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Anschlußnetz / Access Network
Kapitel 5.1

Integrierte Netze
Universität Hannover
Institut für Allgemeine Nachrichtentechnik
Kommunikationsnetze
Prof. Dr.-Ing. K. Jobmann

IGN 5.1.1

Die Weiterentwicklung existierender Teilnehmer-Anschlußnetze (AN) zu anderen Technologien erfordert ein neues Konzept für die Einführung von Anschlußnetzen als eine Infrastruktur, die alle Diensttypen integriert (Existierende Zugänge, Interaktive Video Dienste, Breitband-Internetzugang, u.s.w.). Obwohl eine starke Tendenz zur optischen Übertragungstechnik hin existiert, dürfen die anderen Medien nicht außer Betracht gelassen werden.

Die Triebfeder für die Anwendung neuer Technologien sind neue Anwendungen wie MM oder andere Breitbanddienste sowie ökonomische Gründe, die aus der Deregulierung des Telekommunikationsmarktes herrühren.

Die Anschlußnetze müssen mit den Service-Knoten über Interfaces (Service Node Interfaces) mit flexiblem Multiplexing oder Konzentratoren verbunden werden. Multiplexing bedeutet die statische Belegung von Übertragungskanälen mit Nutzkanälen während Konzentratorfunktionen immer verkehrsabhängig arbeiten.

Existierende Service Node Interfaces sind meist nicht geeignet, neu auftauchende Dienstanforderungen, wie vor allem Breitbandfähigkeit, zu unterstützen.

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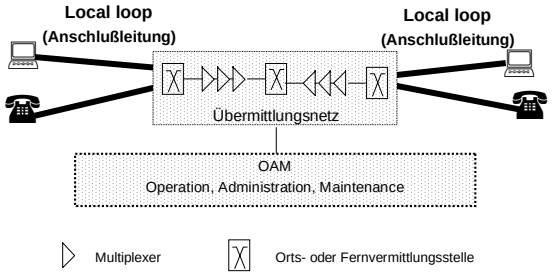
AAL	ATM Adaptation Layer
ACD	Automatic Call Distribution (Buchungsanlage)
AN	Access Network
AN-SMF	Access Network System Management Function
AP	Access Point
ATM	Asynchronous Transfer Mode
BA	Basic Access
B-ISDN	Broadband ISDN
CE	Circuit Emulator
CF	Core Function
CL	Circuit Layer
CM	Circuit Mode
CPE	Customer Premises Equipment
DID	Direct Inward Dialing (Durchwahl)
DS	(access) Digital Section
ET	Exchange Termination
ET-L1	ET-Layer 1 (of the OSI protocol layer model)
ET-L2	ET-Layer 2 (of the OSI protocol layer model)
IN	Intelligent Network
ISDN	Integrated Services Digital Network
MCF	Message Communication Function
MIB	Management Information Base
MPH	Management primitive of the PHysical layer (of the OSI protocol layer model)
NEF	Network Element Function
NT	Network Termination
OSF	Operations System Function
OSF_{AN}	Operations System Function of the Access Network
OSF_{SN}	Operations System Function of the Service Node
PDH	Plesiochronous Digital Hierarchy
PH	Primitive of the PHysical layer (of the OSI protocol layer model)
PRA	Primary Rate Access
PSTN	Public Switched Telephone Network
SDH	Synchronous Digital Hierarchy
SMF	System Management Function
SN	Service Node
SNI	Service Node Interface
SN-SMF	Service Node System Management Function
STM	Synchronous Transfer Mode
SPF	Service Port Function
TCP	Termination Connection Point
TE	Terminal Equipment
TF	Transport Function
TM	Transmission Media Layer
TMN	Telecommunications Management Network
TP	Transmission Path Layer
UNI	User Network Interface
UPF	User Port Function
VC	Virtual Channel
VP	Virtual Path

Positionierung der Teilnehmeranschlußleitung (Local Loop)

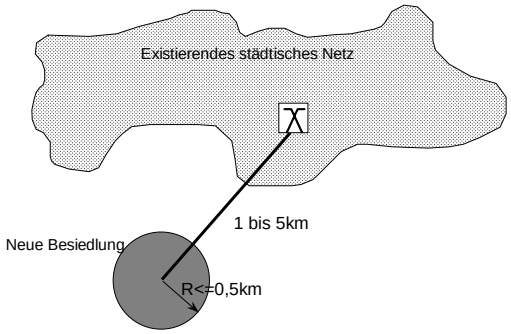


Gründe für neue Technologien im Teilnehmeranschlußbereich

- Erschließung neuer Gebiete und Städte
- wachsender Wettbewerb zwischen Netzbetreibern und zwischen Dienstanbietern
- Neue Dienste (IP-Telefonie, ...)
- Anwendungsintegration (Multimedia)
- Netzintegration (ISDN, ATM, ...)

Im Backbone-Bereich wird meist PDH & SDH über Glasfaser eingesetzt.

Neue Besiedlung in der Nähe einer Stadt



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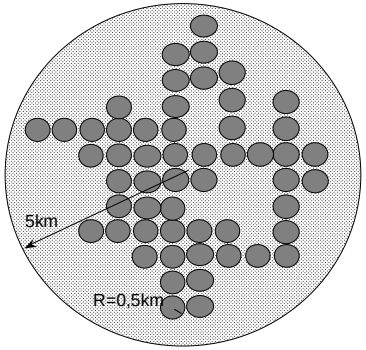
Neubaugebiete erfordern eine Bedarfsanalyse!

Annahmen:
500 - 2000 Endgeräte per km2
0,07 Erl / Endgerät in der Hauptverkehrsstunde, Mischung aus privatem und geschäftlichem Verkehr

A = PI x r² = 3,14 x (500m)² = 0,79 km² ~> 800 TEs ~> 55 Erl in der BH
z.B. 2 x PCM30-Systeme vs. 800DA

Aber Achtung bei Technologieparks!

Erschließung einer neuen Stadt



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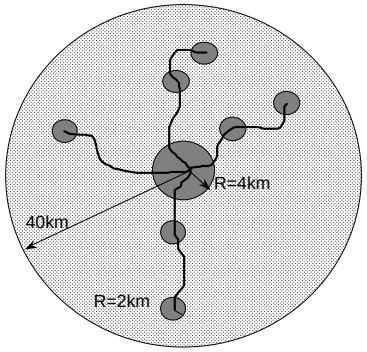
Anwendungen z.B.:
- Ost-Europa in den 90'er
- Entwicklungsländern (Afrika, Asien, Südamerika)

Annahmen: (assumptions)
- Service Areas können in Kreise mit max. 0,5km geclustert werden
- Die Cluster sind zufällig in einem Gebiet verteilt mit max. 5km Radius

Diese Verteilung ist z.B. für DECT Applicationen geeignet.

Bsp.: Skandinavische Länder, weite Handy-Verbreitung!

Versorgung eines ländlichen Gebietes



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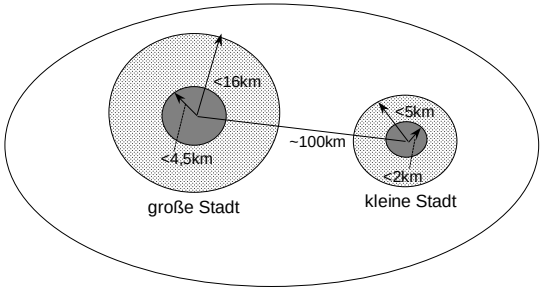
Anmerkungen:

90% aller Teilnehmer sind im inneren Versorgungsbereich mit 4km Radius. Nur 10% befinden sich in den Siedlungsbereichen mit 2km Radius. Die Entfernung zwischen den äußeren Siedlungsbereichen beträgt 5-10km. Es existieren 3-10 dieser äußeren Siedlungsbereiche. Im inneren Versorgungsbereich ist die Teilnehmerdichte 5 bis 50 Teilnehmer /km2. In den Äußeren Siedlungsbereichen sind nur einzelne Endgeräte lokalisiert. Der Verkehr wird für alle Endgeräte mit 0,07Erl/Endgerät in der Hauptverkehrsstunde angenommen.

Neuer Netzbetreiber im Wettbewerbsumfeld gemäß ETSI



Gebietsmonopole vs. Wettbewerb in einem Gebiet

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Anmerkungen:

Große Stadt: 500 000 Endgeräte mit einer Dichte von 2000 Endgeräten pro km² im Innenstadtbereich und 500 Endgeräten pro km² im Vorstadtbereich.

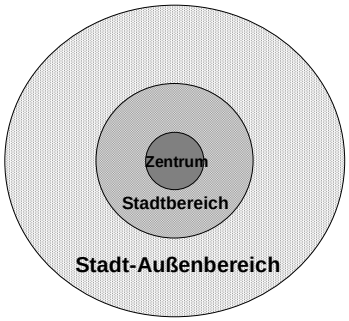
Kleine Stadt: 50 000 Endgeräte mit einer Dichte von 1000 Endgeräten pro km² im Innenstadtbereich und 500 Endgeräten pro km² im Vorstadtbereich.

Zwischen den Städten wird eine mittlere Dichte von 5 Endgeräten pro km², mit Spitzen von bis zu 50 Endgeräten pro km² angenommen.

Alle Endgeräte produzieren einen Verkehr von 0,07Erl in der Hauptverkehrstunde.

Jedes Jahr wird 1% der bestehenden Teilnehmer als Kunde bei dem neuen Betreiber abonnieren, u.z. über eine Periode von 10 Jahren

angenommenes Wettbewerbsszenario



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Anmerkung:

Um exaktere Werte für eine Geschäftsentscheidung zu erhalten wurden für diese Studie für die Städte Bremen, Trier, Hannover, Bremen, Köln und Berlin die realen Daten der Teilnehmerdichte für die drei Bereiche Zentrum, Innenstadt und Vorstadt verwendet. Details sind dem Kapitel Wirtschaftlichkeitsbetrachtungen zu entnehmen.

