# ETSI TECHNICAL REPORT

**ETR 257**

**March 1996**

Source: ETSI TC-SPS

Reference: DTR/SPS-03040

ICS: 33.020, 33.080

**Key words:** V interface, VB5 interface, SN, AN

# V interfaces at the digital Service Node (SN); Identification of the applicability of existing protocol specifications for a $V_{B5}$ reference point in an access arrangement with Access Networks (ANs)

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## Foreword

This ETSI Technical Report (ETR) has been produced by the Signalling Protocols and Switching (SPS) Technical Committee of the European Telecommunications Standards Institute (ETSI).

ETRs are informative documents resulting from ETSI studies which are not appropriate for European Telecommunication Standard (ETS) or Interim European Telecommunication Standard (I-ETS) status. An ETR may be used to publish material which is either of an informative nature, relating to the use or the application of ETSs or I-ETSs, or which is immature and not yet suitable for formal adoption as an ETS or an I-ETS.

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# 1 Scope

This ETSI Technical Report (ETR) examines the functional requirements for a broadband reference point in conjunction with the previously defined V5, Narrowband Integrated Services Digital Network (N-ISDN), and Broadband Integrated Services Digital Network (B-ISDN) protocols in order to define a useful set of protocol component parts.

At this stage, the ETR does not attempt to define a unique protocol stack for a $V_{B5}$ reference point, because many possible network architectures have been identified, some based on an integrated narrowband/broadband local exchange and others based on discrete local exchange architectures. All of these would require different protocol stacks. Within ITU-T Study Group 13 (WP 3) Question 14/13, the various architectures are being examined and provided in draft new ITU-T Recommendation G.902 [12]. It might be possible to reduce the options listed in this ETR and come to a definite list of requirements leading to definitive protocol stacks for the different types of interfaces at $V_{B5}$ reference points (i.e., $V_{B5.1}$ and $V_{B5.2}$). However, this is left to the development of the individual ETSs.

It has been identified that the B-ISDN service will only be provided over an ATM transmission bearer, although that itself may be provided over a synchronous/plesiochronous data link network (e.g. Synchronous Digital Hierarchy (SDH)). This somewhat simplifies the possible permutations of options.

New protocols may be identified for the $V_{B5}$ reference point as required.

Access types so far identified to be supported by the $V_{B5}$ reference point include:

- analogue telephone access;

- ISDN basic access with a line transmission system conforming to ETS 300 297 [4] for the case with a NT1 separate from the Access Network (AN);

- ISDN basic access with a user network interface according to ETS 300 012 [2] at the user side of the AN, (i.e. the interface at the T reference point);

- ISDN primary rate access with a line transmission system conforming to ETS 300 233 [3] for the case with a NT1 separate from the AN;

- ISDN primary rate access with a user network interface according to ETS 300 011 [1] at the user side of the AN, (i.e. the interface at the T reference point);

- other analogue or digital accesses for semi-permanent connections without associated out-band signalling information;

- B-ISDN access;

- Non B-ISDN accesses supporting:

  - asymmetric services (i.e. Video on Demand) (if not part of B-ISDN);
  - broadcast services (if not part of B-ISDN);
  - LAN interconnect functionality (if not part of B-ISDN),

with either:

- flexible (provisioned) Virtual Path Connection (VPC) allocation but without concentration capability at the Virtual Channel (VC) level within the AN; or

- flexible (provisioned) VPC allocation and flexible Virtual Channel Connection (VCC) allocation on a connection by connection basis which provides concentration capability at VC level.

This ETR does not specify the implementation of the requirements within the AN and does not constrain any implementation alternative as long as the functionality at the $V_{B5}$ reference point as specified in this ETR is met.

Analysis of network architecture aspects are included. In particular, the relationship between narrowband and broadband elements (ANs and SNs) are examined.

## 2 References

This ETR incorporates by dated and undated reference, provisions from other publications. These references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this ETR only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

[1] ETS 300 011: "Integrated Services Digital Network (ISDN); Primary rate user-network interface; Layer 1 specification and test principles".

[2] ETS 300 012: "Integrated Services Digital Network (ISDN); Basic user-network interface; Layer 1 specification and test principles".

[3] ETS 300 233: "Integrated Services Digital Network (ISDN); Access digital section for ISDN primary rate".

[4] ETS 300 297: "Integrated Services Digital Network (ISDN); Access digital section for ISDN basic rate".

[5] ETS 300 324-1: "Signalling Protocols and Switching (SPS); V interfaces at the digital Local Exchange (LE); V5.1 interface for the support of Access Network (AN); Part 1: V5.1 interface specification".

[6] 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".

[7] ETS 300 125: "Integrated Services Digital Network (ISDN); User-network interface data link layer specification; Application of CCITT Recommendations Q.920/I.440 and Q.921/I.441".

[8] ETS 300 102-1: "Integrated Services Digital Network (ISDN); User-network interface layer 3; Specifications for basic call control".

[9] ETS 300 443-1: "Broadband Integrated Services Digital Network (B-ISDN); Digital Subscriber Signalling System No. two (DSS2) protocol; B-ISDN user-network interface layer 3 specification for basic call/bearer control; Part 1: Protocol specification [ITU-T Recommendation Q.2931 (1995), modified]".

[10] ITU-T Recommendation G.804 (1993): "ATM cell mapping into plesiochronous digital hierarchy (PDH)".

[11] ITU-T Recommendation G.841 (1995): "Types and characteristics of SDH network protection architectures".

[12] Draft new ITU-T Recommendation G.902: "Framework recommendation on functional access networks. Access networks; Architecture, services, management and service node aspects".

[13] ITU-T Recommendation I.356 (1993): "B-ISDN ATM layer cell transfer performance".

[14] Draft ITU-T Recommendation I.363.1 (July 1995): "B-ISDN ATM adaptation layer (AAL) specification, Types 1 and 2".

[15] Draft ITU-T Recommendation I.371 (July 1995): "Traffic control and congestion control in B-ISDN".

[16] Draft ITU-T Recommendation I.432 (Nov 1994): "B-ISDN user-network interface - Layer 1 specification".

[17] Draft ITU-T Recommendation I.610 (Nov 1995): "B-ISDN operation and maintenance principles and functions".

[18] CCITT Recommendation X.731 (1992) | ISO/IEC 10164-2 (1993): "Information technology - Open systems interconnection - Systems management: State management function".

[19] ITU-T Recommendation I.361 (1993): "B-ISDN ATM layer specification".

[20] ITU-T Recommendation I.150 (1993): "B-ISDN asynchronous transfer mode functional characteristics".

[21] Draft new ITU-T Recommendation I.432.1 (July 1995): "B-ISDN user-network interface - Physical layer specification for 155 520 kbit/s and 622 080 kbit/s".

[22] Draft new ITU-T Recommendation I.432.2 (July 1995): "B-ISDN user-network interface - Physical layer specification for 1 544 kbit/s and 2 048 kbit/s".

[23] Draft new ITU-T Recommendation I.432.3 (July 1995): "B-ISDN user-network interface - Physical layer specification for 51 840 kbit/s".

# 3 Definitions and abbreviations

## 3.1 Definitions

For the purposes of this ETR, the following definitions apply, in addition to those given in the referenced standards:

**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 AN 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 AN may implement. The AN does not interpret (user) signalling (see ITU-T Recommendation G.902 [12]).

**asymmetric services:** Services requiring different bandwidths in each direction at the same point in time.

**complete user port:** The sum of the physical links at an ATM UNI.

**logical user port:** The set of VPs at the UNI carried on one or several physical access links associated by provisioning to one single VB5 reference point.

**(semi)permanent connection:** This is a connection which is set up via management (i.e. triggered via $Q3_{AN}$ and/or $Q3_{SN}$).

NOTE: There may be connections through the AN which are established via management (Q3) which bypass the service node and which are routed e.g. to a dedicated "leased line service network". These connections shall have no impact on the $V_{B5}$ specification and are out of scope of the ETR and the future $V_{B5}$ ETSs.

**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.

**switched connection:** This is a connection which is set up in response to user-to-network signalling.

**user port function:** This function adapts the specific UNI requirements into the core and system management functions (see ITU-T Recommendation G.902 [12]).

**$V_{B5}$:** The VB5 reference point.

**$V_{B5.1}$:** The VB5 reference point with flexible (provisioned) VPC allocation but without concentration capability at VC level within the AN.

**$V_{B5.2}$:** The VB5 reference point with flexible (provisioned) VPC allocation and flexible VCC allocation on a connection by connection basis which provides concentration capability at VC level.

## 3.2 Abbreviations

For the purposes of this ETR, the following abbreviations apply:

| | |
|---|---|
| AAL | ATM Adaptation Layer |
| AN | Access Network |
| ATM | Asynchronous Transfer Mode |
| BA | Basic Access |
| BCC | Bearer Channel Connection |
| B-AN | Broadband Access Network |
| B-BCC | Broadband BCC |
| B-ISDN | Broadband ISDN |
| CBR | Constant Bit Rate |
| CLP | Cell Loss Priority (bit) |
| ET | Exchange Termination |
| GFC | Generic Flow Control |
| HDLC | High level Data Link Controller |
| ILMI | Interim LMI |
| ISDN | Integrated Services Digital Network |
| LAN | Local Area Network |
| LAPD | Link Access Protocol for the D-channel |
| LE | Local Exchange |
| NB | Narrowband |
| N-ISDN | Narrowband ISDN |
| NNI | Network Node Interface |
| NPC | Network Parameter Control |
| NT | Network Termination |
| PDH | Plesiochronous Digital Hierarchy |
| PNOs | Public Network Operators |
| POTS | Plain Old Telephony Service |
| PRA | Primary Rate Access |
| PSTN | Public Switched Telephone Network |
| QOS | Quality Of Service |
| SAAL | Signalling ATM Adaptation Layer |
| SDH | Synchronous Digital Hierarchy |
| SN | Service Node |
| SNI | Service Node Interface |
| TE | Terminal Equipment |
| TMN | Telecommunications Management Network |
| TV | Television |
| UNI | User Network Interface |
| UPC | Usage Parameter Control |
| VC | Virtual Channel |
| VCC | Virtual Channel Connection |
| VCI | Virtual Channel Identifier |
| VC Sw | Virtual Channel Switching function |
| VP | Virtual Path |
| VPC | Virtual Path Connection |
| VPCI | Virtual Path Connection Identifier |
| VPI | Virtual Path Identifier |
| VP XC | Virtual Path Cross Connect function |
| XC | Cross Connect |

# 4 Electrical, physical and procedural interface requirements

It is outside the scope of this ETR to specify the electrical and physical interfaces for the $V_{B5}$ reference point. The physical interface shall however be a standard interface (e.g. SDH or PDH). Future ETSs may provide a limited list of options for physical interfaces in order to restrict the choice of the physical interface to a reasonable number of possibilities. This is to avoid unnecessary diversity of physical implementations, which would increase development costs and would threaten connectivity in multi-vendor environments. This will allow manufacturers and purchasers to develop the most flexible designs from the standards without having to modify the European standards every time a new access mechanism across the $V_{B5}$ reference point is specified.

It has been accepted that an indication of the range of rates to be supported should be indicated as this is likely to affect the addressing range required by $V_{B5}$-related protocols.

It is suggested that the $V_{B5}$ reference point should be applicable for data rates in the range 1,5 Mbit/s to 2,488 Gbit/s (STM16) although other rates are not excluded.

Draft new ITU-T Recommendations I.432.x ([21] to [23]) provide in a flexible form the B-ISDN user-network (UNI) physical layer specifications which cover:

a) cell based and SDH-based UNIs at 155 520 kbit/s and 622 080 kbit/s (ITU-T Recommendation I.432.1 [21]);

b) PDH based UNIs at 1 544 kbit/s and 2 048 kbit/s (ITU-T Recommendation I.432.2 [22]);

c) UNIs at $S_B$ reference point at 51 840 kbit/s (ITU-T Recommendation I.432.3 [23]).

Reference is made to ITU-T Recommendation G.804 [10] for other interfaces, for national use. ITU-T Recommendation G.804 [10] covers the PDH-based physical layers which are defined for ATM transmission.

It could be appropriate to have maximum commonality between the physical layer functions at the $V_{B5}$ SNIs (and NNIs) and the physical layer functions at the UNI defined in ITU-T Recommendations I.432.x ([21] to [23]).

No $V_{B5}$ specific protection switching mechanism will be defined for the $V_{B5}$ reference point or interface. Existing or future mechanisms defined for the physical layer shall be used for $V_{B5}$ (see e.g. ITU-T Recommendation G.841 [11]).

# 5 Services and architecture aspects and requirements

## 5.1 General discussion on services

The broadband architectures defined for use under the general title of B-ISDN should become the predominant telecommunications services at some point in the future. At present, the narrowband services such as Public Switched Telephone Network (PSTN), ISDN-BA and ISDN-PRA are the predominant service offerings by telecommunications operators. There will need to be an interim changeover period when broadband and narrowband services co-exist over the same Access Network infrastructure. It was originally anticipated that $V_{B5}$ would only be of use during this interim period although this assumption is under review.

What is more certain is that there is now a need for Access Networks supporting both narrowband and broadband services over common transmission systems and that this situation is likely to persist for some time.

The services to be supported across the $V_{B5}$ reference point include all those supported by V5.2 with the addition of symmetrical and asymmetric broadband services, broadcast services, and a LAN interconnect function. However, it is not the intention of this reference point specification to restrict any implementation of ANs or SNs to support the full set or a subset of the services listed in this ETR.

It is anticipated that many of the principles developed for the V5 interfaces will also apply here. The most fundamental of which are:

1) That signalling for N-ISDN and B-ISDN services should be handled as near to transparently as possible. This means that the contents of signalling messages should not be checked unless it is unavoidable.

2) That tones and announcements should be generated in the service node(s) and not in the access networks themselves.

3) Charging information is only provided by the service node. This information may be passed over the $V_{B5}$ reference point when a user requires it as part of the service to which he has subscribed and is not passed over the $V_{B5}$ reference point as a means of providing information for use by the access network itself.

4) That it is not a requirement for local switching to be carried out within the Access Network itself, either under SN control or under local control.

5) That the architecture should be designed in such a way as to minimise the costs of implementing the architecture.

6) Concentration shall be supported across a $V_{B5}$ reference point as an option (although it shall always be possible to guarantee bandwidth for user ports who require such a facility such as the security services).

7) In order to support non-ATM interfaces at the AN, semi-permanent virtual connections originating at the user ports have to be provided (for further study).

8) The $V_{B5}$ reference point shall not be limited to a single physical interface (for redundancy and to allow more user ports to be connected).

9) The AN shall perform the UPC function prior to cross connecting different traffic sources towards the $V_{B5}$ reference point (to ensure that errant users do not cause miss-operation at the $V_{B5}$ reference point which could affect other user ports).

10) Technology specific functions, such as control of echo cancellers which might be required in a radio based access network, shall not be supported unless they are already supported by either V5 (in the case of narrowband services) or B-ISDN (in the case of broadband services).

11) Selection of the service provider (i.e. service node) by the user using the control plane (signalling) shall not be possible in the access network. This would require service node functionality in the access network. However, at the UNI different VPs could be statically provisioned such that they are assigned to different $V_{B5}$ interfaces belonging to different service node. This would allows the user of a B-ISDN terminal to choose the service provider by selecting dynamically a certain VP.

    NOTE: No equivalent functionality is provided by V5 interfaces.

12) If multicasting in the AN is used to support broadcast services, this shall be allowed to be performed in the SN to AN direction only. Otherwise multicasting is presumed to be a service provided by the service node functionality.

## 5.2 General requirements for broadband access networks

Many of the requirements for access systems have been well defined and have already been discussed at depth. Additional functionality may be required for access networks incorporating broadband functionality. In particular, the following principles can be identified:

An access network is used in order to multiplex the signalling and data streams from user/network interfaces (UNIs) together in the most cost effective manner and then to present the multiplexed information stream so formed back to the local exchange or service node (SN) in a manner such that the SN can determine the source UNI from which it originates. The aims of the reference point between the SN and the access network (AN) is to reduce the costs of the reference point and to reduce the amount of equipment/cabling etc. needed in order to support multiple UNIs over the case when each of the UNIs were directly connected to the SN over dedicated equipment (whether optical, copper or other).

The SN needs to know the transforms allied to the information streams in order to correctly demultiplex these data streams and then to process them as if they where UNIs directly connected to the exchange from a service point of view.

In the other direction, the SN needs to be able to route signalling and data to the UNIs individually over the multiplexed reference point.

Figure 1 shows the general case of n UNIs being connected to one access network. On the other side of the access network, there is only one multiplexed connection back into the SN.

