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

Summary of course scope
Subscribers can be connected to LE in many ways

- Direct connected
  - analogue and
  - ISDN subscriber lines

<table>
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<tr>
<th>Subscriber multiplexer</th>
<th>V2 (1:1) 2/8/34M</th>
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<td>CAS signaling for subscribers</td>
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<th>Subscriber lines typically &lt; 1km</th>
<th>V5.1 (1:1) 2/8/34M</th>
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<td>Message based subscriber signaling on common signaling channel</td>
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<th>V5.2 (concentration: N:1)</th>
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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 (Q_{AN})
- ETS 300 377-z, 300 379-z (Q_{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

**Testing of subscriber lines and interfaces**
- Parameters
- Acceptance criteria

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

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<th>V5.1/V5.2</th>
<th>SDH</th>
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<td>EX</td>
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<td>LE</td>
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<td>Cu</td>
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<td>MUX</td>
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**DXC - Digital Cross-connect**
**CONC - Concentrator**
**OLT - Optical Line Termination**
**ONU - Optical Network Unit**
**PON - Passive Optical Network**
**BS - Base Station**
**AN - Access Network**
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 (= blocking probability)
V5.1 - interface is the limited version of V5

- PSTN
- ISDN BA
- One 2Mbit/s
- Static multiplexing/ max. 30 subscribers
- Network Management (TMN)
- Local Exchange
- Access network
- QAN

+ leased lines (analogue and digital)

V5.2 interface is an extension of V5.1

- PSTN
- ISDN BA
- ISDN PRA
- Leased line network
- Access network
- QAN
- V5.2 concentrates up to 5000 PSTN subscriber's traffic

1...16 x 2Mbit/s
- Local Exchange
- QLE

+ Leased lines (analogue and digital)
V5.x - Distribution of functions (PSTN)

- signaling adaptation
- time critical actions
- configuration of subscriber interfaces
- subscriber line testing
- configuration settings for services

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!

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

[Diagram showing ISDN signaling frame transport]
**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

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**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

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

AN
ALLOCATE
ALLOCATE COMPLETE
ALLOCATE REJECT
DE-ALLOCATE
DE-ALLOCATE COMPLETE
DE-ALLOCATE REJECT
AUDIT
AUDIT COMPLETE

LE