In der Praxis kommt hinzu:

Mehrere Ballungszentren

lukrativer industrieller Verkehr

Zugangsnetze

- Die Architektur von Zugangsnetzen und deren Anbindung an die Service Nodes (SN)
- Mögliche Zugangsarten durch das Access Network
- Anforderungen für den Transport der möglichen Dienste & Träger durch das System
- Das Management-Konzept und Anforderungen im Zusammenhang mit den Service Nodes
- Anforderungen an die Durchführung und die Kontrolle beim Zugang

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•architecture of the Access Network (AN) and its relation to the Service Nodes (SN);
The description of the architechture is discussed on a functional basis only, not considering the implementation. The implementation is depending on the evolving technologies. The functional architecture shall describe the functions allocated to the AS and the interfaces to interconnect the AS to the environment.

• access types considered to be supported by the Access Network
depending on the accesstypes we will find different functions within the AS. An ISDN subscriber needs less complicated functions than the ATM-Terminal.Thus it is mandatory to restrict the discussions to a limited number of access types

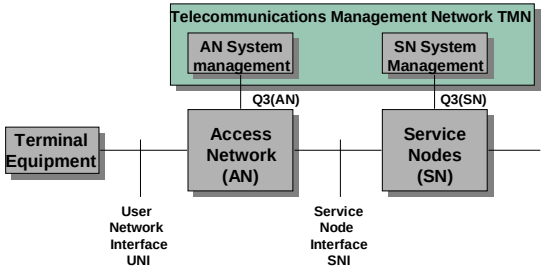
•the bearer transport capabilities and requirements dealwith the transmissionparameters of the user channel. They differ between circuit switched capabilities for voice and cell switched or packet switched characteristics for data applications.

•the management concept and requirements in conjunction with the Service Nodes and the operation and control requirements of accesses
Electronic functions within the access network require sophisticated management operations in order to maintain and operate the systems cost efficently. If the systems shall be implemented using equipment from different suppliers the TMN functions need to be specified

•Klassische / Konventionelle Zugänge direkt an die DIVO

- ⇨ analaog
- ⇨ PRI
- ⇨ BRI

Referenz Konfiguration des Zugangsnetzes



Das AN ist transparent für Nutzdaten und Signalisierung

Die Vielfalt der sich entwickelnden Techniken im Anschlußbereich zwingt zur Festlegung einer Referenzkonfiguration mit eindeutigen Refenzpunkten und eindeutigen Interfacepunkten an die unterschiedlichen Techniken herstellerunabhängig angeschlossen werden können.

Das Terminalequipment steht bei und gehört üblicherweise dem Nutzer. Realisierungen können einfache Telefone, ISDN-Telefone, TK-Anlagen, DECT-Telefone, DECT-TK-Anlagen, ISDN-Einschubkarten für Rechner, Terminaladaptoren, Viedeokonferenzanlagen, Multimedia-Endgeräte, ACD-Anlagen u.s.w. sein.

Das Anschlußnetz (AN) kann in der einfachsten Form als paariges Kupferanschlußnetz ausgeführt sein und mit Multiplexern, Konzentratoren oder Mehrkanalsystemen mehrfach ausgenutzt werden. Für hochbitratige Übertragungen im Anschlußnetz kommen entweder optische Leitungssysteme oder Coaxialleitungssysteme zum Einsatz. Die Coaxialleitungssysteme sind weiterentwickelte TV-Verteilsysteme. Aufgrund des Kosten- und Zeitdrucks im Wettbewerb sind neue Netzbetreiber gezwungen alternativ auch über Funktechnologien im Anschlußbereich nachzudenken.

Zitat aus ITU-T G902:

3.1.5 access network (AN): An implementation comprising those entities (such as cable plant, transmission facilities, etc.) which provide the required transport bearer capabilities for the provision of telecommunications services between a Service Node Interface (SNI) and each of the associated User-Network Interfaces (UNIs). An Access Network can be configured and managed through a Q3 interface. In principle there is no restriction on the types and the number of UNIs and SNIs which an Access Network may implement. The access network does not interpret (user) signalling.

Die Service Nodes können Signale einspeisen (CATV-Verteilung), schalten (CC-Systeme oder Übertragungssysteme) oder vermitteln (Vermittlungssysteme).

3.1.20 service node (SN): A network element that provides access to various switched and/or permanent telecommunication services. In case of switched services, the SN is providing access call and connection control signalling, and access connection and resource handling.

Das AN ist über das Q3-Interface an das TMN anzuschließen, mit dem Ziel (Zitat ITU-T, G902):

3.1.6 AN system management function (AN-SMF): AN System Management function coordinates operations and maintenance of the User Port function, Service Port function, Core function and Transport function within the AN. It coordinates time critical management and operation requirements for the allocated user ports with the Service Node via the SNI. It communicates with the TMN via the Q3 interface for the purpose of being monitored and/or controlled.

Der Netzabschluß gehört zum dem AN!

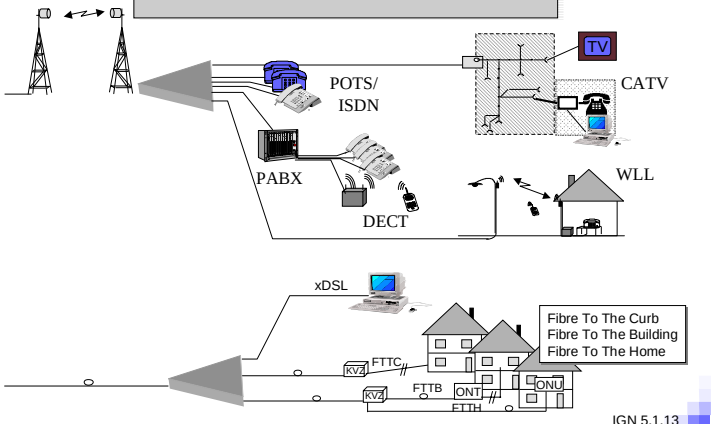
Zugangsarten

- konventionelle PABX
- Multiplexer mit oder ohne Centrex
- optische Netze
- RLL (WLL) Radio in the Local Loop, Wireless Local Loop
  - ⇨DECT, PHS, GSM, Microwave
- CATV, Energieleitungen, ISDN, xDSL,...
- SAT
- Laser-Richtfunk

Der Einsatz einer PABX bringt zwei bedeutende Vorteile:

- ⇨ Kostenfreie Interngespräche
- ⇨ Konzentratorfunktion auf den Link zum öffentlichen Netz
- ⇨ sowie weiter Nebeneffekte:
  - weiterentwickelte Funktionen gegenüber dem öffentlichen Netz
  - Einmalige Investition möglich gegenüber Miete auf System-Lebenszeit

„Letzte Meile“



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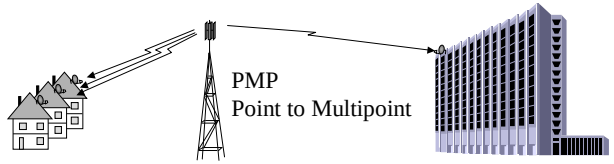
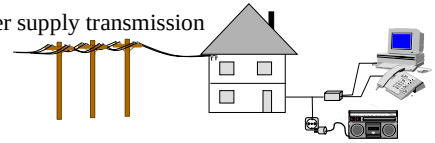


Power supply transmission



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Zu unterstützende Dienste und Träger

- bearers & bearer services
  - ⇨ transparent 64kbit/s
  - ⇨ framerelay
  - ⇨ ATM
  - ⇨ analog video 5MHz/ch
  - ⇨ digital video 4Mbit/s/ch
  - ⇨ SDH transmission rates
- services/multimedia services
  - ⇨ voice
  - ⇨ online access
  - ⇨ joint editing
  - ⇨ teleteaching
  - ⇨ transaction services (banking, shopping)

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Trends in (optischen) Zugangsnetzen

- Verwendung von „fibre to the curb“ (FTTC) anstelle von „fibre to the home“ (FTTH), nur vereinzelte Nutzung von von Glasfaser für Zugangspunkte
- Umstrukturierung der Zugangsnetze mit dem Ziel, die Zahl der Switche zu reduzieren.
- Austausch der festen Multiplexer-Strukturen gegen statistisches Multiplexen / Konzentrieren (V5.2, ATM)
- Bandbreitenreduktion für Bewegtbild-Übertragung (z.B. MPEG)
- Leistungsfähiges NMS, weniger Wartungspersonal (Betriebskosten & Investitionen)

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Kosten des Equipments vs. Kosten/Bit!

