ETSI

ETSI
TECHNICAL
REPORT

ETR 149

November 1994

Source: ETSI TC-NA

Reference: DTR/NA-052105

ICS: 33.080

Key words: ATM, CBDS, MAN, interworking

Network Aspects (NA);
Interworking between Metropolitan Area Networks (MANs) and Asynchronous Transfer Mode (ATM) networks for the Connectionless Broadband Data Service (CBDS)

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Contents

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Foreword

This ETSI Technical Report (ETR) was produced by the Network Aspects (NA) Technical Committee of the European Telecommunications Standards Institute (ETSI).

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Introduction

In order to enable Connectionless Broadband Data Service (CBDS) users connected to Metropolitan Area Network (MAN) and CBDS users connected the Asynchronous Transfer Mode (ATM) based network, to communicate with each other using the individual bearer service 1, as defined in ETS 300 217 [3], the definition of the interworking between these two kinds of network is needed.

This ETR gives the functional definition of the interface for the interworking between MAN and ATM-based network. The defined interface includes functionalities to support the interworking in the case in which the two networks belong to the same network operator domain and in the case in which they belong to different ones.

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1 Scope

This ETSI Technical Report (ETR) describes the network interworking between European standard Metropolitan Area Networks (MANs) (see ETS 300 211 [2]) and an Asynchronous Transfer Mode (ATM) based network, when both networks support the Connectionless Broadband Data Service (CBDS) individual bearer service 1 as defined in ETS 300 217 [3].

The interworking between MANs and the ATM network when MAN and ATM users use other services is outside the scope of this ETR.

The ATM network provides connectionless service directly or indirectly, according to ITU-T Recommendation I.327 [12], and is based on ATM nodes (crossconnects and switches) and on Connectionless Servers (CLSs). The CBDS will be supported in the ATM network via permanent, semipermanent and switched Virtual Channel (VC) and/or Virtual Path (VP) Broadband Integrated Services Digital Network (B-ISDN) connections.

Figure 1 shows user-to-user communications of CBDS users connected to an ATM-based network and/or MAN Switching Systems (MANs).

Direct interconnection of MANs (case A), based on the Dual Queue, Dual Bus (DQDB) protocol, has been specified in ETS 300 275 [4].

Interconnection of MAN Switching Systems (MSSs) via the ATM network (cases B and B') has been specified in the ETS 300 405 [6].

The communication among ATM users using the CBDS (case C) is specified in the ETR 122 [1] and in ITU-T Recommendation I.364 [16].

This ETR specifies the interworking of MAN and ATM users (case D). Case D', representing the access of an ATM user to the MAN via ATM nodes, is not specified in this ETR.

This ETR is restricted to the interworking of MAN and the ATM network when the users use the CBDS individual bearer service 1 as defined in ETS 300 217 [3] and according to the principles for the provision of CBDS over an ATM network contained in ETR 122 [1].

The defined interface applies to the case in which the MAN and the ATM network belong to the same network operator domain and to the case in which they belong to different ones, assuming as basis the ETS 300 211 [2] and the CCITT Recommendation I.321 [11]; the basic data transfer functionalities at the interface are the same for the two cases; additional specific management functionalities are foreseen for each case.

This ETR provides the general principles and functional requirements for the interworking between MANs and ATM network for the support of CBDS; it defines the reference configuration, the functional blocks and their corresponding Protocol Reference Models (PRMs).

The specification of the interface between MAN and the ATM network is based on the Network Node Interface (NNI) and takes into account CCITT/ITU-T Recommendations I.150 [9], I.361 [13], I.362 [14], I.363 [15], I.327 [12], I.364 [16] and DE/NA-053206 [6].

