DSL Forum
Technical Report
TR-037

Auto-Configuration for the Connection Between the DSL Broadband Network Termination (B-NT) and the Network using ATM

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Abstract:

This document defines a set of parameters to be used for configuring and/or provisioning of DSL broadband network termination (B-NT) connection parameters, and recommends protocols for the transport of these parameters. The document is specific to an environment where ATM is used to provide the connection between the network and the B-NT. The document also describes an initial, but not complete, set of DSL service deployment scenarios from which the parameters are partially derived. This report is one of a set of documents that comprise a framework for automatically configuring a B-NT to provide end-user services over DSL technologies.

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1 Introduction

This recommendation specifies a set of configurable parameters for DSL B-NT that will be used to access a variety of broadband services. The B-NT is the functional element that exists between the U and S interfaces at the customer premises (see TR-017 [15] for the DSL Forum reference model). The B-NT configurable parameters are derived from specific protocol-related parameters, as well as parameters necessary for enabling certain types of business models for DSL service deployment. These parameters configure a B-NT to use an ATM virtual channel connection from the B-NT through the Network Access Provider (NAP). It thus allows the B-NT to utilize provisioned ATM communications with the Network Service Provider (NSP) and lays the groundwork for further configuration of services supported by the connections.

An important goal of parameter selection is to avoid, as much as possible, any end-user involvement in the setup and configuration of B-NT. The parameter specification is oriented towards a mass-market, where the consumer often has little or no technical expertise.

Wherever possible, existing management protocols will be utilized for communication of these configurable parameters to the B-NT. The goal is to support auto-configuration of B-NT parameters dealing with the protocols carried over the U-interface.

This recommendation does not define the end-to-end provisioning/operations model but is cognizant that such an environment exists and will be the subject of future work. It is expected that the architectural underpinnings for delivery of these configurable parameters through a network to the B-NT will mark the end of the chain in an overall flow-through provisioning model. The architecture is not limited or bound to a specific deployment scenario or model — instead it will be generic enough to accommodate several models. Usage of these parameters does not require the existence of a complete flow-through environment.

2 Scope

The scope of this recommendation is to provide a robust and reliable B-NT auto-configuration method that will enable a DSL B-NT to obtain automatically from the network sufficient information to utilize Layer 2 connections to one or more network services. It is anticipated that a future recommendation will detail the specifics of layer-3 auto-configuration.

This document provides specific recommendations for Permanent Virtual Connections (PVCs) and Switched Virtual Connections (SVCs). However, the material concerning SVCs is not complete and subject for future work.

This recommendation assumes existence of a packet stream transported over ATM virtual channel connections. Since Layer 2 has multiple sublayers, and because the sublayers may exhibit tight functional coupling, there is no simple statement of scope

that is precise in all cases. Therefore, the term “access protocol” is defined as all of the layer 2 protocols and encapsulations above the AAL.

At completion of the procedures in this document, the B-NT will know:

- What VCCs are provisioned
- ATM Traffic Management parameters, AAL protocol and AAL parameters for each VCC
- What access protocols are carried on those VCCs, and in what formats
- Any associated characteristics of the access protocol.

This recommendation addresses only auto-configuration of B-NT over the U interface. It does not address other network management of B-NT devices, such as fault detection, performance, or firmware upgrade. This procedure augments preexisting interoperability capabilities to allow auto-configuration of the parameters outlined above.

3 Definitions

This document makes use of terms defined in DSL Forum TR-012 [1]. In addition to those definitions, this document uses the following terms:

3.1 Access Protocol

An access protocol is all of the encapsulation and layer 2 protocols necessary to access a service.

3.2 Connection

In this recommendation, a “connection” is an ATM virtual channel connection from the B-NT, through the NAP, to the first-level aggregation point in a network including any access protocol.

3.3 Service

In this document, a service is any layer 3 protocol capability that exists above the connection that is required to provide access to an NSP. The term “service” in the context of this document implies layer 3 service connectivity.

4 Auto-Configuration Requirements

This recommendation is intended to meet the following requirements:

- Minimize customer interaction and truck roll
- Support arbitrary NAP/Multiple NSP/Customer relationships
- Support independent NAP/NSP/Customer Premises Network management schemes
- Support multiple services
- Should work in existing networks, regulatory environments
- Support non-disruptive incremental service provisioning
- Allow incremental deployment/upgrade of auto-configuration framework
- Permit transparent transmission of realm-specific autoconfiguration information through the NAP from the NSP to the customer premises
- Security Aspects shall be considered
- Use other existing standards wherever possible
- Must support initial service provisioning as well as refresh and reconfiguration of services
- Make possible bulk-provisioning of CPE, services and/or connections within this framework

5 Configuration Parameter Categories

For DSL B-NT to establish a connection, the B-NT must be configured with a set of parameters. In the following table, the configurable parameters are identified and specified as to whether they are always required or required conditionally upon the value of other configured objects.

