TR 101 686 V1.1.1 (1999-07)

Hybrid Fiber Coax (HFC) access networks;
Interworking with B-ISDN networks

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Foreword

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

Introduction

Cable TV networks are more and more used for other services than just broadcast service. At the user side service terminals other than TV and radio are attached. At the terminal side, the head end needs to interwork with a number of service related networks. The present document presents a number of different interfaces at the user side and the network side and shows how the HFC access network interconnects them, both for user and signalling data.

1   Scope

The present document defines the interworking between HFC networks on one side and the B-ISDN on the other side.

2   References

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

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.

- For a specific reference, subsequent revisions do not apply.

- For a non-specific reference, the latest version applies.

- A non-specific reference to an ETS shall also be taken to refer to later versions published as an EN with the same number.

See also references in document EG 201 400-1.

[1]   EG 201 400-1 (V1.1): "Hybrid Fiber Coax (HFC) access networks; Part 1: Interworking with PSTN, N-ISDN, Internet and digital mobile networks".

[2]   EN 301 005-1: "V interfaces at the digital Service Node (SN); Interfaces at the VB5.1 reference point for the support of broadband or combined narrowband and broadband Access Networks (ANs); Part 1: Interface specification".

[3]   EN 301 217-1: "V interfaces at the digital Service Node (SN); Interfaces at the VB5.2 reference point for the support of broadband or combined narrowband and broadband Access Networks (ANs); Part 1: Interface specification".

[4]   EN 301 271: "Telecommunications Management Network (TMN); Management interfaces associated with the VB5.1 reference point".

[5]   ETR 230: "Network aspects (NA); Telecommunications Management Network (TMN); TMN standardization overview".

[6]   ETS 300 376-1: "Q3 interface at the Access Network (AN) for configuration management of V5 interfaces and associated user ports; Part 1: Q3 interface specification".

[7]   ETS 300 378-1: "Q3 interface at the Access Network (AN) for fault and performance management of V5 interfaces and associated user ports; Part 1: Q3 interface specification".

[8]   ITU-T Recommendation G.902 (1995): "Framework Recommendation on functional access networks (AN); Architecture and functions, access types, management and service node aspects".

[9]   ITU-T Recommendation G.966 (1999): "Access digital section for B-ISDN".

[10]   ITU-T Recommendation G.967.1 (1998): "V-interfaces at the service node (SN): VB5.1 reference point specification".

[11]   ITU-T Recommendation G.967.2 (1999): "VB5.2 reference point specification".

[12]   ITU-T Recommendation I.361 (1999): "B-ISDN ATM layer specification".

[13]   ITU-T Recommendation I.363 (1993): "B-ISDN ATM Adaptation Layer specification".

[14]   ITU-T Recommendation I.413 (1993): "B-ISDN user-network interface".

[15] ITU-T Recommendation I.432 (1988): "ISDN user-network interfaces; Interface structures and access capabilities".

[16] ITU-T Recommendation I.432.1 (1999): "General characteristics".

[17] ITU-T Recommendation I.432.2 (1999): "B-ISDN user-network interface; Physical layer specification: 155 520 kbit/s and 622 080 kbit/s operation".

[18] ITU-T Recommendation I.432.3 (1999): "B-ISDN user-network interface; Physical layer specification: 1 544 kbit/s and 2 048 kbits operation".

[19] ITU-T Recommendation I.432.4 (1999): "B-ISDN user-network interface; Physical layer specification: 51 840 kbit/s operation".

[20] ITU-T Recommendation I.432.5 (1997): "B-ISDN user-network interface; Physical layer specification: 25 600 kbit/s operation".

[21] ITU-T Recommendation Q.831 (1997): "Fault and performance management of V5 interface environments and associated customer profiles".

[22] ITU-T Recommendation Q.2110 (1994): "B-ISDN ATM adaptation layer; Service specific connection oriented protocol (SSCOP)".

[23] ITU-T Recommendation Q.2130 (1994): "B-ISDN signalling ATM adaptation layer; Service specific coordination function for support of signalling at the user-network interface (SSCF at UNI)".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions in EG 201 400-1 [1] apply.

3.2 Abbreviations

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

AAL	ATM Adaptation Layer
AN	Access Network
ATM	Asynchronous Transfer Mode
B-BBC	Broadband Bearer Control Channel
B-ISDN	Broadband ISDN
DSS2	Digital Signalling System number two
HFC	Hybrid Fibre Coax
MAC	Media Access Control
NT	Network Termination
PMD	Physical Media Dependent
RTMC	Real Time Management Co-ordination
SN	Service Node
SNI	Service Node Interface
UNI	User Network Interface

4 Service Requirements

See ETSI EG 201 400-1 [1].

5 Functional requirements

The basic service requirements of an HFC access network connected to a B-ISDN network are defined as follows:

a) all requirements as given in EG 201 400-1 [1];

b) all requirements as given in EN 301 005-1 [2] (VB5.1 interface) and EN 301 217-1 [3] (VB5.1 interface).