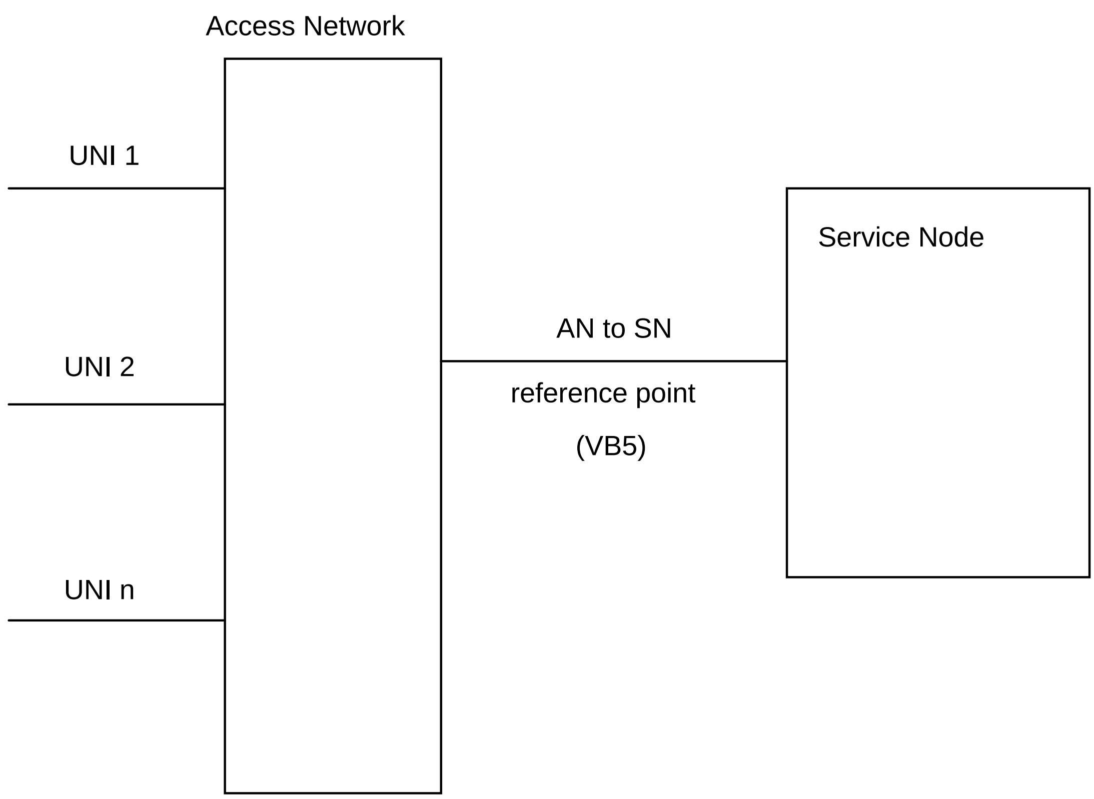



**Figure 1: Multiple UNIs hosted back to one service node port**

## 5.3 General architectural requirements for the $V_{B5}$ reference point

The architecture of the $V_{B5}$ reference points from a service point of view is as yet undefined. It has been identified that the way that the architecture of the Local Exchange(s) is designed can significantly affect the protocol stacks in order to serve them. In order to identify the protocol component parts, it is hence necessary to define the architectures of interest. A generalised model is first presented as figure 2, and then more detailed cases are shown:

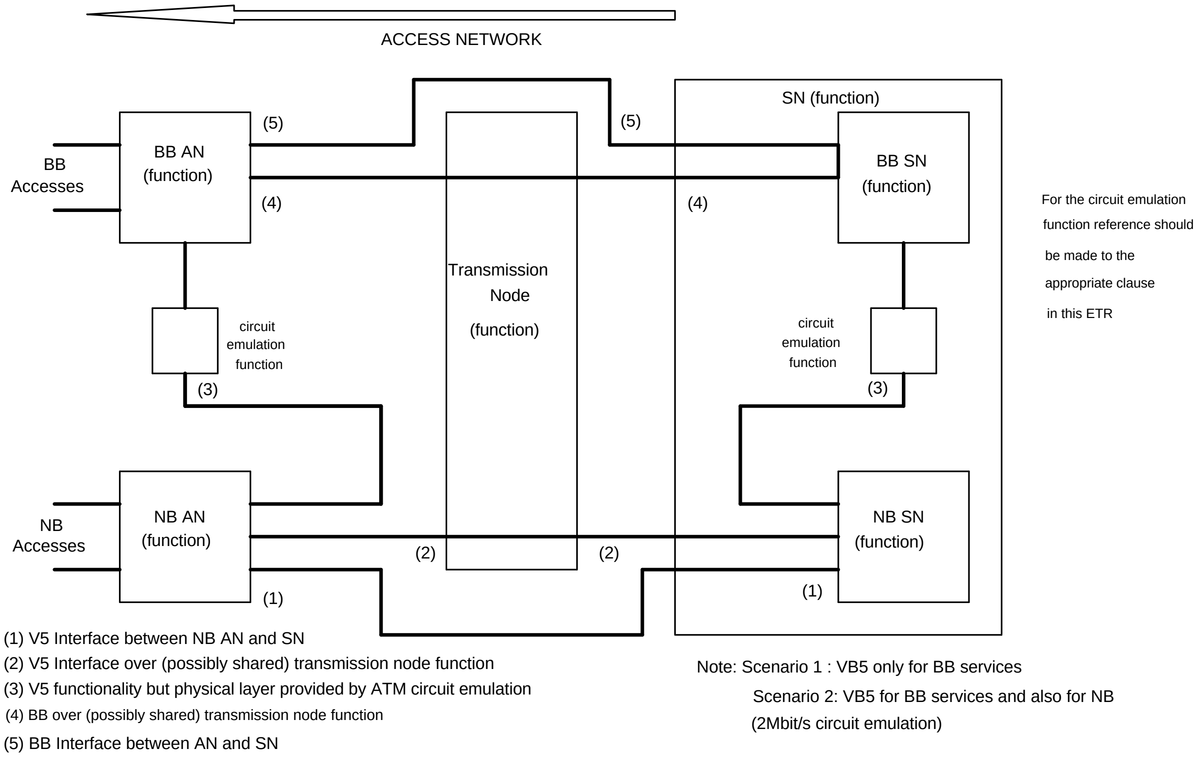



**Figure 2: General architectural scenarios**

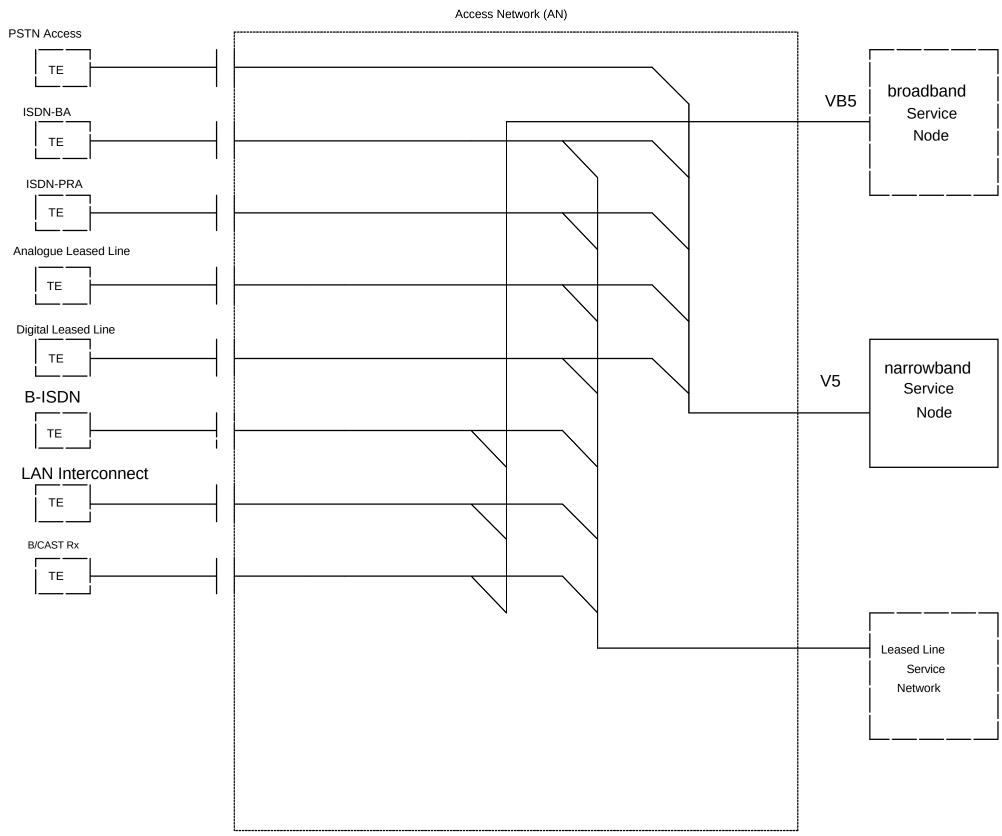
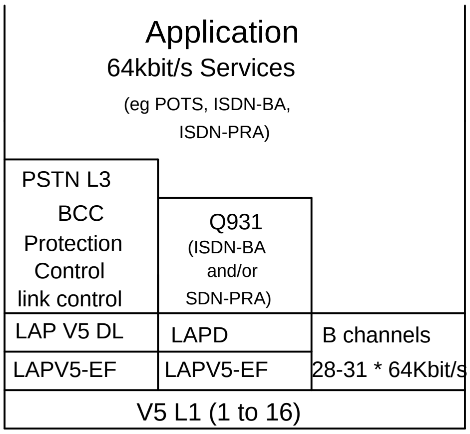



**Figure 3: $V_{B5}$ service architecture (separate broadband/narrowband SNs)**

In the case of figure 3, the V5 interface (either V5.1 (ETS 300 324-1 [5]) or V5.2 (ETS 300 347-1 [6])) shall apply to the narrowband interface between the SN and the AN and shall not be considered further.

For the architectural scenario presented in figure 3, taking into account the V5.2 interface only, the protocol stacks given in figures 4 and 5 are relevant:




NOTE: One frame relay and one LAP V5 DL instance per above protocol.

**Figure 4: V5.2 Protocol Stack related to figure 3**

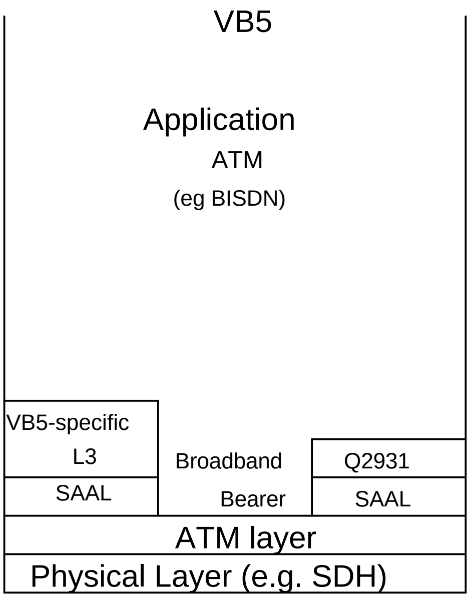



**Figure 5: VB5 reference point protocol stack related to figure 3**

In the case of figure 6, separate narrowband and broadband SNs co-exist in the network. The narrowband SNs may be the old, legacy networks whilst the broadband SNs are likely to be new additions into the network. It is possible that this network architecture would be of use in the short term in order to support both narrowband and broadband services.

From the point of view of the narrowband local exchange the broadband exchange looks like a transmission system and does not affect the narrowband service in any way. In practise the effect of this is to change the physical layer as seen at the $V_{B5}$ reference point.

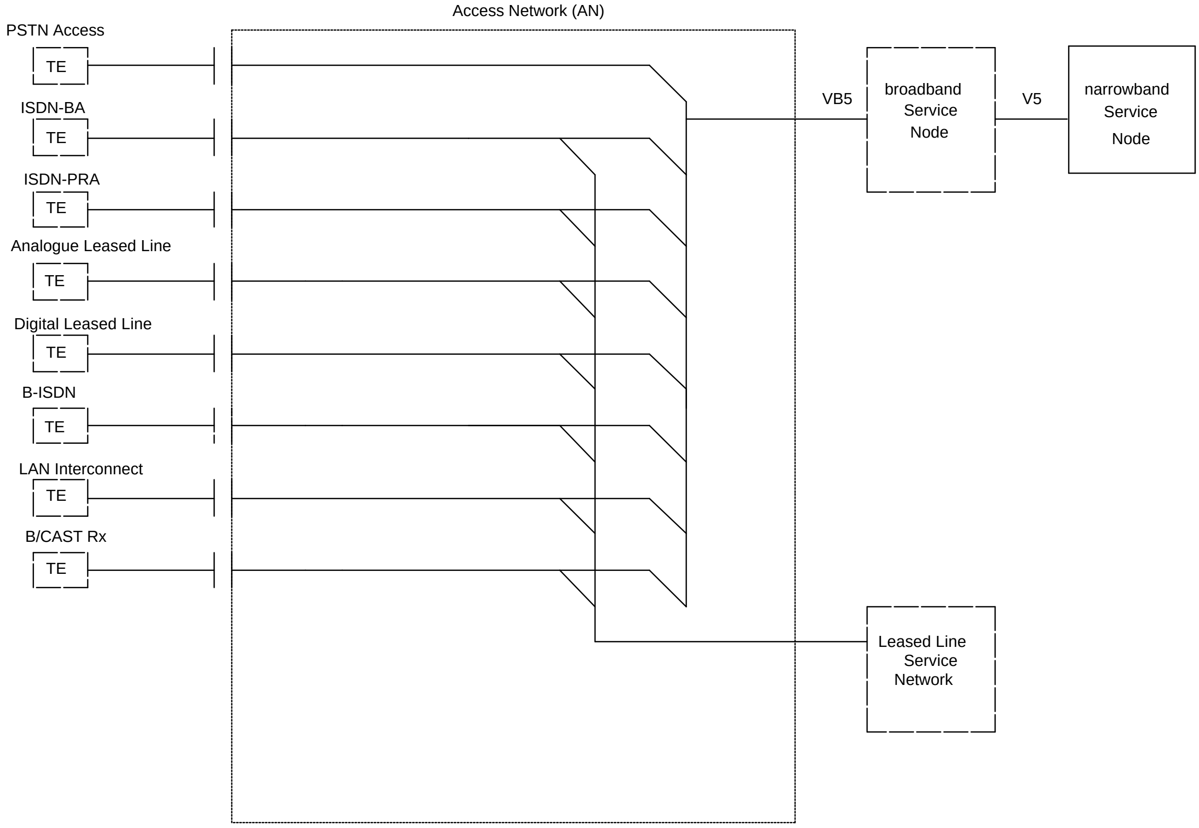
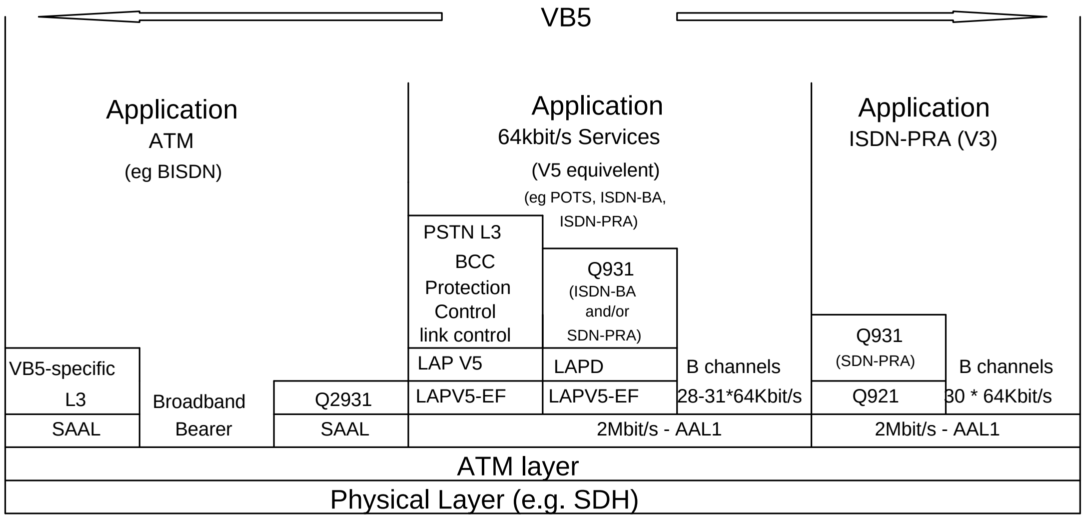



**Figure 6: $V_{B5}$ service architecture (broadband with narrowband SN behind)**

The protocol stack associated with the architecture shown (broadband with narrowband SN behind) is given in figure 7. In this case, the narrowband services are shown as supported within a 2 Mbit/s V5 stream (see details in this ETR).




NOTE: One frame relay and one LAP V5 DL instance per above protocol.

**Figure 7: $V_{B5}$ reference point protocol stack associated with figure 6**

In the case of figure 8, the integrated narrowband/broadband SNs are likely to be completely new. It is possible that this is a cost-effective manner in which narrowband services can be supported in the medium time scale of network evolution.

