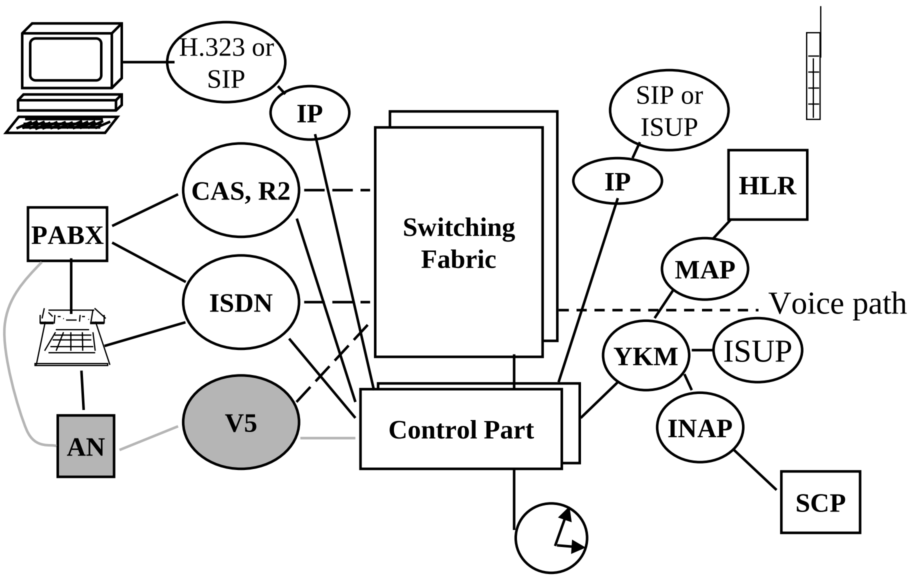
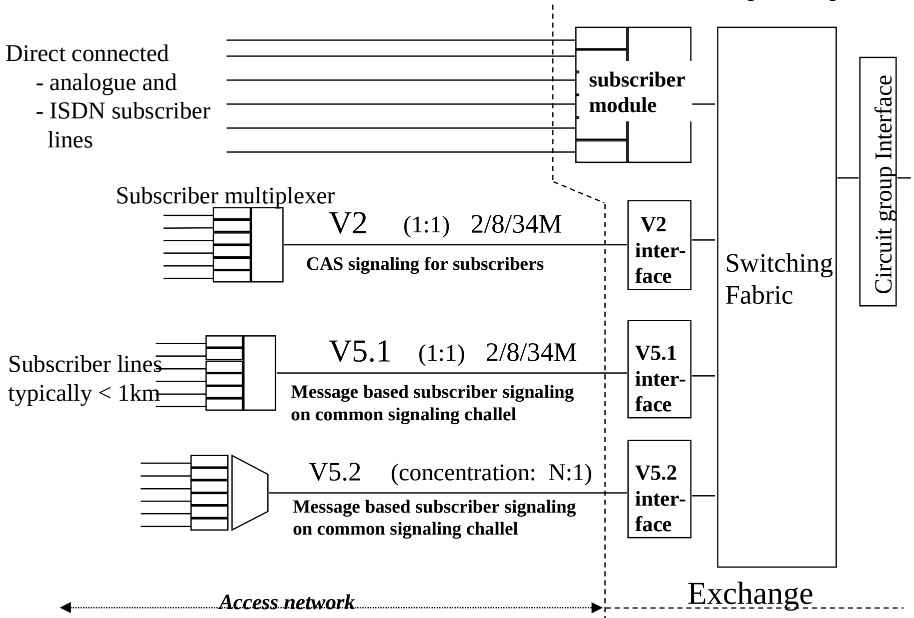
V5.1 and V5.2 interfaces