6 Reference Configuration and Reference Points

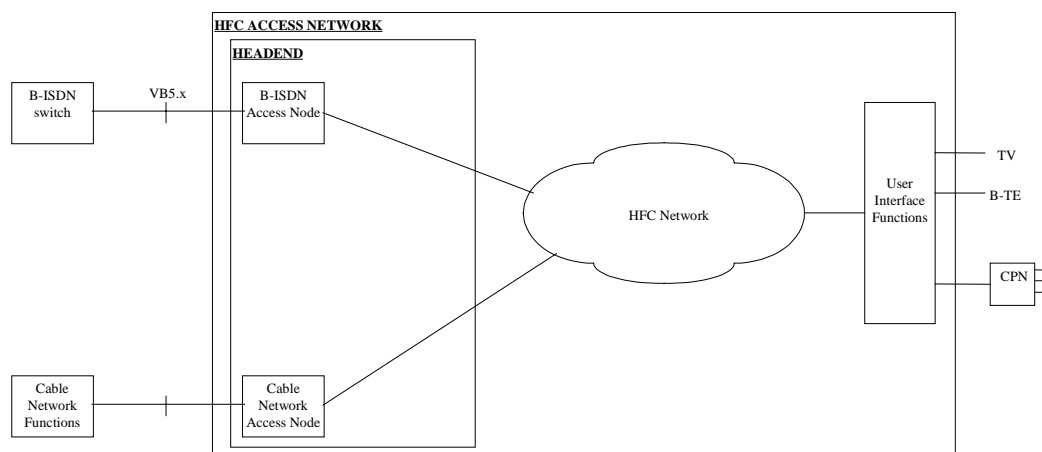## 6.1 The HFC access network general architecture and boundaries

See ETSI EG 201 400-1 [1].

6.2 General reference configuration for HFC Access Networks

See ETSI EG 201 400-1 [1].

6.3 HFC Access Network configuration for the considered network

In figure 1, the reference configuration for the interworking between an HFC access network and the B-ISDN network is shown.

NOTE: This figure only shows a functional architecture. It does not indicate which functions may belong to which network operator. Depending on the choice of the boundary between operators, there may be additional features required in the interface definition.

Figure 1: Reference Configuration for the interworking between an HFC network and other networks

Figure 1 also identifies some of the interfaces and the interworking units.

The interworking configuration outlined in figure 1, illustrates the situation where different networks interconnects with a common node access node head end. This head end acts as the focal point into the HFC network.

6.4   Reference Points

6.4.1   Reference points at the user interface side

The following user network interface is the one of the B-ISDN network.

- UNI at the T_B reference point = B-ISDN UNI.

6.4.2   Reference points at the network interface side

The following service node interface is the one of the B-ISDN network.

- SNI at the VB5 reference point = B-ISDN SNI.

7   User Interfaces
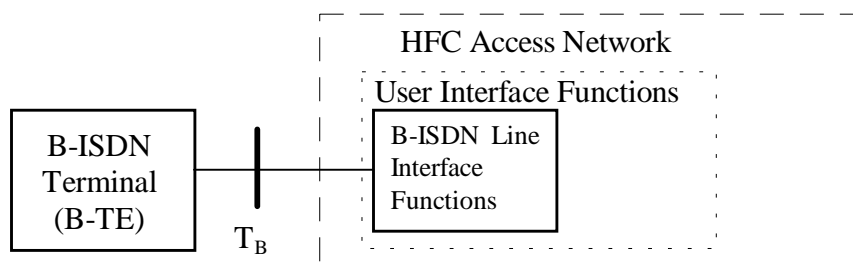
7.1   B-ISDN UNI

Figure 2: Reference configuration at UNI for Broadband ISDN

The B-ISDN UNI is the interface between the HFC access network and the B-ISDN terminal. The B-ISDN terminal is a B-TE terminal or any equipment that is compatible to it (possibly with Terminal Adapter).

The interface is situated at the T_B reference point. The reference configurations of ITU-T Recommendation I.413 [14] apply.

With regard to basic functions, the B-ISDN terminal is not different from a B-ISDN Terminal connected to a B-ISDN local exchange in the same domain.

The B-ISDN Physical interface for a terminal is described in ITU-T Recommendation I.432 [15] series.

7.1.2   Interface references

Standard Number (ITU-T Recommendation)	Short title
I.432.1 [16]	B-ISDN UNI: Physical layer specifications: general characteristics
I.432.2 [17]	B-ISDN UNI: Physical layer specifications: 155 520 kbit/s and 622 080 kbit/s operation
I.432.3 [18]	B-ISDN UNI: Physical layer specifications: 1 544 kbit/s and 2 048 kbit/s operation
I.432.4 [19]	B-ISDN UNI: Physical layer specifications: 51 840 kbit/s operation
I.432.5 [20]	B-ISDN UNI: Physical layer specifications: 25 600 kbit/s operation

7.1.3   User Interface functions - B-ISDN Network Termination

The User interface functions for the B-ISDN services over HFC Access network is fulfilled by a functional grouping called B-ISDN Cable Network Termination. The B-ISDN Cable Network Termination fulfils the interface between the network and the B-ISDN TE or NT-2.

The types of accesses for a single customer are the following:

- B-ISDN accesses with a UNI according to ITU-T Recommendation I.432.2 [17] (155,52 Mbit/s and 622,08 Mbit/s);

- B-ISDN accesses with a PDH based UNI according to ITU-T Recommendation I.432.3 [18] at 1 544 kbit/s and 2 048 kbit/s;

- B-ISDN accesses with a UNI according to ITU-T Recommendation I.432.4 [19] and I.432.5 [20] (51 840 kbit/s and 25 600 kbit/s).