Parameter	Required/Conditional
VPI/VCI	Required
PHY identifier	Conditional
Encapsulation	Required
ATM Traffic Management parameters	Required
AAL	Required
L2 Client Protocol	Conditional
L2 Auth Type	Conditional
L2 Auth Data	Conditional

Table 1: Configuration Parameters

Table Columns

The *Parameter* field is the name of the parameter or parameter group that is being referenced.

The *Required/Conditional* field indicates whether a particular parameter or parameter category is considered required all cases or is conditionally required based on the values of other required objects.

Although L2 Auth Type and L2 Auth Data are parameters that may be required for establishing the connection, they are not auto-configured. Auto-configuration of these parameters would defeat the purposes for which they are intended.

Parameter/Category Descriptions

VPI/VCI – The ATM VPI and VCI (Virtual Path Identifier/Virtual Channel Identifier) uniquely identify the ATM virtual channel connection between the B-NT and the DSLAM, and thus allow the B-NT to identify the ATM virtual channel connection to an NSP.

PHY Identifier – This parameter selects which latency channel (fast or interleaved) is to be used for this VCC. It is used only for dual latency DSL PHYs.

Encapsulation – This parameter group indicates the encapsulation and service layer protocol.

ATM Traffic Management Parameters – This parameter group provides the ATM service category, traffic contract parameters (if any) and QoS parameters (if any) for the connection.

AAL – This parameter group selects the ATM adaptation layer protocol (e.g., AAL2, AAL5, etc.) and its parameters that are being used for this connection.

L2 Client Protocol – (Layer-2 Client Protocol) This parameter selects the access protocol used to access the service.

L2 Auth Type – This parameter selects what type of Layer 2 authentication is required by the NSP (if any).

L2 Auth Data – This parameter provides the authentication parameters to be used for instantiating the L2 connection to the NSP.

6 ILMI-based B-NT Auto-Configuration

DSLAMs supporting B-NT Auto-Configuration shall implement the subset of the ATM Forum ILMI 4.0 specification (and its extensions) defined in this section.

Interfaces to configure the network-side IME, although required, are not described in this recommendation.

From the perspective of the B-NT, the following procedure shall be used for auto-configuration of PVC-based connections.

1. The Network-side IME (Interface Management Entity)-based ILMI objects are populated (possibly through flow-through methods) with the values for the particular subscriber/service associations. In this example, possible service endpoints include NSP1 and NSP 2.
2. If the customer orders both these services, and if the two services are to be provided across separate VCCs, the ILMI MIB containing the service configuration is instantiated with at least two entries in the Service Type and Service Connection Info Tables (NSP1, NSP 2) and two entries in the VCC table (NSP1, NSP 2).
3. The B-NT is powered on and the DSL physical connection is established. Any physical or TC layer configuration can be completed at this time.
4. Cell delineation is achieved and the ILMI channel is initiated.
5. The IMEs at both sides of the link send a Cold Start TRAP. The user-side IME in the B-NT sends GETs for the ILMI Attachment Point Objects. The Network side IME responds to these GETs. (NOTE: both the B-NT and Network should attempt the exchange of Cold Start Traps several times to deal with cases where a trap is corrupted).
6. The User side IME sends a series of GETNEXT REQUESTs to the Network side IME to obtain its user profile (ServiceType Table, VCC Table, ServiceConnInfo Table) and configuration parameters for each PVC. Two of the objects obtained

(the `atmfAtmServiceLayer2ProtocolId` and `atmfAtmServiceLayer3ProtocolId` object) contain information on how the B-NT should access a particular service. The syntax of this object is described in section 8.