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

Course scope



Subscribers can be connected to LE in many ways

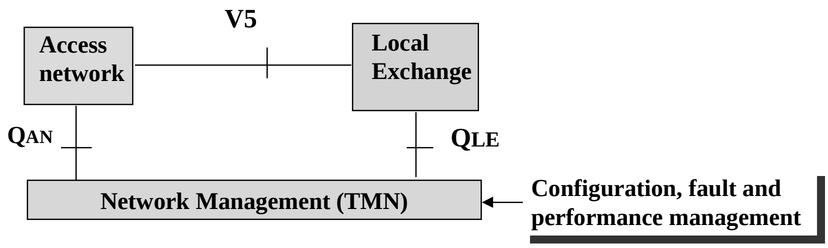


A/D -conversion moves closer to the subscriber, exchanges become bigger and are more remote

- ✔ **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 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

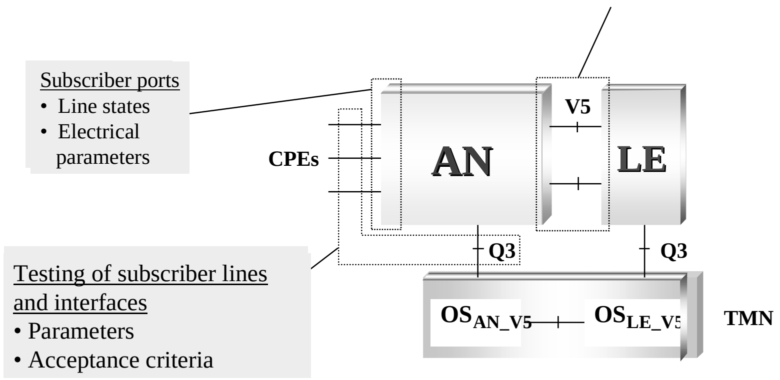
V5.1 **Static multiplexing of calls**
- ETS 300 324-x,
V5.2 **Dynamic multiplexing of calls**
- ETS 300 347-x
Management:
- ETS 300 376-y, 300 378-y ($Q3_{AN}$)
- ETS 300 377-z, 300 379-z ($Q3_{LE}$)

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

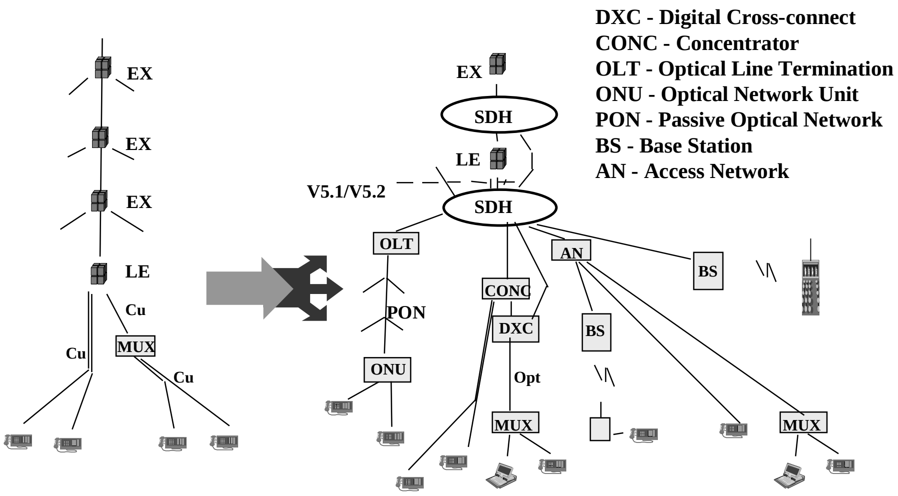
Nationally the PSTN V5 protocol adaptation for each analogue interface must be produced

