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V5.2 controlled Internet access in the Access Network (AN), phase 1;
Part 1: Interface Specification

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Foreword

This Technical Report (TR) has been produced by ETSI Technical Committee Services and Protocol for Advanced Networks (SPAN).

Introduction

Telephone calls to the Internet differ greatly from normal telephone calls; in particular, the holding time is much longer than for voice or fax calls. Therefore traffic models as used for normal telephone service are not applicable for Internet calls. With an increasing amount of traffic to the Internet the classic PSTN/ISDN designed with traffic models based on different rules lack the necessary performance. The present document describes a method of extending the V5.2 interface to allow decoupling of the telephone traffic to the Internet already in the AN or to bypass the LE; the Internet traffic is routed directly from the AN to the Access Server (AS) under control of the LE. Whether the AS offers direct access to the Internet or transports the user data to an ISP which is the gateway to the Internet is not relevant to the present document.

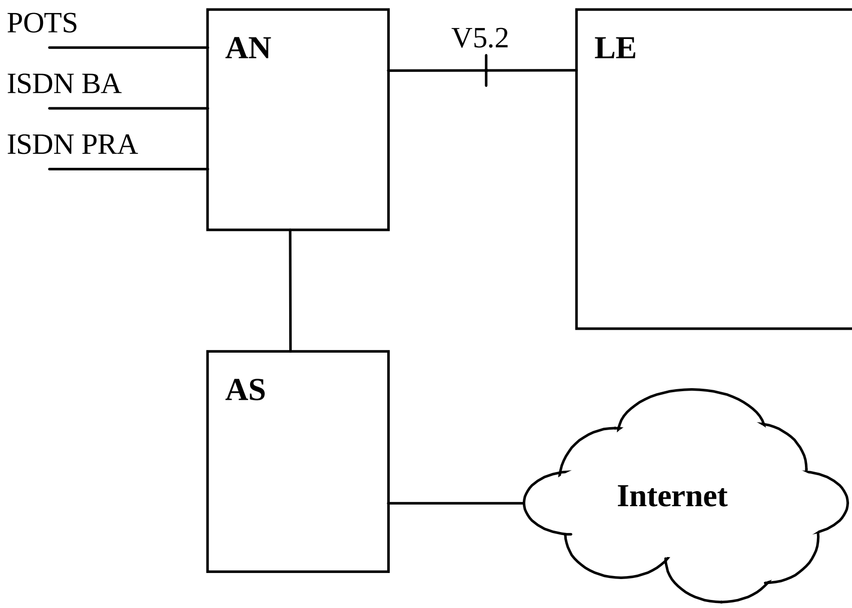

Figure 1: Internet access via AN and AS

The reason for decoupling Internet traffic is that the users allocate bandwidth for the whole time they are online although much less bandwidth is really needed due to the bursty nature of the packet data which is exchanged between user and the ISP (Internet). The basic idea for decoupling the Internet traffic in the AN is that the circuit-switched traffic be taken from the PSTN/ISDN and enter the better suited packet data world as soon as possible. In this scenario the AS, which is probably (but does not have to be) physically located quite close to the AN has the task of terminating the analogue modem traffic and sending the user data to the target ISP using IP protocol. The actual functionality of the AS is not seen to be part of the ETSI work item for V5.2 extension; nevertheless the following tasks can be seen as possible functions of the AS:

- transforming the user data from circuit-switched traffic to packet-oriented traffic;
- forwarding the user data to the addressed ISP, possibly using IP protocols and a tunnelling protocol, e.g. L2TP, to separate the IP addresses of the ISP and the transporting network;
- other packet mode transport from AS to ISP is possible;
- offering direct access to the Internet; in this case, the operator of the AS is an ISP.

Comparable solutions with a decoupling of Internet traffic behind the ingress switch are already available on the market. A solution with a decoupling in the AN would save additional equipment, i.e. interfaces between AN and LE, and switching capacity in the ingress switch. To make such a solution work, efficient use of equipment (i.e. interfaces between AN and AS) would need to be made.

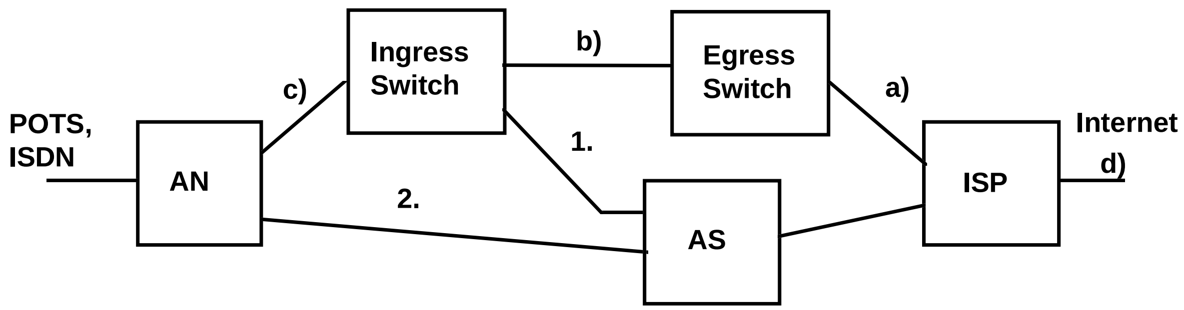

Figure 2: Connection from user to ISP

Figure 2 shows different possibilities of connecting a user with an ISP. Today, the user data reaches the ISP via the ingress switch and maybe an egress switch using a circuit-switched connection, path c), b) and a). Blocking (or at least excessive use of bandwidth) can occur in the PSTN/ISDN network in different places:

a) on the egress of the switch the ISP is connected to. Due to the extremely high traffic on ISP lines, the egress switch has to be designed to be able to carry the traffic;

b) on trunk lines between switches;

c) on the V5.2 interface between the AN and the ingress switch.