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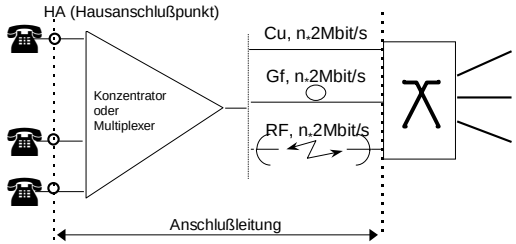
Multiplexer/Konzentrator im Teilnehmerzugang



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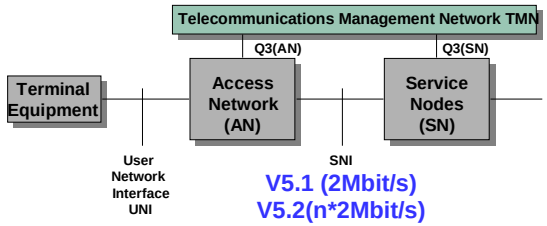
ac alternate current
AI Activate Indication
AIS Alarm Indication Signal
AN Access Network
AN-FR AN Frame Relay function
BCC Bearer Channel Connection
BECN Backward Explicit Congestion Notification
C/R Command/Response
C-channel Communication channel
C-path Communication path
C64 Communication channel 64 kbit/s
CRC Cyclic Redundancy Check
CTRL Control protocol message
Cx Communication channel with index
D16 D-channel 16 kbit/s
dc directed current
DDI Direct Dialling In
DE Discard Eligibility indicator
DI Deactivate Indication
DISC Disconnect
DL primitive between layer 2 and layer 3
DLCI Data Link Connection Identifier
DM Disconnect Mode
Ds D-channel signalling
DS access Digital Section
DTMF Dual Tone Multiple Frequency
EA Address Extension
EF Envelope Function
EFaddr EF address
EI Error Indication
ET Exchange Termination
FCS Frame Check Sequence
FE Function Element
FECN Forward Explicit Congestion Notification
FRI Frame Relaying Information
FRMR Frame Reject
FSM Finite State Machine
ID Identifier
ISDN Integrated Services Digital Network
L1 Layer 1
L2 Layer 2
L3 Layer 3
L3addr L3 address
LAPB Link Access Protocol Balanced for X.25
LAPD Link Access Protocol for ISDN D-channel
LAPF Link Access Protocol for Frame mode
LAPV5 Link Access Protocol for V5 interface
LAPV5-DL LAPV5 Data Link sublayer
LAPV5-EF LAPV5 Envelope Function sublayer
LC Line Circuit
LE Local Exchange
LOF Loss Of Frame alignment
LOS Loss Of Signal
LT Line Termination
MCID Malicious Call Identification
MDL primitive between layer 2 and layer 3 Management
MDU Management Data Unit
MF Mapping Function
MPH primitive between Physical layer and layer 2 Management
NT1 Network Termination 1
NT2 Network Termination 2
P/F Poll/Final
PABX Private Automatic Branch eXchange
PCM Pulse Code Modulation
PH primitive between Physical layer and layer 2
PICS Protocol Implementation Conformance Statement
PL Permanent Line
PSTN Public Switched Telephone Network
QAN Q interface at the AN
QLE Q interface at the LE
RAI Remote Alarm Indication
REJ Reject
RNR Receive Not Ready
RR Receive Ready
SABM Set Asynchronous Balanced Mode
SABME SABM Extended
SAPI Service Access Point Identifier
SDL Specification and Description Language
TE Terminal Equipment (ISDN or PSTN)
TEI Terminal Endpoint Identifier
TMN Telecommunication Management Network
UA Unnumbered Acknowledgement
UI Unnumbered Information
V5DLaddr V5 Data Link address

V5.x Interface, Allgemeines & Standards



Allgemeines:
- kein Demultiplexing vor dem SN
- Protokoll Konversion für analoge Anschlüsse an das AN
- keine Längenbegrenzung AN - SN
- kein interner Verkehr (5.1)
- Switch integration (5.2)

Hauptunterschied:
- V5.1 ohne Konzentrator
- V5.2 mit Konzentrator

--> Einfluß auf die SNI-Verkehrsstatistik!

ETS 300 324-1: V5.1 interface to support the access network;
ETS 300 324-2: Protocol implementation conformance statement for the V5.1 interface;
ETS 300 324-3: Test suite structure and test purposes for the V5.1 interface;
ETS 300 347-1: V5.2 interface to support the access network;
ETS 300 347-2: Protocol implementation conformance statement for the V5.2 interface;
ETS 300 347-3: Test suite structure and test purposes for the V5.2 interface;
ETS 300 376-1: Q3 interface specification at the access network for the configuration management of V5 interfaces and associated user ports;
ETS 300 376-2: Q3 interface specification at the access network; Managed object conformance statement for the configuration management;
ETS 300 377-1: Q3 interface specification at the local exchange for the configuration management of V5 interfaces and associated customer profiles;
ETS 300 377-2: Q3 interface specification at the local exchange; Managed object conformance statement for the configuration management;
ETS 300 378-1: Q3 interface specification at the access network for the fault and performance management of V5 interfaces and associated user ports;
ETS 300 378-2: Q3 interface specification at the access network; Managed object conformance statement for fault and performance management;
ETS 300 379-1: Q3 interface specification at the local exchange for the fault and performance management of V5 interfaces and associated customer profiles;
ETS 300 379-2: Q3 interface specification at local exchange; Managed object conformance statement for fault and performance management;
ETR 150: V5 interface; PSTN protocol mapping examples.

V5.1 Interface Allgemeines und Schicht 1

- Die Verantwortung für den Verbindungsaufbau verbleibt in der LE
- Einbau von Konzentratoren in den SN (1:4 EWSD, 1:8 S12*)
- 1 * 2Mbit/s (30 bearer (user) channels)
  bis zu 30 analoge Teilnehmer oder 15 ISDN Anschlüsse
  bis zu 3 communication (control) channels (ch0 synchronisation, CRC, statusinformation; ch16 and additional ch15 and ch31 layer 2 control)
- Interface für die Endgeräte:
  analog mit oder ohne DID, Notfall-Telefone
  ISDN S_0 (BRI), S2m (PRI) wird von V5.1 nicht unterstützt, aber das AN ermöglicht die Übertragung von S2m als 2Mbit/s Datenstrom, wobei der Switch die Interconnection über das V2m-Interface vornehmen muß. Mietleitungen (permanent, semipermanent) müssen als ständige Durchschaltungen in V5.1 realisiert werden.

*Quelle: Taschenbuch der Telekom PRAXIS 1996, Schiele und Schön,

IGN 5.1.20

Services and architecture aspects and requirements

The following services shall be supported by the V5.1 interface specification. It is however not intended by this specification to restrict any implementation of ANs or LEs supporting the full set or a subset of the services listed in this ETS.

1 On-demand services

On-demand services pass through the V5.1 interface. Two types of accesses are supported, as given in subclauses 6.1.1 and 6.1.2.

1.1 PSTN

a) Single customer:
- with Dual Tone Multiple Frequency (DTMF) or line state signalling;
- with or without supplementary services.

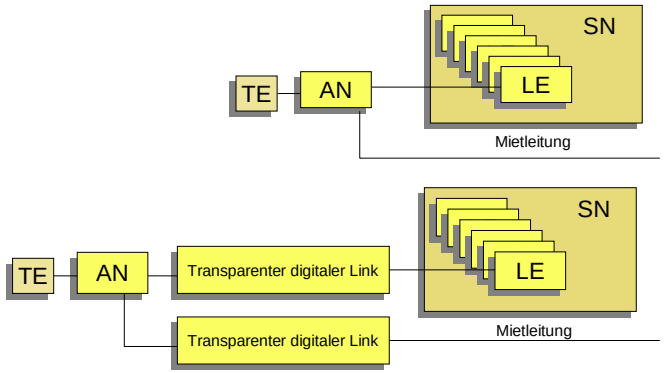
b) PABXs:
- with or without Direct Dialling In (DDI);
- with DTMF or line state signalling;
- with or without supplementary services.

The protocol elements specified in this ETS can be combined in a flexible manner to support dedicated PSTN applications except those using data over voice methods.

1.2 ISDN basic access

With NT1 as integral part of the AN, or as a separate equipment supporting transmission systems described in ETR 080 and conforming to ETS 300 297 [4]:
- for the support of multipoint layer 1 passive bus configuration at the coincident S and T reference point;
- for the support of NT2 (e.g. ISDN PABX) connected at T reference point.

V5.x - Mietleitungen



IGN 5.1.21

There shall be no restriction for teleservices or bearer services using B-channels as well as supplementary services for the ISDN access. Packet mode services through D-channel and Packet-data in B-channel shall also be supported.

Bit rates lower than 64 kbit/s are not supported directly. They are seen as user applications within a 64 kbit/s B-channel.

One or both B-channels may be used for the optional Permanent Line (PL) capability or semi-permanent leased line service,

Permanent Line (PL) capability

The PL capability uses one or both B-channels of an ISDN basic access. The PL B-channel bypasses the LE. For further information on their effect on the V5.1 interface see Annex A.

Provisions have been made in the user port control procedure for the support of this capability (see subclause 14.1).

Semi-permanent leased line

Semi-permanent leased lines pass through the V5.1 interface. For further information on their effect on the V5.1 interface see Annex B.

Three types of semi-permanent leased line services exist:

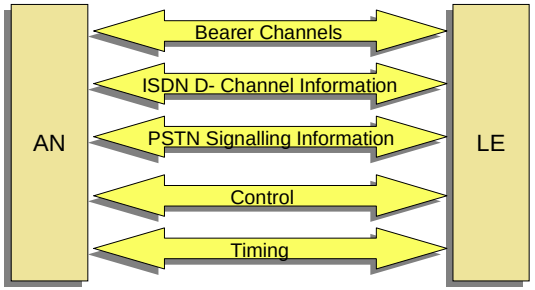
a) use of one or both B-channels of an ISDN basic access;

b) analogue leased line without outband signalling;

c) digital leased line(s) without outband signalling.

The requirements and procedures for the support of the semi-permanent leased lines are covered by the requirements and procedures defined in this ETS.

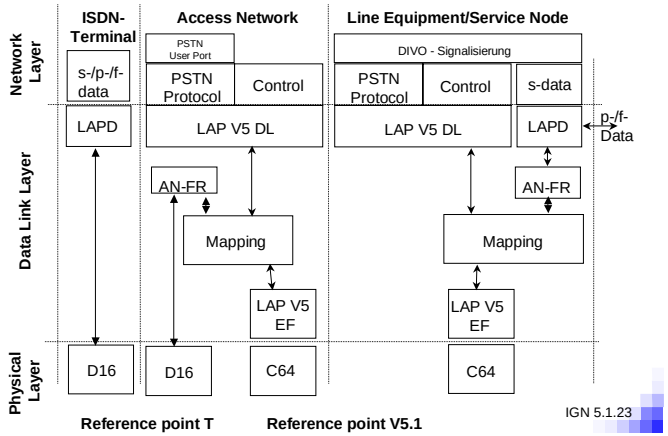
V5.1 Interface, Funktionsbeschreibung



IGN 5.1.22

- bearer channels: to provide the bidirectional transmission capability for allocated B-channels from basic access user ports or PCM encoded 64 kbit/s channels from PSTN user ports;
- ISDN D-channel information: to provide the bidirectional transmission capability for D-channel information from basic access user ports (including Ds-, p- and f-type data);
- PSTN signalling information: to provide the bidirectional transmission capability for signalling information of PSTN user ports;
- control of user ports: to provide the bidirectional transmission capability to carry the status and control of each individual user port;
- control of the 2 048 kbit/s link: frame alignment, multiframe alignment, alarm indication and CRC information of the 2 048 kbit/s;
- control of layer 2 links: to provide bidirectional communication capability to carry control and PSTN signalling information;
- control for the support of common functions: to provide synchronized application of provisioning data and restart capability;
- timing: to provide the necessary timing information for bit transmission, octet identification and frame synchronization. This information may also be used for the synchronization of LE and AN for synchronous operation. There are however various other methods possible to establish synchronous operation therefore the method used for a particular network may depend on the network operator´s requirement and is outside the scope of this ETS.

