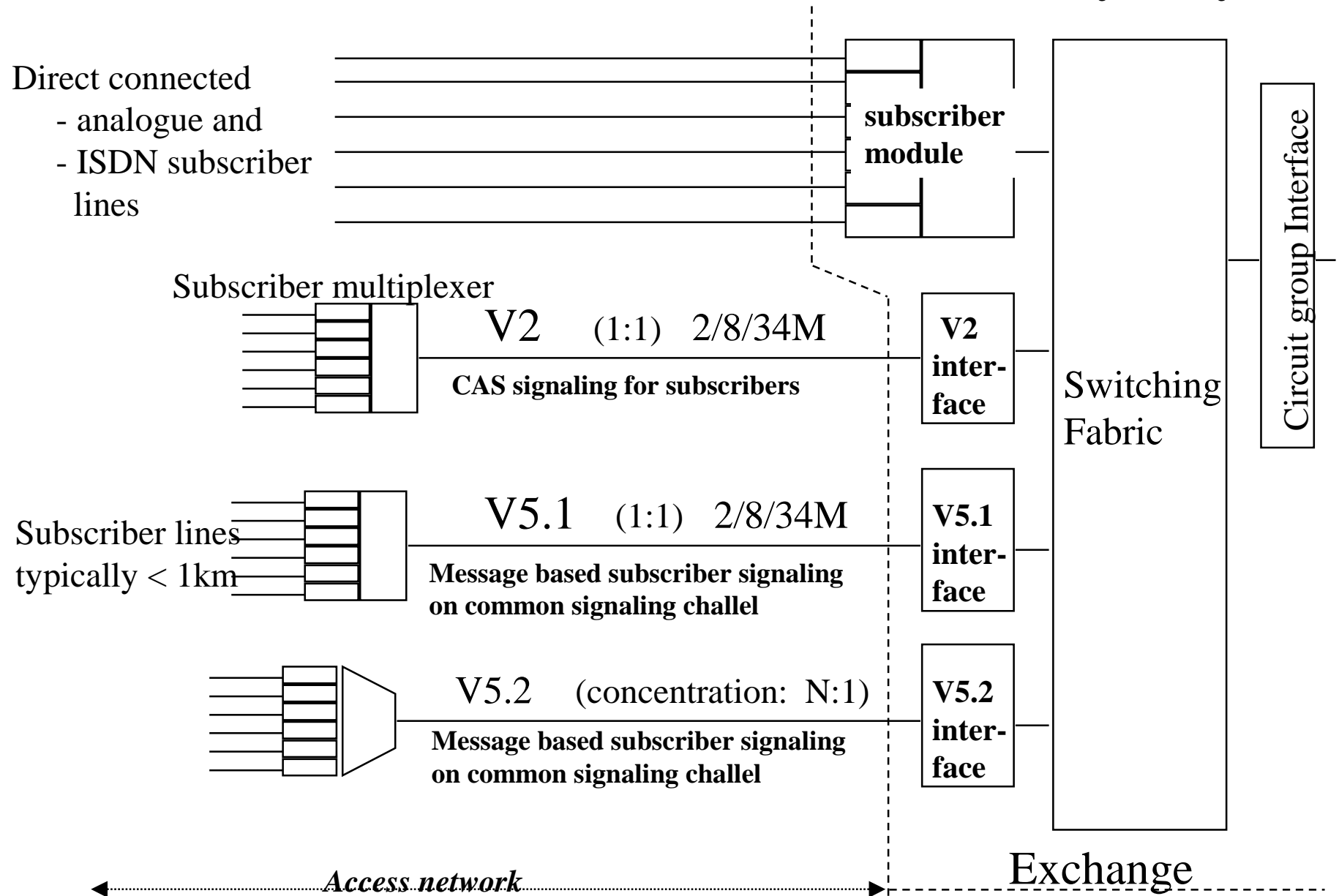# V5.1 and V5.2 interfaces

**V5 is a new way of interfacing the
access network to the local
exchange - based on extended
ISDN signaling**

Course scope

- H.323 or SIP
- IP
- CAS, R2
- PABX
- ISDN
- V5
- AN
- Switching Fabric
- Control Part
- SIP or ISUP
- IP
- HLR
- MAP
- Voice path
- YKM
- ISUP
- INAP
- SCP

Subscribers can be connected to LE in many ways

Direct connected
- analogue and
- ISDN subscriber
   lines

subscriber module

Subscriber multiplexer

V2   (1:1)   2/8/34M

CAS signaling for subscribers

V2 inter-face

Subscriber lines
typically < 1km

V5.1   (1:1)   2/8/34M

Message based subscriber signaling on common signaling challel

V5.1 inter-face

V5.2   (concentration: N:1)