7.1.4   Protocol stack and peer communication stack reference

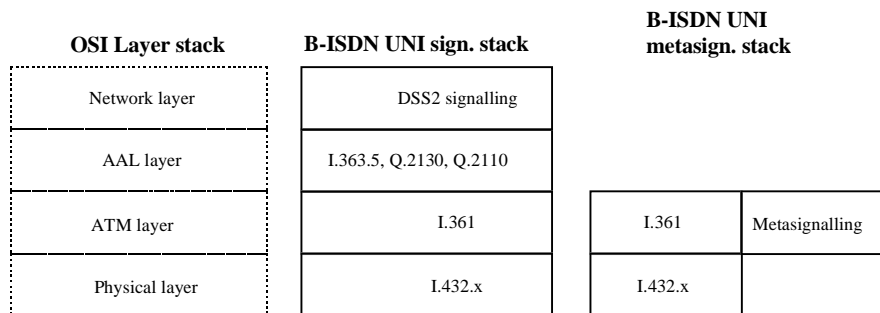The protocol stacks for B-ISDN signalling and meta-signalling at UNI are the following:

Figure 3: Protocol stack for signalling at B-ISDN UNI at TB reference point

The peer communication stack configuration for signalling, from NT view, is given in figure 4. Signalling at AAL layer and layer 3 is not interpreted in the HFC access network.
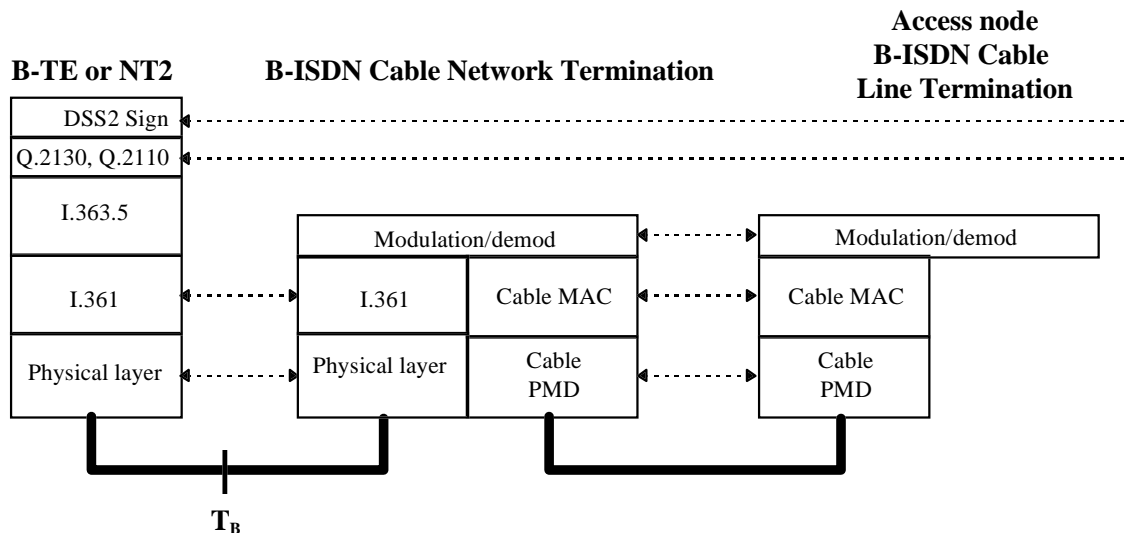

Figure 4: Protocol peer configuration for B-ISDN signalling

The peer communication stack configuration for meta-signalling, from NT view, is given in figure 5. Meta-signalling is not interpreted in the access network.
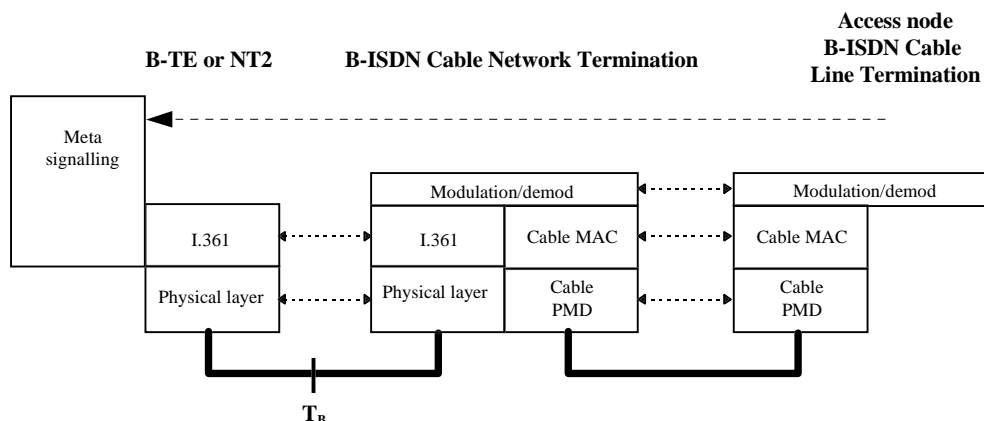
Figure 5: Protocol peer configuration for B-ISDN meta-signalling