Bandwidth is wasted because the data is transported circuit-switched up to the ISP. Better use of the bandwidth is made if the AS, located as close as possible to the user, transforms the datastream into the packet mode and transports it then to the ISP. A connection of the AS to the ingress switch (path 1) is already available on the market and can also be used for users connected via a V5.2 interface. The scope of the present document is the direct connection of the AS to the AN (path 2) and therefore, the saving of bandwidth in the ingress switch.

1 Scope

The present document describes scenarios whereby Internet traffic could bypass the local exchange by being routed in the Access Network directly to the Internet access services.

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies.
- A non-specific reference to an ETS shall also be taken to refer to later versions published as an EN with the same number.

[1] ITU-T Recommendation E.164 (1997): "The international public telecommunication numbering plan".

[2] Bellcore: GR-303-CORE Issue 2: "IDLC Generic Requirements, Objectives, and Interface", December 1998; associated: Issues List Report: GR-303-ILR Issue 2A, December 1998.

[3] ETS 300 347-1: "Signalling Protocols and Switching (SPS); V interfaces at the digital Local Exchange (LE); V5.2 interface for the support of Access Network (AN); Part 1: V5.2 interface specification" (also ITU-T Recommendation G.964).

3 Abbreviations

For the purposes of the present document, the following abbreviations apply:

AN	Access Network
AS	Access Server
BCC	Bearer Channel Connection
CPE	Customer Premises Equipment
DSP	Digital Signal Processor
IAC	Internet Access Control
IP	Internet Protocol
ISDN	Integrated Services Digital Network
ISDN-BA	ISDN Basic Access
ISDN-PRA	ISDN Primary Rate Access
ISDN-PRI	ISDN Primary Rate Interface
ISP	Internet Service provider
LE	Local Exchange
LL	Leased Lines
L2TP	Layer 2 Tunnelling Protocol
NAS	Network Access Server
POTS	Plain Old Telephone Service
PSTN	Public Switched Telephony Network
RAS	Remote Access Server
VoIP	Voice over IP
VPN	Virtual Private Networking

4 Basic functionality of the LE Bypass mechanism

When an end customer, whose line is terminated on an AN with the Internet Bypass feature, goes off-hook, dial tone is provided by the ingress LE via the V5.2 interface just as it is done today. If the customer (or CPE) dials the destination E.164 address of a contracted ISP, the LE will re-route the Bearer channel from the V5.2 interface to the AS, so that the end-customer has a direct bearer channel connection to the AS and the resource on the V5.2 interface is freed. The signalling path from the end customer to the LE is still kept active as long as the call is ongoing. As the LE knows about this re-routed call, billing and usual call processing (e.g. call waiting, call forwarding) are still possible.

New signalling has to be introduced for communication from LE to the AS port, as this is the b-leg of the call; signalling with the AS is necessary to inform the LE about the AS accepting the call (begin of charging) and a possible release of the call by the AS.

Although Internet traffic is mentioned to be rerouted in the present document, it shall not be excluded to use the Internet Bypass functionality to e.g. reroute voice traffic to an AS which serves as a VoIP Gateway.

5 Progress of standardization work

At the outset, it was intended that the standardization should start with a simple first phase without signalling from the LE towards the AS interface. A second phase was planned for the introduction of a signalling protocol. The simple first phase was abandoned after realising that, without a signalling protocol, proper billing in the LE for re-routed calls would not be possible. It was agreed that signalling between LE and AN at the AS interface is a necessity from the start. At the time of writing, the details of this signalling remain undetermined, as does the definition of the interface between AN and AS. Another open item is whether the AS port is located on the subscriber or network side of the AN. The open items are discussed in more detail below.

5.1 First results

The following basic requirements have been identified:

- "The aim of the activity is to bypass the LE".
- The V5 standard is to provide connection capabilities in the AN such that Internet traffic is directly connected from the user to the AS.
- The capability should not impact on existing services; service as seen by the user should be as for the non-bypass case.
- The capability is to be available to PSTN (POTS), ISDN-BA and ISDN-PRA users.
- The solution is to be generic, with no knowledge in the LE about the services other than to handle the connection; LE does not interact with the contents of the bearer channel.
- The "Always On/Dynamic ISDN" service is not to be affected by the Internet Bypass capability.
- The AN will not have any subscriber provisioning data that belongs to the LE, only connection data.
- The solution should be simple; minimum complexity; easily manageable (particularly provisioning); minimum development and deployment costs.
- Support of current AN architectures which (can) handle V5.2; (as a good objective) AN equipment which is currently being deployed or under development should be (software) upgradable to support Internet Bypass.
- The solution for Internet Bypass is to allow for correct (i.e. accurate/reliable) billing.
- The subscriber is not to notice any difference whether the connection to the RAS goes via the Internet Bypass function or not; nor should there be any difference between a direct connection which uses V5 and the Internet Bypass function.