7. The ATM Layer is now active, PVCs are configured, and the B-NT has sufficient information to utilize the connection to the NSP.
8. Whenever the network changes the configuration of any ATM connection on the U interface (including when the service table associated with that connection has changed), the Network-side IME sends either the atmfVCCchange or atmfVPCchange traps. This causes the User-side IME to query the Network-side IME for an update of the auto-configuration and other MIB elements regarding the connection that may have changed. A robust implementation SHOULD attempt to discover and apply the parameters modified on the Network-side IME, as this prevents disruption to services being delivered across the IME representing the B-NT's U interface. Section 8.3.5 of [2] specifies that the B-NT should reset the IME receiving the atmfVCCchange or atmfVPCchange when there are changes to objects that are not in the Virtual Path Group or the Virtual Channel Group. SNMP traps are not assumed reliable, and SNMP version 1, as used by ILMI, does not provide for acknowledgement of traps. However, the parameter poll from the B-NT IME can be interpreted as the acknowledgement of these traps. If the Network-side IME does not receive the parameter poll before expiry of a timer (which is network specific) it may re-send the trap. However, the Network-side IME must allow sufficient time to prevent repeated action by the User-side IME, should the User-side IME's response to the first trap be delayed.

After PVCs are auto-configured, the B-NT may undergo address registration if it supports SVCs; the procedures are defined in section 9.5 of [2].

Use of SVCs and PVCs on the same DSL is not precluded.

7 Use of ILMI Layer 2 and Layer 3 Protocol Id Objects

This section describes the syntax and usage of the ILMI atmfAtmServiceLayer2ProtocolId and atmfAtmServiceLayer3ProtocolId objects. These objects are defined in the ATM Forum PVC Autoconfiguration Addendum [5]. This recommendation defines how these objects shall be used to select access protocols that are used in the DSL environment. The syntax is based on ISO/IEC TR9577 Network Layer Protocol Identification [9], and is compatible with the coding of the Broadband Low-Layer Information (B-LLI) information element in ITU-T Recommendation Q.2931 [10] (which is referenced by Sig 4.1). This coding was selected because it:

- Covers all wide-spread deployments

- Can be extended to most foreseeable applications, without requiring approval by other standards bodies
- Is consistent with SVC signaling

Additional guidance on the use of the NLPID encoding is derived from are RFC 2684 [14] (Multi-protocol Encapsulation over ATM, which obsoletes RFC 1483), and ITU-T Recommendation Q.2931 [10]. Further guidance is taken from RFC 1755 [11] (Signaling for IP over ATM), and RFC 2364 [12] (PPP over ATM), which includes signaling. This recommendation extends the codings of these RFCs to cover specific access protocols common in the DSL environment.

NOTE: This recommendation divides the access protocol into two parts: the "encapsulation" and the protocol included by the encapsulation. Recommendation Q.2931 and Sig 4.0 call these two parts "layer 2" and "layer 3." However, the access protocol may be below layer 3 (e.g., Ethernet), even though it is specified in the "layer 3" parameter (atmfAtmServiceLayer3ProtocolId object or User Information Layer 3 Protocol in the B-LLI Information Element).

The encoding of the Layer2 and Layer 3 protocol ID objects is specifically chosen to be the same as that in the corresponding octet groups of the Q.2931 B-LLI Information Element. The auto-configuration procedure requires using both the User Information Layer2 and User Information Layer 3 octet groups of the B-LLI Information Element (as permitted by RFC1755).

This recommendation does not provide a method to auto-configure multiple services over a single connection, other than to specify the highest common multi-protocol encapsulation. Further multiplexing may be done using in-band protocol identification.

ISO/IEC TR-9577 provides for an Initial Protocol Identification and a Subsequent Protocol Identification, thereby allowing for two sublayers of protocol (e.g., above the encapsulation layer). The Subsequent Protocol Identification is not presently needed in the DSL environment, and cannot be encoded in the B-LLI Information Element.

7.1 Usage of LLC

There are two categories of encapsulations: RFC 2684 LLC encapsulations, and "null" (sometimes called "VC-multiplexed") encapsulations. This recommendation allows configuration of LLC or "null" encapsulation, independent of the access protocol.

The abstract syntax of the ILMI `atmfAtmServiceLayer2ProtocolId` object is an octet string. In the auto-configuration procedure for PVCs, the Network IME sets the object to either have a value equal to '0x00' (indicating the null encapsulation), or have a length of 1 octet with the value '0x0C' (indicating LLC encapsulation).

7.2 Access Protocol

There are a variety of access protocols in use in the DSL environment, e.g., Ethernet, IP, PPP, as well as combinations such as IP over Ethernet. This method configures the access protocol using the syntax of ISO/IEC TR9577 [9], but with additional semantics defined here. Since ISO/IEC TR9577 specifies a "protocol," (rather than a protocol and an encapsulation), this recommendation defines how the TR9577 syntax may be used to specify the "encapsulation".