The peer communication stack configuration for user info, from NT view, is given in figure 6. The information is transported over the access network to the telecommunication network.
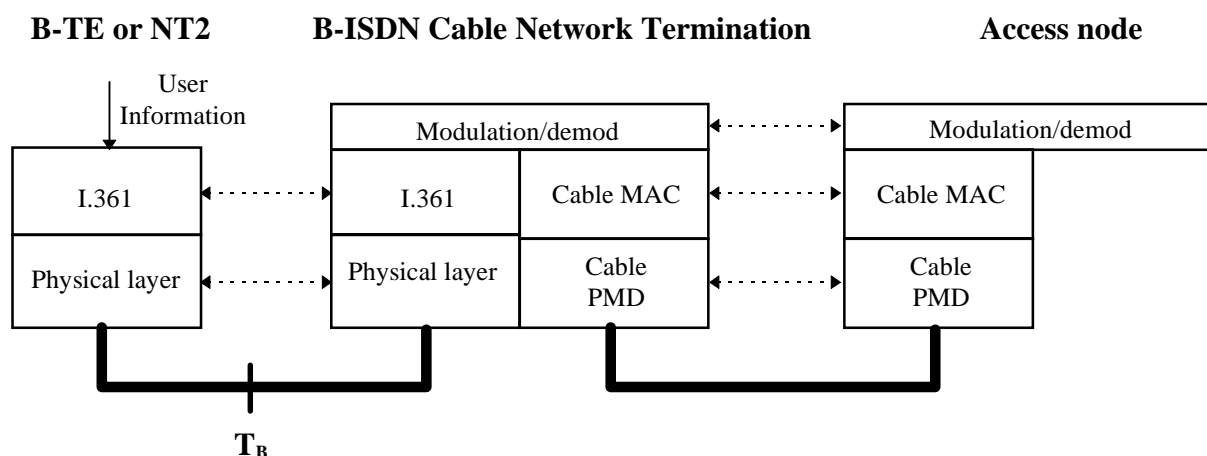
Figure 6: Protocol peer configuration for B-ISDN user information

8 Service Node Interfaces (SNI) (Access Node Interface)

8.1 VB5 functional specification model

8.1.1 General reference model for the VB5.1 reference point

The general reference model for the VB5 reference point concept is detailed in subclause 5.2 of EN 301 005-1 [2].

NOTE: The general reference model is identical for the VB5.1 and the VB5.2 reference point concept.

8.1.2 Integration of narrow-band customer access types

The integration of narrowband and other non B-ISDN access types is described in subclauses 4.2 and 4.3 of EN 301 005-1 [2]. Note that these concepts apply to both the VB5.1 and VB5.2 reference point.

8.2   B-ISDN SNI

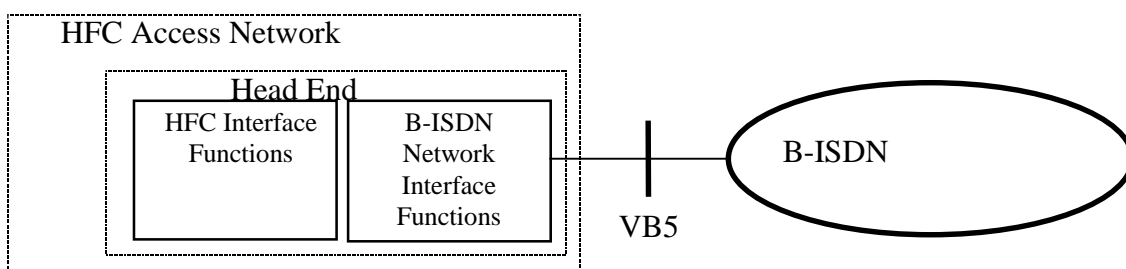**Figure 7: Reference configuration at SNI for Broadband ISDN**

Requirements for the physical layer interface(s) at the VB5 interface are given in subclause 6.2 of EN 301 005-1 [2].

NOTE: These requirements apply to both the VB5.1 interface and theVB5.2 interface.

8.2.1   Interface references

Standard Number	Short title
EN 301 005-1 [2]	Interfaces at the VB5.1 reference point for the support of Broadband or combined narrowband and broadband Access networks; part 1: Interface Specification
EN 301 217-1 [3]	Interfaces at the VB5.2 reference point for the support of Broadband or combined narrowband and broadband Access networks; part 1: Interface Specification
ITU-T Recommendation G.966 [9]	Access Digital section for B-ISDN
ITU-T Recommendation G.967.1 [10]	V-interfaces at the service node SN: VB5.1 reference point specification
ITU-T Recommendation G.967.2 [11]	V-interfaces at the service node SN: VB5.2 reference point specification

8.2.2   Network interface functions - B-ISDN Cable Line Termination

The Network interface functions for the B-ISDN information over HFC Access network is fulfilled by a functional grouping called B-ISDN Cable Line Termination. The B-ISDN Cable Line Termination is located at the Head End.