- The physical AS interface will not be defined in the extended V5.2 standard.
- It is to be possible to use the same physical AS interface for all ports on different V5.2 interfaces on the same AN.
- The LE need have no knowledge of the AN architecture.

5.2 Open items

5.2.1 General architecture

In the current V5 standard [3], the AN supports user-side to network-side connections. Signalling from the LE to the subscriber ports is passed transparently through the AN or mapped from messages to line signals. Regarding the AS interface this could be seen as a network side interface or a user port. There are advantages for both viewpoints.

In favour of the network-side interface:

In general, ANs currently only support user-side to network-side connections. This has major architectural benefits, particularly in the simplification and minimization of the 64 kbit/s cross-connection function. The V5 specification, particularly the BCC protocol, reflects this. In these early days of Internet access, it may seem appropriate to treat ISPs as telecommunications network users. However, ultimately, from a network architecture (and ONP) viewpoint, ISPs should be treated as network service providers, on an equal footing with present telecoms network providers, and accessed as such. AN architectures should not need to change from current implementations just to support Internet access.

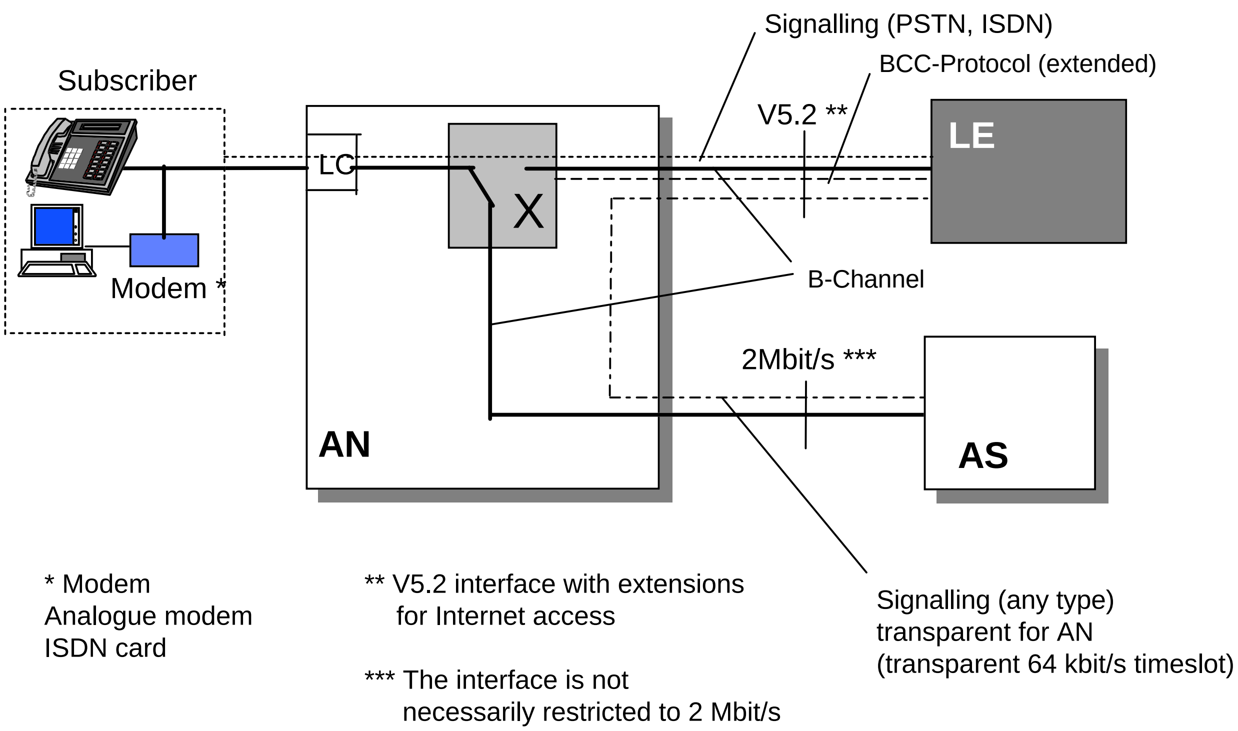

Figure 3: AS on network-side

In favour of the user-side interface:

Today ISPs are connected like "normal" telecom. network users, mostly with ISDN PRI. If the interface between AN and AS is seen as a transition of such an interface from LE to AN the AS would still be connected like a user to the network. In addition signalling from the LE towards the AS could be passed transparently through the AN which would also make the AS interface more of an user side interface. A proposal was presented with a ISDN PRI towards the AS, with the D-channel coming from the LE transparently passed through the AN, but the B-channel directly connected from the calling user to the AS interface. In the standardization for the GR303 [2] interface a similar proposal has been made.