⊲────────▷   user to user communication
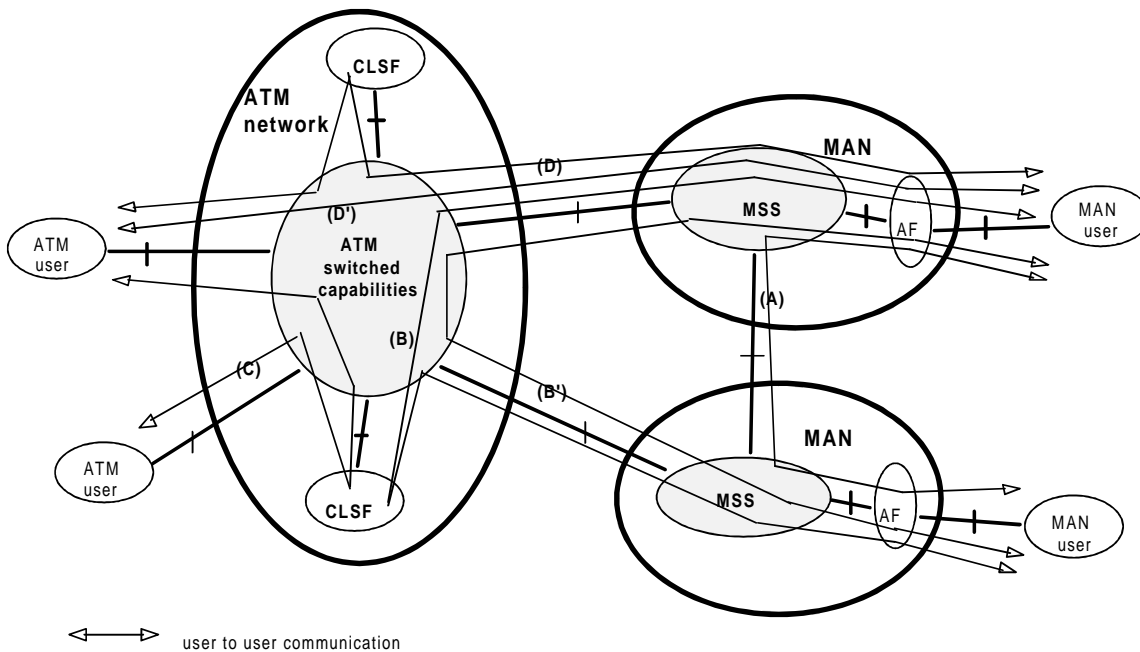
NOTE: AF stands for AF1 or AF2b

Figure 1: User-to-user communications of CBDS users connected to ATM-based network and/or MANs

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]   ETR 122: "Network Aspects (NA); Connectionless Broadband Data Service (CBDS) over Asynchronous Transfer Mode (ATM)".

[2]   ETS 300 211: "Network Aspects (NA); Metropolitan Area Network (MAN); Principles and architecture".

[3]   ETS 300 217: "Network Aspects (NA); Connectionless Broadband Data Service (CBDS)".

[4]   ETS 300 275: "Network Aspects (NA); Metropolitan Area Network (MAN); Interconnection of MANs".

[5]   ETS 300 405: "Network Aspects (NA); Metropolitan Area Network (MAN); Interconnection of MAN Switching Systems (MSS) based on an Asynchronous Transfer Mode (ATM) interface".

[6]   DE/NA-053206: "Network Aspects (NA); Connectionless Broadband Data Service (CBDS) over Asynchronous Transfer Mode (ATM); Network Node Interface (NNI) specification".

[7]   CCITT Recommendation E.164 (1991): "Numbering plan for the ISDN era".

[8]   ITU-T Recommendation I.113 (1993): "Vocabulary of terms for broadband aspects of ISDN".

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

[10]   ITU-T Recommendation I.311 (1993): "B-ISDN general network aspects".

[11]   CCITT Recommendation I.321 (1991): "B-ISDN protocol reference model and its application".

[12]   ITU-T Recommendation I.327 (1993): "B-ISDN functional architecture".

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

[14]   ITU-T Recommendation I.362 (1993): "B-ISDN ATM adaptation layer (AAL) functional description".

[15]   ITU-T Recommendation I.363 (1993): "B-ISDN ATM adaptation layer (AAL) specification".

[16]   ITU-T Recommendation I.364 (1993): "Support of broadband connectionless data service on B-ISDN".

[17]   ITU-T Recommendation I.432 (1993): "B-ISDN user-network interface - Physical layer specification".

[18]   ITU-T Recommendation I.610 (1993): "B-ISDN operation and maintenance principles and functions".