Message based subscriber signaling on common signaling challel

V5.2 inter-face

Switching Fabric

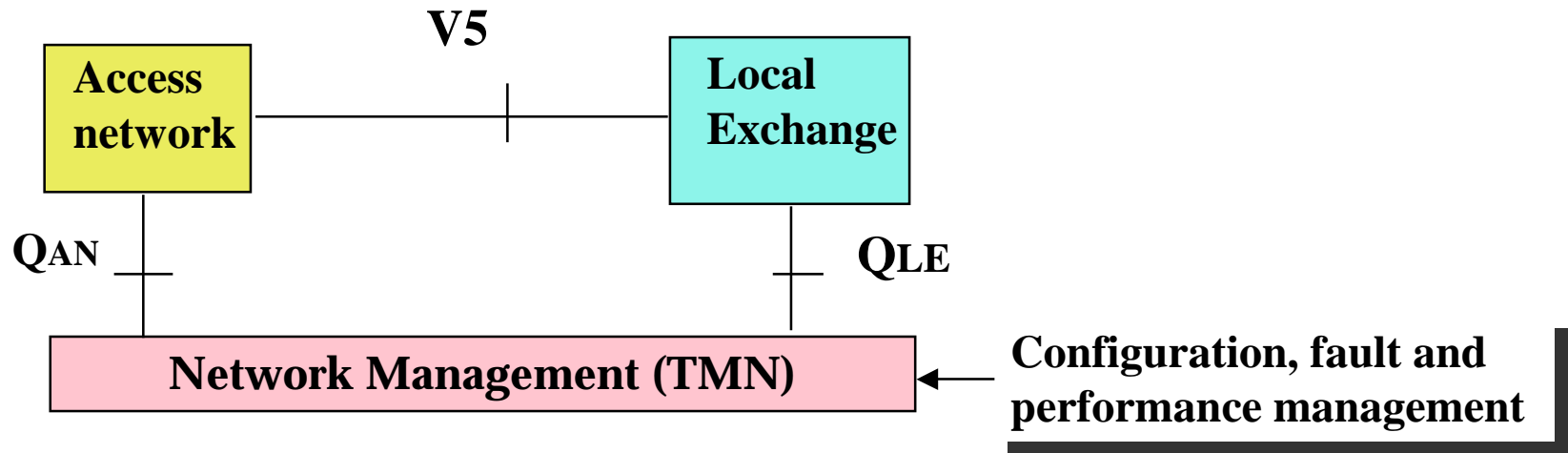Circuit group Interface

Exchange

Access network

A/D -conversion moves closer to the subscriber, exchanges become bigger and are more remote

- **Although line is analogue, in a green field development it is typically connected to an active device (Mux, rss, V5-AN, DSLAM), which does the A/D conversion.**

- **V5 brings a multi-vendor interface between the active devices and the LE. This breaks the former vertical exchange market into two independent segments:**
  - ✓ AN-market
  - ✓ Exchange processor market

- **In the same time, the economic size of an exchange has grown to something like 100000 subscribers due to maintenance costs.**

V5 architecture defines three interfaces

- **V5 -Interface:**   **Access network/Local Exchange (LE)**

- **Q_{LE}:**   **TMN interface in the LE**

- **Q_{AN}:**   **TMN interface in Access network**

V5

| Access network | | Local Exchange |

Q_{AN} Q_{LE}

Network Management (TMN) ← **Configuration, fault and performance management**

V5 standards are produced by ITU-T, ETSI and national standard bodies

Status: releases start from 1994. Equipment in use. Vendor implementations differ (different subsets - interworking is an ISSUE!

ITU-T: Q.512, G.964, G.965, etc

ETSI - European Telecommunications Standards Institute

V5.1	Static multiplexing of calls
	- ETS 300 324-x,
V5.2	Dynamic multiplexing of calls
	- ETS 300 347-x

Management:
- ETS 300 376-y, 300 378-y   ($Q3_{AN}$)
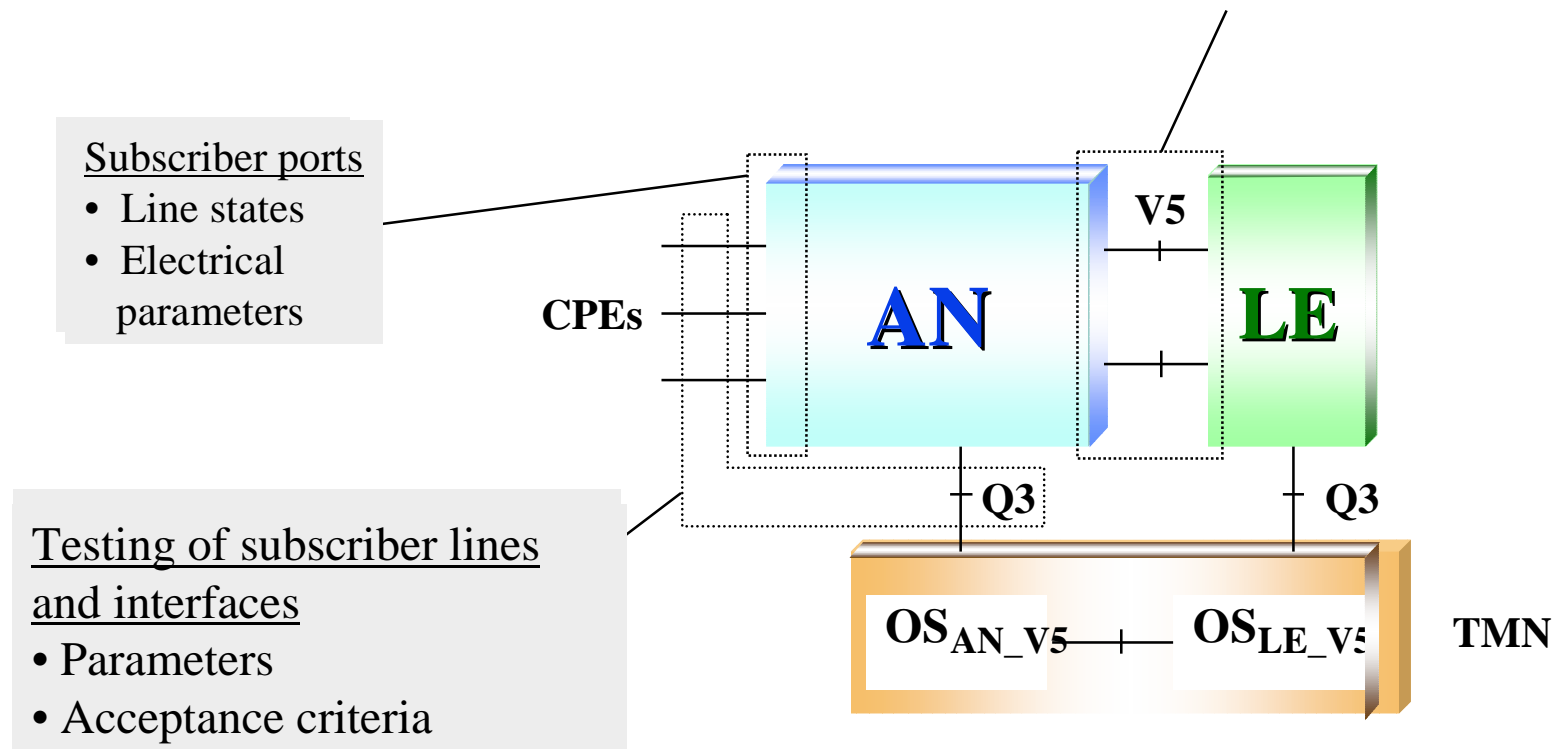- ETS 300 377-z, 300 379-z   ($Q3_{LE}$)