V5.1 interface, Protokoll Architektur



IGN 5.1.23

The ISDN D-channel information shall be multiplexed at layer 2 and frame relayed over the V5.1 interface. The capability to separate p-type and f-type data from s-type signalling data onto different communication channels shall be supported by the AN and the LE, but it shall be possible to carry them on a single communication channel as a traffic engineering option, which requires that this can be provisoned.

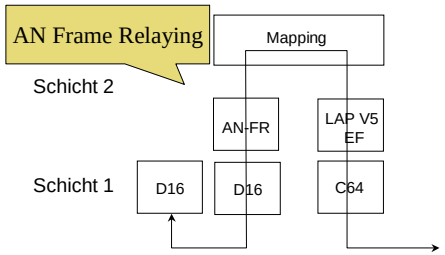
The protocol specification for PSTN ports is based on the following:

- the analogue PSTN signalling information shall be transported over the V5.1 interface using the layer 3 messages of the V5-PSTN protocol;
- signalling information shall be multiplexed at layer 3 and carried over a single layer 2 data link;
- only the LE shall have knowledge about the PSTN services under operational condition of the V5.1 interface;
- DTMF senders, receivers, tone generators and announcements shall be located in the LE.

NOTE: DTMF senders, receivers, tone generators and announcements may also be present in the AN e.g. for:

- line maintenance (via the Q interface);
- emergency call handling in case of V5.1 interface failures; the required facilities shall only be activated for long term failures. This function is optional.

V5.1 Interface, Multiplexing und Relaying der Schicht 1 ISDN Signale



IGN 5.1.24

AN frame relay sublayer

General

The AN executes an AN frame relay function, which means that the customer's D-channel data link layer protocol is not fully terminated. The AN only performs the following core procedures in its relay process:

- frame delimiting, alignment and transparency;
- frame multiplexing/demultiplexing using the ISDN layer 2 address field according to subclause 8.5;
- inspection of the frame to ensure that it consists of an integral number of octets prior to ZERO bit insertion or following ZERO bit extraction;
- inspection of the frame that it is neither unbounded nor too short;
- insertion of HDSL flags if no layer 2 frames have to be sent; and
- detection of transmission errors.

Valid frames incoming from an ISDN access, shall be multiplexed onto an allocated V5 communication channel on the basis of the ISDN layer 2 frame address, after adding the EFaddr related to the frame's user port of origin. The definition of invalid frames from the ISDN user port is given below.Valid frames incoming from the LE, shall be demultiplexed and relayed to the relevant user port after EFaddr removal. Invalid frames shall be detected and handled by the LAPV5-EF function. The main function of the AN concerning ISDN protocol handling, is to add in the AN to LE direction the EFaddr and to remove this number in the AN to customer direction as defined in this subclause shows the frame relaying function in the AN.

Handling of Frames received from LE

- Receive EFaddr and envelope information field from the mapping function
- Determine ISDN user port with EFaddr using provisioning data;
- Create frame with opening flag;
- Copy the envelope information field after the flag;
- Generate the frame check sequence;
- Add closing flag.

Handling of Frames received from ISDN user port

- Check for valid frame;
- Remove flags and FCS;
- Retrieve allocated EFaddr from provisioning data;
- Pass EFaddr and processed frame to mapping function in accordance with subclause 12.3.

Time slots

There shall be only one 2 048 kbit/s link on a V5.1 interface and layer 1 of the V5.1 interface is structured according to ETS 300 167 [2]. Timeslots 1 to 31 of the 2 048 kbit/s link shall be used for channels allocated by provisioning:

- time slots which carry ISDN and PSTN bearer channels;

- communication channels which carry ISDN D-channel information, PSTN signalling information and control information.

Time slot allocation for communication channels

If only PSTN user ports are supported the capability for 2 communications channels shall be provided, assigned through provisioning.

If either ISDN user ports or ISDN and PSTN user ports are supported the capability for 3 communications channels shall be provided, assigned through provisioning.

If only one communication channel is allocated then it shall be timeslot 16 (C-channel 1). If two communications channels are allocated then they shall be timeslots 15 and 16 (C-channels 2 and 1, respectively).

If all three communications channels are allocated then they shall be timeslots 15, 16 and 31 (C-channels 2, 1 and 3, respectively). The following types of data have been defined which shall be conveyed over the V5.1 interface as communication paths:

a) p-type data: This is ISDN D-channel data with SAPI 16;

b) f-type data: This is ISDN D-channel data with SAPI = 32 to 62;

c) Ds-type: This is ISDN D-channel signalling type data with SAPI not equal to any of those above;

NOTE 1: It has been identified that services using previously reserved SAPIs may be provided in

the future. Giving a default allocation at least allows earlier implementations of V5.1 to transport these D-channel signalling types across the AN although their future data type allocation may be changed.

d) PSTN: This is PSTN signalling information;

e) Control: This is control information data.

The control communication path shall always be allocated to C-channel 1. The other communication paths shall be allocated to any C-channel by provisioning. Ds-type data shall be kept within a single C-channel. The same applies for PSTN.

p-type data from an ISDN user port shall be placed in a single C-channel. f-type data from an ISDN user port shall be placed in a single C-channel. Both p-type data and f-type data from an ISDN user port may be placed in the same C-channel or split over different C-channels. p-type and f-type data with different EFaddr may be split into different communication paths which shall be conveyed over different C-channels, following the rules above.

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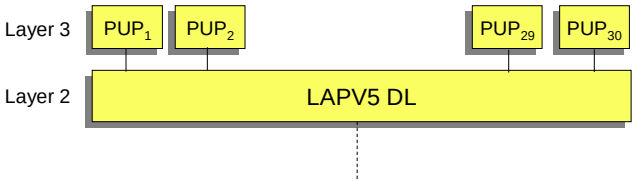
V5.1 Interface, Multiplexen der Schicht 3 PSTN-Siganle



Schicht 3 Multiplexing
Die Signalisierung für mehrere PSTN Teilnehmeranschlüsse wird in Schicht 3 gemultiplexed und über einen einzelnen Schicht 2 Link über das V5.1 Interface transportiert. Gleichzeitig wird auch Kontroll-Information über diesen Link transportiert. Die Adressierung der einzelnen Teilnehmer-Ports ist in den Schicht 3 Nachrichten für das PSTN und den Kontroll-Information enthalten.

IGN 5.1.27

PSTN signalling protocol specification and layer 3 multiplexing - General Introduction

The PSTN protocol on the V5.1 interface is basically a stimulus protocol; i.e. it does not control the call procedures in the AN it rather transfers information about the analogue line state over the V5.1 interface.

The V5.1 PSTN protocol shall be used in conjunction with the national protocol entity in the LE (see figure 14). The national protocol entity in the LE, which is used for customer lines which are connected directly to the LE, will also be used to control calls on customer lines which are connected via the V5.1interface. For time critical sequences it is also required to extract certain signalling sequences (e.g.compelled sequences) from the national protocol entity into an "AN part" of the national protocol entity.

However, the V5.1 PSTN protocol has a relatively small functional part which is concerned with path setup, release of the path on the V5.1 interface, call collision resolution on the V5.1 interface and handling of new calls in case of overload conditions in the LE. The majority of line signals will not be interpreted by the V5.1 PSTN protocol, but simply transferred transparently between the user port in the AN and national protocol entity in the LE.

PUP - PSTN-User-Protocol

Separation of responsibilities

The LE shall be responsible for providing the service (call control, supplementary services). DTMF

senders, receivers, tone generators and announcements shall be located in the LE. This implies that address information using DTMF shall be carried transparently between user port and LE whereas line state signalling shall be interpreted in the AN and then carried over the V5.1 interface by means of layer 3messages.

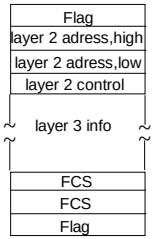
It shall be the responsibility of the AN to handle access specific parameters related to the protocol such as recognition times of analogue signals, duration, voltage and frequency of meter pulses, ringing current or the specific details of a signalling sequence (AN part of the national protocol entity). These parameters shall be set either in hardware, software or in data. In the latter case this data shall be pre-defined but some of the data may be overruled by "protocol parameter" messages via the V5.1 interface for a call.

For time critical responses to customer signalling it is necessary for the AN to respond autonomously. This shall be explicitly required for ring trip and dial tone suppression. There may be other time critical responses required in national PSTN protocols which shall be defined in the national PSTN protocol mapping specification.

For time critical signalling sequences (e.g. autonomous seizure acknowledge for ground start PBXs) it shall also be necessary for the AN to control the time-critical part of the signalling sequence autonomously. In this case, the autonomous signalling sequence shall be triggered by the national protocol entity in the LE. After executing the autonomous signalling sequence, the AN may return aresponse to the LE.

The protocol definition is provided in this Clause. Background information and flow diagrams are provided in Annex H. The SDL diagrams are given in Annex L. Annex D provides additional information for the use of the information elements to define the national PSTN protocol mapping.