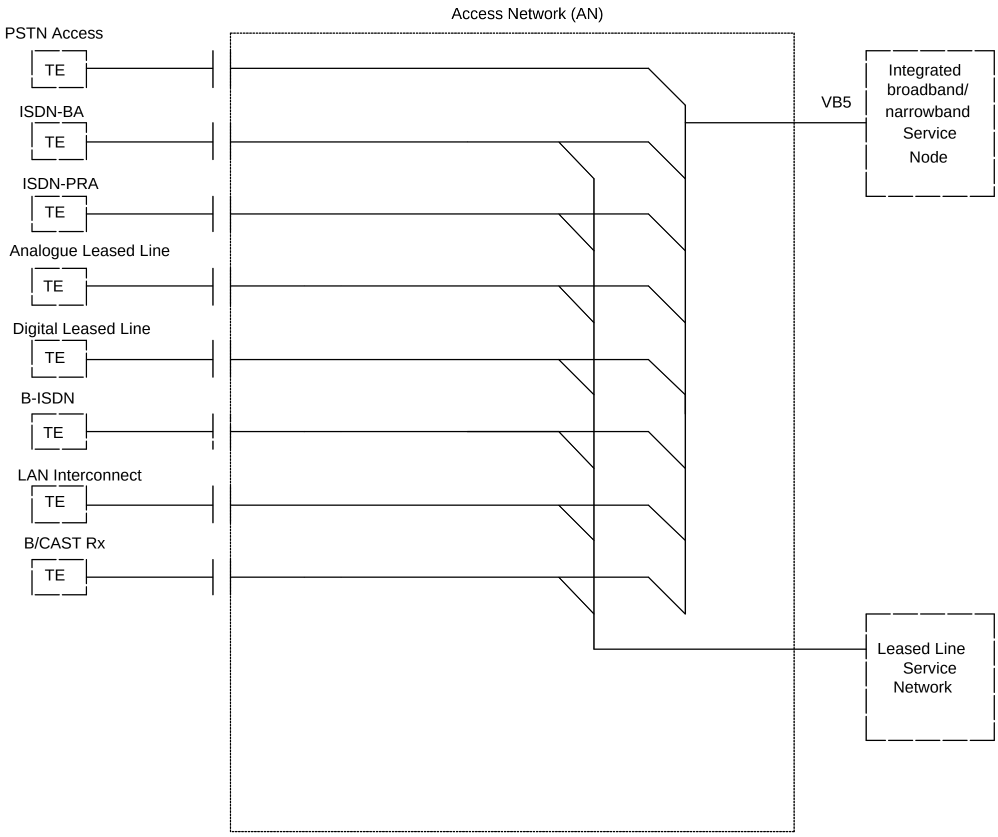
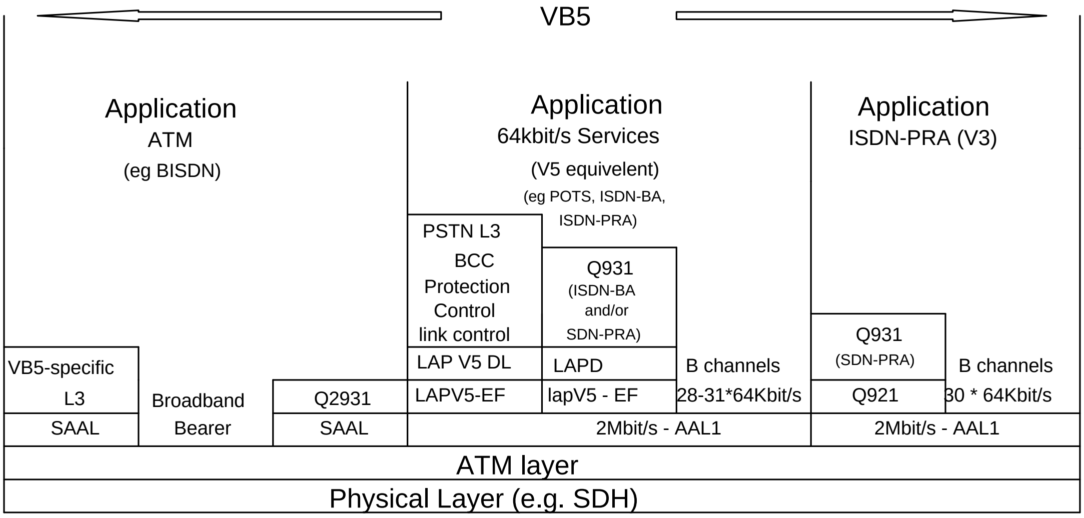



**Figure 8: $V_{B5}$ service architecture (integrated broadband/narrowband SN)**

The protocol stack associated with the architecture shown (integrated broadband/narrowband SN) is given in figure 9. In this case, the narrowband services are shown as supported within a 2 Mbit/s V5 stream (see details in this ETR).




NOTE 1: One frame relay and one LAP V5 DL instance per above protocol.

NOTE 2: As figure 7 (the V5 link control and protection protocols are redundant but retained in order to minimise the number of software variants.

**Figure 9: $V_{B5}$ reference point protocol stack associated with Fig 8.**

NOTE: There is some question as to whether there is any value in maintaining either the link control protocol or the protection protocol for the case of figure 9 (see clauses later within the ETR).

Figure 10 shows the case when narrowband services are no-longer supported. In this case $V_{B5}$ will only be used if it gives advantages to the operation/support of the broadband exchanges.

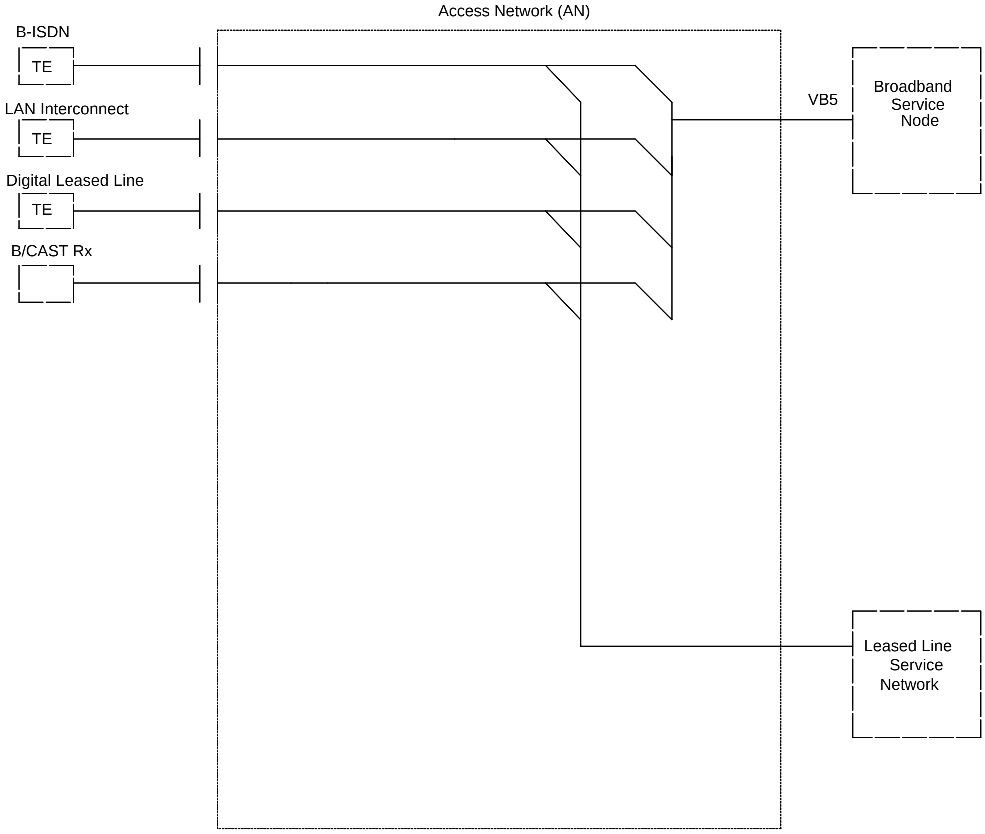



**Figure 10: $V_{B5}$ service architecture (broadband SN using $V_{B5}$)**

The protocol stack associated with the architecture shown (broadband SN only) is given in figure 11.

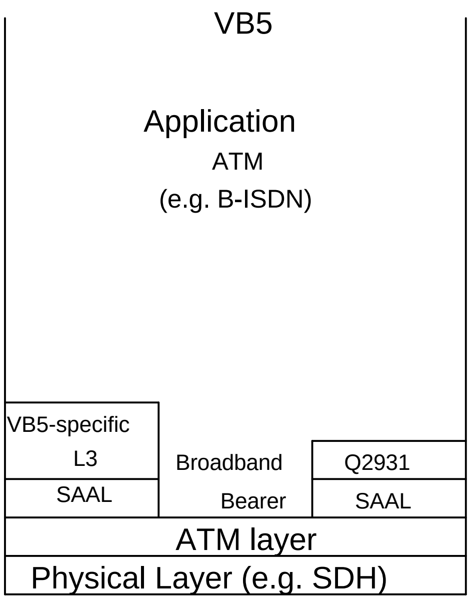
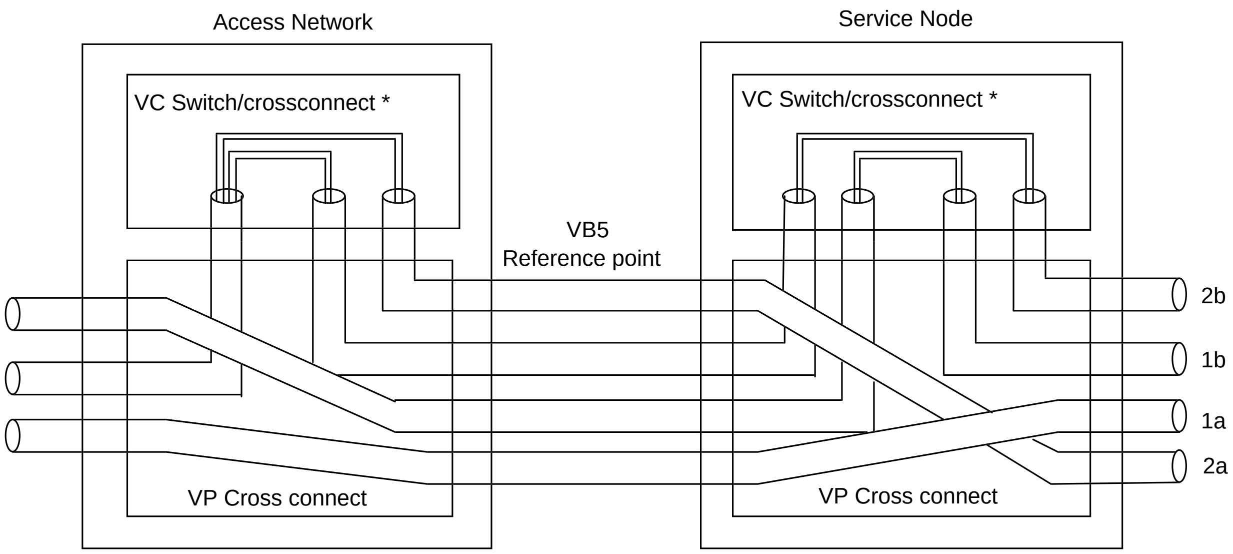



**Figure 11: VB5 reference point protocol stack associated with figure 10**

## 5.4 Applicability of the connection types

Table 1 indicates the applicability of switched and (semi)-permanent connections in the context of the $V_{B5}$ reference point and the entities at both side of the reference point as depicted in figure 1.




* may not be present in some configerations

**Figure 12: Broadband AN connection types**

**Table 1: Applicability of connections types (X = applicable)**

| Connection nr. | Switched connection | Semi-permanent connection |
|---|---|---|
| 1a | -- | X |
| 1b | X | X |
| 2a | -- | X |
| 2b | X | X |

### 5.4.1 Connection characteristics

For $V_{B5.1}$ interfaces VP (semi)-permanent connections are always established within the AN via $Q3_{AN}$ (see connections 1a or 1b).

For $V_{B5.2}$ interfaces (semi)-permanent connections may be established within the AN via $Q3_{AN}$ or via B-BCC (see connections 2a and 2b).

For $V_{B5.2}$ interfaces switched connections are established within the AN via B-BCC (see connections 2b).

For cross-connected VC connections in the AN the B-BCC is triggered via $Q3_{SN}$.

For switched VC connections in the AN the B-BCC is triggered via user-to-network signalling and service node call control.

Switched connections may be set-up and released at any time on demand, i.e. on a per call basis.

(Semi-) permanent connections are established part time on a scheduled basis or are available at any time during the period of installation.

VC connections which are established via B-BCC protocol and VC connections which are established via $Q3_{AN}$ shall not use the same VP at the UNI and at the $V_{B5}$ interface.

# 6 ATM functionality required over a $V_{B5}$ reference point

The $V_{B5}$ reference point will constrain the functionality available in the Access Network. This clause will examine the various configurations identified as appropriate.

## 6.1 General concepts relating to the $V_{B5}$ reference point

Service affecting faults in the AN need to be advised to the SN in real time, i.e. via $V_{B5}$.

In contradiction to the V5 reference point, a user point is not necessarily associated with a physical user port. Therefore the term "logical user port" is introduced. A logical user port is defined as a set of VPs at the UNI carried on one or several physical access links associated by provisioning to one single $V_{B5}$ reference point. All on-demand switched connections established on any of the VPs within a single logical user port are controlled by the same signalling VC.

Further details on user port definitions and some examples are given in annex D.

It has been established that a set of VPs may be distributed over several physical access links, where non-associated signalling is used at the UNI. Other VPs in the same access link or set of links may provide access to an alternative SN and will therefore constitute a second logical user port, with its own signalling VC.

It was noted that the sum of the VP peak throughput, set by provisioning, on a physical access link, is not permitted to exceed the link throughput, i.e. there can be no statistical multiplexing gain between VPs but only on the VCs within them. Otherwise the concept of multiple logical user ports associated to SNs is not tenable. Dynamic control of UNI VP properties is not covered by ITU-T Recommendations.

It was agreed that the possibility of dynamic control of UNI VP properties should not be considered, unless ITU-T changes its position on the matter.

Operational states for resources related to logical user ports shall be maintained by the SN and AN to indicate whether these resources are operational or not. It is not possible to change the operational state by the operator via Q3 interfaces.

Administrative states for resources related to logical user ports shall be maintained by the SN and AN. Administrative states are controlled by the operator(s) via Q3 interfaces, e.g. to lock or unlock logical user port resources. In case of locking of resources due to urgent operation and maintenance actions by the operator of the AN, ongoing services may be affected. In case of the $V_{B5.2}$ interface the operator of the AN may request from the SN a graceful shut down of resources to avoid interference with ongoing services. The locking of resources is then fully under control of the SN which has the information about the usage state.

In the AN the usage state is not used because the AN has no knowledge about ongoing services. Related to $V_{B5}$ "logical user port control" the usage state is only known in the SN.

From the current states of the resources related to a logical user port it is possible to derive information on whether a service can, in principle, be provided to the customer by the SN or not. This basic information on the availability of user port related resources should be available in the AN and SN on a real time basis. The information should be synchronized via the $V_{B5}$ interface with the peer side as far as possible to get a common view for every point in time.

This can be achieved via dedicated control protocols or using existing ATM O&M cell flows. In the simple $V_{B5.1}$ case, F4 flows may be used to synchronize or co-ordinate the states. For $V_{B5.2}$ interfaces F4 flows are terminated in the AN and can therefore not be used to synchronize the operational states.

A $V_{B5}$ reference point may consist of multiple physical links. Each of the active physical links may carry up to 4 096 VPs. For each of VPI, a unique VPCI value within the $V_{B5}$ is assigned. The VPCI values are used by the B-BCC protocol for the resource handling.

It is assumed that a $V_{B5.1}$ interface will always consist of one active physical interface.

The number of VPs and VCs a user has access to cannot easily be defined as it depends upon the service agreement between the customer and the service provider.

No user VC connections will be terminated in the AN. It was identified that this might affect in particular the ILMI protocol which needs now to be terminated either inside the SN or further within the core network.

Two variants of the $V_{B5}$ reference point have been identified. These are $V_{B5.1}$ and $V_{B5.2}$. These will discussed separately.

Figure 13 shows the perceived functions to be supported over a $V_{B5}$ reference point.