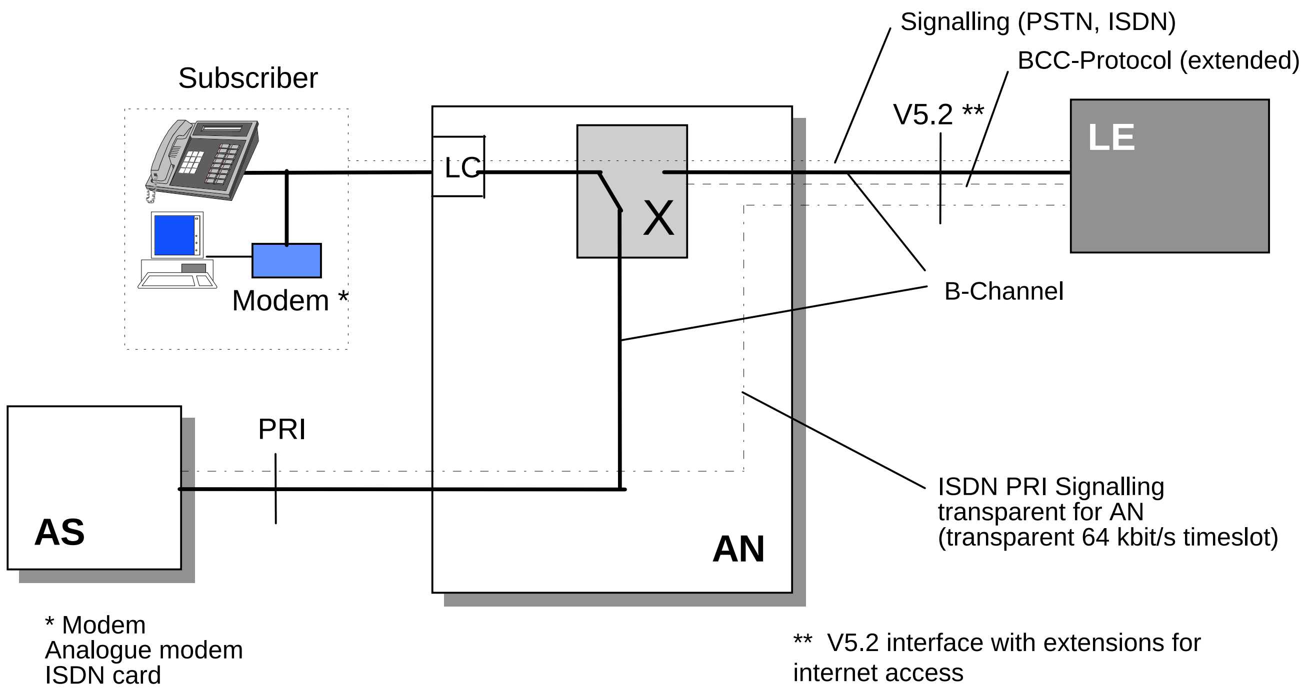

Figure 4: AS on the user side

AS ports could be treated as network ports from a physical viewpoint and as user ports from a signalling viewpoint, perhaps with a mirroring function for the signalling in the AN.

Related to the architectural aspect is the question of whether port maintenance is necessary or possible for the AS interface; if the AS interface is seen on the user side, a user port FSM has to be assigned with the advantage that the LE can be informed about failures of this interface.

5.2.2 AS interface

With the decoupling of Internet traffic in the AN a new interface between AN and AS is required. In the extension of the V5.2 standard for decoupling, this interface plays an important role; nevertheless it is not clear whether the interface can or should be part of the V5.2 interface or if the actual implementation of this interface should be hidden from the LE. Several scenarios are possible:

AS interface defined by V5 standard

If the interface between AN and AS is defined in the V5.2 extension, standardization work is probably much easier, especially for defining the signalling protocol between AN and LE in respect of the AS port. The interface could be defined as a reference point or an actual physical interface; nevertheless the definition of an interface would limit possible implementations, e.g. use of all AS (RAS-) interfaces currently available on the market, unless all possible interfaces are integrated into the standard.

AS interface open to any implementation

If the AS interface is not defined in the V5.2 extension, all manufacturers can implement the interface which is the most desirable for them or their customer. The signalling between LE and AN should be chosen to allow a simple mapping between the signalling protocol used on the extended V5.2 interface and the AS interface implemented. This would mean that the AN would always need an interworking function to map the signalling protocol on the V5.2 interface to the protocol on the interface between AN and AS.