The two basic rules for encoding of the Layer 3 protocol identifier octet string are:

1. The "SNAP" encoding of Layer 3 protocol identifier indicates "LLC-SNAP" if the Layer 2 protocol identifier indicates "LLC". In this case, the first six octets of each AAL5 PDU contain a SNAP header. Otherwise, SNAP is used only to select the access protocol used with the Null encapsulation.
2. If the Layer 3 protocol identifier indicates Ethernet, it may be optionally followed by a 2-byte Ethertype, to further qualify the protocol supported. Such a specification indicates Ethernet encapsulation, and support for the given Ethertype. Obviously related Ethertypes are also supported; for example, IP over Ethernet (Ethertype 0x0800) includes support for ARP over Ethernet (Ethertype 0x0806), and PPPoE (Ethertype 0x8864) includes support for PPPoE Setup (Ethertype 0x8863). (See "A Method for Transmitting PPP over Ethernet", RFC 2516 [13] for more information on PPPoE.)

   Another example is arbitrary Ethertypes directly over AAL5 (without the Ethernet encapsulation). Such protocols can be specified with a Layer-3-Information of SNAP, and OUI of 00-00-00, and the Ethertype.

The ILMI `atmfAtmServiceLayer3ProtocolId` object is an octet string. In the auto-configuration procedure for PVCs, the Network-side IME sets the object to the octet string for the access protocol.

7.3 Encapsulation Specification Encodings

This section shows how the `atmfAtmServiceLayer2ProtocolId` and `atmfAtmServiceLayer3ProtocolId` objects shall be encoded for those combinations of access protocol and encapsulation that are widely used in the DSL environment. Other access protocols and encapsulations are not precluded, and shall be encoded in a fashion consistent with this section and the ATM Forum PVC Autoconfiguration Addendum.

The encapsulation identifier sequence specifies only the required lower protocol layers of the service. The service may support any combination of higher layer protocols above the lower layer service definition. For example, in the case of Ethernet bridged (RFC 2684) encapsulation, IP, IPX, AppleTalk could all be run as higher-layer protocols. In the case of IP over Ethernet bridged (RFC 2684) encapsulation, only IP would be run, including all associated helper protocols such as ARP and DHCP.

The following table shows the encodings of these objects for combinations of access protocol and encapsulation. In some case, the semantics of each encoding is given in an adjoining row or column of the table. All encodings are in hexadecimal. All multi-octet values are NBO (Network Byte Order, or Big-Endian). The parsing rules may be represented as a tree, as shown in Figure 1. The "Diagram Case" column provides the tree branch corresponding to the protocol/encapsulation in the table.

Access Protocol	Dia-gram Case	Encap	Protocol Stacking		Layer 2 Pro-tocol ID	Layer 3 Protocol ID								
					LLC/ None	ISO 9577								
PPPoA	A	LLC	PPP		0C	0B	CF							
	B	Null	PPP		00	0B	CF							
							PPP							
Classical IP	C	LLC	IP		0C	0B	80	00	00	00	08	00		
							snap	OUI			E'type IP			
	D	Null	IP		00	0B	CC							
							IP							
RFC2684 Bridged	E	LLC	eth no fcs		0C	0B	80	00	80	C2	00	07		
	F	Null	eth no fcs		00	0B	80	00	80	C2	00	07		
							snap	802.1 oui			Eth no fcs			
		LLC	eth fcs		0C	0B	80	00	80	C2	00	01		
		Null	eth fcs		00	0B	80	00	80	C2	00	01		
							snap	802.1 oui			Eth w/ fcs			
RFC2684 Bridged w/ IP	G	LLC	eth no fcs	IP	0C	0B	80	00	80	C2	00	07	08	00
	H	Null	eth no fcs	IP	00	0B	80	00	80	C2	00	07	08	00
							snap	802.1 oui			Eth no fcs		IP	
		LLC	eth fcs	IP	0C	0B	80	00	80	C2	00	01	08	00
		Null	eth fcs	IP	00	0B	80	00	80	C2	00	01	08	00
							snap	802.1 oui			PID eth fcs		IP	
RFC2684 Bridged W/ PPPoE	J	LLC	eth no fcs	PPP	0C	0B	80	00	80	C2	00	07	88	64
	K	Null	eth no fcs	PPP	00	0B	80	00	80	C2	00	07	88	64
							snap	802.1 oui			Eth no fcs		PPPoE	
		LLC	eth fcs	PPP	0C	0B	80	00	80	C2	00	01	88	64
		Null	eth fcs	PPP	00	0B	80	00	80	C2	00	01	88	64
							snap	802.1 oui			PID eth fcs		PPPoE	
Routed IPX		LLC	IPX		0C	0B	80	00	00	00	…	…		
							snap	OUI			Ethertype			
L2TP / ATM	M	LLC	L2TP		0C	0B	80	00	00	5E	00	07		
	N	Null	L2TP		00	0B	80	00	00	5E	00	07		
							snap	IANA OUI			PID L2TP			
Arbitrary E'type/ ATM		Null	Arbitrary E'type		00	0B	80	00	00	00	XX	XX		
							snap	Ethertype OUI			Ethertype			