[19]   COM 11-R14: "B-ISDN signalling ATM Adaptation Layer overview description".

[20]   COM 11-R15: "Service Specific Connection Oriented Protocol (SSCOP)".

[21]   COM 11-R16: "Service Specific Coordination Functions (SSCF) for signalling at the UNI".

[22]   COM 11-R17: "Service Specific Coordination Functions (SSCF) for signalling at the NNI".

3   Definitions and abbreviations

3.1   Definitions

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

For B-ISDN related terms and definitions, see ITU-T Recommendation I.113 [8].

ATM Control Function (ACF) Block: This contains functions for the handling of switched VC and/or VP connections.

ATM crossconnect: This could be either VP cross connect or VC cross connect: see ITU-T Recommendation I.311 [10].

ATM Mapping Functions (AMF) Block: This contains the mapping functionality.

ATM switch: it could be VP, VC or VP/VC switch: See ITU-T Recommendation I.311 [10].

ATM Transit Access Function (ATAF) block: This contains functions to receive and transmit information over a medium. It is based on ATM.

ConnectionLess Network Interface Protocol (CLNIP): See ITU-T Recommendation I.364 [16].

ConnectionLess Server (CLS): See ETR 122 [1].

ConnectionLess Service Functions (CLSF): See ETR 122 [1].

Interworking MAN ATM Interface (IMAI): An ATM based interface for the interworking between MAN and ATM network belonging to the same or to different network operator domains.

Interworking Management Funtions (IMF) block: This includes the management functions relevant to the handling of the IMAI interface.

MAN Switching System (MSS): See ETS 300 211 [2].

Mapping Functions: Logical collection of CLS/MSS functions that supplements the CLNIP/Initial MAC Protocol Data Unit (IMPDU) layer functionalities in order to provide CBDS over a multi-CLS/multi-MSS network (see note 2).

MSS ATM Interface (MAI): An ATM based interface for the interconnection of MSS and ATM-based network belonging to the same or to different network operator domains.

MSS Management Functions (MMF) block: See ETS 300 405 [6].

Network interconnection: This indicates a configuration in which users connected to two networks of the same kind (e.g. MANs) communicate through a third network (e.g. ATM-based network). The third network is called transit network; it may also consist of a single link (e.g. direct MAN interconnection) (see note 2).

Network interworking: This indicates a configuration in which users connected to two networks of different kinds (e.g. a MAN and an ATM-based network) communicate directly (see note 2).

Reference point Ym: See ETS 300 211 [2] (see note 1).

Reference point Zm: See ETS 300 211[2] (see note 1).

> NOTE 1: The reference points Ym and Zm are defined and used only in ETSI; no counterpart exists in CCITT.

Transit Access Termination (TAT): See ETS 300 211 [2].

> NOTE 2: These definitions are restricted to the scope of this ETR and are not intended to have general significance.

3.2 Abbreviations

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

AAL	ATM Adaptation Layer
ACF	ATM Control Functions
AMF	ATM Mapping Functions
ATAF	ATM Transit Access Function
ATM	Asynchronous Transfer Mode
B-ISDN	Broadband Integrated Services Digital Network
CBDS	Connectionless Broadband Data Service
CLNAP-PDU	Connectionless Network Access Protocol PDU
CLNIP	Connectionless Network Interface Protocol
CLS	Connectionless Server
CLSF	Connectionless Service Functions
DQDB	Dual Queue, Dual Bus
IMAI	Interworking MAN ATM Interface
IMF	Interworking Management Functions
IMPDU	Initial MAC PDU
MAI	MSS ATM Interface
MAN	Metropolitan Area Network
MMF	MSS Management Functions
MSS	MAN Switching System
NNI	Network Node Interface
OAM	Operation Administration and Maintenance
PDU	Protocol Data Unit
PRM	Protocol Reference Model
QoS	Quality of Service
SAAL	Signalling AAL
TAT	Transit Access Termination
VC	Virtual Channel
VCC	Virtual Channel Connection
VP	Virtual Path
VPC	Virtual Path Connection

4 Interworking interface (IMAI) requirements

The characteristics of the interface between MSS and the ATM based network enable to support the service described in the ETS 300 217 [3].