In Finland:
- SFS 5665
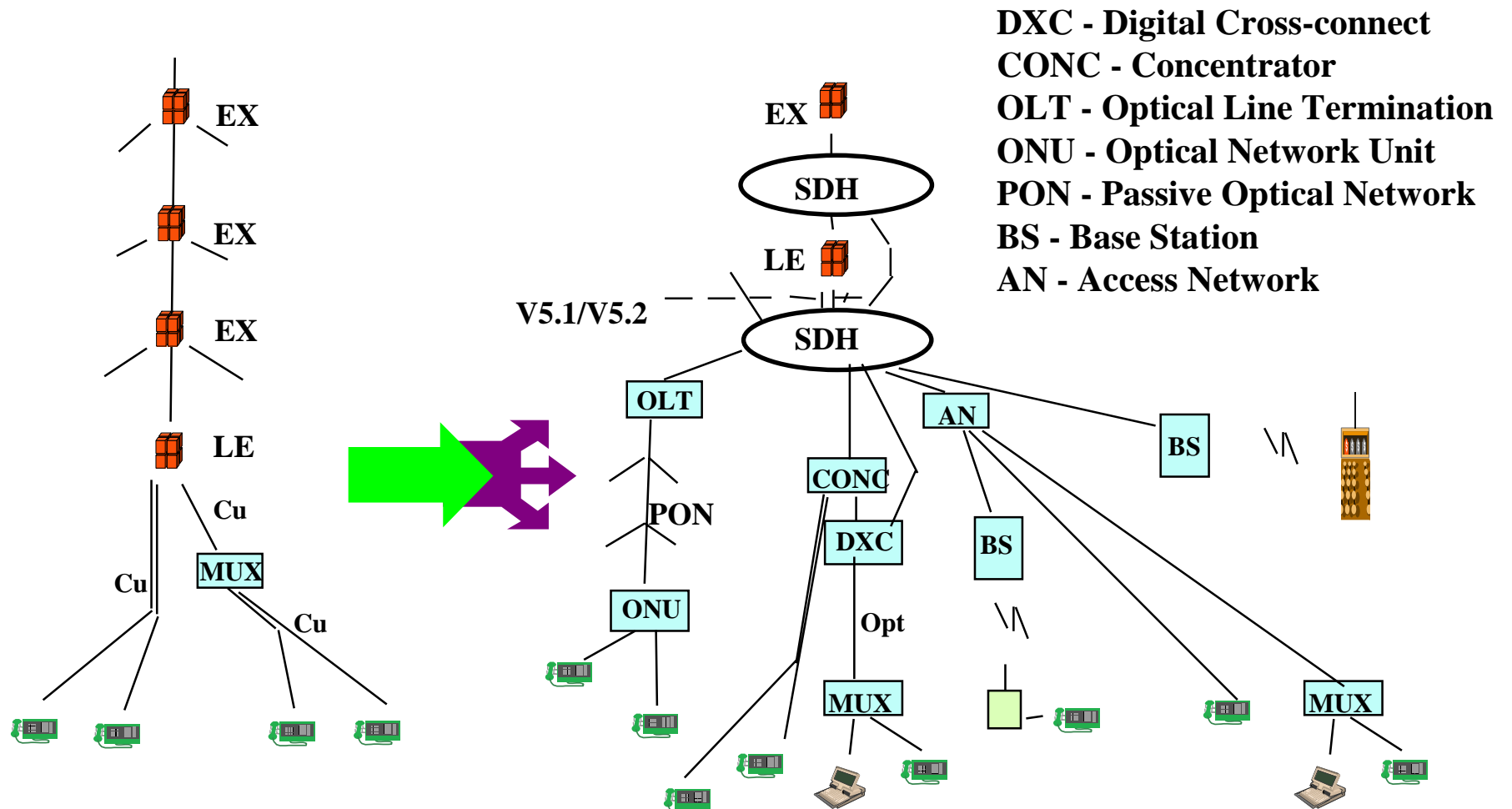- National guideline document by THK: GFI 9404

Nationally the PSTN V5 protocol adaptation for each analogue interface must be produced

PSTN PROTOCOL Adaptation
- ETSI ETR 150 gives guidelines for national adaptations of analogue interface specifications. Adaptation is done on *generic V5 PSTN protocol*

Subscriber ports
- Line states
- Electrical parameters

CPEs

AN

V5

LE

Q3

Q3

Testing of subscriber lines and interfaces
- Parameters
- Acceptance criteria

OS_{AN_V5} —— OS_{LE_V5} TMN

V5 -interface is a general purpose way of connecting access networks to exchanges - but many interface types coexist

DXC - Digital Cross-connect
CONC - Concentrator
OLT - Optical Line Termination
ONU - Optical Network Unit
PON - Passive Optical Network
BS - Base Station
AN - Access Network

EX

EX

EX

LE

Cu

Cu

MUX

Cu

EX

SDH

LE

V5.1/V5.2

SDH

OLT

AN

BS

PON

CONC

DXC

BS

ONU

Opt

MUX

MUX

Advantage of V5 is increased vendor competition

✓ Independence from access network vendors - a multi-vendor solution (access vs LE) is possible, in principle.