Table 2: Encapsulation Encodings

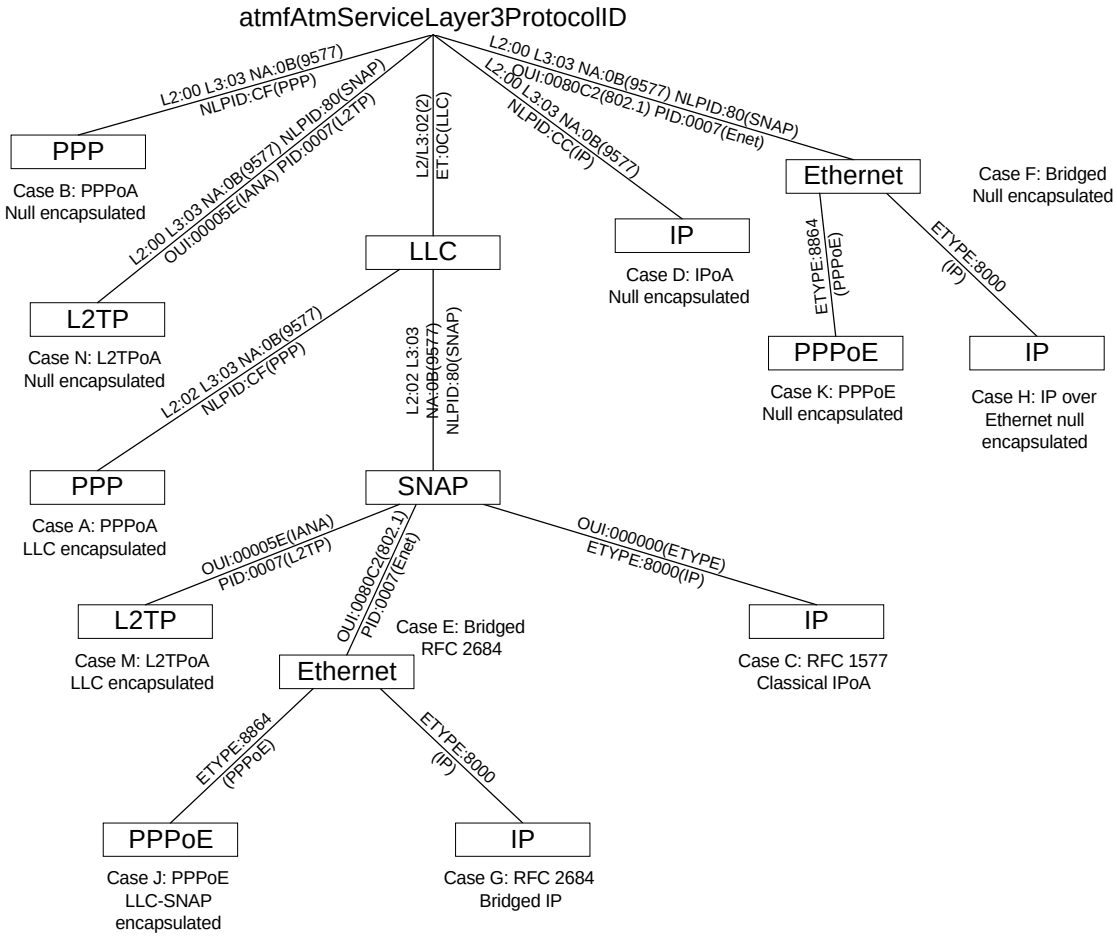

Figure 1: **Tree representation of access protocols and encapsulations**

8 Required ILMI Objects

The MIB tables, objects and traps specified in Table 3 are mandatory requirements, with the exception of the rules specified in section 8.1 , and must be imported from their corresponding MIBs to support auto-configuration of PVCs.