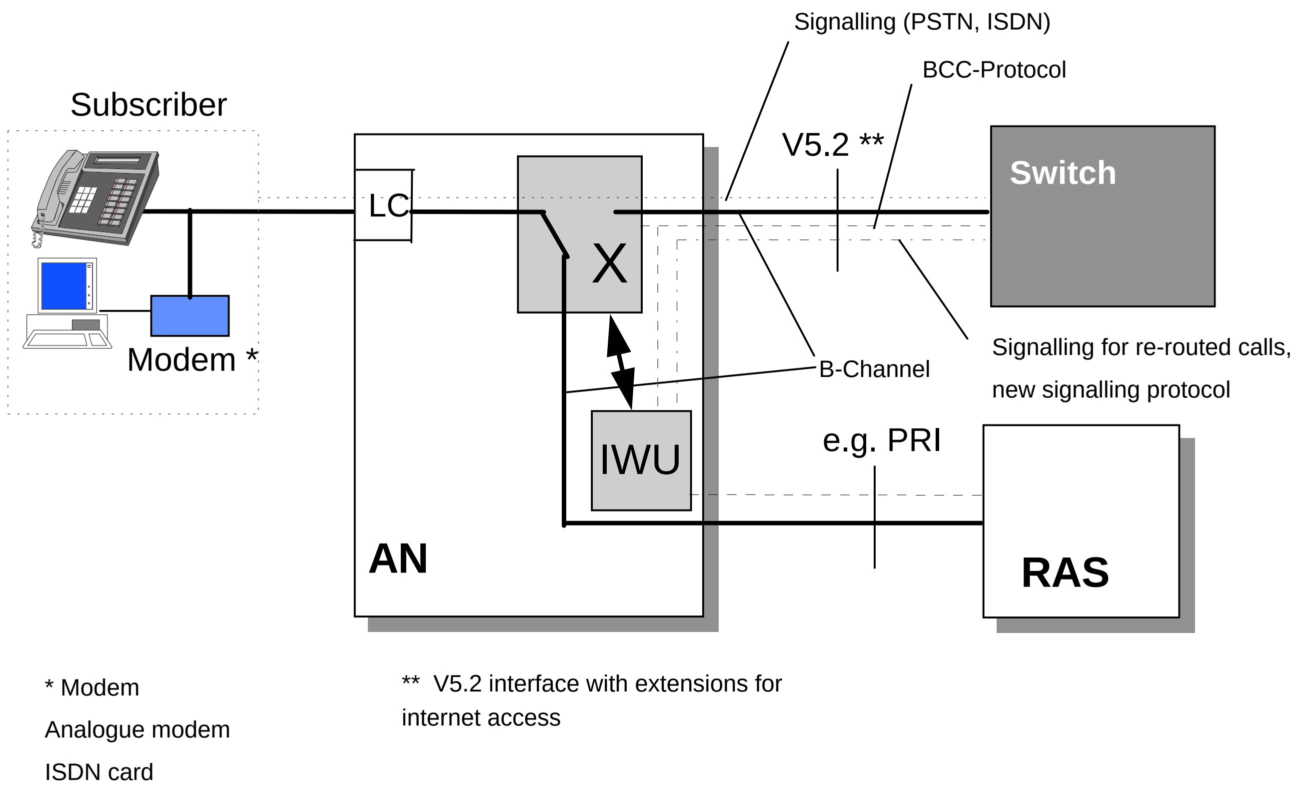

Figure 5: New signalling protocol on V5.2 interface with interworking to AS signalling

AS interface shared between several V5 interfaces on the same AN

A physical AN may be connected via several V5.2 interfaces to one or several LEs. Users from all V5.2 interfaces are re-routed to the AS; for concentration reasons it is highly desirable to be able to use the same AS interface(s) for all subscribers on the same AN, even if belonging to different V5.2 interfaces. This implies that the resource management for the AS interface is under control of the AN, or the LE has knowledge of the actual AN architecture, i.e. which V5.2 interfaces can access the same AS interface. This means also that the messages in the extended BCC protocol can address a resource (B-channel on AS interface), which can again be addressed by a message from a different V5.2 interface. This is impossible for V5.2 interfaces belonging to different LEs, which is an allowed configuration. Sharing a resource over several V5.2 interfaces also means considerable changes in the LE (provisioning, accessed data); it might even in some cases not be possible to be done at all if the interfaces are handled in independent entities in the LE.

Therefore sharing the AS interface for users on several V5.2 interfaces on the same AN should be done with the resource management for the AS interface controlled by the AN. A possible solution has been examined addressing the AS interface with an AS label, which shows e.g. the intended routing information (e.g. ISP), but not the resource to be used; the AN has the responsibility of assigning a B-channel on the AS interface.

This introduces more functionality to the AN, i.e. resource management and maybe even some level of call control, which contradicts with the initial worksplit of LE and AN.