✓ Efficient and cost efficient access network - A/D conversion closer to the subscriber --> less copper and decreased maintenance cost

✓ standard network management interfaces (not all vendors support)

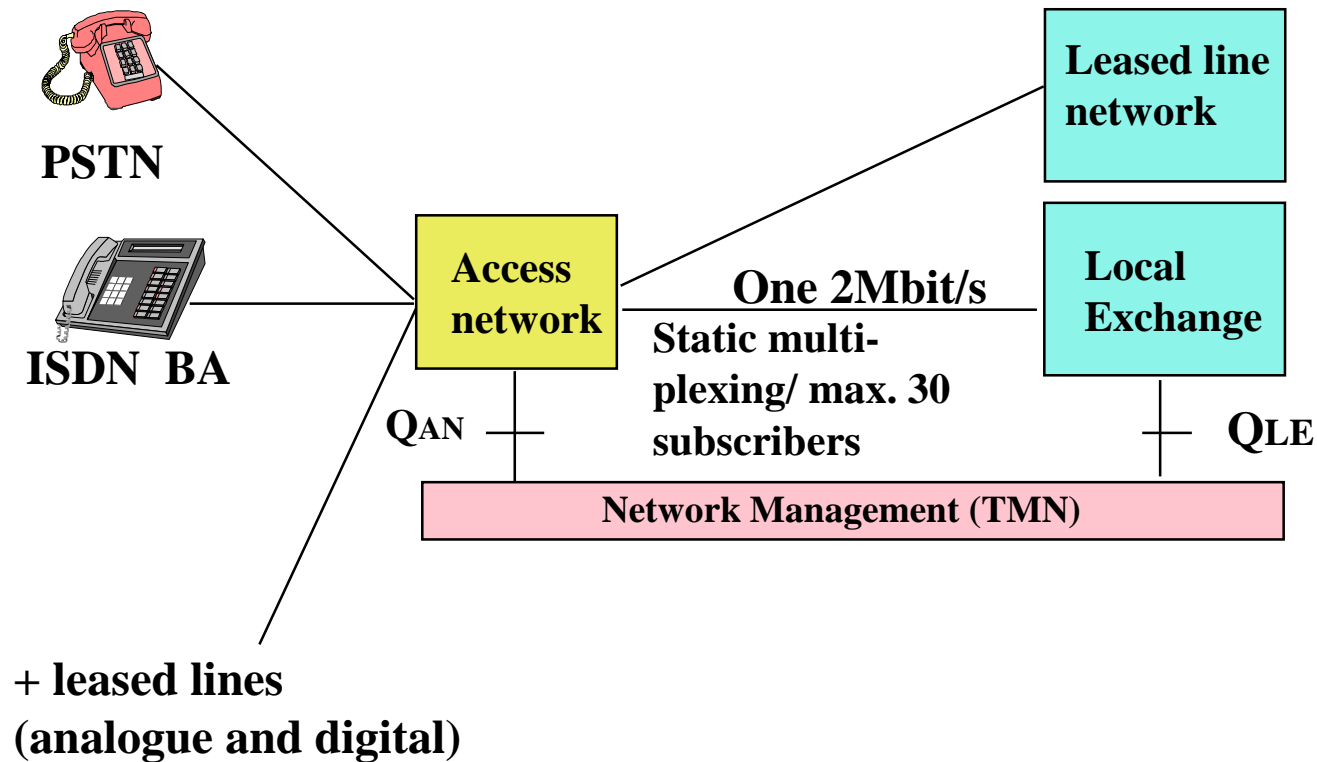✓ Increased competition (vendors and operators)
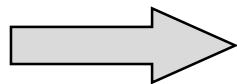
⟹ Decreased investment and maintenance costs can be expected.
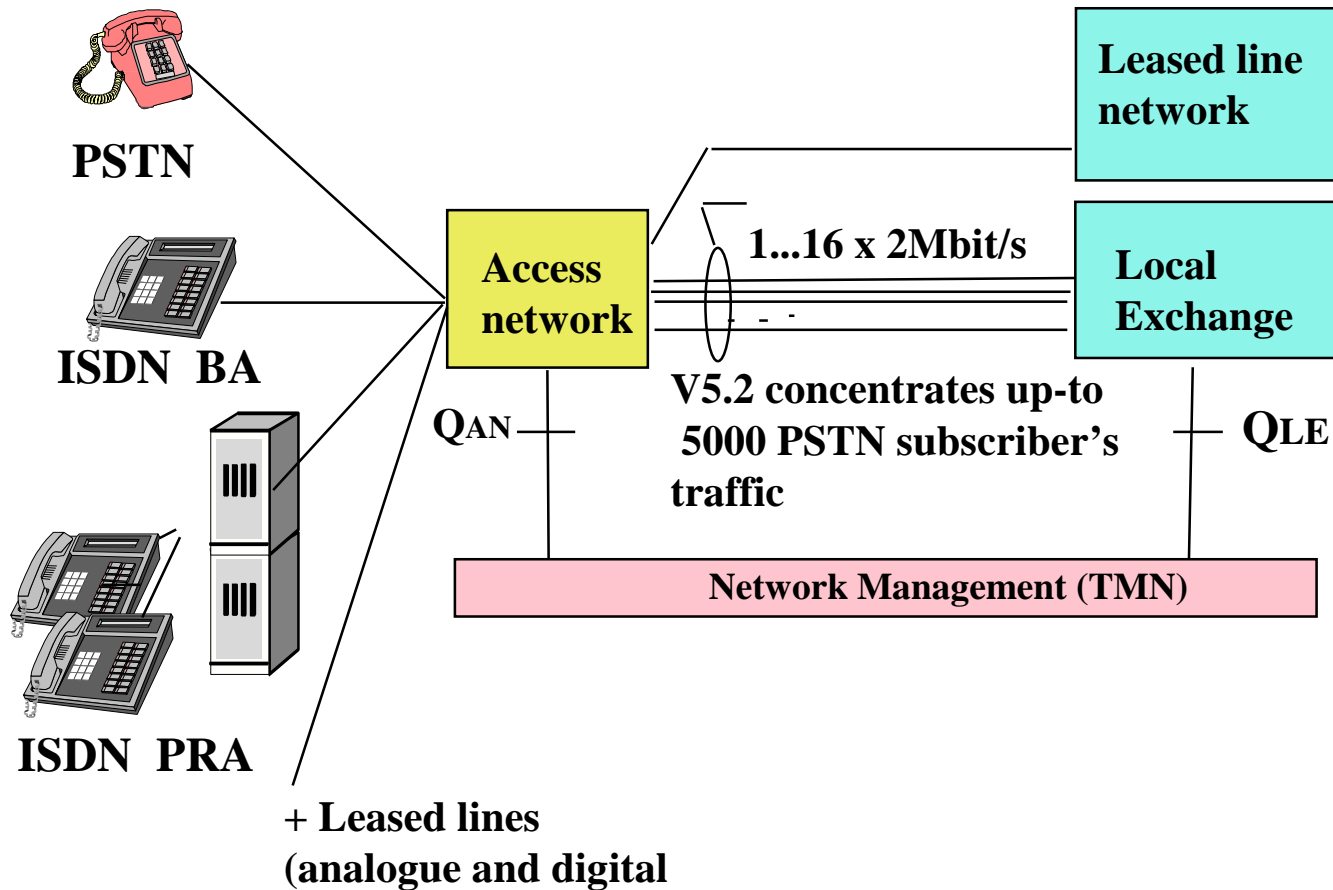
V5 sets requirements to the operator