8.2.3   Protocol stack and peer communication stack reference configurations

8.2.3.1   Protocol stacks

8.2.3.1.1   VB5.1 interface

Figure 8 shows the protocol stack architecture for the VB5.1 interface. The functions performed are defined as follows (more information can be obtained in the VB5.1 recommendation).

-    Virtual Path links and virtual channel links support for U-plane, C-Plane, and M-Plane.

-    VB5.1 Real Time Management Plane Co-ordination (RTMC) functions as defined in clause 13 of
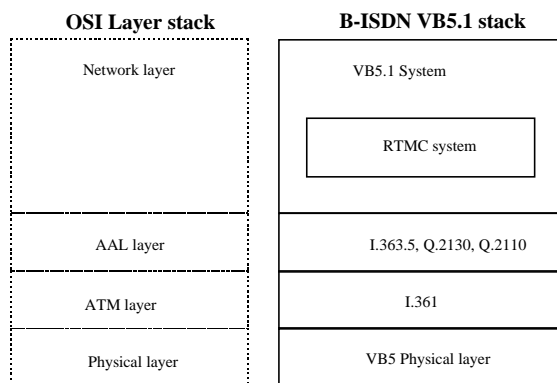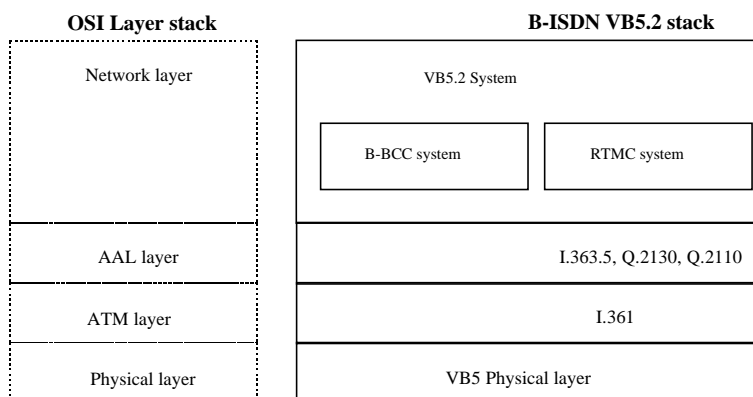   EN 301 271 [4].

OSI Layer stack   **B-ISDN VB5.1 stack**

OSI Layer stack	B-ISDN VB5.1 stack
Network layer	VB5.1 System RTMC system
AAL layer	I.363.5, Q.2130, Q.2110
ATM layer	I.361
Physical layer	VB5 Physical layer

Figure 8: Protocol stacks for VB5.1

8.2.3.1.2   VB5.2 interface

Figure 9 shows the protocol architecture for the VB5.2 interface. The functions performed are defined as follows (more information can be obtained in the VB5.2 recommendation).

- Virtual Path links and virtual channel links support for U-plane, C-Plane, and M-Plane.

- VB5.2 Real Time Management Plane Co-ordination (RTMC) system functions as defined in clause 13 of EN 301 271 [4].

- VB5.2 Broadband Bearer Connection Control (B-BBC) system functions as defined in clause 13 of DEN/TMN-00003.

OSI Layer stack   **B-ISDN VB5.2 stack**

OSI Layer stack	B-ISDN VB5.2 stack
Network layer	VB5.2 System B-BCC system RTMC system
AAL layer	I.363.5, Q.2130, Q.2110
ATM layer	I.361
Physical layer	VB5 Physical layer

Note: VB5.2 RMTC is equal to VB5.1 RMTC

Figure 9: Protocol stacks for VB5.2

8.2.3.2 Protocol peer configurations

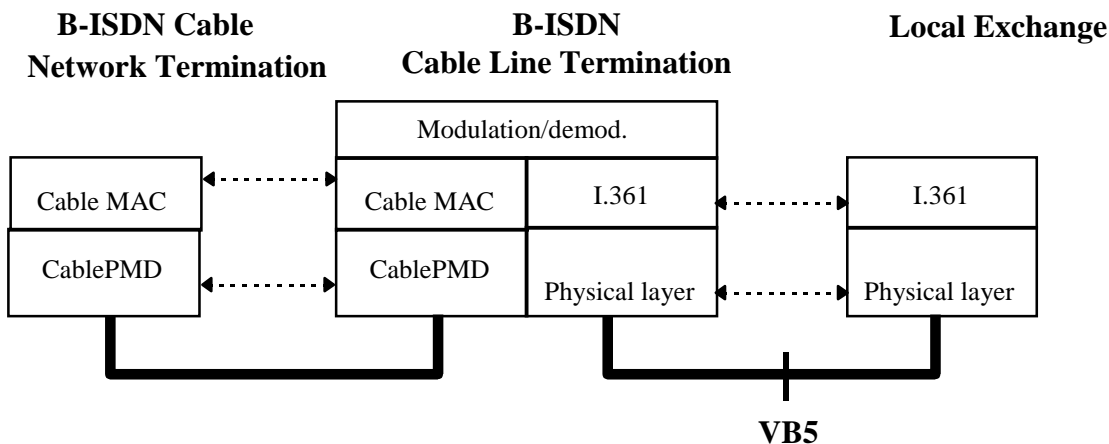Figure 10 shows the Protocol peer configuration for the User information for B-ISDN.