The interworking between MAN and the ATM network allows the exchange of connectionless data units between MAN users and ATM users. The relationship between the CL data units at the Ym reference point (IMPDU) and the ones at the Tb reference point (Connectionless Network Access Protocol PDU (CLNAP-PDU)) is shown in figure 2. The interworking between MAN and the ATM network allows the transparent transfer of the corresponding parts of the connectionless data unit between the Ym reference point in the MAN and the Tb reference point in the ATM-based network. The connectionless data unit sequence integrity is preserved between MAN and the ATM network to maintain the sequence order between end users.
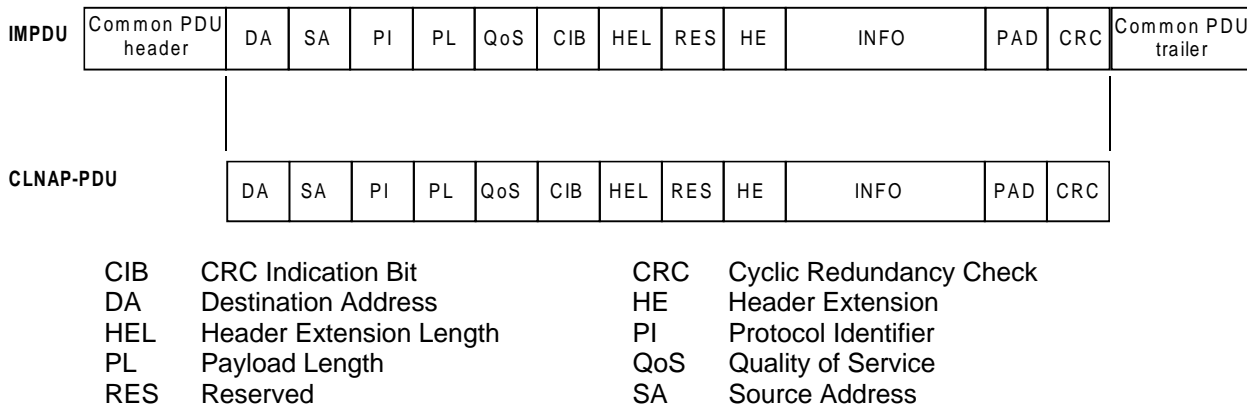

CIB	CRC Indication Bit			CRC	Cyclic Redundancy Check						
DA	Destination Address			HE	Header Extension						
HEL	Header Extension Length			PI	Protocol Identifier						
PL	Payload Length			QoS	Quality of Service						
RES	Reserved			SA	Source Address						

Figure 2: Relationship between IMPDU and CLNAP-PDU

The routeing of connectionless data units is based on the hierarchical E.164 number (CCITT Recommendation E.164 [7]). Both individual and group addressed data units transport handling is provided at the interface.

The defined interface supports the CBDS features in two cases: the MSS and the ATM based network belong to the same network operator domain or they belong to different network operator domains. In the first case additional functions for internal routeing and congestion management may be supported; in the second one operational functions related to the interworking between networks managed by different network operators may be supported.

Two techniques are allowed to forward/receive the data units across the IMAI:

- encapsulation of either the IMPDUs (which are defined at the Ym reference point) or the CLNAP-PDUs (which are defined at the Tb reference point) within the CLNIP-PDUs, according to the mechanism defined in ETR 122 [1]; or

- non-encapsulation of either the IMPDUs (which are defined at the Ym reference point) or the CLNAP-PDUs (which are defined at the Tb reference point) within the CLNIP data units (see ETR 122 [1]).

The requirements defined in ETS 300 405 [6] for the application of these techniques at the MAI also apply to the IMAI.

NOTE: For NNI applications between network operators, encapsulation is always used for both group and individually addressed PDUs; for NNI applications within a single operator's network, encapsulation and/or non-encapsulation may be used depending on the choice of the network operator.

The interface between an MSS and the ATM based network is based on the NNI.

5 Reference configuration

The reference configuration for the interworking between MAN and ATM network is depicted in figure 3.