- **National adaptations for V5 protocol standards**

- **Network management in a multi-vendor environment is a big ISSUE**

- **More alternatives in access network planning**

- **V5 and traditional access network coexist - network management differs, in particular - business processes must be adapted**

- **V5.2 concentrates traffic -> need to measure traffic, follow GoS reconfigure if low GoS and maintain planning principles**

GoS - grade of service (= bloking probability)

V5.1 - interface is the limited version of V5

PSTN

ISDN BA

Access network

Q_{AN}

One 2Mbit/s
Static multi-
plexing/ max. 30
subscribers

Leased line network

Local Exchange

Q_{LE}

Network Management (TMN)

+ leased lines
(analogue and digital)

V5.2 interface is an extension of V5.1

PSTN

ISDN BA

ISDN PRA

+ **Leased lines (analogue and digital**

Leased line network

Access network

1...16 x 2Mbit/s

- -

Local Exchange

Q_AN

V5.2 concentrates up-to 5000 PSTN subscriber's traffic

Q_LE

Network Management (TMN)

V5.x - Distribution of functions (PSTN)

V5

PSTN

Access network

Local Exchange

Q_{AN}

Q_{LE}

Network Management (TMN)

- signaling adaptation
- time critical actions

- call control

- configuration of subscriber interfaces
- subscriber line testing

- configuration settings for services

V5.1 protocol architecture

AN   **Local exchange**

Network layer

PSTN	Control

LAPV5-DL

PSTN	Control

ISDN

LAPV5-DL

LAPD

**p- and
f-data**

Link layer

Mapping function

Mapping function

AN FR / ISDN

LAPV5-EF

LAPV5-EF

**physical
layer**   ISDN
subscribers

16 kbit/s

64 kbit/s

64 kbit/s

PSTN - adaptation of analogue subs signaling
Control - control protocol

LAPV5-EF - relay function

V5.1 architecture continued ...

Settings (provisioning using the Q-interface)
- mapping of subscriber interfaces and protocol channels to 2M time-slots

ISDN - AN support
- ISDN signaling is relayed to LE without processing (FR -function)
- all ISDN services are supported
- layer 2: s - signaling, p- packet traffic, f-frames

PSTN protocol
- rotary dialing, push button (DTMF - reception --> mainly in LE)
- residential interfaces and PBXs
- for PBXs also Direct-Dialing-In, if analogue signaling supports DDI

Control(protocol)
- interface status queries and settings - each port has its own state machine
   in AN and in LE
- 2M-frame synchronization, multi-frame sync, CRC, 2M-alarms.
- AN -restart.

V5.1 C-kanavat

C-channel (Communication Channel) is used to carry
- control protocol
- PSTN signaling protocol
- ISDN signaling, p- ja f-frames - can also be routed to leased lines

Are allocated using the Q-interface
- tsl-16 + others (tsl-15, t31) as the need arises
- from each port or interface, all frames with the same SAPI always use
 a single C-channel

AN Frame Relay function

Is not the same thing as the Frame Relay -service in data networks!

AN does not terminate the LAPD-protocol for a subscriber, but relays the frames i.e. implements the FR-functions:

- frame delimitation and re-packing without touching the contents

- frame multiplexing and de-multiplexing

     - multiplexing is based on the EF-address, which points to the interface

- checking the length of the frame and

- adding HDLC flags (delimiters) , when there is nothing to send

- detection of transfer errors

=> ISDN layer 3 is processed completely in the LE!