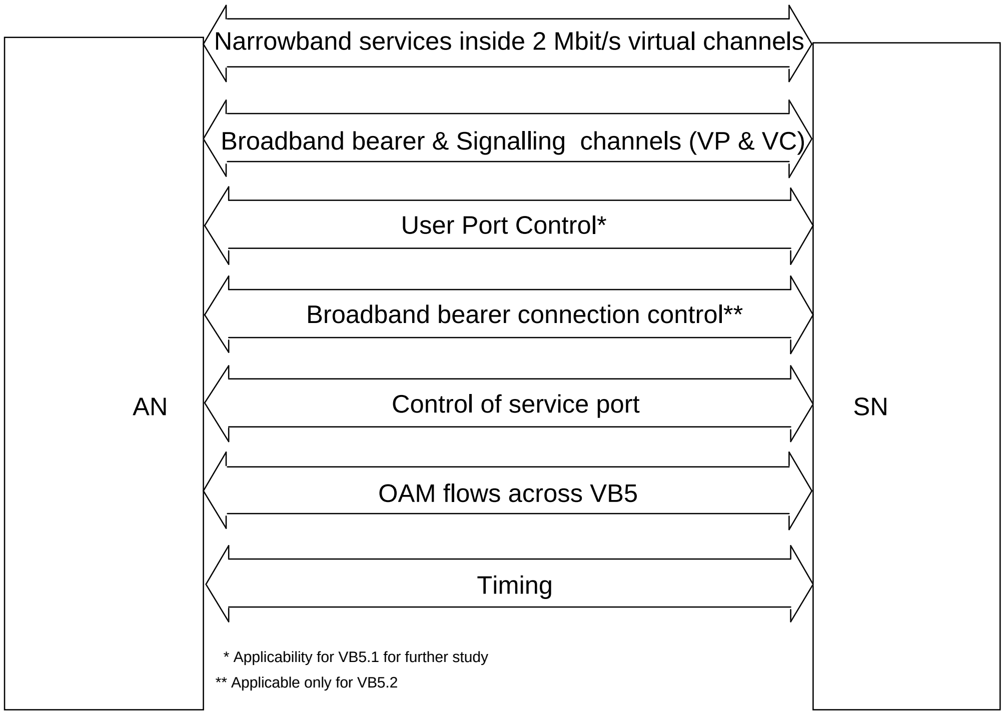


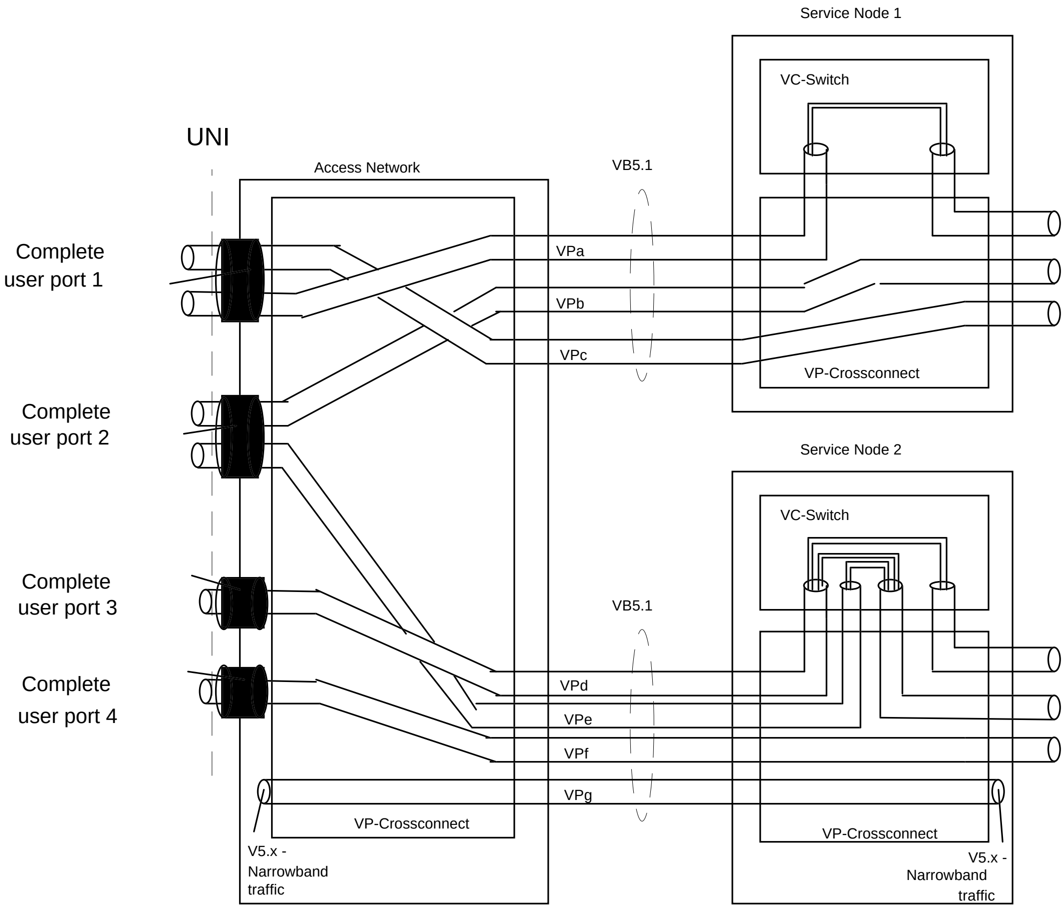

**Figure 13: Functional and procedural requirements at the VB5 reference point**

## 6.2 The $V_{B5.1}$ reference point

The $V_{B5.1}$ interface is an interface between an AN and an SN with flexible (provisioned) VPC allocation but without concentration capability at VC level within the AN".

This will be a relatively simple reference point configuration. The ATM-relevant section of the AN will consist of a VP cross connect function as shown.

Figure 14 gives a pictorial representation of the AN configuration for $V_{B5.1}$.




Notes to figure 14:

User ports 1 , 2, 3, and 4 are physical user ports.

A VP at the UNI is assigned by provisioning to one and only one Service Node ($V_{B5}$ interface) at a time. In the example shown, VPa, VPb, and VPc are assigned by provisioning to Service Node 1, whereas VPd, VPe, VPf, and VPg are assigned to Service Node 2.

The VPI values at the UNI and at the $V_{B5.1}$ interface are typically not identical.

In the example shown the physical User Ports 2 and 3 support two VPs at the UNI.

On the lower $V_{B5.1}$ interface, connecting Service Node 2, VPg is provisioned to carry V5.x narrowband traffic (as an example).

On the network side the VP may be terminated in the SN or another network element.

VPb, VPc, and VPf are provisioned as (semi-)permanent connections on VP level.

**Figure 14: VB5.1 AN configuration**

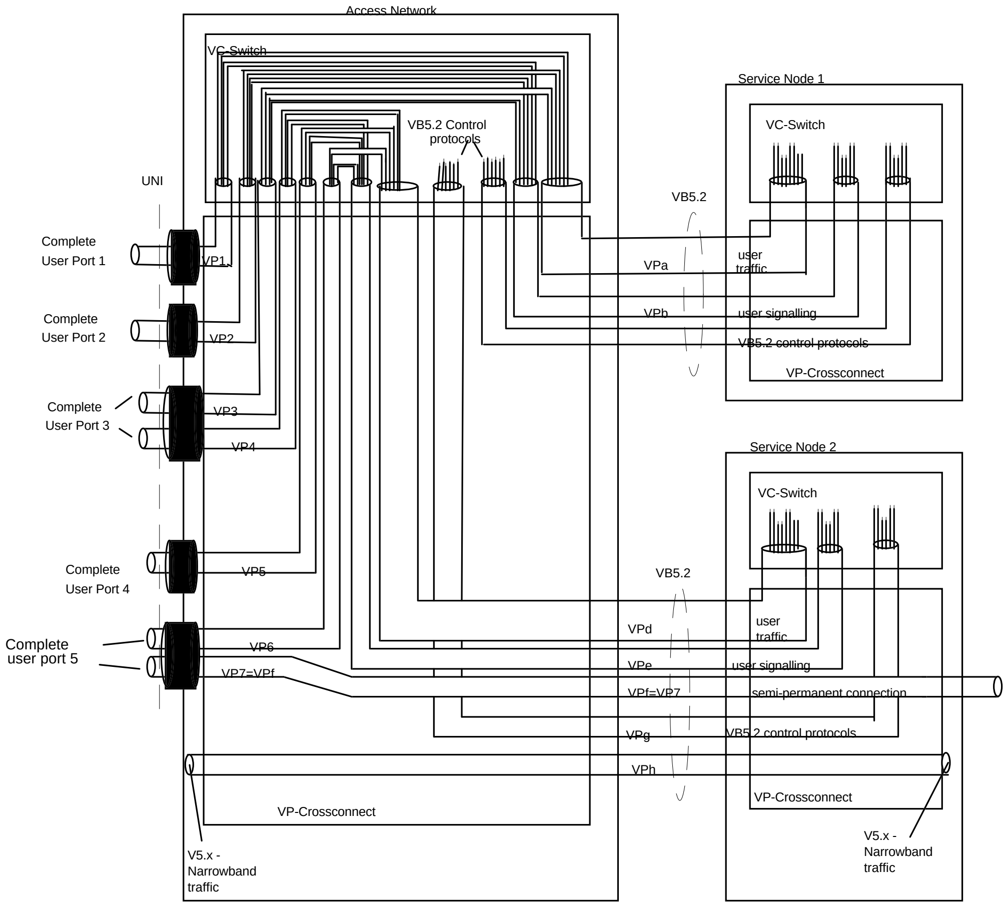
## 6.3 The $V_{B5.2}$ reference point

The $V_{B5.2}$ interface is an interface between an AN and an SN with flexible (provisioned) VPC allocation and flexible VCC allocation on a connection by connection basis which provides concentration capability at VC level".

This will be a more complex reference point configuration. The ATM-relevant section of the AN will consist of a VP, VC switch type function as shown.

NOTE: The switch functionality is a cross between a classical ATM switch and a cross connect in that it performs a real time dynamic cross connection function between VPs and VCs without providing other service functions such as tones, announcements, billing etc.

Figure 15 gives a pictorial representation of the AN configuration for $V_{B5.2}$.




Notes to figure 15:

On the lower $V_{B5.2}$ interface, connecting Service Node 2, VPh is provisioned to carry V5.x narrowband traffic (as an example).

A VP at the UNI is assigned by provisioning to one and only one Service Node ($V_{B5}$ interface) at a time. In the example shown, VP1, VP2, and VP3 at the UNI are assigned by provisioning to Service Node 1, whereas VP4, VP5, VP6, and VP7 at the UNI are assigned to Service Node 2.

In the example shown the physical User Ports 3 and 5 support two VPs at the UNI. In case of User Port 3 one of the VPs (VP3) is assigned to Service Node 1 and the other (VP4) is assigned to Service Node 2.

VP7 is provisioned as semi-permanent connection on VP level.

**Figure 15: VB5.2 AN configuration**

A possible mechanism for dealing with unavailability of individual access links, when F5 flow for the signalling VC does not indicate complete logical user port outage, should be preferably by the control protocol or could be by B-BCC allocation failure cause on call attempt to failed VP.

Resource management in the AN, for ATM related resources, should be done by the SN and that an AN with traffic concentration may manage its transmission resources based on information from the SN and the TMN.

The resource allocation for all ATM VC connections in the AN, that are carried over the $V_{B5}$ interface, is done by the SN via $V_{B5}$. It is a firm requirement that all VCs in a user VP shall go to the same SN.

# 7 Narrowband accesses: Conclusions for implementations at the $V_{B5}$ reference point

Narrowband services should be carried over a $V_{B5}$ reference point using the V3, the V5.1 and/or V5.2 formatted structures based on 2 Mbit/s links. All of the functionality as supplied in the base standards for V5.1, V 5.2 and/or V3 shall be used, including control, link control, and the protection protocols.

These will be transported on a common constant bit rate ATM carrier. AAL1 has been identified for this application. The following reasoning follows from this directly.

## 7.1 Conclusions on ATM caused speech path delays for narrowband services

Narrowband services should be provided in 2 Mbit/s blocks corresponding to the V5 transmission link data rate using AAL1 as the method of transferring this constant bit rate across an ATM system. This means that the delay introduced by the ATM transmission system will be of the order of 125 microseconds.

A single VP may support several V5 interfaces, in order to save on VPI addresses (only 4 096 VPs max. across any $V_{B5}$ reference point).

The several 2 Mbit/s links of a V5.2 interface may need to be split between VPs in separate $V_{B5}$ physical links for reliability.

## 7.2 Narrowband services: Speech path delay considerations

One of the reasons why 2 048 kbit/s circuit emulation is used for the support of narrowband services is speech path delay. Speech path delay considerations are applicable to both the PSTN and narrowband ISDN services. The problems are more acute for the PSTN case were a 2-wire transmission system is encountered. Annex A provides considerations on the delays caused by 64 kbit/s based bearer channels including delay figures. Using 2 048 kbit/s circuit emulation as described above will decrease the delay caused by packetising/depacketising to a value in the order of 200 microseconds and below, which is acceptable.

## 7.3 AAL1 definition for the support of narrowband services

The AAL type 1 "unstructured mode" according to ITU-T Recommendation I.363.I [14] (July 95) is appropriate for emulation of 2 048 kbit/s streams (e.g., V5.1, V5.2, V3 interfaces). For the AAL type 1 protocol the parameters provided in I.363.1 [14] Appendix 2 paragraph 2.1.2 case of synchronous transport shall be used:

a) CBR rate at AAL service boundary: 2 048 kbit/s

b) Source clock frequency recovery: Synchronous

c) Error correction mode: Not used

d) Error status indication at receiver: Not used

e) Pointer: Not used

f) Partially fill cell method: Not used

# 8 Broadband access: The B-ISDN access requirements and $V_{B5}$ implementation

## 8.1 Discussion - The B-ISDN access

This is a new access type, currently not completely specified within the standards organisation and hence not yet implemented anywhere within Europe.

The layer 3 protocol designed to provide the basic call control required by all of the B-ISDN services is contained in ETS 300 443-1 [9].

Additional functionality may be required in order to provide bearer-channel allocation and concentration functions for B-ISDN accesses. These functions will be discussed in a different clause.

## 8.2 The preferred B-ISDN signalling protocol

The preferred method of passing the B-ISDN functionality across the $V_{B5}$ reference point is via Q.2931 as defined in ETS 300 443-1 [9]. Other non-standard signalling systems could be used, however their use would mean that code translations would be required in the access network leading to additional complexity and expense.

## 8.3 The data link layer for the B-ISDN signalling protocol

The data link layer shall be the SAAL which has been identified specifically for the task.

# 9 Broadband accesses: The LAN interconnect service requirements and $V_{B5}$ implementation

This clause provides information on how non-B-ISDN/non-ATM access types shall be handled. A typical application would be the support of LAN interconnections. Therefore in the following the text mentions only LAN interconnections. However, it is noted that the described principles shall not be restricted to LAN interconnections, but shall be applied to all non-B-ISDN/non-ATM access types, except those access types already covered under narrowband accesses in a different clause within this ETR.

There are two ways in which LAN services may be supported:

## 9.1 LAN interface support - Type 1

No interworking/adaption function within the AN.

LAN services can be provided over an ATM public network directly via the B-UNI. With respect to ANs and the $V_{B5}$ interface, this type of service should be handled under the framework of broadband UNI and hence does not need any specific treatment. Eventually this may be the only way for data communication. However, for many years to come, alternative interfaces will be used for LAN interconnection.

## 9.2 LAN interface support - Type 2

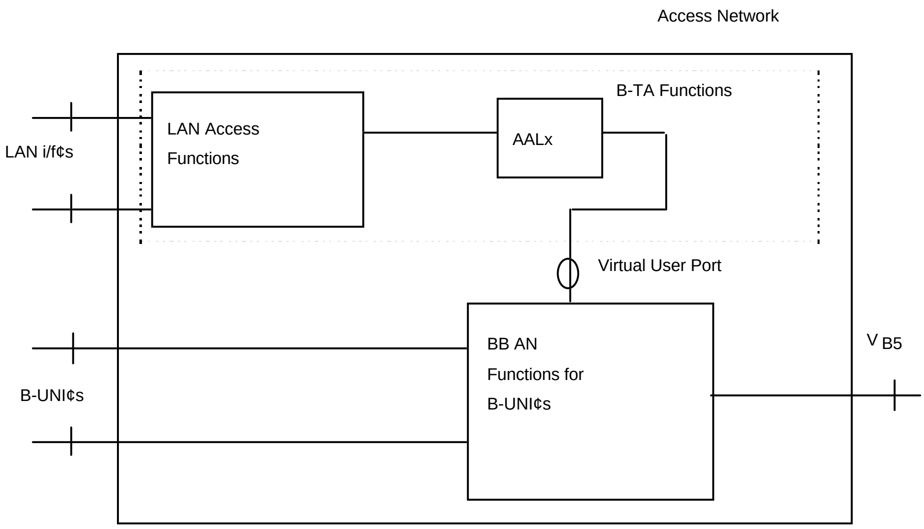
Interworking/adaption functions are within the AN.

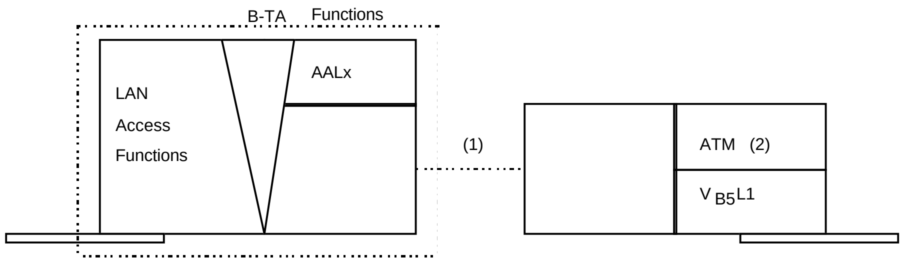
Existing, non-ATM interfaces can be used for LAN interconnection: e.g. Ethernet IEEE 802.3, Frame Relay Interface (FRI), PDH.