V5.1 Interface, Schicht 2



Schicht 2 Rahmen
ETS 300 125

- wird im Zeitschlitz 16 übertragen
- unnumerierte Rahmen (SABME, UA, DM) zur Verbindungskontrolle
- Flußkontrolle und Time-Outs mit nummerierten Rahmen (RR, RNR, REJ)
- Übertragung in Schicht 3 (Signalisierung) erst nach Aufbau der darunter liegenden Schichten.

connection control: set up, supervision, release

SABME: Set Asynchronous Balanced Mode (extended asynchronous mode in which user and network are balanced)

initialize acknowledged information transfer for point to point connections

UA: Unnumbered Acknoledgement for SABME

DM: Disconnect Mode

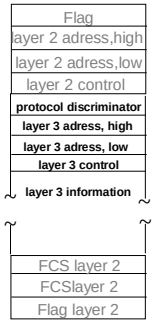
Flow control (window control):

RR: Receive Ready

RNR: Receive Not Ready

REJ: Reject

V5.1 Interface, Schicht 3



Schicht 2 und 3 Rahmen

Schicht 3 Kontrolle:

Auf- und Abbau der Signalisierungs-Verbindung durch die AS

Durchschaltung der Nutzkanäle durch die AS-System

Kontrolle der User-Ports & Status Transfer

V5.1 Interface, Start des Systems

- Schicht 1
  - Synchronisation beider Systeme (AN, SN),
  - using ch0 of layer 1 (flag detection)
- Schicht 2
  - Einleitung des Mehrfachrahmenmodus durch Aussendung von SABME und Empfang von UA
  - RR mit Rahmenzählern zur Bestätigung
- Aufbau der Schicht 3 Verbindung
  - Überprüfung der Interface Nummer und Configurations-Version, Austausch der Interface ID und der Version
- Fortsetzung der Schicht 2
  - Verbindungsaufbau für die analogen Endgeräte (signalling conversion)
- Freischaltung aller verfügbaren User-Ports
  - common control restart, port control unblock

IGN 5.1.31

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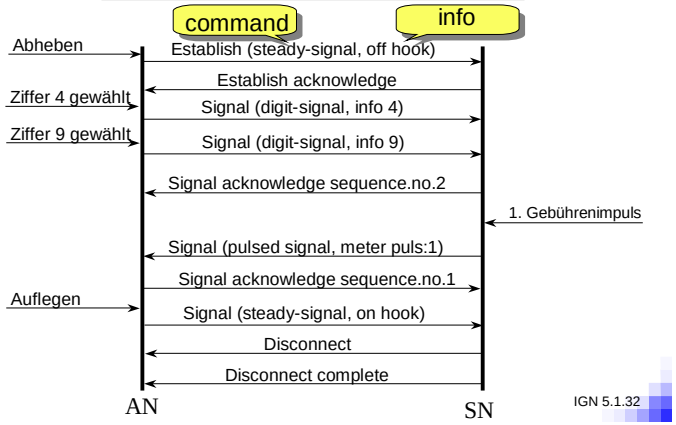
V5.1 Interface, Beispiel einer PSTN Verbindung



IGN 5.1.32

V5.2 Interface, Allgemeines

- Kann 1 bis 16 komplette 2Mbit/s-Systeme enthalten
- Notfall-Vermittlung auf AS-Ebene realisiert
- Ähnliche Rahmenstruktur wie V5.1, zusätzlich wird jedoch der Zeitschlitz 0 für die Schicht 1 Überwachung verwendet
- Zeitschlitze 15, 16 und 31 können für Signalisierung, und Kontrollzwecke verwendet werden.
- Signalisierung über:
  - PSTN-control protocol, ISDN-control protocol,
  - link control protocol
  - bearer channel connection protocol (BCC)(dynamic channel allocation)
  - Protection protocol (protection switching)

IGN 5.1.33

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V5.2 Interface, BCC

Bearer Channel Control (BCC)

- Dynamische Kanalvergabe
  - ⇨ Anforderung vom Endgerät oder vom SN
  - ⇨ Kontrolle durch das SN
- Konzentration 1:8
  - ⇨ bis zu 4000 analoge Endgeräte
  - ⇨ bis zu 2000 ISDN Endgeräte
  - ⇨ Gemischt

IGN 5.1.34

V5.2 Interface Sicherheitsprotokoll

- Nicht assoziierte Signalisierung

  ⇨ Nutzkanal und Signalisierungskanal können dynamisch auf verschiedenen Links eingerichtet werden, Gefahr hierbei: Ein defekter Link kann eine ganze Reihe intakter Links beeinträchtigen

  ⇨ Bei mehreren Links werden Reservelinks für die Signalisierung vorgesehen. Operation mode : „Hot-Stand-By“

V5.2 Interface Protokoll zur Verbindungskontrolle

- Blockierung und Aufhebung der Blockierung für einzelne Links
- Aufsicht über die physikalischen Links durch den Zeitschlitz 0
- BCC

Radio in the Local Loop
RLL

IGN 5.1.37

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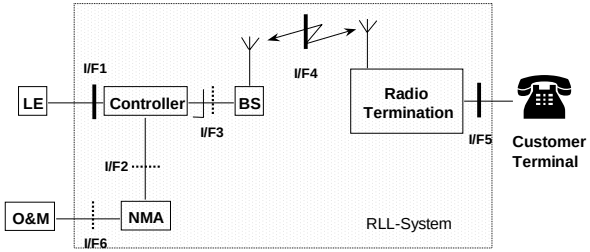
RLL-Referenz Modell



LE: Local Exchange
BS: Base Station
NMA: Network Management Agent

I/Fn: Interface number n, n = 1..6

IGN 5.1.38

Local Exchange (LE): steht repräsentativ für das öffentliche Übermittlungsnetz für Sprache und Daten, auch Festverbindungsleitungen sind nach ETSI eingeschlossen.

Controller: adaptiert die Signalisierung von der BS ins Übermittlungsnetz, steuert die BS´n und nimmt die OAM -Funktion durch die BS´n war.

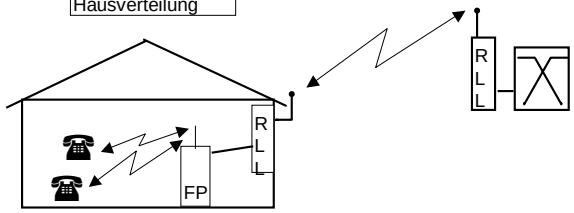
Base Station (BS): Verfügt über alle notwendigen Funkbaugruppen um Informationen und Signalisierung zu empfangen und zu senden. Außerdem hat sie die Fähigkeit den Funkkanal zu warten und zu messen.

Radio Termination: hat die Möglichkeit auf die Luftschnittstelle (I/F4) zuzugreifen. Als Customer Terminals werden ISDN, PSTN und leased lines unterstützt. Die Radio Termination muß nicht alle Dienste gleichzeitig unterstützten können, dafür können unterschiedliche Geräte zum Einsatz kommen.

Network Management Agent (NMA): behandelt z.B. Konfigurationsdaten, Kunden-, System- und Funkparameter. Die NMA kann auch Leitungsmerkmale des RLL realisieren

Hausverteilung

DECT-Hausverteilung



IGN 5.1.39

Mehrwegeausbreitung ist nicht im DECT-Standart beachtet worden (Heimanwendung).
--> Probleme bei größeren Entfernungen

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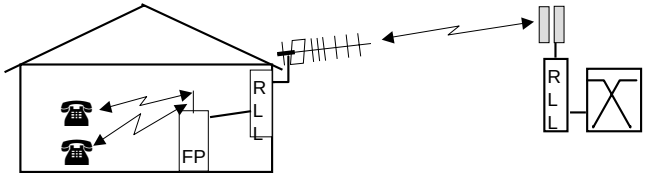
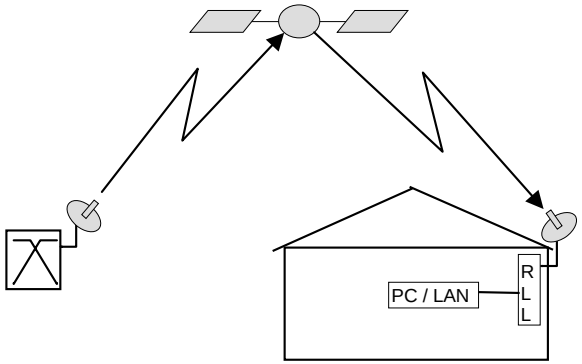
- Richtfunk
- Sektorantennen
- variable Bandbreite
- beherrschbare Mehrwegeausbreitung



IGN 5.1.40

Sattelitenübertragung



IGN 5.1.41

Astra: Kosten ca. DM 1,- pro MByte , gewaltige Flächendeckung

Unidirektional

„Rückkanal“ muß konventionell realisiert werden, z.b. semipermanente ISDN Verbindung der Rechnernetze über ein Low-Cost BRI-Router

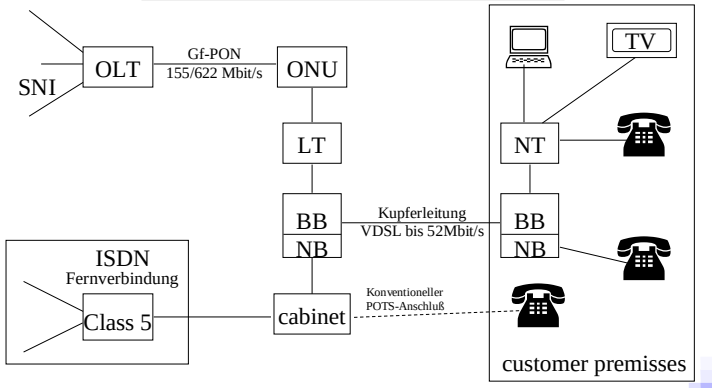
Anwendungen:

Verteilung von Doks, etc bei großen Firmen, Verbänden

Bulk-Mails

Anbindung von Proxy-Servern

Mehrdienste-Zugangsnetz



IGN 5.1.42

Abbreviations and translations:

SNI Service Node Interface

OLT Optical Line Termination

ONU Optical Network Unit

LT Line Termination

BB Broad Band

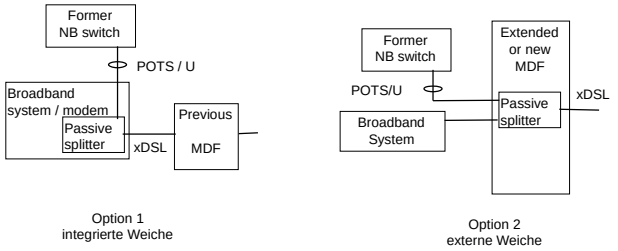
NB Narrow Band

cabinet Kabelverzweiger

VDSL Very high bit rate Digital Subscriber Line

NT Network Termination

Installation der Weiche in einer FTTExch-Architektur



IGN 5.1.43

In the case of an FTTExch architecture, the ONU being located at the local exchange and the distribution segment is fully copper pairs based. The MDF is a copper one, with a major difference with its present feature: the services carried are broadband ones. In order to physically combine the NB and BB services on the copper pairs two major options appear:

- The combination is performed in a passive xDSL splitter located within the broadband system.
- The combination is performed in a new or extended copper MDF.