FR- frame relay function transports ISDN-signaling to the Local Exchange

Local Exchange

isdn signaling frame

AN

z | **isdn signaling frame**

isdn -interface z

z

ISDN signaling process
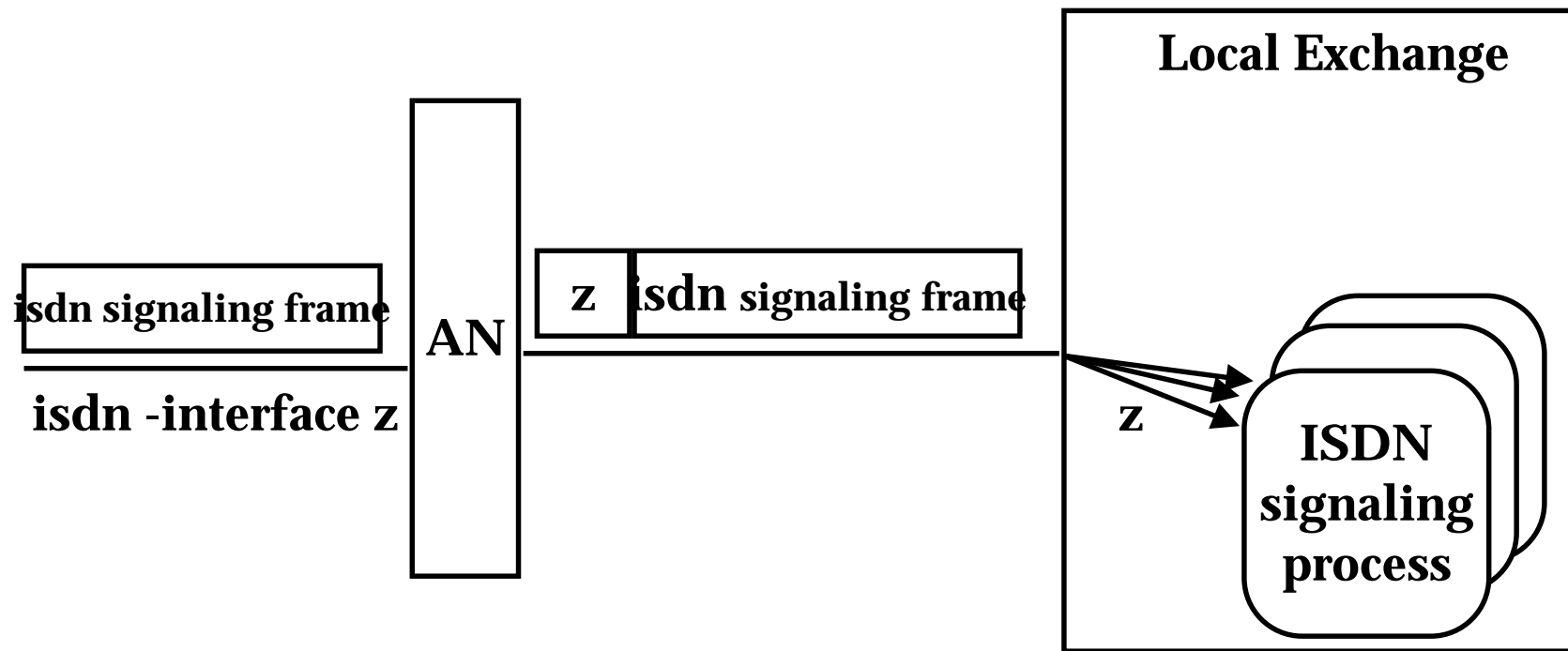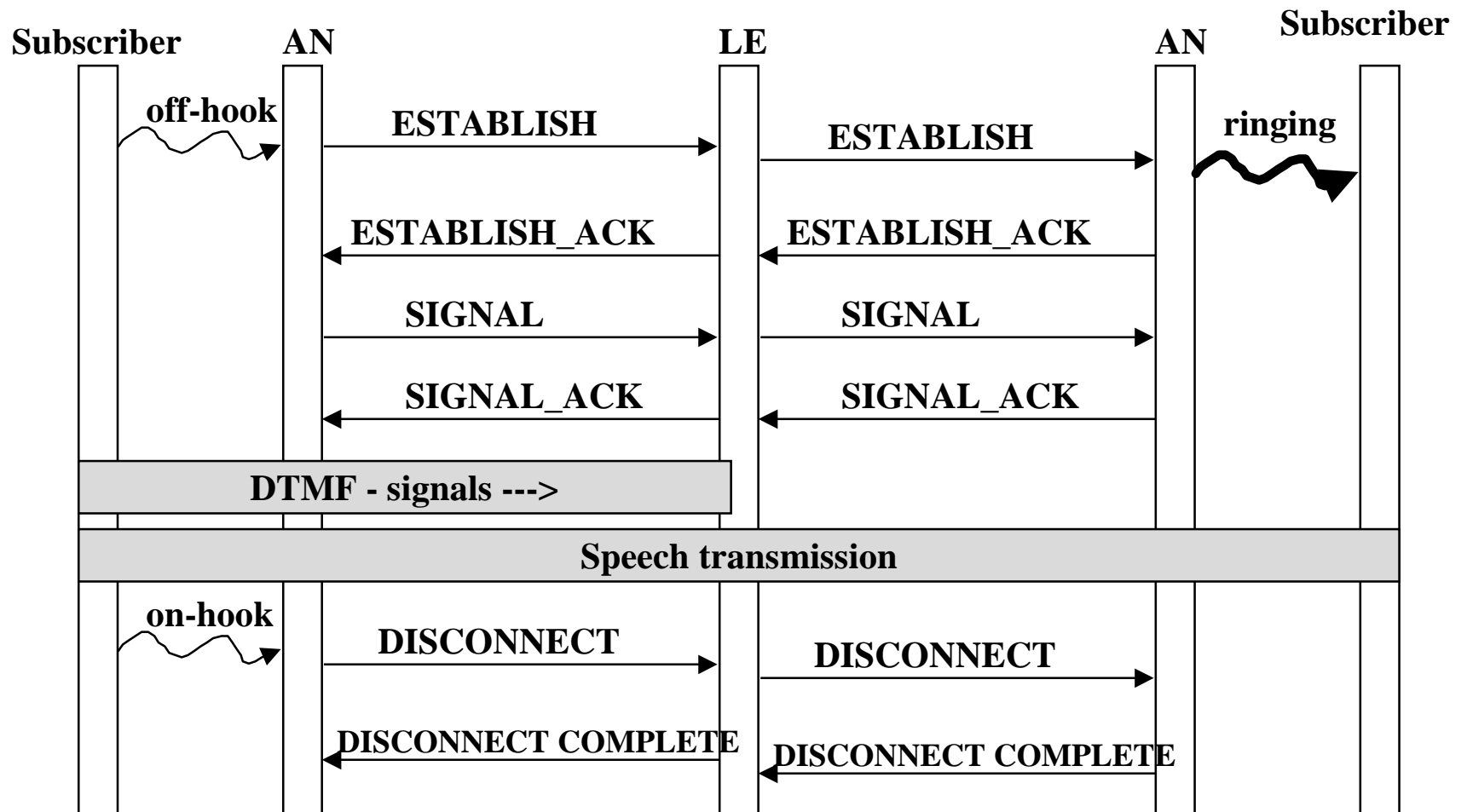
PSTN protocol
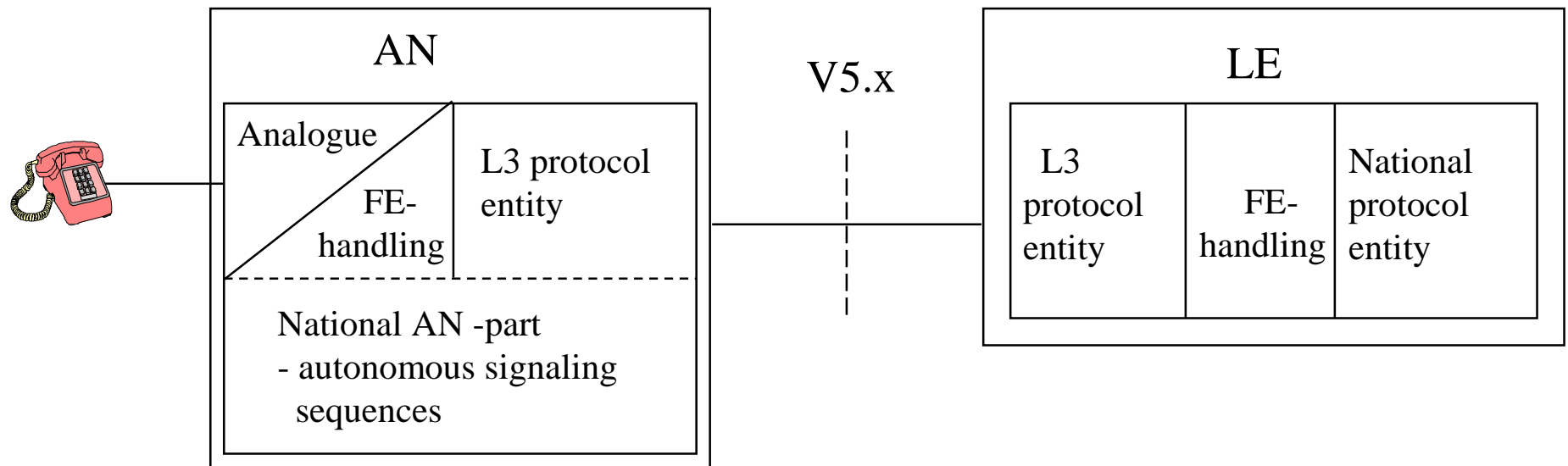
AN takes care of:
- **timing and duration of analogue signals**
- **voltage and frequency of meter pulses**
- **ringing current**
- **nationally specified autonomous tasks**