The required functionality and associated protocol stack is depicted in figure 16.

Compared to the case of a B-UNI access, a LAN interface will require an AAL functionality to be performed in the Access Network. This can be any standardised type (i.e. AALx, with x = 1, 2, 3/4, 5 or others in future). Other functionalities will depend on the type of the LAN interface and is referred to as "LAN Access Functions" in figure 16.

Figure 16 gives the general idea for treating LAN interfaces. The LAN Access Function and its associated AAL, although becoming Access Network Functions, should not be part of $V_{B5}$ related standards. Instead, references to dedicated standards could be included.




(1) Internal reference point representing the Virtual User Port, which is assumed to be ATM based.
(2) The protocol stack can go up to the VP level (case $V_{B5}1$) or up to the VC level (case $V_{B5}2$)

**Figure 16: User plane functionality and protocol stack for LAN interconnection**

Note the similarity with the block diagrams for handling narrowband accesses via emulation of V5 interfaces.

At the level of the $V_{B5.1}$ interface, LAN traffic will be supported via virtual channels. The associated virtual channel connection is terminated at the customer side within the Terminal Adaptation (TA) functions. The other connection termination point may be located in the SN or further on in the network.

For the purpose of connection identification within the AN a Virtual User port is introduced. The virtual user port within the access network has functionalities equivalent to a logical user port, enabling the support of non-ATM services via interworking or adaptation functions.

# 10 Broadband accesses: The broadcast TV service requirements and $V_{B5}$ implementation

The requirements of this service have yet to be agreed. However some information could usefully be presented.

## 10.1 Discussion - The broadcast TV service

A broadcast TV service could be designed based upon the B-ISDN protocols. This would imply that the bandwidth would need to be reserved across the Access Network on a per-user basis. Given that more than one user could utilise the information at any one time, this seems to be expensive in terms of bandwidth consumed. Indeed, it is possible that more than one user, on any single user port, could require the same channel (and hence data stream) at any one time.

It is also fairly obvious that the SN needs to know which user ports are connected to which broadcast TV data streams in order that charging and other service management functions are correctly implemented.

When a broadcast connection for a TV-channel is not being used by user ports on that AN, then there is no requirement to continue feeding that TV-channel into the AN unless a particular Access Network requires it.

The outcome from this discussion is that:

a) for the $V_{B5.1}$ and the $V_{B5.2}$ reference points, broadcast TV channels presented across the $V_{B5}$ reference point should be connectable to more than one user port within the Access Network;

b) for the $V_{B5.2}$ reference point only, the SN needs to control the connection of user ports to the broadcast TV channels.

# 11 Broadband accesses: Signalling bandwidth allocation

## 11.1 Signalling bandwidth allocation - General discussion

It is common practise to over-dimension the signalling channels for accesses in order to limit the signalling information transfer delay, especially for huge messages (i.e. set-up message in N-ISDN) and for critical sequences (i.e., answer - to prevent speech clipping).The concept - handling signalling in the AN as near to transparently as possible - which is agreed and specified for the V5 interface family is also agreed for the $V_{B5}$ reference point. However, in the V5 interface concept, the PSTN signalling information and the ISDN D-channel information from the user ports are transported as multiplexed information channels between the AN and the SN. For the $V_{B5}$ concept it is assumed that the signalling virtual channels from the individual accesses are not multiplexed into one common signalling channel between the B-AN and the SN. For most telecommunications services, it is anticipated that there will be no need for a lot of bandwidth to be allocated to signalling. If this concept is accepted, then signalling bandwidth could be pre-allocated and then fixed. This is known as pre-defined or pre-provisioned bandwidth allocation. The distinction is primarily one of whether the bandwidth allocation is fixed (i.e. in firmware) when it is considered to be pre-defined or changeable via an operating system within the local exchange(s) or access system(s), when it is known as pre-provisioned.

This argument does not always hold however. In the case of access networks where the services delivered are of diverse types, or the customers require service only sporadically, there may be a requirement to dynamically allocate signalling bandwidth. This section attempts to broadly quantify the likely demand for dynamic signalling channel allocation, and the means of providing it if it is appropriate at all.

### 11.1.1 Dynamic signalling bandwidth allocation - for ATM bearers

Dynamic signalling bandwidth is provided by means of the meta-signalling procedure within the B-ISDN protocols. It is as yet unclear whether there will really be a need for this functionality, and even whether this will be provided within the ETSI standards, although support for such a procedure is growing.

Meta signalling works by allocating a very small bandwidth at all times. In the event of a signalling channel being required, the extra signalling bandwidth is dynamically requested and assigned from the local exchange using the small amount of permanently assigned bandwidth. Once the signalling bandwidth has been assigned, then the normal signalling protocols are used in the normal way.

NOTE: This section refers to one method of how users could obtain signalling bandwidth and NOT how bandwidth for the users is set up over the $V_{B5}$ reference point. It is assumed that bandwidth will be reserved across the $V_{B5}$ reference point using some (as yet undefined) bandwidth allocation protocol.

# 12 Broadband accesses: Bearer channel bandwidth allocation and concentration

## 12.1 Bearer channel bandwidth allocation and concentration - General discussion

For V5.1 (ETS 300 324-1 [5]), bearer channel allocation is not available dynamically. The situation for V5.2 is not the same and dynamic bearer channel allocation is the norm. In this case, the dynamic bandwidth allocation is achieved by a unique protocol known as the Bearer Channel Connection protocol (BCC).

The B-ISDN protocols have dynamic bearer channel allocation built into them inherently in the form of ATM cells which are inserted into the data stream only when the Bearer channels are required. It is anticipated that this procedure is followed for the $V_{B5}$ reference point although there may be advantages in providing extra dynamic channels allocation indication.

Dynamically allocation of bearer channels does not necessarily imply concentration at the $V_{B5}$ reference point however introducing concentration could be a valuable addition to the $V_{B5}$ reference point as providing it could significantly reduce the cost on a user port basis of access networks as the infrastructure of the AN is shared over more users. The degree of concentration should depend upon the requirements of the operator and should not be the subject of international standards, at least until experience has been gained as to the use of real access networks in practice.

It is proposed that dynamic bearer channel using a specific bearer channel connection protocol is required over the $V_{B5}$ reference point but only for the specific case of $V_{B5.2}$.

Many Access Networks are likely to require to route bearer channels on a call by call basis as they will have only limited bandwidth. They will probably also provide a concentration function at the same time. Given that the bandwidth allocator is likely to be provided at a central point, and that this point is normally expected to be the local exchange, then there are only two ways in which this information can be obtained. Either the signalling cells passing this point are examined (which means that service-related information for ALL service types needs to be stored at this point), or the local exchange is required to explicitly pass the information as to the required bandwidth, and the destination port, to this point. In the first case, a lot of service-specific information will have to be stored in the Access Network, which is difficult to guarantee and will lead to compatibility problems when services are upgraded. In the second case a separate protocol, similar to the bearer channel connection protocol, needs to be provided.

## 12.2 Establishment of signalling virtual channels

The signalling virtual channels are established before the user makes the first call. That is, if a user port is installed at the access network and the user is subscribed at the service node also the point-to-point signalling virtual channel shall be established via the normal BCC protocol for setting up connections. If required, specific quality of service classes could be indicated.

The main purpose of the BCC protocol will be to indicate the user port to which the connection shall be routed via the AN and to indicate the resources which are needed for the connection within the AN.

The establishment will be under the control of the SN BCC resource manager.

# 13 Implementing dynamic bearer connection allocation on a $V_{B5}$ reference point

It is assumed that at a $V_{B5}$ reference point, the narrowband services are to be supported using V5.1 or V5.2 within a transmission pipe which is kept logically separated from that used for broadband transmission. For this reason, should dynamic bearer channel allocation be required for the narrowband services, then the V5.2 interface needs to be used whereon the BCC protocol already defined for V5.2 can be used.

For the broadband case, a bearer channel connection protocol is required which would be similar to the one provided for V5.2. It would have to support broadband services only however due to the layer 1 differences between 2 Mbit/s bearers used for the V5 interfaces, and the ATM bearers used for the $V_{B5}$ reference point, the existing bearer channel connection protocol as defined for V5.2 would not be sufficient. Hence a new, additional, bearer channel connection protocol will be required for the $V_{B5}$ reference point.

### 13.1 Functionality of a B-BCC protocol for use at a $V_{B5}$ reference point

It has been decided that the AN implemented using $V_{B5.1}$ principles will not require a B-BCC protocol. An AN constructed using $V_{B5.2}$ principles will have a B-BCC protocol. This will perform the following functions:

a) it will notify the AN of bandwidth requirements on a connection by connection basis unless the user has reserved bandwidth in which case the bandwidth will be pre-assigned on a semi-permanent basis using the BCC protocol;

b) the AN will have the ability to reject the bandwidth request giving suitable cause values if appropriate;

c) across a $V_{B5.2}$ reference point, VCs shall be set up using functions within a B-BCC protocol;

d) the following UPC/NPC information shall be routed into the AN across a $V_{B5.2}$ reference point using the B-BCC protocol:

- UPC(VC);
- NPC(VC).

The B-BCC is shown in figure 17.

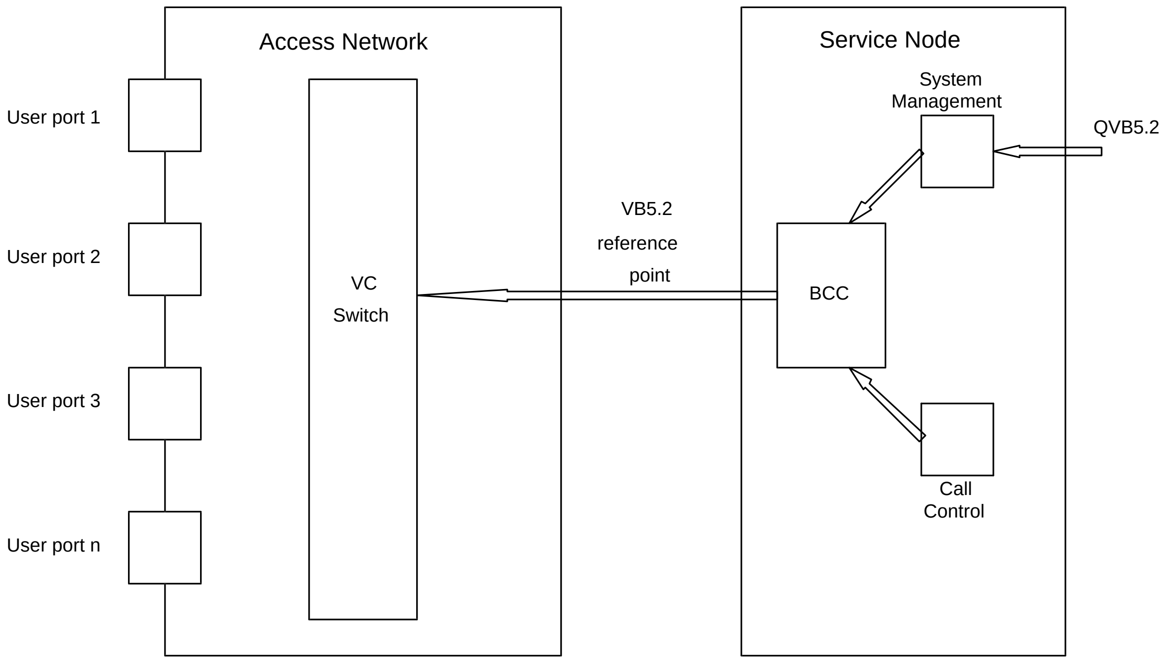



**Figure 17: B-BCC functional block diagram**

### 13.2 The data link protocol for the B-BCC protocol

The B-BCC protocol is being used in order to support broadband services over an ATM sub-layer, and should be based on the SAAL data link layer.

## 14 Broadband accesses: Control protocol

### 14.1 Control protocol - General discussion

The equivalent of V5.1 and V5.2 user port blocking via the $V_{B5}$ interface is necessary for maintenance purposes, if not for the non-intrusive testing possible in ATM.

CCITT Recommendation X.731 [18] states should be used instead of V5 states for the control protocol.

# 15 Broadband accesses: Link control protocol

## 15.1 Link control protocol - General discussion

It has been agreed to use the procedures in ITU-T Recommendation I.610 [17] for maintenance at the $V_{B5}$ reference point.

### 15.1.1 Link control protocol - $V_{B5.1}$

No requirements for a link control protocol has been identified.

### 15.1.2 Link control protocol - $V_{B5.2}$

The functionality of the "Link Identification procedure" as described in the ETS for V5.2 interfaces can be realised by built-in mechanisms (e.g. path trace) of transmission systems used at the $V_{B5}$ reference points.

The applicability of existing protocol specifications (i.e. B-ISUP) for link control functions above the physical layer will be specified in the relevant ETSs for interfaces at the $V_{B5}$ reference point.

# 16 Broadband accesses: Multiplexing cells for individual users onto a common transmission system - General

There is a major difference between the multiplexing of signalling and bearer channels on the V5 reference points and the multiplexing of ATM cells of both signalling and bearer data types.

The differences stem from the fact that V5 had individual 64 kbit/s data channels. These were numbered and then allocated to either signalling or bearer channel functions. ATM designs utilise one common data stream over which all information is sent in the form of cells. For this reason it is unhelpful to make a distinction as to the type of ATM cells to be passed to a user port.

There are many ways in which ATM cells for different UNIs can be multiplexed together. The most easily understood ways are as follows:

a) to unpack and re-address the data carried in the ATM header within the SN and then to re-pack the cells in their original manner once the cells have been transported to a point within the AN near the UNI to which they refer;

b) to relay the entire cells with the use of an additional header as a UNI address type mechanism. This header would be removed within the AN at a point near the user port;

c) to translate the ATM header addresses by whatever means within the SN, and then to translate the ATM addresses back within the AN at a point near the user port.

It has already been identified by the $V_{B5}$ experts group that:

**Method a)** would be cumbersome and would not lead to cost-effective AN implementations.

**Method b)** would result in non-standard cell lengths at the $V_{B5}$ reference point and was not considered appropriate despite its technical simplicity. This approach has been shelved.

**Method c)** has been chosen as the mechanism most likely to success. This method will be followed within this ETR.

It has been agreed that two types of $V_{B5}$ reference points are required.

The first should be based around the functionality obtained from a simple VP cross connect and that the limitations that this would impose need to be made plain from an architectural point of view.

The second would be a more complex being based on the functionality obtained from a VP/VC switch.

# 17 Broadband accesses: Conclusions for implementations at the $V_{B5}$ reference point

## 17.1 Conclusions on ATM caused speech path delays for broadband services:

It is known that ATM framing will cause delays to 64 kbit/s services.

It is outside the scope of this ETR to identify/propose implementations/algorithms to solve this essentially broadband problem.

## 17.2 Conclusions on the preferred protocol to support narrowband services

This is the situation where voice terminals are supported via a terminal adapter function into a B-ISDN environment. In this case, there are two specific cases:

### 17.2.1 The preferred protocol to support a POTS or pseudo POTS service

This has not been defined within the standards arena although the ATM forum are currently working on suitable standards. This is considered outside of the scope of the $V_{B5}$ reference point report and will not be considered further.

### 17.2.2 The preferred protocol to support narrowband ISDN based services

Mappings exist/are being created, in order to map narrowband ISDN protocols into the B-ISDN protocols. This is considered outside of the scope of the $V_{B5}$ reference point report and will not be considered further.

## 17.3 Conclusions on the preferred B-ISDN signalling protocol

This is assumed to be Q2931 as specified by the relevant broadband standards but is outside the scope of this ETR.

## 17.4 Conclusions on the preferred B-BCC protocol for bandwidth allocation procedure

It has been decided that the AN implemented using VP cross connect functions will not require a B-BCC protocol. The reference point corresponding to this architecture has been designated as $V_{B5.1}$.

An AN constructed using switched VC principles will have a B-BCC protocol. The reference point corresponding to this architecture has been designated as $V_{B5.2}$. This will perform the following functions:

a) it will notify the AN of bandwidth requirements on a connection by connection basis unless the user has reserved bandwidth in which case the bandwidth will be pre-assigned on a semi-permanent basis using the B-BCC protocol;

b) the AN will have the ability to reject the bandwidth request giving suitable cause values if appropriate;

c) across a $V_{B5.2}$ reference point, VCs shall be set up using functions within a B-BCC protocol;

d) the following UPC/NPC information shall be routed into the AN across a $V_{B5.2}$ reference point using the B-BCC protocol:

   - UPC(VC);
   - NPC(VC).

### 17.5 Conclusions on the preferred control protocol

It has been identified that a co-ordinated and synchronised control function will be required across the $V_{B5}$ reference point between the AN and the SN. In particular, the need for controlled blocking was identified.

It notes that, whilst "lock" and "unlock" (immediate blocking and unblocking) could be covered by ITU-T Recommendation I.610 [17], "shutdown" (deferred blocking) requires a separate protocol function since this is not covered by ITU-T Recommendation I.610 [17].