It must be clear that this discussion has also to take place at other network levels, between the ONUs and the NTs. But in FTTExch, the MDF extension, whether replacement or enlargement and refurbishing, is an issue of utmost importance, because the MDF is housed in an environment where space is often a scarce resource. For the other architectures, the real challenge is to be able to collocate the broadband ONUs with access to the POTS copper cables in an area where an additional housing can be installed.

xDSL-Technologien
(Digital Subscriber Line)

- HDSL - High Data Digital Subscriber Line
  - 2 oder 3 Kupfer-Doppeladern
  - bidirektional auf jedem Adernpaar
  - 1.5 oder 2 Mbit/s
  - Ersatz für T1/E1-Strecken
- SDSL - Single Line Digital Subscriber Line
  - 1 Adernpaar
- ADSL - Asymetric Digital Subscriber Line
  - Up-/Downstream mit unterschiedlichen Datenraten (z.B. 640k/9M)
  - quasi-unidirectionaler Betrieb möglich
  - z.T. auf 1 DA (bestehender TlnAnschl.Ltg)
  - Fq-Bänder können außerhalb des Basisbandes liegen (Telefonie)
- VDSL - Very High Digital Subscriber Line
  - geplamt: 50 Mbit/s, Anschluß an Gf-Netze, Massiver DSP-Einsatz

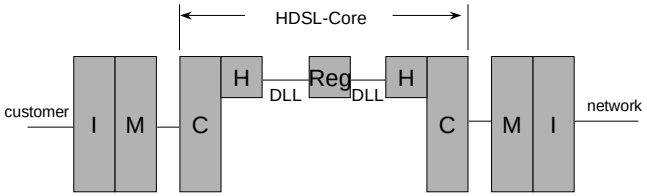
IGN 5.1.44

Es ist immer ein Modempaar erforderlich!

ADSL-Feldversuch (Campus) in den USA im Feb'98 : $600 Installation, $80 monatlich

Übung : Erläutern Sie warum E1/T1-Strecken via HDSL realisiert werden!

HDSL (High Bitrate Digital Subscriber Line)



Network Termination (Slave)

Line Termination (master)

C common equipment
H HDSL Transceiver
I Interface
M Management

An access digital section which uses HDSL technology can be considered as a number of functional blocks. Depending upon the HDSL transceiver (H) transmission rate, a fully equipped HDSL core consists of **two 1 168 kbit/s or three 784 kbit/s HDSL transceiver pairs** connected by Digital Local Lines (DLLs) (and optional regenerators (REGs)), which are linked by some common circuitry (C). The HDSL core is application independent. Operation with a non-fully equipped HDSL core is also permitted. An application is defined by the interface (I) and mapping & maintenance (M) functionality's.

The functionality's at the exchange side constitute the Line Termination Unit (LTU) and act as master to the (slave) customer side functionalities, which collectively form the Network Termination Unit (NTU) and the REGs where applicable.

NOTE: A fully equipped HDSL CORE consists of two or three H, REG and DLL combinations depending on HDSL transceiver data transmission rate. REGs are optional.

It should be noted that throughout this notes, reference is made to the terms REG-C, REG-R and individual HDSL transmission systems. REG-R identifies functionalities located at the LTU side of the regenerator, REG-C identifies functionalities located at the NTU side of the regenerator, and an individual transmission system can be considered to consist of H + DLL (with optional REG) + H functional groups.

The information transmitted between the NTU side (slave side) and LTU side (master side) is handled as follows:

At the application interface (I), the data flow is grouped in application frames (e.g. 32 time slot ISDN primary rate frames, as specified in ETS 300 011 [7]).

The mapping function (part of functional block M) then takes the application frame and inserts it into a 144 byte core frame (in some applications not all data bytes will contain valid information and may be set to idle patterns).

The core frame is then given to the common circuitry (C) where it is combined with any necessary alignment bits, maintenance bits and overhead bits, in order to be sent transparently in HDSL frames over the DLLs. The use of REGs is optional.

At the receiving side, data within the HDSL frames is multiplexed by the common circuitry to again form the core frame which is passed to the mapping function where it is mapped into the application frame and transmitted over the application interface.

Funktionen für den HDSL Kern LTU / NTU / REG

- Transparent transport of core frames (144 bytes) <---->
- CRC-6 procedures and transmission error detection <---->
- Error reporting, Failure detection, Failure reporting <---->
- Bit timing, Frame alignment, Stuffing and destuffing <---->
- HDSL transceiver autonomous start-up control ----->
- Loopback control and co-ordination ----->
- Mapping of core frames into HDSL frames <---->
- Control of maintenance channel <---->
- Synchronisation and co-ordination of HDSL transceivers ----->
- Identification of pairs, Correction of pair identification Note <---->

5.1.1 Transparent transport of core frames

This function provides for the bi-directional transmission of the core frames with 144 bytes over two or three parallel HDSL transceiver systems connected by separate pairs.

5.1.2 Stuffing and destuffing

This function provides for the synchronisation of the application data clock to the HDSL transceiver system clock, by means of adding zero or two stuffing quats per HDSL frame.

5.1.3 CRC-6 procedures and transmission error detection

This function provides for error performance monitoring of the HDSL transceiver systems in each HDSL frame.

5.1.4 Error reporting

This function provides for the reporting of errors detected by means of the CRC-6 procedure.

5.1.5 Failure detection

This function provides for the detection of failures in the HDSL transceiver system.

5.1.6 Failure reporting

This function provides for the reporting of failures detected in the HDSL transceiver systems by means of messages in the maintenance channel realised i.e. by HDSL frame overhead bits.

5.1.7 Bit timing

This function provides bit (signal element) timing to enable the HDSL transceiver systems to recover information from the aggregate bit stream.

5.1.8 Frame alignment

This function provides information to enable the HDSL transceiver systems to recover the HDSL frame and the HDSL frame overhead.

5.1.9 HDSL transceiver autonomous start-up control

This function provides for the recovering of the operational state after first powering or break down of the HDSL transceiver systems.

Funktionen der Stromversorgung LTU / NTU / REG

- Fernspeisung (optional) ----->
- Wetting current (optional) ----->

5.1.10 Loopback control and co-ordination

This function provides for the activation and release of loopbacks in the LTU, the REG and the NTU.

5.1.11 Mapping between core frames and HDSL frames

This function provides for the mapping between the 144 bytes core frame and the HDSL frame(s).

5.1.12 Control of the maintenance channel

This function provides for the control of the maintenance channel formed by the HDSL frame overhead bits.

5.1.13 Synchronisation and co-ordination of HDSL transceivers

This function provides for the synchronisation of the HDSL transceiver systems, the equalisation of different signal delays on the pairs and the correct sequence of the signals coming from the separate pairs.

5.1.14 Identification of pairs

This function provides for the marking of the pairs at the LTU/NTU by means of two or three Z bits per pair to enable the correct identification of the pairs.

5.1.15 Correction of pair identification

This function provides for the realignment of the identification of pairs if an unintentional interchange of pairs has occurred and was detected by the NTU.

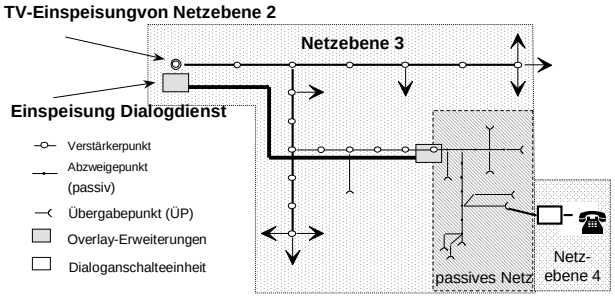
5.1.16 Remote power feeding

This optional function provides for remote power feeding of either the NTU (if no REG is provided) or the REG from the LTU via the pairs.

5.1.17 Wetting current

This optional function provides for the feeding of a low current on the pairs to mitigate the effect of contact corrosion.

Local Loop über CATV-Netze



Hinweis: Teilweise gesonderte Kabelführung zum passiven Netz

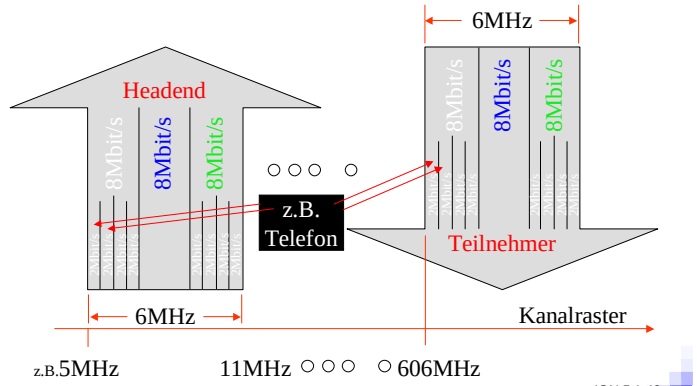
CATV-Netze müssen eine genügend hohe Bandbreite zur Verfügung stellen, um Engpässe bei der Kanalvergabe zu vermeiden. Am besten auf 800MHz aufrüsten.