FE - function element primitives
- **primitives describing the state of analogue circuits**
- **either AN or LE describe the interface to analogue subscriber signaling**

DTMF reception and tone generation
are typically in LE

Basic sequences in the PSTN protocol

Subscriber AN LE AN Subscriber

off-hook

ESTABLISH → ESTABLISH →

ringing

ESTABLISH_ACK ← ESTABLISH_ACK ←

SIGNAL → SIGNAL →

SIGNAL_ACK ← SIGNAL_ACK ←

DTMF - signals --->

Speech transmission

on-hook

DISCONNECT → DISCONNECT →

DISCONNECT COMPLETE ← DISCONNECT COMPLETE ←

L3-address in messages = PSTN port number

Additionally:
- STATUS ENQUIRY, STATUS ja
  PROTOCOL PARAMETER messages

V5.2 protocol architecture

Network layer

PSTN	Control	Pr	Link C	BCC

LAPV5-DL

PSTN	Control	Pr	Link C	BCC

LAPV5-DL

ISDN

LAPD ↔ ↔

p- and f-data

Data
Link
Layer

Mapping function

Mapping function

FR / ISDN

LAPV5-EF

LAPV5-EF

Physical layer

ISDN ↔
AN

16 / 64 kbit/s

64 kbit/s

64 kbit/s
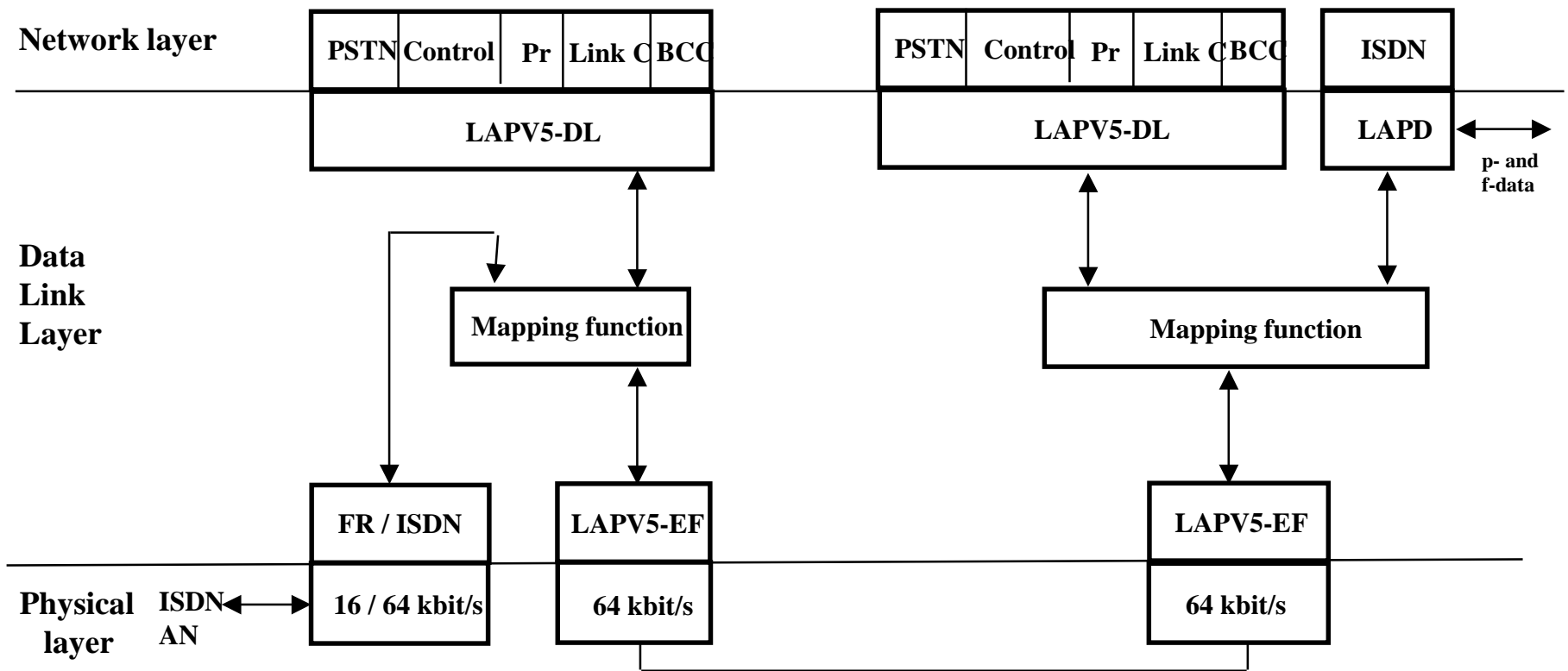
PSTN - adaptation to analogue subscriber signaling