PSTN PROTOCOL Adaptation

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



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



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)**

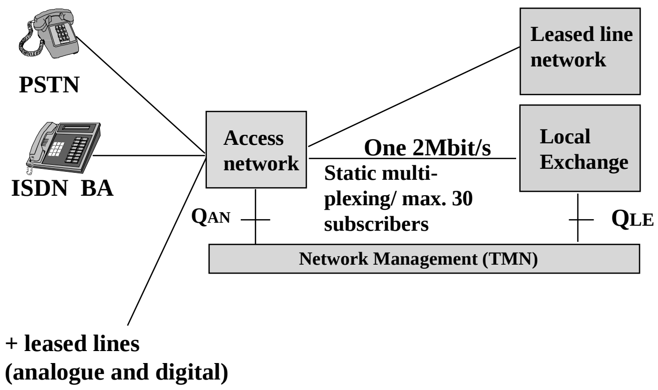
⇨ **Decreased investment and maintenance costs can be expected.**

V5 sets requirements to the operator

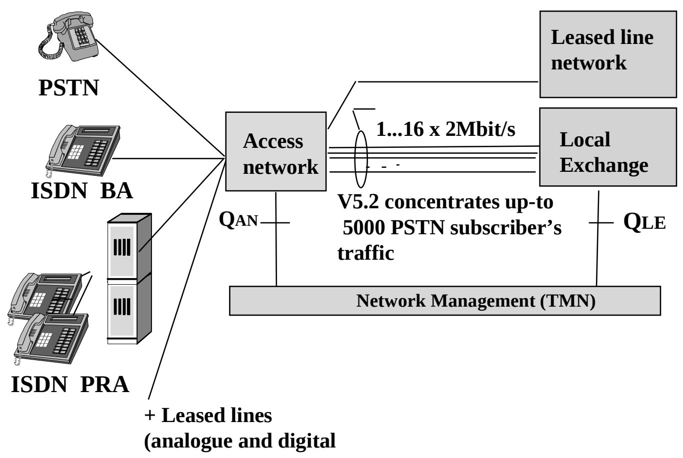
- **National adaptations for V5 protocol standards**
- **Network management in a multi-vendor environment is a big ISSUE**
- **More alternatives in access network planning**
- **V5 and traditional access network coexist - network management differs, in particular - business processes must be adapted**
- **V5.2 concentrates traffic -> need to measure traffic, follow GoS reconfigure if low GoS and maintain planning principles**

GoS - grade of service (= bloking probability)

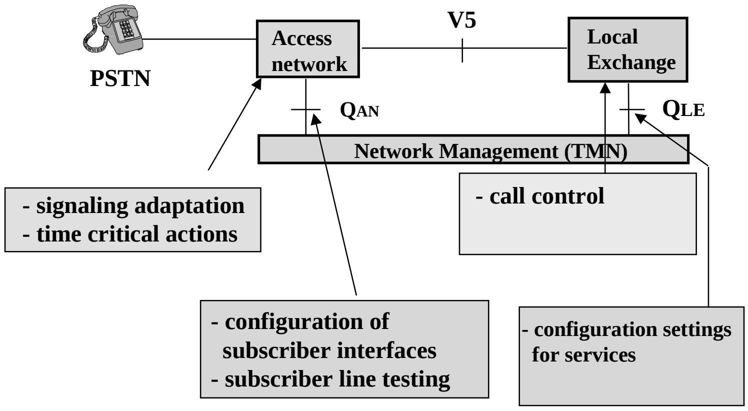
V5.1 - interface is the limited version of V5