The details of the co-ordination and synchronisation of operation and administration state transitions across interfaces at the $V_{B5}$ reference point together with the definition of managed objects are specified in the relevant $V_{B5}$ series ETSs and are not further discussed within this ETR.

### 17.6 Conclusions on the preferred link control protocol

#### 17.6.1 Link control protocol - $V_{B5.1}$

No requirements for a link control protocol has been identified.

#### 17.6.2 Link control protocol - $V_{B5.2}$

The functionality of the "Link Identification procedure" as described in the ETS for V5.2 interfaces can be realised by built-in mechanisms (e.g. path trace) of transmission systems used at the $V_{B5}$ reference points.

The applicability of existing protocol specifications (i.e. B-ISUP) for link control functions above the physical layer will be specified in the relevant ETSs for interfaces at the $V_{B5}$ reference point.

It has been agreed to adopt the procedures in ITU-T Recommendation I.610 [17] if required.

### 17.7 Conclusions on the preferred method of protection of signalling paths

Protection switching is not going to be specifically defined for the $V_{B5}$ interface, other than the physical layer protection already defined (e.g. in ITU-T Recommendation G.841 [11]) or likely to be defined in these or similar standards, in the future.

### 17.8 Conclusions on resource allocation and policing for a $V_{B5}$ based system

Annex C considers the 2 options of Access Network VP Cross connect (VP XC) and VC Switch (VC Sw) and the possible location for performing UPC/NPC functions when associated with a Service Node and shows that:

a) when an AN uses a VP cross connect for its basic functionality, then both the UPC(VP) and optional NPC(VP) for the downstream direction are pre-defined or pre-provisioned quantity;

b) when an AN uses a VC switch for its basic functionality, then the situation is more complex in that the following needs to be supported:

The UPC(VC) and optional NPC(VC) for the downstream direction should be dynamically assigned on a per-connection basis.

A protocol will be required in order to dynamically assign UPC(VC) in the upstream direction and optional NPC(VC) in the downstream direction on a per connection basis.

#### 17.8.1 Conclusions on the use of the GFC field and its implementation in a $V_{B5}$ scenario

It has been agreed that the use of the GFC field (as specified in ITU-T Recommendations I.150 [20] and I.361 [19]) is outside the scope of this ETR as it is purely related to the user port. It has been agreed that the functionality of the GFC field is assumed to be local to the user port itself and has no impact on the SN itself. For this reason, there is no requirement to transfer information as to the status of the GFC field/function, over the $V_{B5}$ reference point back to the SN.

#### 17.8.2 Conclusion as to the use of the CLP bit of ATM messages at the $V_{B5}$ reference point

It has been agreed that the CLP bit in ATM cell headers shall be used as specified in ITU-T Recommendation I.371 [15]. No additional usage of the CLP bit at the $V_{B5}$ reference point has been identified.

## 18 Items for further study

This ETR has been written as a basis for a new series of standards based at the $V_{B5}$ reference point. Items for further study will have to be resolved during the creation of these standards.

Among the issues for further study are:

The management of VCs which may either terminate in the AN or be carried over the $V_{B5}$ interface (e.g. ILMI in user VC 16) is for further study. Contributions requested.

## 19 Future standardisation requirements for the $V_{B5}$ reference point

This list is not yet complete but aims to give an indication of the work that will be necessary in order to bring the $V_{B5}$ reference point up to a similar level to that provided by the V5 series of ETSs.

1) A $V_{B5.1}$ interface standard is required. This will assume that the AN has the functionality of a VP cross connect. The $V_{B5.1}$ interface standard will be based around a minimum-functionality architecture which will support the multiplexing of cells from different users but will not neither support on demand bandwidth allocation nor VCC concentration between the SN and the AN. Additionally, this interface standard might require the specification of other protocols if a need for them is clearly identified. This interface will support both narrowband and/or broadband services. In the case of narrowband service support, the narrowband services will be supported by underlying V5.1 and/or V5.2 based systems (ETS 300 324-1 [5] and ETS 300 347-1 [6]).

2) A $V_{B5.2}$ interface standard is required. This will assume that the AN has the functionality of a fast VC cross connect.

   The $V_{B5.2}$ interface standard will be designed to support on demand bandwidth allocation and VCC concentration between the SN and the AN. Additionally, this interface standard might require the specification of other protocols if a need for them is clearly identified.

   This interface will support both narrowband and/or broadband services. In the case of narrowband service support, the narrowband services will be supported by underlying V5.1 and/or V5.2 based systems (ETS 300 324-1 [5] and ETS 300 347-1 [6]). Both the interface standards of type $V_{B5.1}$ and $V_{B5.2}$ will be based on the material and information contained in this ETR with departures from the principles agreed within this ETR only if additional information is made available showing a clear need for such changes.

3) ETSs for the management of $V_{B5}$ interfaces, which specify the information models for configuration management, fault and performance, etc. have to be produced. It is possible that separate ETSs for $V_{B5.1}$ and $V_{B5.2}$ management will have to be produced. It is furthermore possible that separate ETSs for AN side and SN side will be produced.

4) It is expected that PICS and MOCS ETSs will be produced. It is for further study whether test specifications, e.g. protocol implementation tests for $V_{B5}$ specific protocols are required.

# Annex A: Performance parameters associated with an ATM SN

It has been recognised that performance parameters will have to be specified in order that the $V_{B5}$ reference point can be used in a real network. The following is information presented by Deutsche Telekom and might provoke discussions/contributions on the subject. It does NOT imply any additional architectural or functional design of networks at the $V_{B5}$ reference point:

## A.1 Introduction

ITU-T Recommendation I.356 [13] performance parameters for cell transfer in the ATM-layer of a broadband ISDN are described.

However there are not any explicit information about values of these parameters and there are also no recommendations of a measurement configuration.

In order to give the PNOs the possibility to set requirements for the necessary quality of service parameters this ETR gives an overview of a useful measurement method. The results of these experiments serve as a basis for the proposal of a cell delay through an ATM SN.

## A.2 Measurement experience

The experimental results have been achieved with artificial traffic resources which were connected to the UNI and NNI STM1 interfaces of an ATM service node. Figure A.1 shows a part of the used test configuration. Some of the results for the cell delay measuring are given.

For simulating real service node behaviour two types of traffic connections have been used:

- foreground traffic on VP- and VC- connections with different bit rates, whose cells are editable with time stamps and sequence numbers; and

- background traffic which serves for loading purposes on the ATM SN.

The performance values are obtained on the foreground traffic connections with a Bernoulli traffic characteristic and a constant bit rate. The maximum bit rate did not exceed 80% of the available bandwidth.

On the foreground connections, the cell delay was measured over a time of four hours. In addition to this parameter, the cell loss ratio and the cell error ratio were recorded.

The evaluation of the measurements showed that the cell delay did not exceed 100 microseconds and averaged 60 microseconds. It is expected that these values would increase if variable bit rate traffic was allowed onto the system. Other experiments with several different load configurations showed a clear dependence between load characteristic and cell delay. The suggested values for standardisation should therefore be higher than the measured values in the configuration shown.

In the measurement period of 4 hours, no cell losses or cell errors occurred. A longer measuring duration is therefore necessary and no values can yet be assigned.

## A.3 Proposal

The 99% value of the cell transfer delay figure for CBR services should be in the order of 150 microseconds.

The mean cell transfer delay for CBR services should be in the order of 100 microseconds.

The maximum cell transfer delay ($10^{-10}$ quantile) figure for CBR services should be in the order of 300 microseconds.

In order to obtain the other performance parameters, practical experience with longer measuring durations will be required.

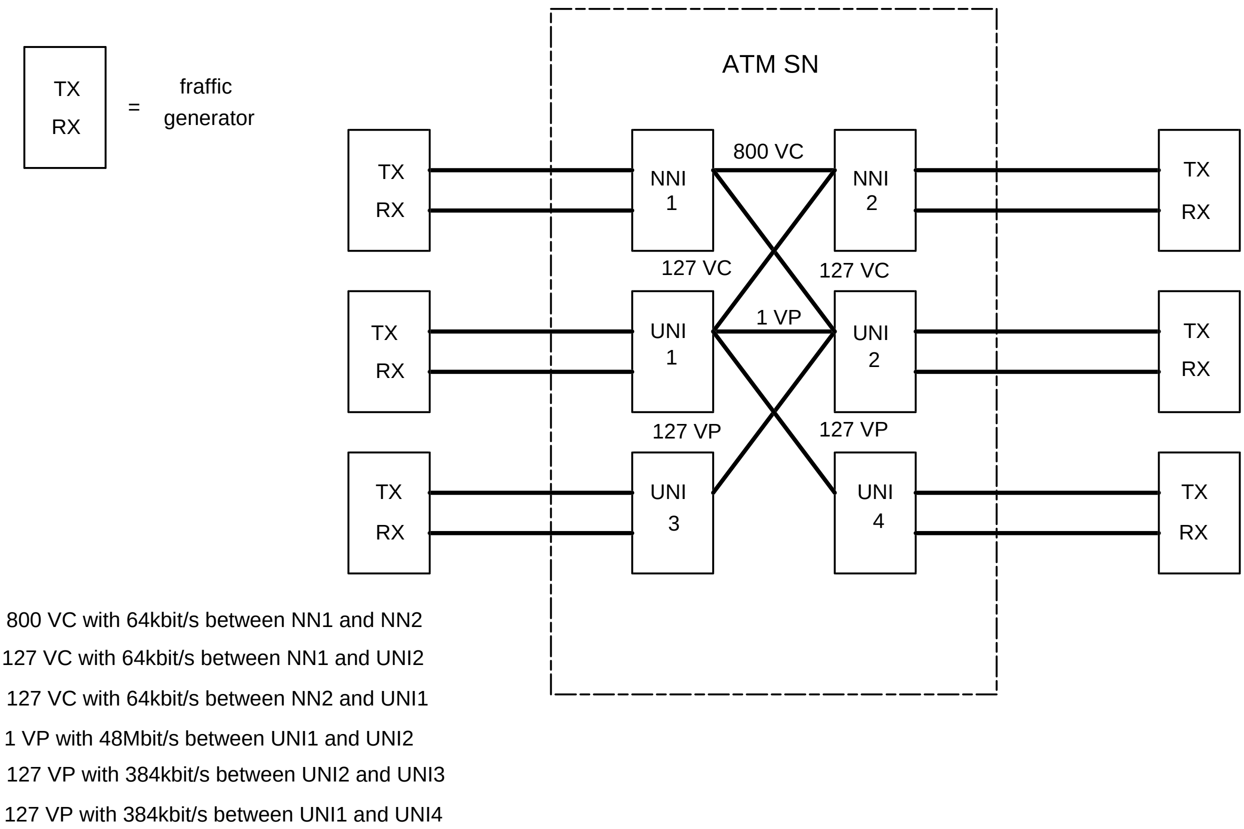



**Figure A.1: ATM SN configuration for which measurement occurred**

# Annex B: Delay on the bearer channels associated with PSTN traffic

The maximum amount of delay tolerable on a PSTN link has been fixed at 25 ms although it should be recognised that impairments are audible at delays of as low as 13 ms. The maximum delay can be apportioned between various parts of the network, with the link from the Local Exchange to the user port, including the Access Network itself, typically being allocated 2 ms.

NOTE: In the ITU Recommendations an end-to-end delay of 25 ms is quoted for the PSTN service, but a breakdown of this value over parts of the network depend upon the exact configuration used within that network. In the UK a figure of 3 ms is used between the UNI and the point of interconnect which typically will include both a local and a trunk exchange.

## B.1 Speech path delay considerations when an ATM bearer is used

Given that the $V_{B5}$ reference point is being defined for an ATM bearer, the following discussion is valid:

An ATM cell has 48 bytes of user data available. When used for 64 kbit/s data, it would take:

$$\frac{48 \times 8 \times 1 \times 10^{-3}}{64} = 6 \text{ ms}$$

This means that a delay of 6 ms would be incurred every time a cell was filled with bearer data. As this would take longer than the delay apportioned to the Access Network, this is unacceptable. There are two easy ways to avoid this given that the data portion of an ATM cell is fixed as length 48 bytes:

**Method 1:**

Only partially fill each cell. By allocating the maximum delay of 2 ms, this leads to a useful cell length of:

$$\frac{X(\text{octets}) \times 8 \times 1 \times 10^{-3}}{64} = 2 \times 10^{-3}, \text{ with } X = 16 \text{ octets}$$

This means that the efficiency of each cell would be less than 25 %, taking into account the header, which is unacceptable for most purposes.

**Method 2:**

Filling the cells with data from more than one telephony bearer channel. It would make sense to allocate ATM cells in blocks, possible using the 2 Mbit/s constant bit rate service. This would get the delay caused by packetisation/depacketisation down to be in the order of 200 microseconds or less, which is acceptable. The problems with adopting this approach is that it does not help the equipment designer when the Access Network uses an ATM based data link mechanism as that will probable not be built around 2 Mbit/s streams, however this is outside the scope of this ETR and will not be further pursued here. It also relies on there being sufficient telephony data to efficiently fill such 2 Mbit/s constant bit rate streams.

Within the main text, the recommendation for the method for reducing bearer channel delay is given as using method 2 as this was preferred by the technical experts.

# Annex C: Policing and the UPC/NPC functions

This clause contains the definition and a brief description of the UPC/NPC functions (ITU-T Recommendation I.371[15]) and the application of these principles to a configuration comprising an access network and a service node.

## C.1 UPC/NPC definition and description

Usage Parameter Control (UPC) and Network Parameter Control (NPC) perform similar functionalities at different interfaces: the UPC function is performed at the user-network interface, whereas the NPC is performed at the Inter-Network Interfaces.

The use of UPC function is recommended, and the use of NPC function is a network option.

Usage/network parameter control is defined as the set of actions taken by the network to monitor and control the traffic in terms of traffic offered and validity of the ATM connection, at the user access and the network access respectively. Their main purpose is to protect network resources from malicious as well as unintentional misbehaviour which can affect the QOS of other already established connections by detecting violations of negotiated parameters and taking appropriate actions.

Connection monitoring encompasses all connections crossing the UNI or inter-network interface. Usage Parameter Control and Network Parameter Control apply to VCCs/VPCs, whatever their usage.

The monitoring for UPC and NPC is performed for VCCs and VPCs respectively by the following two actions:

a) checking the validity of the VPI/VCI and checking the traffic parameters agreed upon are not violated for active VCCs;

b) checking the validity of the VPI and checking the traffic parameters agreed upon are not violated for active VPCs.

## C.2 UPC/NPC location

Usage Parameter Control is performed on VCCs or VPCs at the point where they are first terminated within the network.

Network Parameter Control is performed on VCCs or VPCs at the point where they are first terminated within the network.

NOTE: Subclauses A.3.1 and A.3.2 are designed to be in accordance with ITU-T Recommendation I.371 [15].

## C.3 UPC/NPC in an AN-SN configuration

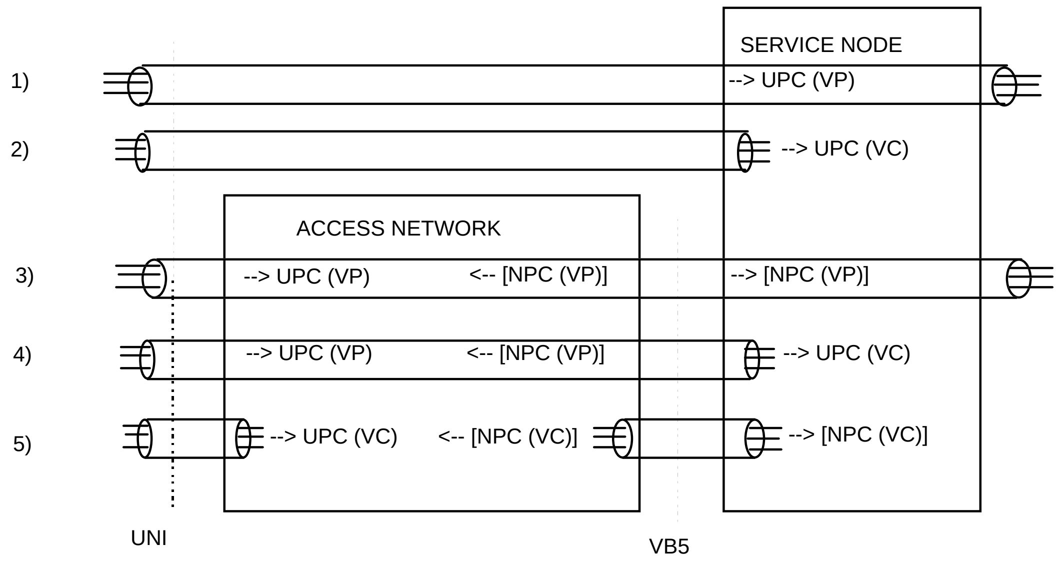
### C.3.1 UPC/NPC location

The following principle is applied in the next sections:

**an entity performs Policing only on the objects (VPs or VCs) it controls**:

- a VP Cross connect performs UPC/NPC on VPs;

- a VC fast cross connect performs UPC/NPC on VCs and it may perform UPC/NPC on VPs.