Link C - link control protocol

Control - control protocol

BCC - Bearer channel connection control

Pr - Protection/switch-over protocol

LAPV5-EF - multiplexing function

V5.2 Link control protocol
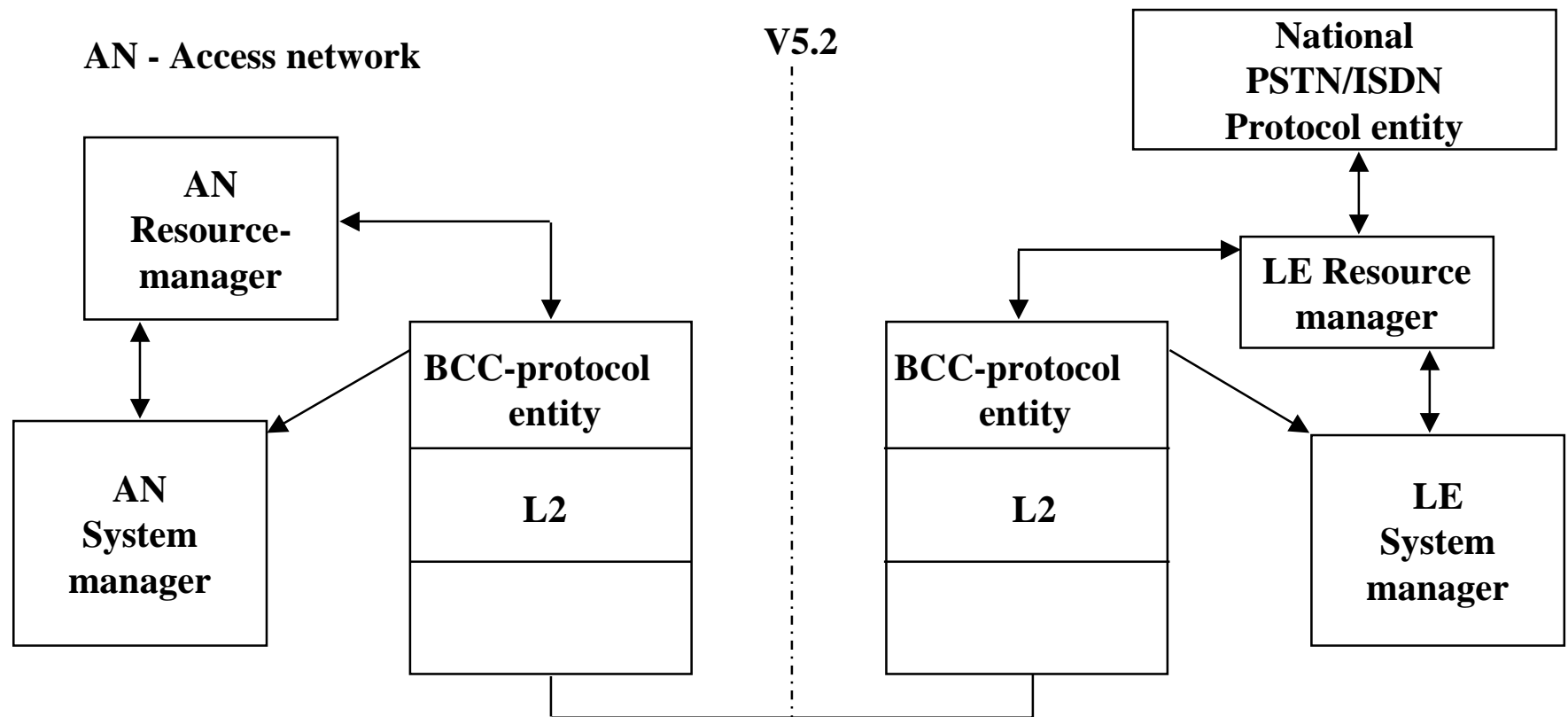
V5.2 supports 1...16 2M-links

- link identities are needed

- checking the link identities:

  - LE/AN assigns the Id - response in even tsl-0's
    Sa7-bit

- blocking of (failed) links

- all this is managed using the link control protocol

V5.2 Protection protocol

✓ Switch-over of C-channels, permanent and semi-permanent connections from one 2M -link to another

✓ Uses the tsl-16 on the primary PCM.

✓ Logical C-channels are allocated to physical C-channels

✓ N+K -protection is supported for the C-channels
(N -logical channels, K - physical spare channels

V5.2 BCC -Bearer Channel Connection Protocol

The LE uses the BCC -protocol to allocate and thruconnect bi-directional voice/data channels in AN on call-by-call basis or due to a Q_{LE} -operation. Connection from ports to V5.2 2M-time-slots can also be queried.

AN - Access network

V5.2

| National PSTN/ISDN Protocol entity |

| AN Resource-manager |

| BCC-protocol entity |
| L2 |

| AN System manager |

| BCC-protocol entity |
| L2 |

| LE Resource manager |

| LE System manager |

BCC - protocol messages

AN   LE

ALLOCATION

ALLOCATION COMPLETE

ALLOCATION REJECT

DE-ALLOCATION

DE-ALLOCATION COMPLETE

DE-ALLOCATION REJECT

AUDIT

AUDIT COMPLETE