In figure 4 an example of correspondence between network elements and U plane protocol stacks is shown.

The IMAI is located at the Zm reference point (see ETS 300 211 [2]).
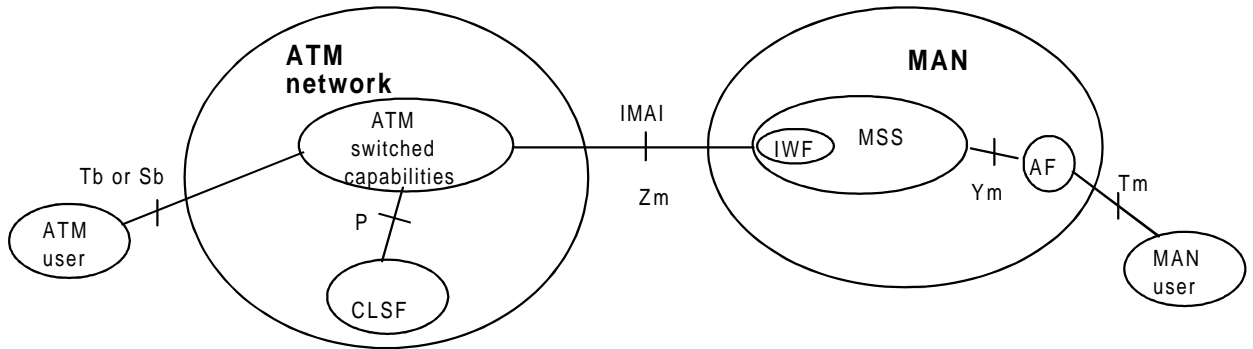
IMAI: Interworking MAN ATM interface

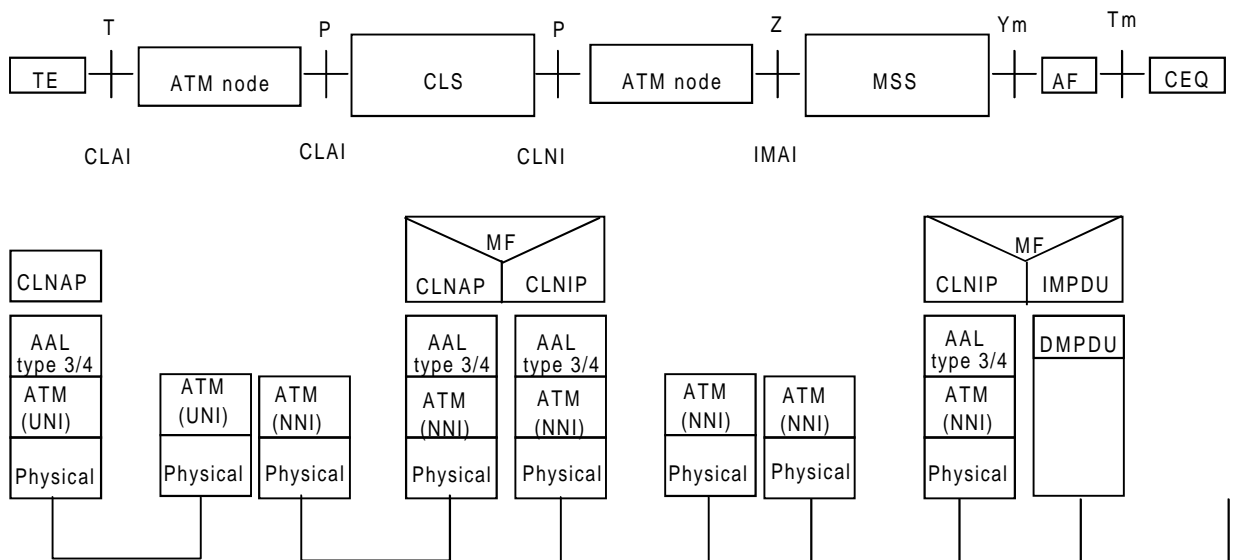**Figure 3: Reference configuration for MAN/ATM network interworking**

Figure 4: Correspondence between network elements and U plane protocol stack (example)

6 Functional architecture

6.1 ATM switched capabilities and CLSF

The ATM network provides connectionless service directly or indirectly, according to ITU-T Recommendation I.327 [12], and is based on ATM switched capabilities and on CLSF.