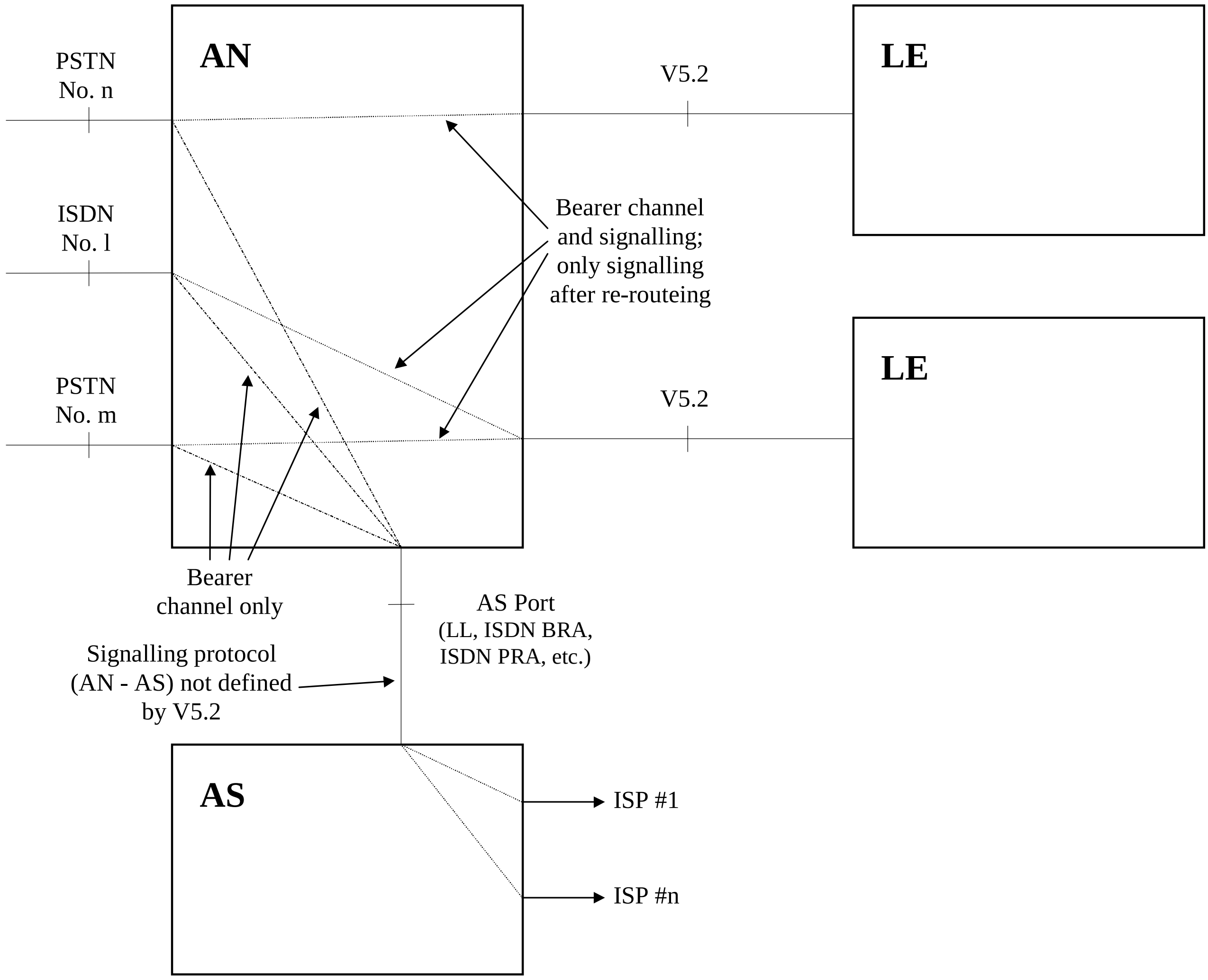

Figure 6: Scenario with AS interface shared by subscribers belonging to different LEs

Close relation for AN and AS or LE and AS

The AS interface is strongly dependent on whether the AS is seen as more related to the AN or to the LE. One point of looking at the AS scenario is to assume that the AS is the same physical equipment as RAS on the ISP premises. This RAS should not need to be changed when used in conjunction with the decoupling in the AN; therefore the same interface is to be expected on the AS as is already used for the RAS interface. This implies that the signalling would be passed from the LE transparently through the AN to the AS.

However the RAS serves only one ISP and is located on the ISP's premises; the AS will possibly serve several ISPs. This means that the functionality of the AS might be different from that of a currently deployed RAS; the main task of the AS is to terminate analogue modem traffic and to allow packet-oriented data transport instead of circuit-switched transport and therefore allowing a saving of bandwidth when transporting data to or from the ISP. With such a new scenario, also the AS product might be different from a RAS; the ISP site will probably not be moved to the AN site. Connecting the ISP RAS directly to the AN would be an option; but this would mean that each served ISP would get its own interface at the AN which is not a solution making good use of concentration. For best use of the bandwidth it might be necessary to change the functionality of the RAS or to choose a new interface.

5.2.3 Signalling between LE and AS

Signalling between the AS and LE is already operational in live implementations, as the AS is connected directly to the LE, and it is essential to avoid a number of issues. Firstly, a lack of signalling implies a level of call control in the AN which is inconsistent with the existing approach in V5 and should be avoided as far as possible. The LE model used throughout the V5 standards provides that the LE alone has control over calls. Secondly, billing issues will result because the LE has no confirmation that the AS has actually answered the call and no knowledge if the AS drops the call due to a failure, etc.

Signalling between the AS and LE is therefore an important part of the Internet access method.

Several options offer a basis for the selection of the signalling:

Using the BCC protocol for signalling information

Using the BCC protocol for signalling information about the b-leg of the connection (i.e. the connection to the AS) is not valid for two reasons:

1) using a protocol to deliver information it is not designed for is not a clean solution and should be avoided in a standard;

2) implementation of such a functionality is probably much more complicated (especially in the LE) than the few changes to the standard might suggest; e.g. a new communication is needed between the entities serving the BCC protocol and call processing.

Allowing the use of an existing signalling protocol

The V5.2 extension can dictate one existing signalling protocol to be used for signalling from LE to the AS. A good example would be the use of the ISDN signalling which looks appropriate as it is widely used for existing RAS. This protocol offers enough functionality and is already implemented in most LEs. Nevertheless some adaptations have to be made in the LE implementation as the ISDN signalling protocol is used in a connectionless mode, i.e. no bearer channel is used on the V5.2 interface. A disadvantage of allowing only one protocol is that all implementations which do not use an ISDN PRI interface towards the AS have to implement a complex interworking unit in the AN. Also sharing the AS interface between several V5.2 interfaces requires complex interworking.

Allowing any existing signalling protocol

The idea is to allow the use of almost any signalling protocol which can be transported transparently in a 64 kbit/s channel through the AN. Any AS connected to the LE, provided it uses a 2 Mbit/s interface and a signalling protocol with the described attributes, can then be connected to the AN; the AN does not need to be adapted to support different signalling protocols towards the AS. Nevertheless some adaptations have to be made in the LE implementation as the signalling protocol is used in a connectionless mode. Also sharing the AS interface between several V5.2 interfaces and/or different LEs might require complex interworking.

New signalling protocol on LE - AN interface

A new signalling protocol, probably based on existing protocols, could be defined in the V5.2 extension specifically to address the AS port. Interworking in the AN is always necessary with this approach, but is probably much simpler than to interwork an ISDN protocol and it allows for sharing the AS interface between several V5.2 interfaces. For using different AS interfaces the AN has to be adapted, but the LE interface and functionality need not be changed.