Figure 10: Protocol peer configuration for B-ISDN User information

8.2.3.2.1 VB5.1 interface

Figures 11, 12 and 13 show different Protocol peer stack configurations for different contexts.
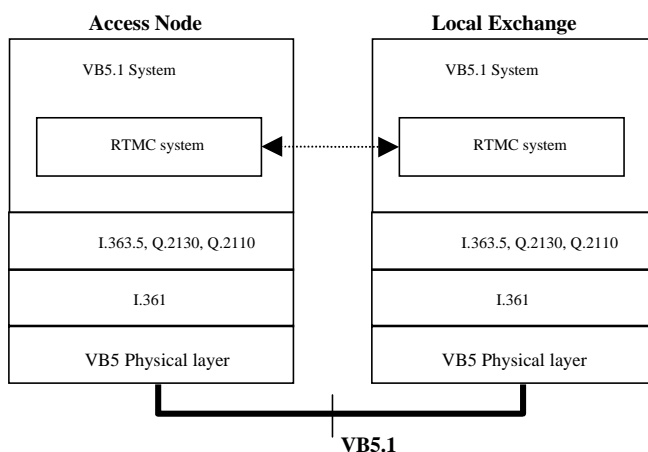

Figure 11: Protocol peer configuration for pure VB5.1 signalling functions (No B-ISDN signalling)
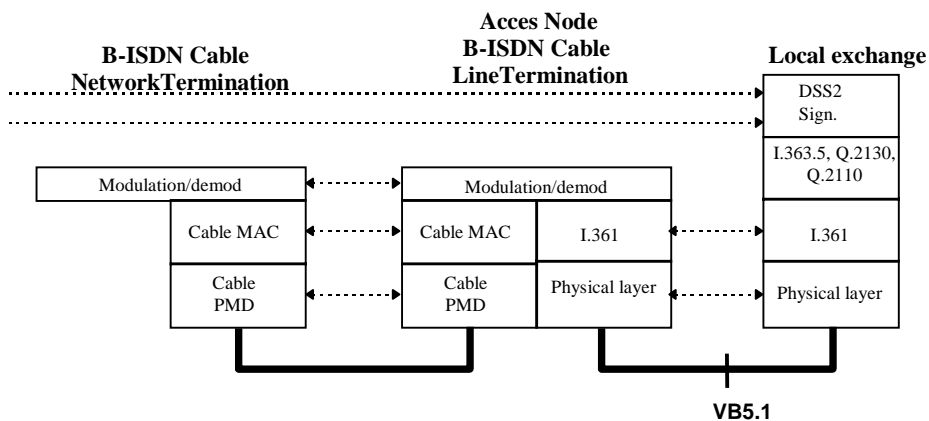

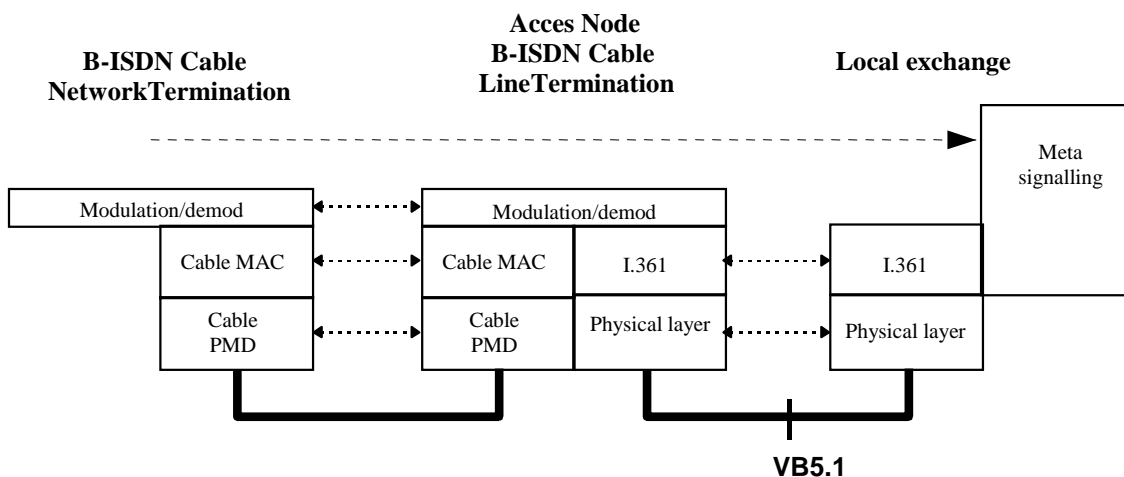**Figure 12: Protocol peer configuration for VB5.1 for B-ISDN signalling**

B-ISDN Cable
NetworkTermination

Acces Node
B-ISDN Cable
LineTermination

Local exchange

Meta
signalling

Modulation/demod	Modulation/demod		I.361
Cable MAC	Cable MAC	I.361	
Cable PMD	Cable PMD	Physical layer	Physical layer