The ATM switched capabilities support the ATM transport network functionalities, corresponding to the physical and ATM layers of the B-ISDN PRM, as defined in ITU-T Recommendation I.311 [10].

For the interworking between MAN and the ATM network these functionalities are provided by the ATM nodes (cross-connect and switches); they support permanent, semipermanent and switched VC and/or VP connections between the MAN and the network element providing CLSF, between two network elements providing CLSF and between the user and the network element providing CLSF. If switched ATM connection are supported, the ATM node is directed by control plane functions; if permanent/semipermanent ATM connection are supported, the ATM node is directed by the management plane functions.

The CLSF terminates the B-ISDN connectionless protocol, providing functions such as address handling/resolution and routeing of ConnectionLess data units, and includes functions for the adaptation of the connectionless protocol to the intrinsically connection oriented ATM transport network functionalities. The CLSF are provided by the ConnectionLess Server. The functional description of the ConnectionLess Server is given in ETR 122 [1].

6.2 MAN Switching System (MSS)

In order to provide the functionality for the interworking of MAN and the ATM network, the following functional blocks are envisaged inside the MSS (see figure 5) (see note):

- the MMF block, which provides the functions related to the MSS management. As far as the management of the IMAI interface is concerned the IMF functional component is envisaged;

- the TAT (Transit Access Termination) block, which includes the data transfer and control functions for terminating the transit link at the Zm reference point.

    NOTE: The complete functional description of MSS is given in the ETS 300 211 [2]; only the functions related to the interworking between MAN and ATM network are listed in this ETR

A MSS can contain more than one TAT, one for each physical layer connection. The appropriate TAT for each connectionless data unit to be forwarded on the ATM based network is chosen by the MSS on the basis of the addressing information.

For each physical layer connection more than one Virtual Path Connection can exist. (ITU-T Recommendations I.311 [10] and I.432 [17]).

The functions described in the following do not imply any particular implementation.

6.2.1 Transit Access Termination (TAT)

As depicted in figure 5, the TAT terminates the transit link at the Zm reference point where the IMAI interface is defined.

Three functional blocks, namely ATAF, AMF and ACF, are envisaged within the TAT (see figure 5):

- **ATM Transit Access Functions (ATAF) block:** this contains functions to receive and transmit information over a medium. It is based on ATM and includes the protocol functionalities of the physical, ATM, ATM Adaptation Layer (AAL) type 3/4 and CLNIP layers of the B-ISDN PRM;

- **AMF block:** this contains the mapping functionalities;

- **ACF block:** this contains the functions for the handling of switched VP and/or VC connections. It is based on ATM and includes the functionalities of the physical, ATM, S-AAL and higher layers of the B-ISDN PRM control plane protocol stack.
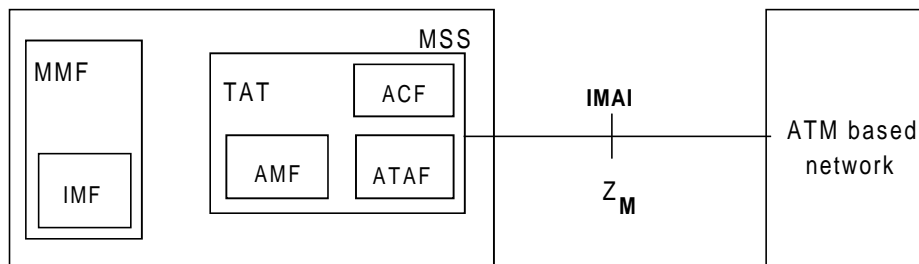

Figure 5: MSS functional model

The detailed functional description of the ATAF and the AMF blocks, as well as the description of the interaction between these two blocks, as given in subclause 7.3 and Annex A of ETS 300 405 [6] for the MAI, apply also to the IMAI specified in this ETR.