1) For user-to-user permanent VP connections (no AN).
2) For VC connections switched on a per-connection basis in SN.
3) For user-to-user permanent VP connections.
4) For user-to-network VP connections but switched on VC level at the service node.
5) For VC connections switched on a per-connection basis in AN and SN.

NOTE: Recommended functions are shown without square brackets; optional functions are shown in square brackets.

**Figure C.1: The UPC/NPC function locations for various scenarios**

The figure presents examples of possible UPC/NPC function location in the two entities Access Network and Service Node which are compliant with the ITU Recommendation I.371 [15].

The following text refers to figure C.1:

$V_{B5.1}$ contains connection types 3 and 4.

$V_{B5.2}$ contains connection types 3, 4 and 5.

In case 1) the Service Node shall perform UPC(VP) for user-to-user VPCs.

In case 2) the Service Node shall perform UPC(VC) for switched VCCs.

In case 3) The Access Network is a VP cross connect. The AN has to perform UPC(VP) in the upstream direction and may optional perform NPC(VP) in the downstream direction. The Service Node may optional perform NPC(VP) in the upstream direction.

In case 4) The Access Network is a VP cross connect. The AN has to perform UPC(VP) in the upstream direction and may optional perform NPC(VP) in the downstream direction. The Service Node has to perform UPC(VC) in the upstream direction.

In case 5) The Access Network is a VC switch. The AN has to perform UPC(VC) in the upstream direction and may optional perform NPC(VC) in the downstream direction. The Service Node may optional perform NPC(VC) in the upstream direction. NOTE: UPC/NPC on VP level is not necessary in the AN and SN for this connection type.

## C.4 Consequences

A Service Node may have to cope with different policing functions (UPC/NPC on VP/VC) when dealing with subscribers directly connected and subscribers connected through an access network

In cases 1, 3 and 4 the VP traffic parameters may be provided to the policing functions in the AN and in the SN respectively through $Q_{AN}$ and $Q_{SN}$.

In case 5 the on-demand VC connection requests from the users are conveyed transparently through the AN to the SN where the requests are treated. Policing on VCs is performed in the AN. Connection Admission Control functions for the VCCs needs to be performed in both the AN and the SN. A real-time mean of exchange of information between the Access Network and the Service Node seems to be needed to transfer traffic parameters related to the police and CAC functions performed in the AN.

# Annex D: Examples of configurations of logical and physical user ports at the UNI

## D.1 General principles

At the UNI VPs are provisioned by management with flexible but static bandwidth for services supported via $V_{B5}$ interfaces.

A VP at the UNI may only be assigned to one and only one $V_{B5}$ interface at a time. A single physical interface may carry at the same time a number of different VPs, which are assigned to different VB5 interfaces. This corresponds to a shared UNI according to ITU-T Recommendation G.902 [12]. A single user may use multiple physical links at the UNI to carry VPs assigned to the same $V_{B5}$ interface and controlled by the same signalling connection. This is known as non-associated signalling.

## D.2 Examples of scenarios at the UNI

The following scenarios shall give some examples to illustrated the above definition.

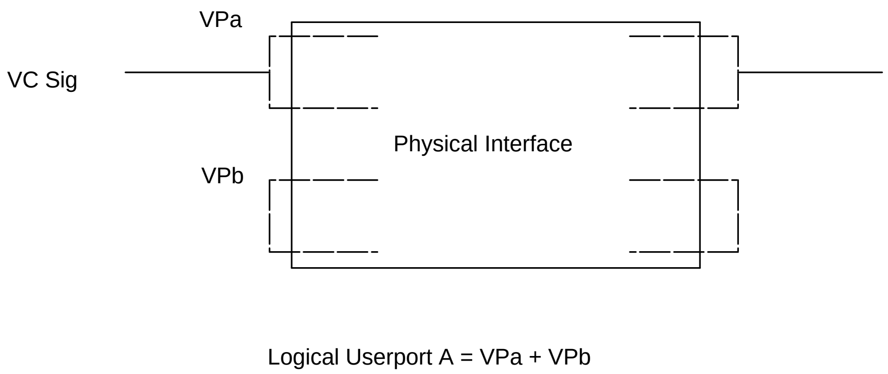



**Figure D.1: One logical user port on one physical interface (expected case)**

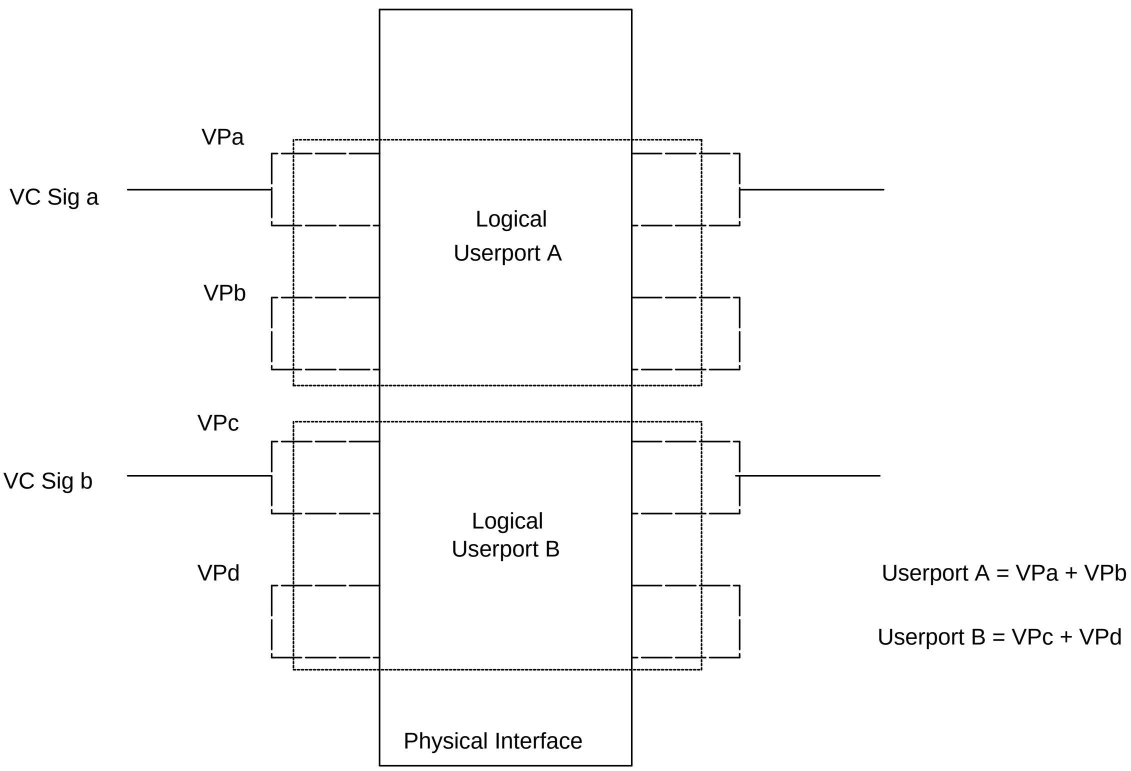



**Figure D.2: Two logical user ports on one physical interface**

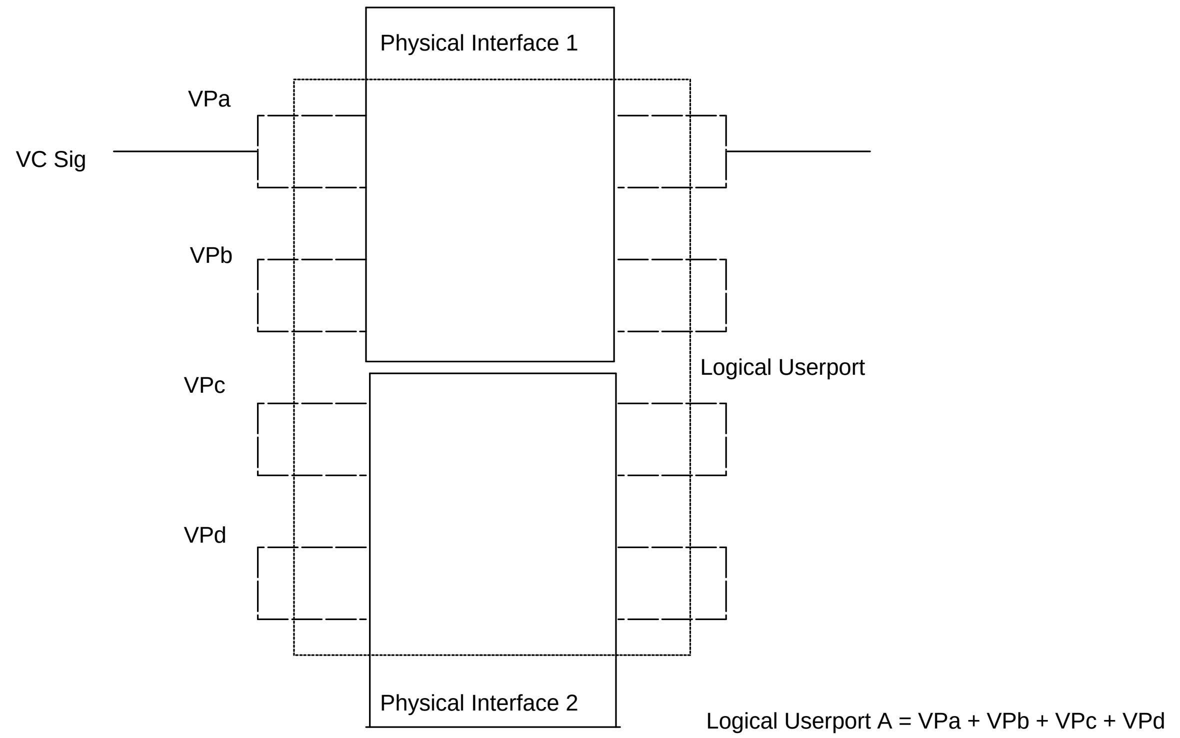



**Figure D.3: One logical user port comprising of two physical interfaces**

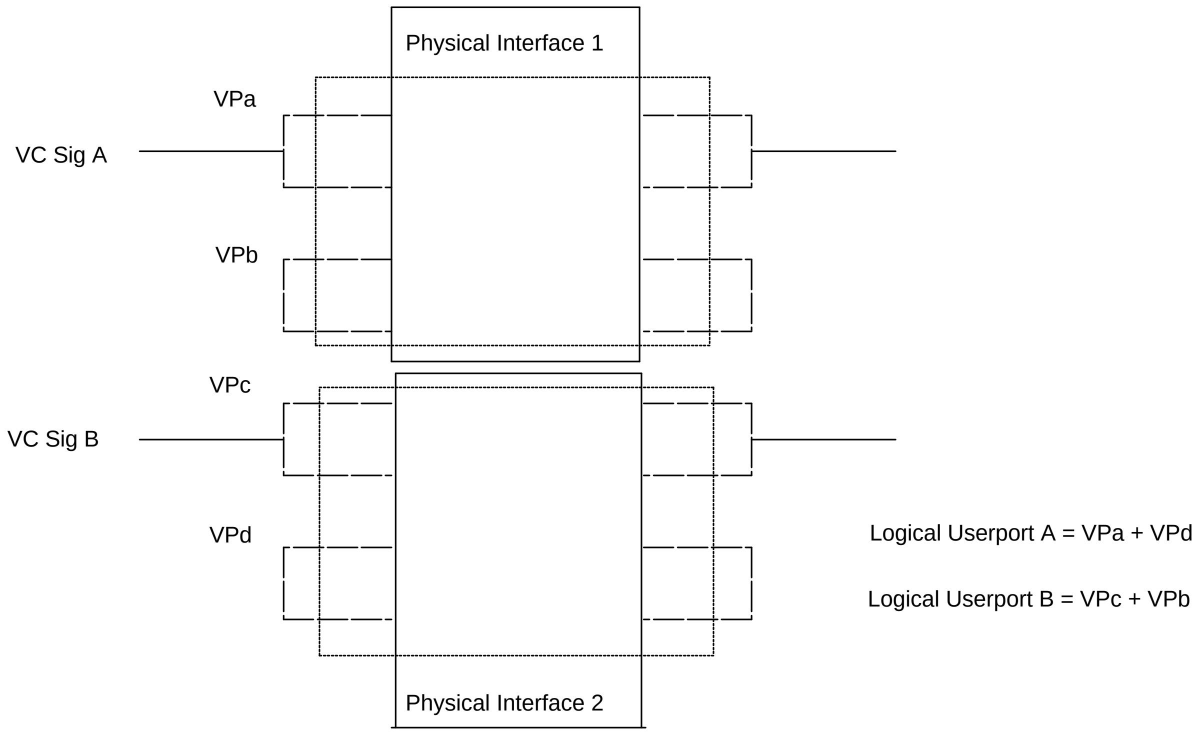



**Figure D.4: Two logical user ports, each with one Vp within another physical interface**

## D.3 Requirements for operation and maintenance

### D.3.1 Grouping of blockable objects

At the 3rd SEG meeting the question was raised which grouping of blockable/lockable objects the standard on $V_{B5}$ should foresee. The following selection was given:

- complete user port;
- complete logical user port (Editor's note: difference to first item not clear);
- all switched-service VPs in a logical user port;
- individual physical access link;
- switched-service VPs in a physical access link;
- (group of physical access links, e.g. all links served by one board) (etc.).

### D.3.2 Different requirements for AN and SN

The requirements for the grouping will probably be different for AN and SN. E.g., for the SN the physical configuration at the UNI should be irrelevant. Therefore, from an SN point of view there is no need for a blocking mechanism for a physical interface. On the other hand from the AN point of view a shut down (request) for a physical interface issued by the AN operator would be an important requirement since maintenance actions would normally affect the whole physical interface.

### D.3.3 Possible approaches to meet requirements

There are basically two approaches to cover all requirements:

1) Specify the superset of all possible blockable/lockable objects and define relevant protocol functions and procedures for each of them. This means a lot of specification work, and would be an inflexible and implementation dependent solution, e.g. in case requirements would change in future.

2) Base all user port related exchange of control information on the $V_{B5}$ interface on individual VPs. At the Q3(AN) or Q3(SN) individual groupings can be defined which are tailored to the requirements of the AN or SN, respectively. This would mean e.g. that a shut down request for a physical interface issued by the AN-operator will be transformed in a shut down request message for each affected VP on that physical interface. In the SN the individual VPs would be locked as soon as appropriate, but the SN operator would not recognize those actions as a shutting down of a physical interface in the AN.

## D.4 Conclusion

From a $V_{B5}$ point of view there is no need to define a logical or complete user port according to clauses 2 and 3. The blockable/lockable objects for the $V_{B5}$ interface are VPs at the UNI and their associated resources. Only for these objects there is a need to synchronize the administrative and operational states between the AN and SN. If this is accepted, as a next step, the different states and the means of communication between AN and SN can be decided on.

# Annex E: General narrowband services discussion

## E.1 Discussion - The PSTN service

The PSTN service is well defined within Europe, although it is differs in detail between the various member states. A digital access signalling system based on a common channel signalling approach has been standardised by ETSI for use in supporting these PSTN services. Some countries have already adopted this new protocol, whilst others are actively considering using it in the near future. The technical standards containing the details on the PSTN protocol are V5.1 (ETS 300 324-1 [5]) and V5.2 (ETS 300 347-1 [6]).

### E.1.1 The preferred PSTN signalling protocol

The preferred PSTN protocol within Europe is that contained in V5.1 (ETS 300 324-1 [5]) and V5.2 (ETS 300 347-1 [6]). These standards detail all of the layer 3 building blocks needed in order to support any analogue services required throughout Europe.

The actual mapping of the functional PSTN services are not described in ETS 300 324-1[5] and ETS 300 347-1 [6]. These are, in general, country-specific.

This ETR follows the European standard and recommends the V5.1 and the V5.2 PSTN protocol specifications as the basis for full analogue functionality support at a $V_{B5}$ reference point.

### E.1.2 The data link layer for the PSTN signalling protocol

The data link layer for the PSTN service has been specified as a point to point, HDLC LAPD protocol (ETS 300 125 [7]), within V5.1 (ETS 300 324-1 [5]) and V5.2 (ETS 300 347-1 [6]).

## E.2 Narrowband services: The ISDN-BA requirements and $V_{B5}$ implementation

### E.2.1 Discussion - The ISDN-BA service

There are a number of core specifications in the memorandum of understanding that will be implemented across Europe within the ISDN-BA service although member countries are at liberty to add new services in addition to these core functions.

The layer 2 protocol designed to provide the functionality required by all of the ISDN-BA services is contained in ETS 300 125 [7].

The layer 3 protocol designed to provide the functionality required by all of the ISDN-BA services is contained in ETS 300 102-1 [8].

Additional functionality is required in order to provide the Activation/Deactivation functions which are required for the layer 1 of the ISDN-BA user port itself.

### E.2.2 The preferred ISDN-BA layer 3 signalling protocol

The preferred method of passing the ISDN-BA functionality across the $V_{B5}$ reference point is via Q.931 as defined in ETS 300 102-1 [8]. Other non-standard signalling systems could be used, however their use would mean that code translations would be required in the access network leading to additional complexity and expense which is to be avoided if at all possible.