VB5.1

Figure 13: Protocol peer configuration for VB5.1 for B-ISDN meta signalling

8.2.3.2.2   VB5.2 interface

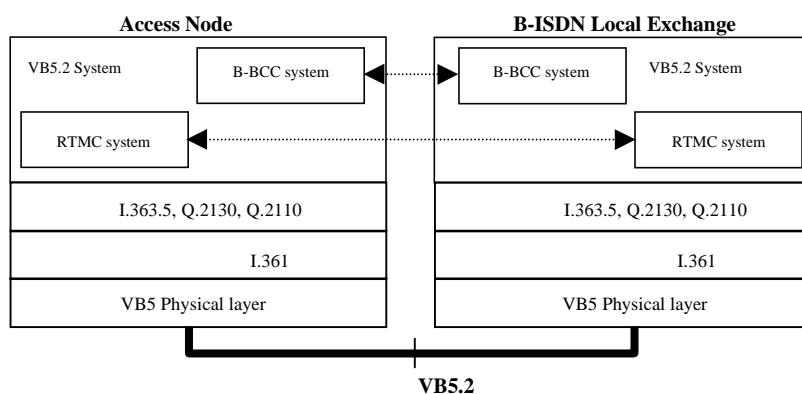Figures 14, 15 and 16 show different Protocol peer stack configurations for different contexts.

Access Node   **B-ISDN Local Exchange**

VB5.2 System B-BCC system	B-BCC system VB5.2 System
RTMC system	RTMC system
I.363.5, Q.2130, Q.2110	I.363.5, Q.2130, Q.2110
I.361	I.361
VB5 Physical layer	VB5 Physical layer

VB5.2

Figure 14: Protocol peer configuration for pure VB5.2 signalling functions (no B-ISDN signalling)

B-ISDN Cable
NetworkTermination

Local exchange

DSS2
Sign.

I.363.5, Q.2130,
Q.2110

Modulation/demod	Modulation/demod		
Cable MAC	Cable MAC	I.361	I.361
Cable PMD	Cable PMD	Physical layer	Physical layer
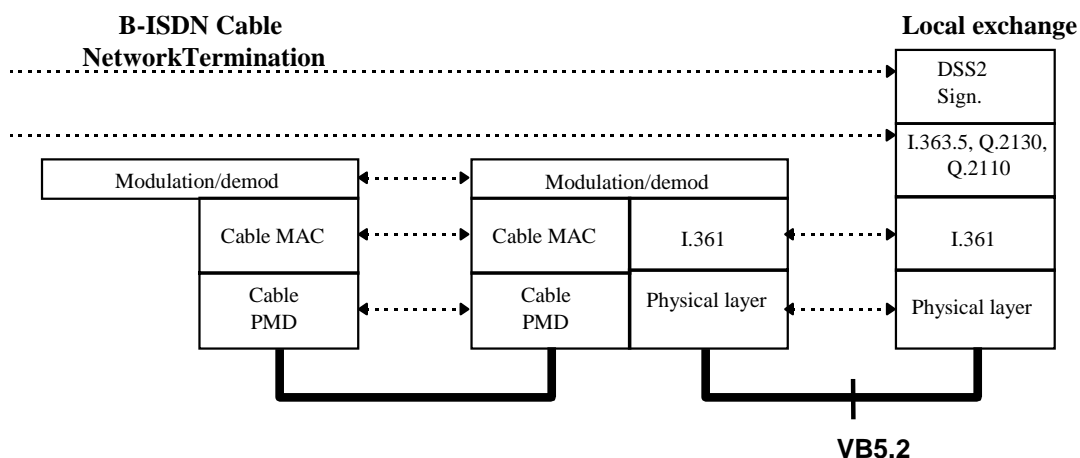
VB5.2

Figure 15: Protocol peer configuration for VB5.2 for B-ISDN signalling

B-ISDN Cable
NetworkTermination

Acces Node
B-ISDN Cable
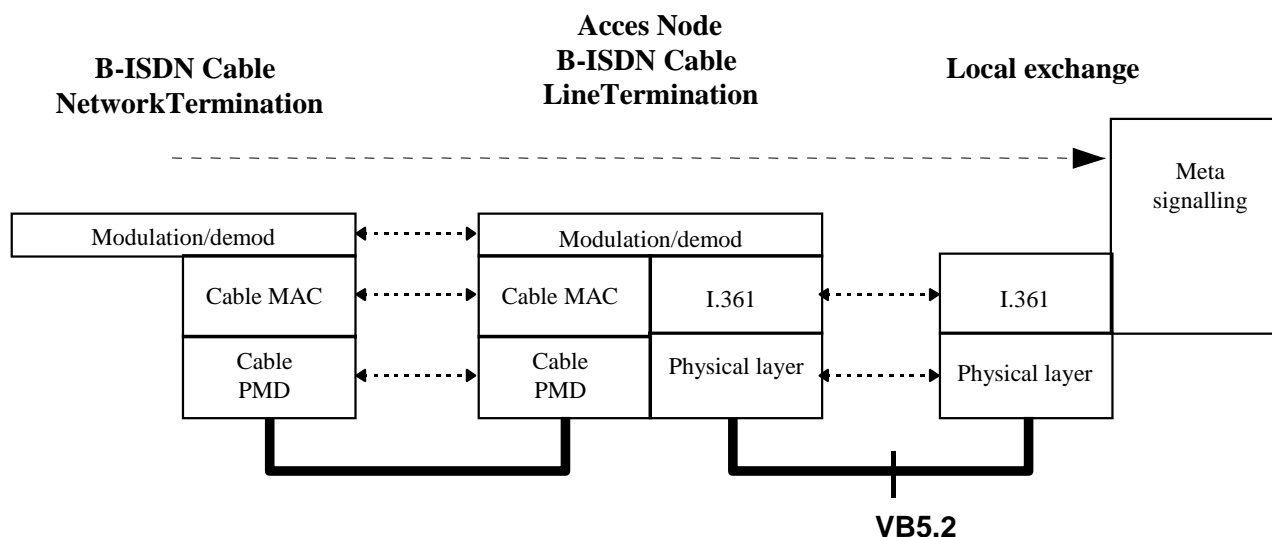**LineTermination**