ACF: this block performs the B-ISDN network signalling functionalities for the set-up, monitoring and clear down of VP and/or VC switched connections between the MSS and the network element providing CLSF (CL server). The request for the set up of ATM connections may be originated by the CL server or by the MMF in the MSS. The ACF interacts with the MMF for the updating of the global routeing, management and operational information subsequent to the setup of new ATM connections.

6.2.2 Interworking Management Functions (IMF)

The IMF is included inside the MMF block and is depicted in figure 5.

The IMF includes both protocol layer management functions for the ATAF and the ACF blocks and management functions related to operational aspects of the AMF block (e.g. loading and error reporting in case of unknown address).

The IMF also contains functionality to gather statistics for traffic exchanged between MSSs and the ATM based network.

The IMF supports routeing and congestion management functions if required for the interworking within the same network operator domain, and provides operational functions (e.g. provision of charging capabilities) for the interworking between different network operator domains, in addition to the respective measurement implemented in each network domain (see ITU-T Recommendation I.610 [18]).

The IMF also includes management functions for the handling of VC and/or VP connections in accordance with the B-ISDN PRM management plane protocol stack as given in CCITT Recommendation I.321 [11].

7 Protocol reference model applicable at the IMAI

According to CCITT Recommendation I.321 [11] the B-ISDN PRM for ATM is composed of a user plane, a control plane and a management plane. The PRM for the IMAI is shown in figure 6.
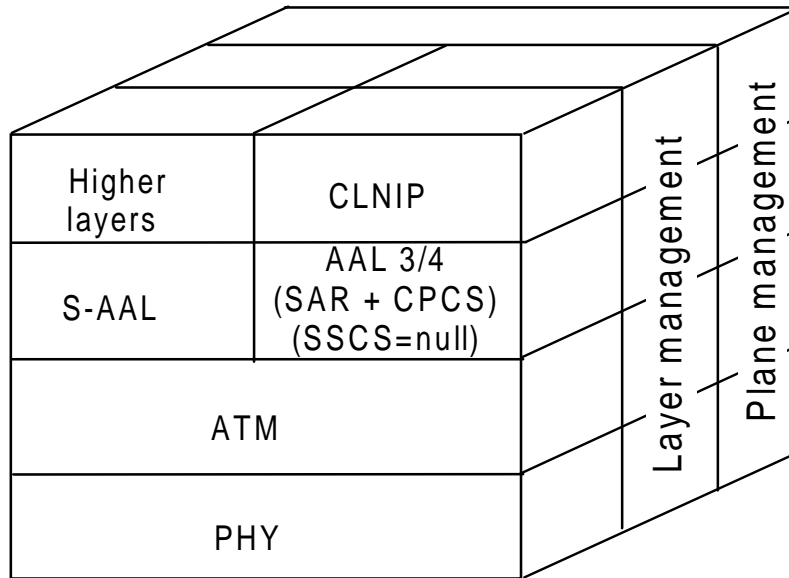

Figure 6: Protocol reference model for IMAI

For the user plane the physical, ATM, AAL type 3/4 and CLNIP layers are identified. The CLNIP protocol is defined in ETR 122 [1]. The functionalities and characteristics of each layer are given in CCITT/ITU-T Recommendations I.321 [11], I.150 [9], I.361 [13], I.362 [14], I.363 [15].

The control plane has a layered structure and performs the signalling functions necessary to set up, supervise and release VC and/or VP connections. The functionalities and characteristics of physical, ATM, S-AAL layers are given in CCITT/ITU-T Recommendations I.150 [9], I.361 [13], I.362 [14], I.363 [15] and in the documents COM 11-R14 [19], COM 11-R15 [20], COM 11-R16 [21] and COM 11-R17 [22]. The higher layer structure and functionalities are being defined in the relevant CCITT Recommendations.

The management plane includes functionalities of local coordination, that reside in the plane management, functionalities related to the Operation Administration and Maintenance (OAM) for each corresponding layer of the user and control planes and functionalities for the establishment of permanent/semipermanent VC and/or VP connection and for the management of all the active connections, that reside in the layer management. The structure and layering of the layer management is outside the scope of this ETR.

History

Document history	
November 1994	First Edition
February 1996	Converted into Adobe Acrobat Portable Document Format (PDF)