5.3 NAS/NAS Controller architecture

As the NAS/NAS Controller architecture is quite different from the AS, the scenario warrants specific discussion.

5.3.1 Network architecture

The interconnection between the trunk and data networks may be achieved by using Network Access Servers (NASs) which are controlled and managed by NAS Controllers, a brief description of which is given below.

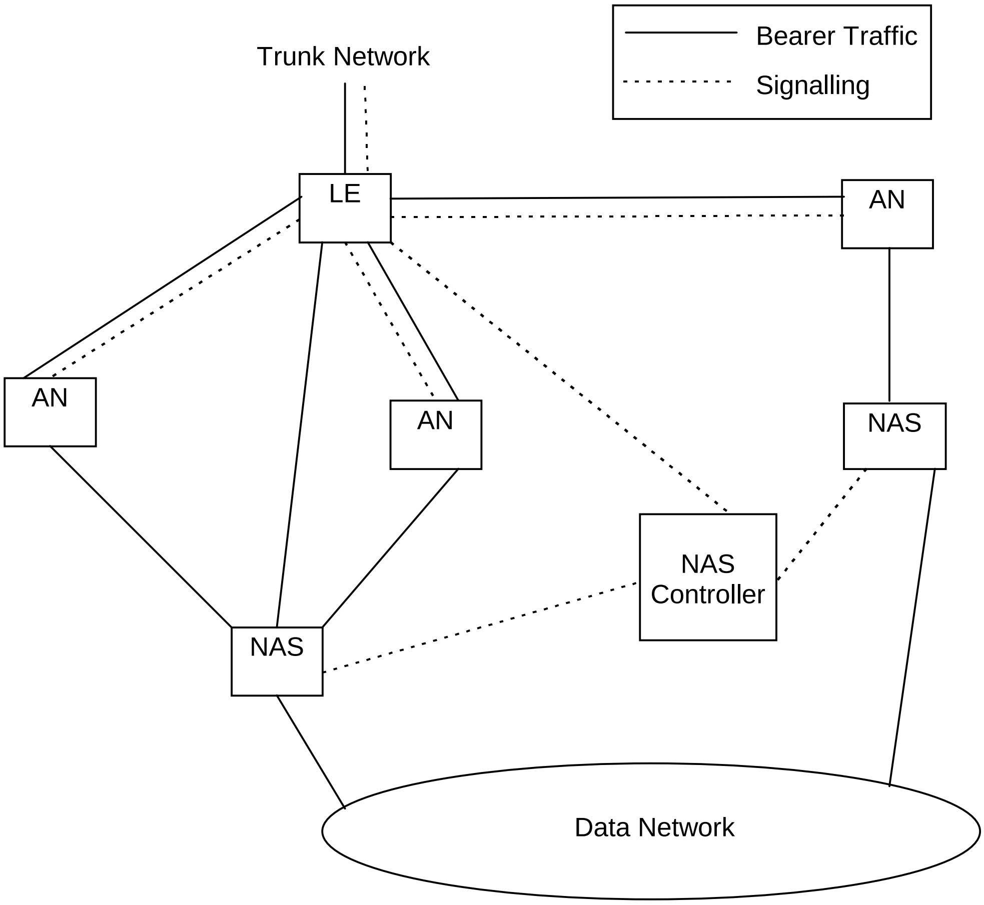

Figure 7: Example Internet Data Network

Early versions of the access servers used analogue direct exchange lines or ISDN primary rate interfaces. These are now evolving and SS7 control is becoming the standard for the LE - NAS Controller interface in order to meet the demands of their widespread deployment and management within the network. The NAS Controller - NAS interface is to remain open so any (including proprietary) signalling system may be used.

The requirements for the NAS and NAS Controller are being defined by other bodies (e.g. ETSI Project TIPHON and the Internet Engineering Task Force).

5.3.1.1 NAS Controller

The NAS Controller interfaces the LE to one or more NASs and, together with the LE, provides the call processing intelligence within the network. It is also able to exercise certain management capabilities, either automatically or on operator command. It co-ordinates the provision of services such as modem dial-up, packet voice transport, digital cross-connect, or Virtual Private Networking (VPN) by accepting and responding to signals and providing detailed operating instructions to the NAS.

During call processing, the NAS Controller must send detailed instructions to the NAS in order to control functions such as circuit connection and modem assignment. The NAS Controller must have the ability to manage the NASs and their individual components to allow control of traffic, recovery from failure, and co-ordination of maintenance with call processing. It will also have the ability to initiate maintenance actions in a NAS.

5.3.1.2 Network Access Server

Under the direction of the NAS Controller, a NAS performs a number of functions involving physical components which, in general, are addressable and selectable by the NAS Controller. These functions may include the termination of modem connections, acting as a host on the packet network, and the making and breaking of connections between selected physical components as well as performing any required transformations on data flowing through the NAS (e.g. echo cancellation, packetization or encryption).

The NAS has a number of physical components which are the resources manipulated by the NAS Controller. These may include circuit terminations, Digital Signal Processors (DSPs), modems and packet data ports.

5.3.2 Internet traffic grooming within the Access Network

Internet traffic grooming within the AN allows certain traffic, under control of the LE, to use bearer channels other than those between the AN and LE. The identification of such traffic is typically based on directory numbers provisioned within the LE.