Defined In	Group	How Indexed
ATM Forum ILMI Specification (af-ilmi-0065.000)	atmfVccTable	By VCC
	atmfVccChange TRAP	By VCC
ATM Forum Autoconfiguration of PVCs Specification (af-nm-0122.000)	atmfAtmServiceTypeTable	By ServiceType
	atmfAtmServiceConnInfoTable	By VCC
	atmfAAL1ProfileTable	By Profile
	atmfAAL34ProfileTable	By Profile
	atmfAAL5ProfileTable	By Profile
ATM Forum Addendum to the ILMI Auto-configuration Extension (fb-nm-0165.000)	atmfAAL2CommonProfileTable	By Profile
	atmfAAL2TrunkingProfileTable	By Profile
	atmfAAL2LESProfileTable	By Profile
	atmfAtmServiceConnInfoExtensionTable	By VCC
	atmfAtmServiceTypeExtensionTable	By ServiceType
	atmfAtmServiceConfFail TRAP, atmfAtmServieConfFailReason OBJECT, atmfAtmServiceConfFailOID OBJECT	

Table 3: Required ILMI Objects

The B-NT, by accessing the objects defined in Table 3, can obtain the necessary information to determine ILMI connectivity and configured PVCs in a PVC-only environment.

8.1 ATM Service Category and Traffic Conformance Definition Objects

There are overlapping objects within the set of MIB tables identified in Table 3. These are related to the specification of the ATM service category and the

conformance definition to be used for an ATM PVC. In order to provide compatibility with the ATM Forum Traffic Management Specification version 4.1 (af-tm-0121.000) and to remove the overlap within the MIB tables the following rules shall be used.

1. To specify the ATM service category for a PVC the atmfAtmServiceTMCategory object defined in the atmfAtmServiceTypeTable of [4] shall be used. The atmfVccServiceCategory object defined in the atmfVccTable is not applicable and shall not be used.
2. To specify the ATM traffic conformance definition for a PVC the atmfAtmServiceTMConformanceDef object defined in the atmfAtmServiceTypeTable of [4] shall be used. The objects atmfVccTransmitTrafficDescriptorType, atmfVccReceiveTrafficDescriptorType and atmfVccBestEffortIndicator defined in the atmfVccTable are not applicable and shall not be used. The interpretation of atmfVccTransmitTrafficDescriptorParam1-5 and atmfVccReceiveTrafficDescriptorParam1-5 objects defined in the atmfVccTable shall remain the same as specified in section 7.1 of [2]. The traffic type shall be inferred from the value of the atmfAtmServiceTMConformanceDef object.

9 References

[1] Broadband Service Architecture for Access to Legacy Data Networks over ADSL, Issue 1, TR-012, DSL Forum, June 1998

[2] Integrated Local Management Interface 4.0, af-ilmi-0065.000, ATM Forum, September 1996

[3] User-Based Security Model for SNMP Version 3, RFC 2574, Blumenthal U., Wijnen B., April 1999

[4] Auto-configuration of PVCs Specification, af-nm-0122.000, ATM Forum, May 1999

[5] Addendum to the ILMI Auto-Configuration Extension, fb-nm-00165.000, ATM Forum, to be published April 2001

[6] Point-to-Point Protocol, RFC 1661, Simpson W., June 1994

[7] Internet Protocol Control Protocol, RFC 1332, McGregor G., May 1992

[8] Dynamic Host Configuration Protocol, RFC 2131, Droms R., March 1997

[9] Protocol Identification in the Network Layer, ISO/IEC TR 9577, 1990

[10] Broadband Integrated Services Digital Network (B-ISDN); Digital Subscriber Signaling System No. 2 (DSS 2); User-Network Interface (UNI) Layer 3 Specification for Basic Call/Connection Control, Q.2931, ITU-T, 1995

[11] ATM Signaling Support for IP over ATM, RFC 1755, Perez, M. et al., February 1995

[12] PPP Over AAL5, RFC 2364, Gross, G. et al., July 1998

[13] Method for Transmitting PPP Over Ethernet (PPPoE), RFC 2516, Mamakos, L., February 1999

[14] Multiprotocol Encapsulation over ATM Adaptation Layer 5, RFC 2684, Grossman, D., Heinanen, J., September 1999

[15] ATM over ADSL Recommendation, TR-017, DSL Forum, March 1999