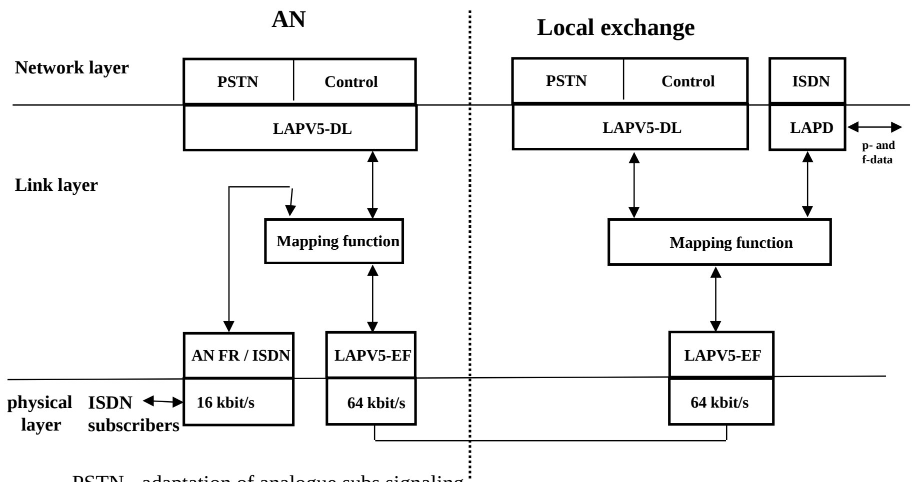
V5.2 interface is an extension of V5.1



V5.x - Distribution of functions (PSTN)



V5.1 protocol architecture



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

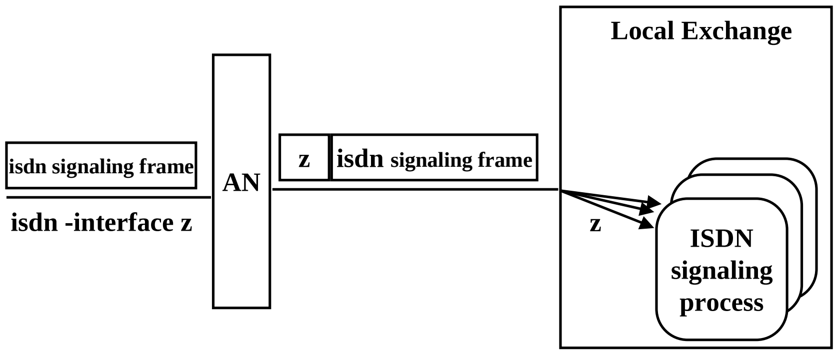
Is not the same thing as the Frame Relay -service in data networks!

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

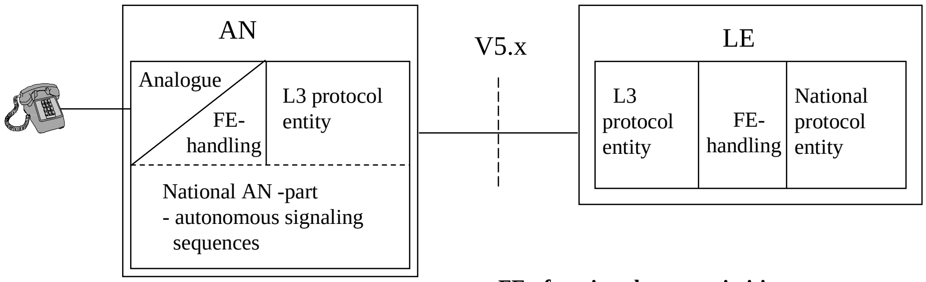
- frame delimitation and re-packing without touching the contents
- frame multiplexing and de-multiplexing
    - multiplexing is based on the EF-address, which points to the interface
- checking the length of the frame and
- adding HDLC flags (delimiters) , when there is nothing to send
- detection of transfer errors