Local exchange

Figure 16: Protocol peer configuration for VB5.2 for B-ISDN meta-signalling

9 Management Aspects

As any other (sub)network, the HFC access network needs to be managed. This clause indicates reference documents and the reference configuration.

9.1 Management References

All TMN principles and references to ETSI covering this subject can be found in ETR 230 [5]. These principles are also applicable to HFC access networks. The document fails however to handle Access networks separately, as it does with other networks. Some references with regard to management of access networks are given below:

Reference	Title
ETR 230 [5]	Network aspects (NA); Telecommunications Management Network (TMN); TMN standardization overview
ETS 300 376-1 [6]	Signalling Protocols and Switching (SPS); Q3 interface at the access network (AN) for configuration management of V5 interfaces and associated user ports; Part 1: Q3 interface specification
ETS 300 378-1 [7]	Signalling Protocols and Switching (SPS); Q3 interface at the access network (AN) for fault and performance management of V5 interfaces and associated user ports; Part 1: Q3 interface specification
ETS 300 378-2	Signalling Protocols and Switching (SPS); Q3 interface at the access network (AN) for fault and performance management of V5 interfaces and associated user ports; Part 2: Managed object conformance statement proforma specification
Q.831.1	Access management for V5
EN 301 271 [4]	Management interfaces associated with the VB5.1 reference point
DEN/TMN-00003	Management interfaces associated with the VB5.2 reference point
Q.831 [21]	Fault and performance management of V5 interface environments and associated customer profiles

9.2 Access network management reference configuration and interfaces

Figure 17 shows the reference configuration for an HFC Access Network. It is based on the functional architecture of a general Access Network as shown in ITU-T Recommendation G.902 [8], figure 3.
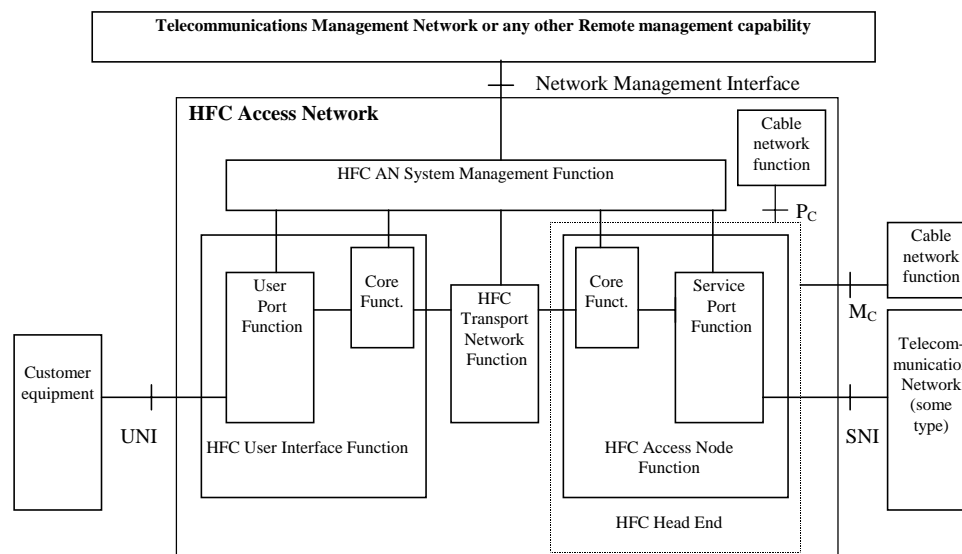
Figure 17: General HFC Access Network reference configuration

The access network may interface to the Telecommunications Management Network via a Q3 interface. As long as no Q3 interface is defined for the appropriate SNI functionality or for the HFC network aspects, other remote management arrangements can be set up over a Network Management Interface.

At the time of release of the present document, no Q3 is defined yet for an HFC access network. Q3 interfaces are defined however for a number of SNI interfaces, and for ISDN and analogue customer access, including access networks in general. See references in subclause 9.1.

Bibliography

The following material, though not specifically referenced in the body of the present document (or not publicly available), gives supporting information.

- DEN/TMN-00003: "Telecommunications Management Network (TMN); Management interfaces associated with the VB5.2 reference point".

- ETS 300 378-2: "Signalling Protocols and Switching (SPS); Q3 interface at the Access Network (AN) for fault and performance management of V5 interfaces and associated user ports; Part 2: Managed Objects Conformance Statement (MOCS) proforma".

- ITU-T Recommendation Q.831.1: "Access management for V5".

History

Document history		
V1.1.1	July 1999	Publication