CATV-Netze müssen Rückkanalfähig sein oder umgerüstet werden.

Dienste: alle TV-features (VoD, Pay per View,...), Kabelmodems, Telefonie, BB-Internet,...

Alternative für neue Netzbetreiber anstelle die Cu-DA von der DTAG zu mieten

Kanalbedarf für die Dialogdienste

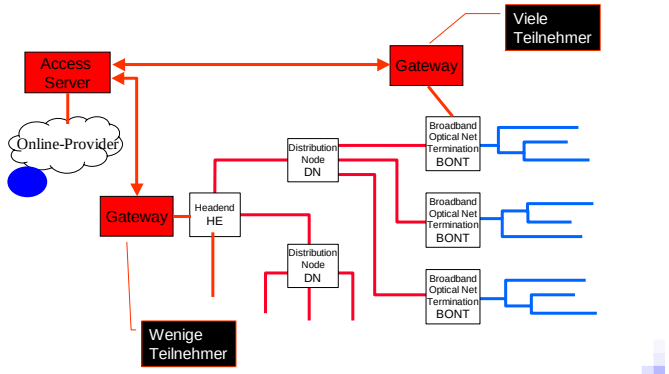


IGN 5.1.49

Eckdaten einiger Kabelmodems:

- Motorola Cyber Surfer (30Mbps / 768kbps)
- NEC CM 500 (30Mbps / 2Mbps)
- Toschiba (10Mbps / 2Mbps)
- Zenith HWU (500kbps / 500kbps)

Positionierung der HeadEnds



IGN 5.1.50

Die Position des ÜP/Headends ist abhängig von der Nutzung der Dienste!

VB5-Interface

There are only two potentially divergent SNI standards likely to emerge,

- ATM Forum RBB group ANI
- ETSI/ITU-T/DAVIC VB5

The ATM Forum ANI will encompass both VB5.1 and VB5.2 as alternative approaches.

The key differences between the current ATM Forum RBB group approach and that adopted by ETSI/ITU-T is the handling of user signalling.

Additional capital costs are likely with the ATM Forum approach since additional functionality, to terminate and manage user signalling, is required. Due to the relative immaturity of the specifications however, in particular the ATM Forum RBB ANI, a worthwhile comparison of the likely relative capital cost is impractical at this stage.

The ATM-F approach effectively incorporates some or all of the functions of the local exchange in the AN. The ability of the AN to support new and evolving services is tied to the capability of the LE functionality in the AN, since the AN processes user signalling. In addition the distinction between the AN and the core network is blurred.

The VB5 concept keeps the AN functionality to a minimum by applying a successful technique already employed in narrowband networks. The AN is transparent to user signalling and so largely independent of any particular service.

None of the SNI standards discussed in the document have yet been formally published. The relatively simple VB5.1 is probably the most advanced, having been approved by ETSI SPS3. VB5.2 on the other hand is still being actively discussed within ETSI and the ITU-T have both VB5.1 and VB5.2 as current work items. It is therefore possible that some of the assumptions in this document will prove to be incorrect when the standards are finally published.

The ATM Forum RBB group also have much more work to do to complete their ANI specification. There may be scope for convergence between the two groups, but it is unlikely.

Eigenschaften / Grundprinzipien von VB5

- Verwendung von ATM als Transportmedium für die Nutzinformation
- Prinzipien des V5-Interfaces weitgehend übernommen
- User/Network Signalisierung wird transparent transportiert
- Das AN muß Nicht-ATM Signale adaptieren
- BRI-Teilnehmer werden mit V5 Interface angebunden !
- Zwei Versionen mit und ohne Konzentration werden verfügbar sein VB 5.1 & VB 5.2
- Keine Beschränkung bezüglich des physikalischen Übertragungsmediums
- Aufbau von Kanälen und Pfaden wird durch interne Signalisierung unterstützt (wie bei V5)
- FSAN - “Full Services Access Network“ Initiative

•**ATM is used to transport user information**
ATM is the standard transfer mode for B-ISDN. Because there are no hard bandwidth limitations in the terrestrial access network ATM is the right choice. The cell format is identical to the ATM format of the Network to Network Interface (NNI, see ITU-T, I361)

•**Principles of V5-Interface are adopted**
The Service Node (SN) is responsable for the service, not the AS! The functionality of the AS is limited to a minimum. There is no call control in the AN. nevertheless there is internal signalling in the AN in order to control channels and pathes.

•**user/network-signalling is transported transparently** through the AN

•**the AN has to adapt non ATM-Signals**
The AN converts non ATM user and signalling streams into ATM cells and vice versa.This is important in order to act transparent for POTS, ISDN, LAN, Video on demand and other traffic without the need to care about new technologies and implementations at the terminal site. ATM is the intermediate standard for teh transport of all other signals, if they are standardized or not. This simplifies the adaptation of the AN to the AAF.

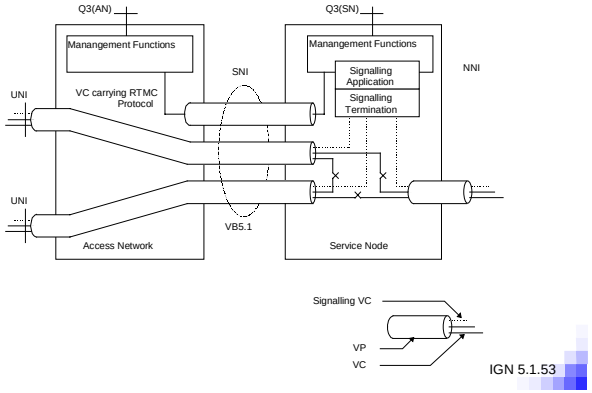
•**narrowband users are connected via V5 interfaces !**
Narrow band non ATM users suffer from the packetizing delay of the conversion to ATM. This delay can be minimized by parallel packetizers, if the signals of at least 48 users are offered in parallel to the AAF. Therefore it is proposed to interface not the individual narrowband subscriber to the VB5, but a multiplexed signal of a V5-Mux or -concentrator.

•**two versions, with/without concentration will be available: VB5.1 and VB5.2**

•**no restrictions regarding the physical layer, but SDH is preferred**

•**channel and path setup is supported by internal signalling (like with V5)**
virtual channels and virtual pathes are supported within the AN. The AN is able to inform the SN about the available ressources in real time.

VB5.1



IGN 5.1.53

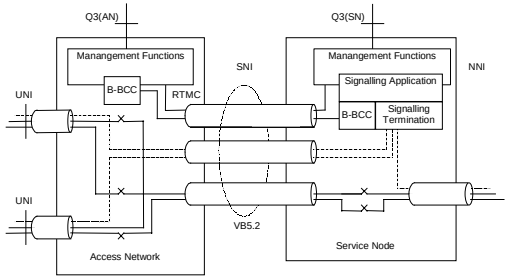
The VB5.1 Interface

The principal attributes of the VB5.1 interface are:-

- ATM based
- It can be implemented at the ATM layer almost without regard to the physical layer.
- Scaleable - the number of transmission paths at one interface is limited only by the VPCI addressing capabilities.
- Largely independent of user signalling protocols since signalling is not terminated in the AN
- Supports multi-host UNIs. (i.e. one UNI may be connected to a number of different SNs via separate SNIs).
- Supports B-ISDN & Non B-ISDN UNIs
- Enables broadband/narrowband integration
- Supports ANs with internal VP and VC cross-connects
- Supports point-to-multipoint (broadcast) connections in the AN
- Incorporates a real-time management protocol for efficient network operations (i.e. when Access and Core networks are operated by different organisations or independent departments).
- specified with ONP in mind

The AN in this case can be considered as a VP cross-connect. A key part of VB5.1 is the Real-time Management Co-ordination (RTMC) protocol. This allows changes in AN resource availability to be communicated to the SN, particularly when these changes arise due to administrative activities

VB5.2



* The support of Intra-AN connections are still the subject of discussion within ETSI/ITU.

IGN 5.1.54

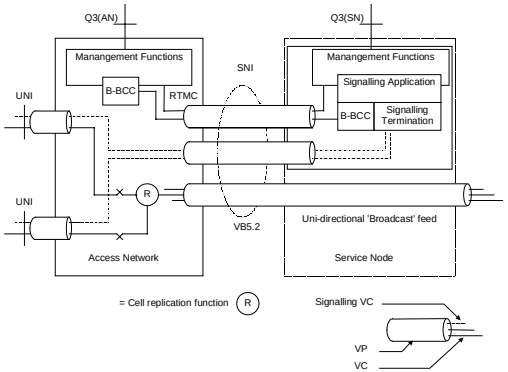
The VB5.2 Interface

The VB5.2 interface builds on the VB5.1 interface allowing dynamic allocation of resources in the AN on a connection by connection basis under control of an SN. This is realised by adding a Broadband Bearer Channel Connection (B-BCC) protocol. shows the VB5.2 interface applied to B-ISDN switched connections.

The AN does not terminate user signalling. Instead this is performed in the SN just as it was the VB5.1 case. The SN signalling application now uses the B-BCC to allocate the necessary resources in the AN to make the signalled connections.