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

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



PSTN protocol

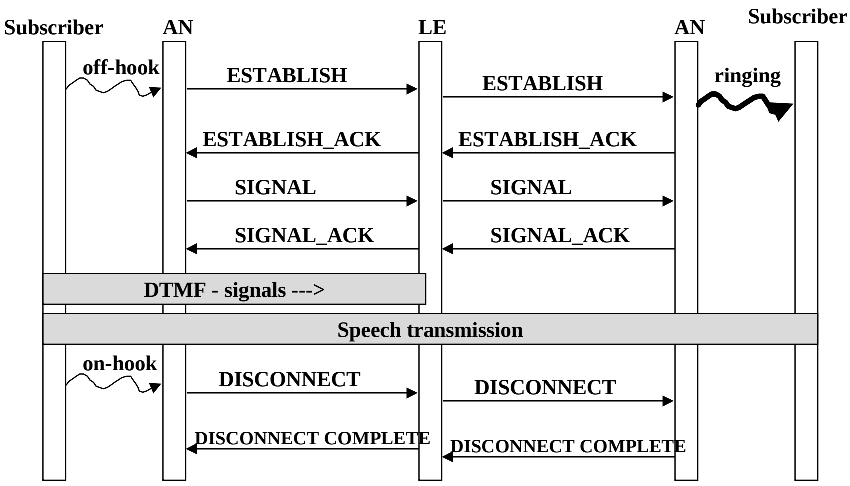


AN takes care of:
- timing and duration of analogue signals
- voltage and frequency of meter pulses
- ringing current
- nationally specified autonomous tasks

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

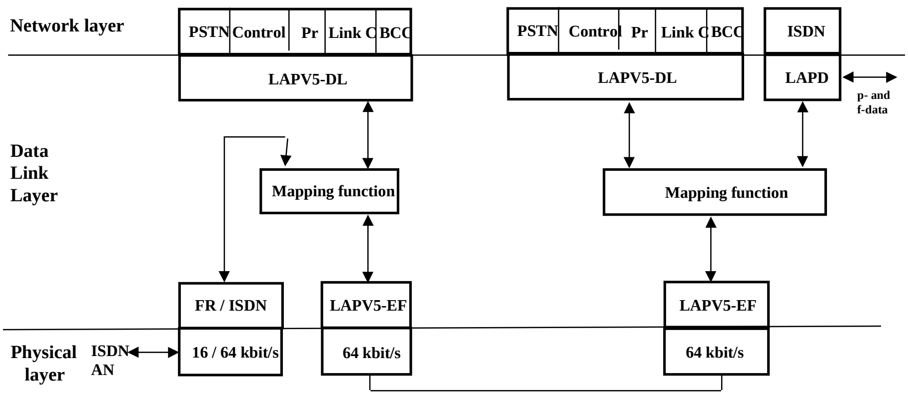
Basic sequences in the PSTN protocol



L3-address in messages = PSTN port number

Additionally:
- STATUS ENQUIRY, STATUS ja PROTOCOL PARAMETER messages

V5.2 protocol architecture



PSTN - adaptation to analogue subscriber signaling
Control - control protocol
Pr - Protection/switch-over protocol

Link C - link control protocol
BCC - Bearer channel connection control
LAPV5-EF - multiplexing function

V5.2 Link control protocol

V5.2 supports 1...16 2M-links

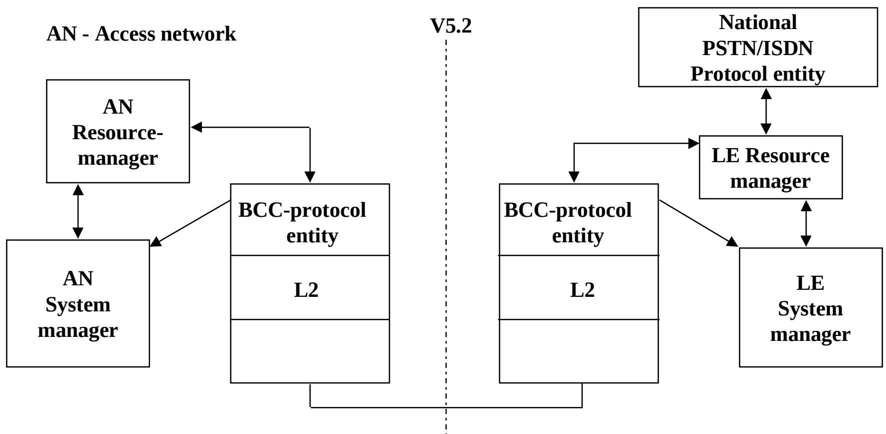
- link identities are needed
- checking the link identities:
    - LE/AN assigns the Id - response in even tsl-0's Sa7-bit
- blocking of (failed) links
- all this is managed using the link control protocol

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.



BCC - protocol messages