### E.2.3 The data link layer (layer 2) for the ISDN-BA signalling protocol

It has been accepted for V5.1 (ETS 300 324-1[5]) and V5.2 (ETS 300 347-1 [6]) that a frame relay approach should be adopted in order to get the data link layer functionality from a narrow band Local Exchange to a user port as the data link layer is terminated within the customer's equipment in the case of the ISDN-BA service. This cannot be used in the same way in an ATM environment.

It is suggested that the HDLC LAPD point-to-multipoint data link layer as specified in ETS 300 125 [7] should be used, however, in order to use this layer 2 over an ATM sub-layer, this protocol should be run on top of the AAL1 signalling data link provided by ATM for the support of constant bit rate services.

An alternative approach would have been to convert the data link layer into an SAAL form at the broad band exchange, but it would have had to be converted back at some point before the user port which appears to over complicate the system somewhat.

## E.3 Narrowband services: The ISDN-PRA requirements and $V_{B5}$ implementation

### E.3.1 Discussion - The ISDN-PRA service

There are a number of core specifications in the memorandum of understanding that will be implemented across Europe within the ISDN-BA service although member countries are at liberty to add new services in addition to these core functions.

The layer 2 protocol designed to provide the functionality required by all of the ISDN-PRA services is contained in ETS 300 125 [7].

The layer 3 protocol designed to provide the functionality required by all of the ISDN-PRA services is contained in ETS 300 102-1 [8].

### E.3.2 The preferred ISDN-PRA layer 3 signalling protocol

The preferred method of passing the ISDN-PRA functionality across the $V_{B5}$ reference point is via Q.931 as defined in ETS 300 102-1 [8]. Other non-standard signalling systems could be used, however, their use would mean that code translations would be required in the access network leading to additional complexity and expense which is to be avoided if at all possible.

### E.3.3 The data link layer (layer 2) for the ISDN-PRA signalling protocol

It has been accepted for V5.2 (ETS 300 347-1 [6]) that a frame relay approach should be adopted in order to get the data link layer functionality from a narrow band Local Exchange to a user port as the data link layer is terminated within the customer's equipment in the case of the ISDN-PRA service. This cannot be used in the same way in an ATM environment.

It is suggested that the HDLC LAPD point to multipoint data link layer link layer as specified in ETS 300 125 [7] should be used, however, in order to use this layer 2 over an ATM sub-layer, this protocol should be run on top of the AAL1 signalling data link provided by ATM for the support of constant bit rate services.

An alternative approach would have been to convert the data link layer into an SAAL form at the broad band exchange, but it would have had to be converted back at some point before the user port which appears to complicate the system somewhat.

## E.4 Narrowband services: Signalling bandwidth allocation

Signalling bandwidth shall be allocated within 2 Mbit/s channels using the pre-defined or pre-provisioned mechanisms already adopted for V5.1 (ETS 300 324-1 [5]) and V5.2 (ETS 300 347-1 [6]).

## E.5 Narrowband services: The control protocol

A control protocol is used for V5.1 (ETS 300 324-1 [5]) and, in a slightly different form, for V5.2 (ETS 300 347-1 [6]).

### E.5.1 Control protocol for narrowband services

A control protocol will be required for use over the $V_{B5}$ reference point for the support of narrowband services. This will be used in a similar manner to that for the V5.2 interface (ETS 300 347-1 [6]). The reason for the control protocol is two-fold:

1) to control the activation and deactivation of the layer 1s of the ISDN-BA ports;

2) to allow blocking of all of the port types on a port by port basis. This is necessary in order to allow the provisioning of ports or interfaces using the management port ($Q_{AN}$) as required.

The control protocol shall be identical to that specified in V5.1 (ETS 300 324-1 [5]) or V5.2 (ETS 300 347-1 [6]) depending which variant is to be supported over the $V_{B5}$ reference point.

### E.5.2 The data link layer for the control protocol

The data link layer for the control protocol has been specified as a point to point, HDLC LAPD protocol (ETS 300 125 [7]), within V5.1 and V5.2.

## E.6 Narrowband services: Link control protocol layer 3

The link control protocol is not used in V5.1 (ETS 300 324-1 [5]).

The link control protocol is used in V5.2. In this case it has the following functions:

1) it allows a means of checking that the correct physical 2 Mbit/s bearers are connected, in the correct order, across the reference point;

2) it allows the blocking of physical 2 Mbit/s bearers for maintenance purposes.

The link control protocol utilises a specific layer 3 protocol defined in V5.2 (ETS 300 347-1 [6]) as well as relying on bits from the 2 Mbit/s frame structure being available.

In the architecture presented in figure four, where a separate narrowband and broadband SN is shown, there is a physical realisation of the 2 Mbit/s links between the exchanges. In this case there is no reason why this structure should not be passed across the $V_{B5}$ reference point.

In the architecture presented in figure five, where an integrated narrowband and broadband SN is shown, the physical timing structures associated with 2 Mbit/s links will probably not exist. In this case, it would not be possible to use the link control protocol as specified in V5.2 (ETS 300 347-1 [6]) unless such a timing stream was specifically created. The choices are:

a) to artificially recreate the timing streams; or

b) to not provide the link control protocol.

It has been agreed to follow approach a. in all cases. At the very least, this will prevent compatibility problems with alternative arrangements of AN equipment, expecting a fully compatible V5.2 data stream.

## E.7 Narrowband services: Protection of signalling cells at the $V_{B5}$ reference point

V5.2 utilises a protection protocol in order to guarantee that signalling streams are given access from the local exchange to the Access Network and vice versa. It has been suggested that this function will no longer be required in the case of a $V_{B5}$ reference point. The reason for this is that the underlying layers will be inherently protected anyway being (most likely) based on SDH or something similar. This was not the case for the V5.2 protocol where the individual 2 Mbit/s streams had no inherent protection. Furthermore, both the SAAL and the HDLC LAPD data link layers provide sufficient protection unless major layer 1 failures occur.

In the architecture presented in figure 6, where a separate narrowband and broadband SN is shown, there is a physical realisation of the 2 Mbit/s links between the exchanges. In this case there is no reason why this structure should not be passed across the $V_{B5}$ reference point.

In the architecture presented in figure 8, where an integrated narrowband and broadband SN is shown, the physical structures associated with 2 Mbit/s links will probably not exist. In this case, it would not be possible to use the protection protocol as specified in V5.2 (ETS 300 347-1[6]) unless such a protocol was specifically created. The choices are:

a) to artificially recreate the protection protocol;

b) to not provide the protection protocol.

It has been agreed to follow approach a. in all cases. At the very least, this will prevent compatibility problems with alternative arrangements of AN equipment, expecting a fully compatible V5.2 data stream.

# Annex F: General discussion on dimensioning of ATM access networks

A user access provided through an Access Network (AN) has to provide the same access bearer capability at the User-Network interface, and therefore to the customer equipment, as in the directly connected access case. This ensures, that the user does not experience any difference between the various access implementations and thus the same "service" will be delivered regardless of the access implementation within the network. In case of an ATM UNI, one conclusion is, that the user needs to have the possibility to use any VPI/VCI value in the cell header out of the range defined in ITU-T Recommendation I.361 [19]. It is possible to establish 256 VP connections, each containing up to 65 536 VC connections within one physical link of a UNI. For implementation reasons the number of simultaneous VP- and VC-connections at one interface will be restricted e.g. by subscription. This limitation is in principle necessary independent whether the UNI has a direct line to the service node or an access network is installed between the UNI and the Service Node Interface ($V_{B5}$ reference point).

It was agreed at the meeting in Antwerp, that the NNI header is used at the $V_{B5}$ reference point, when an access network is installed. This gives the opportunity to have 4 096 VPI values available between an access network and the service node. Considerations are made, based on the assumption, that narrowband accesses are integrated in Broadband ANs by Emulation of 2 Mbit/s bit streams. Emulation of V5 2 Mbit/s streams should be done by using AAL1 for carrying it through the Broadband AN.

## F.1 The $V_{B5.1}$ reference point

This assumes a VP-based AN with static allocation. Each V5.1 Emulation requires one VPI value. The VCI value needs to be chosen between both ends, where the 2 Mbit/s stream is terminated. The Broadband UNI handles VPI and VCI values in exactly the same manner as for direct lines. No additional restriction to the total amount of simultaneous VP- and VC-connections for one UNI appears, when a VP-based AN is installed. No concentration function can be provided in a VP-based Broadband AN. The cell rates of the VP are constant after installation, whether they are used or not.

The following scenarios could appear and worst case calculations are provided in order to present some of the issues:

### F.1.1 The AN is used for broadband UNIs only

If each UNI requires 256 VPCs simultaneously, one $V_{B5}$ reference point can handle 16 UNIs.

Probably this is not a realistic assumption, by having in mind, that for on demand connections one VPC per UNI could be sufficient and the necessary VPCs for leased lines have usually a limited number. Assuming that 10 simultaneous VPCs per UNI are sufficient approx. 400 broadband customers can be connected to one $V_{B5}$ reference point. On the other hand in a 622 Mbit/s interface a capacity of 2 Mbit/s per UNI restricts the total amount of UNIs per $V_{B5}$ to 256, 16 VPCs are then possible per UNI.

### F.1.2 The broadband AN is used for 2 Mbit/s emulation only

In the case of a 622 Mbit/s interface, a capacity of 2 Mbit/s per UNI restricts the total amount of UNIs per $V_{B5}$ to 256, 16 VPCs are then possible per UNI.

This means that case 256 V5.1 interfaces can be transmitted via one $V_{B5}$ reference point. This allows the transportation of 7 680 narrowband channels, which is equivalent to 7 680 analogue lines or 3 840 basic accesses. In any case 256 VPCs are sufficient. For V5.2, concentration has to be done in front of the broadband AN and needs probably only one VPC per V5.2 interface, if the 2 Mbit/s bit streams are emulated in a virtual channel connection. For each V5.2 emulation one VPC with a capacity up to 32 Mbit/s has to be allocated.

### F.1.3 The broadband AN with mixed traffic

Mixed traffic means to have both types, narrowband and broadband, transmitted via the same $V_{B5}$ reference point.

Starting with the available VPI values in an arrangement with 256 V5.1 interfaces, 15 Broadband UNIs could coexist in addition, when the number of V5.1 interfaces are reduced to 241. Each UNI has a maximum bit rate of 2 Mbit/s and theoretically all 256 VPCs can be established. The number of narrowband channels are 7 230, which leads to the conclusion, that approximately 1 broadband UNI (256VPs/2 Mbit/s) is possible per 500 analogue lines or 250 ISDN basic accesses.

For any new requirement, whether a B-UNI has to be installed in addition or the bit rate of an UNI increases, the number of V5.1 interfaces need to be reduced. Having in mind that migration from narrowband to broadband is going on, an existing B-AN probably needs to be rearranged in such a situation.

## F.2 The $V_{B5.2}$ reference point

This assumes a VC-based AN with static allocation of VPs and dynamic allocation of VCs.

Dynamic allocation of VCs allows in addition to the scenarios described in the relevant clause, a flexible handling of VCCs for on demand services, which require only a limited number of VPCs at the $V_{B5}$ reference point. At minimum one VPC could handle all connections established via signalling. For practical reasons the assumption is made, that each QOS-class and signalling is transmitted in an individual VPC at the $V_{B5}$ reference point. 16 VPCs for on demand connections seems to be the right choice. The other 240 values can then be used for 2 Mbit/s emulation. The number of narrowband channels are 7 200 (3 600 ISDN BAs). The number of broadband UNIs are independent of the narrowband accesses if enough capacity is provided by $V_{B5}$. In a 622 Mbit/s interface, this leaves only a total of $16 \times 2$ Mbit/s for all B-UNIs. This is not enough and therefore a 2,4 Gbit/s interface is highly recommended, which is able to handle 784 broadband UNIs in addition, each using 2 Mbit/s. The alternative is, to reduce the number of emulated 2 Mbit/s channels. The number of broadband and narrowband UNIs provided could be in the order of 10 000 for one AN.

Within the 16 VPCs, reserved for broadband on demand connections, 1 048 560 VCCs can theoretically be established simultaneously, which seems sufficient.

## F.3 Conclusion on dimensioning of ATM networks

A VP-based broadband access network can be used for early implementations, but does not fulfil the requirements when migration is going on. Static VP allocation only leads to an inflexible network, which requires new arrangement in a short time period after installation. If no V5 structure is included in the AN, the VP case is not possible due to the very limited address range of the VP field in the ATM header.

Only the VC-based AN gives the full flexibility without having really restrictions at the amount of simultaneously established VC connections per customer. The customer can use any value in the ATM header for VP/VC allocation. Branching points for point-to-multipoint connections can easily be implemented.

It is suggested that one $V_{B5}$ interface at the $V_{B5}$ reference point could have a capacity in the order of 2,4 Gbit/s. This does not imply that all $V_{B5}$ reference points need to have this capacity or that this is a maximum capacity that one could achieve from such a reference point. A lower capacity reduces the number of UNIs per $V_{B5}$ and/or the installed cell rate per UNI.

# Annex G: Examples for the support of LAN interconnect via $V_{B5}$

The examples described in this annex should not be considered as a specification of the adaptation function for the LAN interconnect service across the VB5 reference point. The specification of the adaptation function is outside the scope of the ETR.

| Interface | Relevant Recommendation | AN functionality (top layer functionality) |
|---|---|---|
| Ethernet (IEEE 802.3) using multiprotocol encapsulation.<br>Two possibilities exist :<br>- LLC encapsulation<br>- VC based multiplexing | Internet IETF RFC 1483 | Ethernet MAC frames<br>(+ LLC encapsulation, if any) <-><br>AAL5 (CPCS+SAR) |
| Frame Relay Interface | ITU-T Recommendation I.555 | Core-DL (LAPF) frames <-><br>AAL5 (FRSSCF+CPCS+SAR) |
| ATM DXI on n × 64 kbit/s or E1 rate | ATM Forum | 1) DXI data link <-> AAL5 or AAL3/4<br>2) AAL3/4 CPCS frames (carried in DXI data link) <-> AAL5 (CPCS+SAR) |
| SMDS/CBDS DXI on n × 64 kbit/s or E1 rate | SIG-TS-005/93<br>ETR 122 | DXI DL <-> AAL3/4 (CPCS+SAR) |
| n × 64 kbit/s on G.703/G.704 interface | ITU-T Recommendation I.363.3 | AAL1 Structured Data Transfer |
| 2 Mbit/s (E1) on G.703 | ITU-T Recommendation I.363.3 | AAL1 Circuit Emulation<br>(synchronous and asynchronous) |

## G.1 User plane

### G.1.1 $V_{B5.1}$ based access networks

It is proposed to limit the relevant virtual channel connection(s) to (semi)-permanent connection(s).

Note that within the AN there exists no connection point for this virtual channel, but only a connection termination point. The associated virtual channel link, which belongs to the Virtual User Port, is identified by a VPI and VCI value. Both values will be provisioned. The virtual channel link belongs, by creation, to a virtual path connection, which can be cross-connected within the AN.

### G.1.2 $V_{B5.2}$ based access networks

In addition to virtual channel connections as used for VB5zz.1, also switched and (semi)-permanent channel connections, which are cross-connected in the AN, can be associated to a LAN Access Function.

## G.2 Control plane

### G.2.1 $V_{B5.1}$ based access networks

If only (semi)-permanent connections are supported, no control plane protocols are required.

### G.2.2 $V_{B5.2}$ based access networks

For the case of switched virtual channel connections, broadband signalling may be required as part of the Terminal Adaptation Functions. The BCC will allow for the establishment of the virtual channel connection within the AN. However, it is assumed that the broadband signalling will provide the necessary information in order to associate the virtual channel connection to the LAN Access Function (i.e. a LAN connection).

Note that in this case the Terminal Adaptation Function within the AN may be originating broadband signalling.

## G.3 Management plane

Towards the CPE a LMI is optionally to be implemented as part of the AN (i.e. as user port function). This is however out of the scope of $V_{B5}$ related standards. Instead, references to existing standards should be used.

From the $Q_{AN}$ interface it should be possible to configure/monitor the AALx and the LAN Access Functions. Hence the MIB of the AN has to be extended for the AALx and the LAN specific objects. The relevant objects and associated actions/notifications shall be specified in dedicated standards and may be considered as part of the $Q_{AN}$ (for $V_{B5}$) specifications (e.g. by referencing).

The establishment of a (semi)-permanent virtual channel connection, with one endpoint in the Terminal Adaptation Functions, should be possible via the $Q_{AN}$. This is very similar to (semi)-permanent path connection establishment across a B-UNI. The differences are:

- the ATM resources specified at the user side now belong to a Virtual (B-UNI) User Port. The VCI value of the virtual channel link has to be specified in addition to the VPI and VPCI value;

- there is a need for a message to associate the LAN Access Function (i.e. LAN connection) with the appropriate ATM connection.

## History

| Document history | |
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| March 1996 | First Edition |
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ISBN 2-7437-0558-2
Dépôt légal : Mars 1996