It should be noted that although the following diagram shows intra-AN connections with VB5.2, the support of these connection types has yet to be conclusively discussed within ETSI/ITU-T

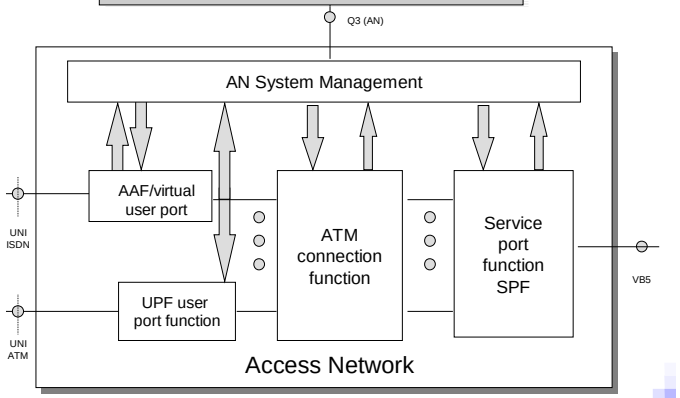
VB5.2-Applikation
(Switched Digital Video Broadcast)



IGN 5.1.55

The signalling termination and application functions are not limited to the ITU-T Digital Signalling System No. 2 (DSS2). A switched digital video broadcast (SDVB) application for example could be accommodated by the same AN architecture as B-ISDN but use a radically different SN configuration, as shown in .

Funktionales Referenzmodell
VB5, Access Network

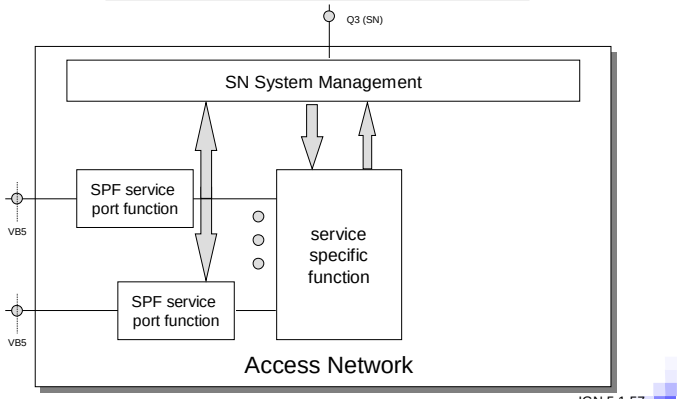


IGN 5.1.56

The User Port Function (UPF) provides access to the network via the User Network Interface (UNI). The UPF realizes the physical termination, the activation and deactivation, the maintnance and the testing of the UNI.

The standard access type is the B-ISDN (I432).For the purpose of the downward compatability it is necessary to interconnect also ISDN, POTS and CATV subscribers. These signals will be transported via ATM cells as well. Thus an ATM adaptation function (AAL) is required. The user port for non ATM terminal signals is called virtual user port in order to state that the requested service is not transparent but virtual.

Funktionales Referenz Modell VB5, Service Node



IGN 5.1.57

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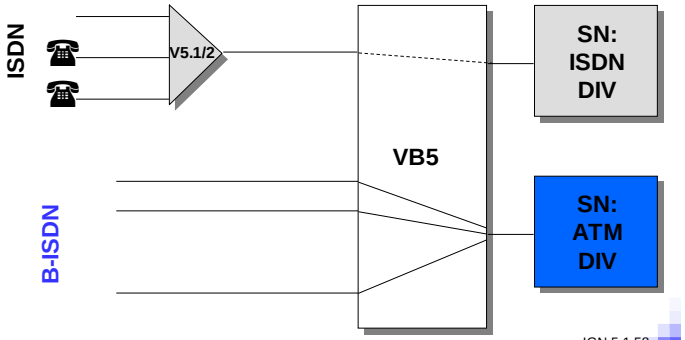
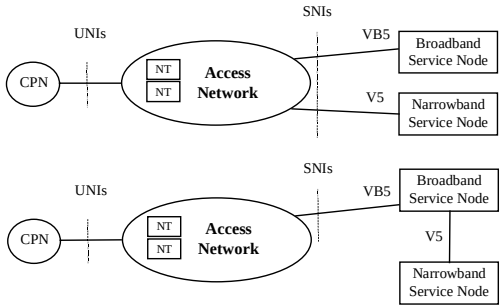
Anbindung von Schmalband-Teilnehmern über VB5



IGN 5.1.58

Anbindung des AN an die BB- und NB Service Nodes.



IGN 5.1.59

In the first case the BB and NB services are overlaid on the network, while in the second they are integrated.

2.Fall: Einsparung der physikalischen V5-Schnittstelle im AN!

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Institut für Allgemeine Nachrichtentechnik Kommunikationsnetze
Prof. Dr.-Ing. Klaus Jobmann
IANT Universität Hannover

Übung

- Warum werden E1/T1-Links durch HDSL ersetzt ?
- Erläutern und bewerten Sie die Einsatzbereiche der verschiedenen Möglichkeiten der Last-Mile-Teilnehmeranbindung!
- Aus dem xDSL-Paper erarbeiten:
  - ⇨ Welche technischen Fortschritte haben zu den neuen Modem Technologien (V.34, V.90, xDSL) geführt?
  - ⇨ Erläutern Sie ein Konzept zur Flächendeckenden VDSL-Versogung ohne neue Service-Nodes/Vermittlungsstellen aufzustellen!

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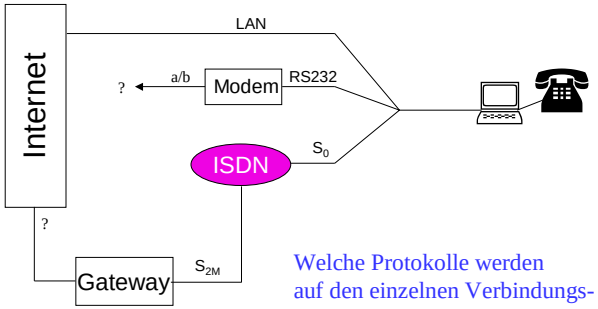
Varianten der Internet-Telefonie



Welche Protokolle werden auf den einzelnen Verbindungs-leitungen eingesetzt?

IGN 5.1.61

Reasons for the internet telephony

- price pressure on the public network operators (might disappear)
- multimedia applications using one single protocol >> IP !!

Data speed :

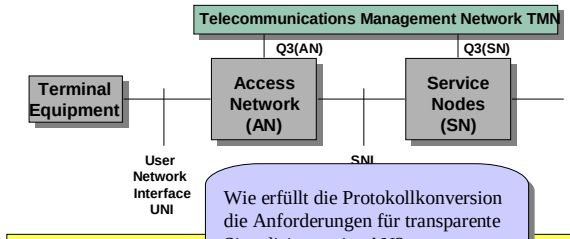
LAN: 10, 100, 1000 Mbit/s

Modem: n* 56 / n* 64kbit/s, n=1..30

cable Modem: 2Mbit/s HDSL in Europe
4Mbit/s HDSL in US
64kbit/s/ 56Mbit/s ADSL

ISDN: n* 56 / n* 64kbit/s, n=1..30 (56kbit/s in US, 64kbit/s in Europe)

V5.x Interface



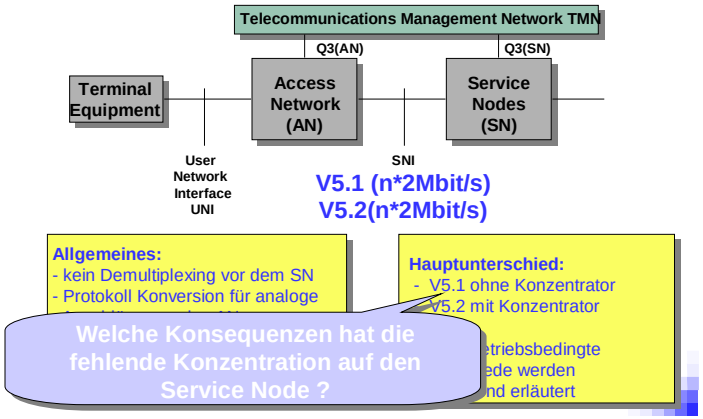
Wie erfüllt die Protokollkonversion die Anforderungen für transparente Signalisierung im AN?

Allgemeines:
- kein Demultiplexing vor dem
- Protokoll Konversion für analoge Anschlüsse an das AN
- keine Längenbegrenzung AN - SN
- kein interner Verkehr
- Switch integration

- V5.1 ohne Konzentrator
- V5.2 mit Konzentrator

weitere betriebsbedingte Unterschiede werden nachfolgend erläutert

V5.x Interface



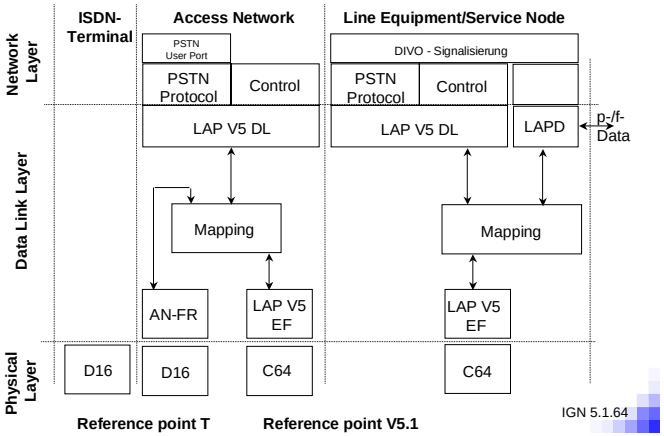
Allgemeines:
- kein Demultiplexing vor dem SN
- Protokoll Konversion für analoge

Hauptunterschied:
- V5.1 ohne Konzentrator
- V5.2 mit Konzentrator

etriebsbedingte
ede werden
nd erläutert

Welche Konsequenzen hat die fehlende Konzentration auf den Service Node ?

Zeigen Sie den Weg einer ISDN-und einer PSTN-Signalisierung durch die Protokoll-Stacks!



Um was für ein Terminal (TE) handelt es sich ?

Analoges TE, Wo ist die LT-Funktion, Signalisierung ?