For an originating call the LE will analyse the called party number and if the call is suitable for grooming it will attempt to terminate it on the NAS Controller. Up to this point, the call setup protocols seen over the V5.2 interface are identical to those used for standard calls. At the point the call is successfully established to the NAS Controller, the LE will switch the bearer from the V5.2 interface to the NAS using a modified BCC protocol (see figure 8).

In the event that there is no NAS connected to the AN or it is busy the LE may route the call to a NAS connected elsewhere. However this has no impact on the V5.2 interface (i.e. the bearer connection remains via the V5.2 interface) and the AN will remain unaware of the routeing.

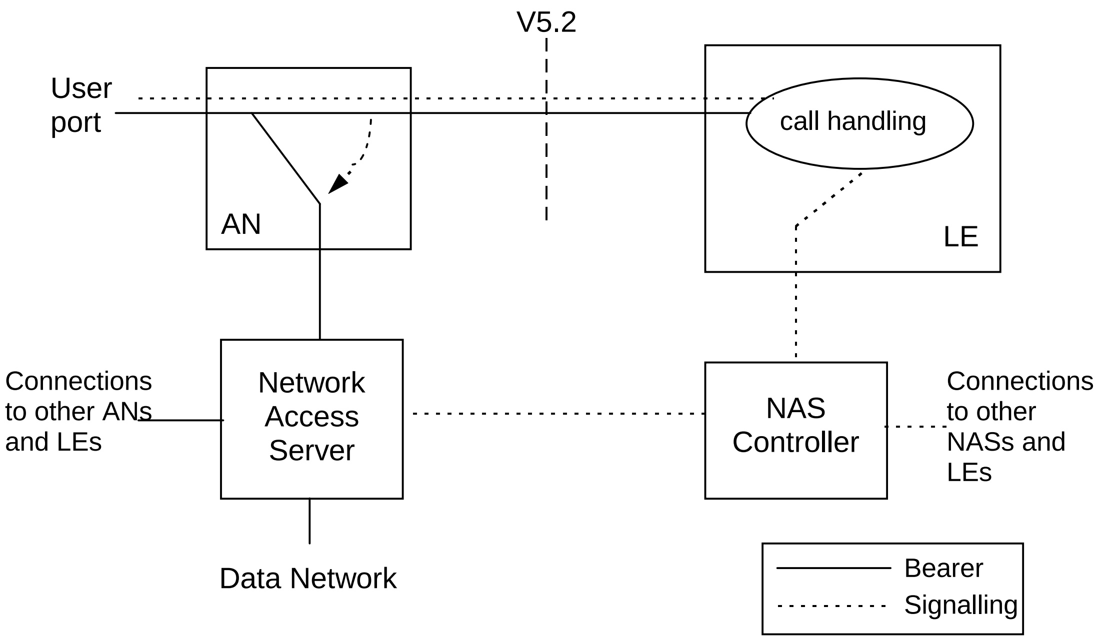

Figure 8: V5.2 architecture for Internet access

Configurations may exist in which it is appropriate to route the signalling between the NAS and NAS Controller over a semi-permanent leased connection on the V5.2 interface. This architecture is shown in figure 9.

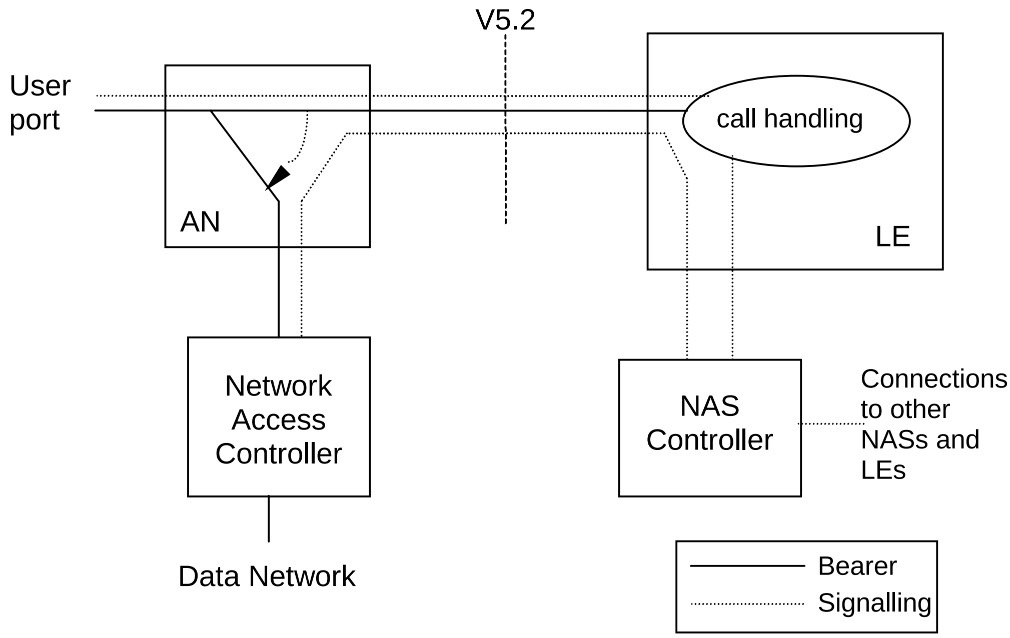

Figure 9: V5.2 Architecture with signalling routed over V5.2 semi-permanent leased line

History

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