

# DSL Forum Technical Report TR-045

(Formerly WT-052v8)

## PPP Static Interoperability Testing

March 2002

**Abstract:**

This document addresses static interoperability testing for the higher protocol layers running over DSL. As the first key application for DSL has been to provide high speed Internet access, this document focuses on the Point to Point Protocol (PPP) test scenarios covering static interoperability testing.

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## Table of Contents

<b>1. REVISION HISTORY .....</b>	<b>3</b>
<b>2. INTRODUCTION.....</b>	<b>3</b>
2.1 REFERENCE MODEL .....	3
<b>3. SCOPE OF PPP STATIC INTEROPERABILITY TESTING.....</b>	<b>4</b>
3.1 SCOPE .....	4
3.2 THE POINT-TO-POINT PROTOCOL STATIC INTEROPERABILITY TESTING .....	4
<b>4. TEST GROUPS .....</b>	<b>5</b>
4.1 TEST GROUP 1 - RFC 2684, “MULTI-PROTOCOL ENCAPSULATION OVER AAL5” .....	5
4.2 TEST GROUP 2 - RFC 2131, “DHCP FUNCTIONALITY” .....	5
4.3 TEST GROUP 3 – RFC 1661, RFC 2364, “PPP OVER ATM” .....	5
4.3.1 Subgroup 3.1 – Encapsulation.....	5
4.3.2 Subgroup 3.2 – PPP LCP .....	5
4.3.3 Subgroup 3.3 – PPP Authentication .....	5
4.3.4 Subgroup 3.4 – PPP IPCP.....	5
4.3.5 Subgroup 3.5 – PPP extensions .....	5
4.4 PPP FRAME FORWARDING TEST METHODOLOGY .....	5
<b>5. TEST CASE TEMPLATE.....</b>	<b>6</b>
<b>6. REFERENCES.....</b>	<b>8</b>
<b>7. ACRONYM LIST .....</b>	<b>8</b>
<b>8. ACKNOWLEDGMENTS.....</b>	<b>9</b>
<b>ANNEX A: TEST GROUP 1, “MULTI-PROTOCOL ENCAPSULATION OVER AAL5” .....</b>	<b>10</b>
GROUP_1_TEST_1 / LLC_SNAP_ENCAPSULATION.....	11
GROUP_1_TEST_2 / VC_MULTIPLEXING_ENCAPSULATION.....	12
GROUP_1_TEST_3 / LLC_SNAP_ETHERNET_BRIDGED_ENCAPSULATION .....	13
GROUP_1_TEST_4 / LLC_SNAP_ETHERNET_BRIDGED_FCS_ENCAPSULATION .....	14
GROUP_1_TEST_5 / LLC_SNAP_VPN_ENCAPSULATION .....	15
<b>ANNEX B: TEST GROUP 2, “DHCP FUNCTIONALITY” .....</b>	<b>16</b>
GROUP_2_TEST_1 / ATU-R_DHCP_DIRECT .....	17
GROUP_2_TEST_2 / ATU-R_DHCP_NATPAT .....	18
<b>ANNEX C: TEST GROUP 3, “PPP OVER ATM” SUBGROUP 1, “ENCAPSULATION” .....</b>	<b>19</b>
GROUP_3_1_TEST_1 / LLC_SNAP_PPP_ENCAPSULATION .....	20
GROUP_3_1_TEST_2 / VC_MULTIPLEXED_PPP_ENCAPSULATION .....	21
GROUP_3_1_TEST_3 / RECOVERY_VC_MULTIPLEXED_TO_LLC .....	22
GROUP_3_1_TEST_4 / RECOVERY_LLC_TO_VC_MULTIPLEXED .....	23
<b>ANNEX D: TEST GROUP 3, “PPP OVER ATM” SUBGROUP 2, “PPP LCP” .....</b>	<b>24</b>
GROUP_3_2_TEST_1 / PPP_LCP .....	25
GROUP_3_2_TEST_2 / ACCEPT_MAGIC_NUMBER_PAP .....	26
GROUP_3_2_TEST_3 / ACCEPT_MAGIC_NUMBER_CHAP .....	27
GROUP_3_2_TEST_4 / ACCEPT_MAGIC_NUMBER_MRU .....	28
GROUP_3_2_TEST_5 / ACCEPT_MAGIC_NUMBER_MRU_PAP.....	29
GROUP_3_2_TEST_6 / ACCEPT_MAGIC_NUMBER_MRU_CHAP .....	30
GROUP_3_2_TEST_7 / REJECT_MRU .....	31

GROUP_3_2_TEST_8 / REJECT_MAGIC_NUMBER .....	32
GROUP_3_2_TEST_9 / REJECT_PAP.....	33
GROUP_3_2_TEST_10 / REJECT_CHAP.....	34
GROUP_3_2_TEST_11 / REJECT_MAGIC_NUMBER_MRU .....	35
GROUP_3_2_TEST_12 / ACCEPT_PAP .....	36
GROUP_3_2_TEST_13 / ACCEPT_CHAP .....	37
GROUP_3_2_TEST_14 / MESSAGE_ECHO_REPLY .....	38
GROUP_3_2_TEST_15 / MESSAGE_CODE_REJECT .....	39
GROUP_3_2_TEST_16 / MESSAGE_DISCARD_REQUEST.....	40
GROUP_3_2_TEST_17 / MESSAGE_TERMINATION .....	41
GROUP_3_2_TEST_18 / MRU_MATCHES_MTU .....	42
GROUP_3_2_TEST_19 / PFC_NOT_RECOMMENDED.....	43
GROUP_3_2_TEST_20 / FCS_ACFC_ACCM_FORBIDDEN .....	44
GROUP_3_2_TEST_21 / LINK_LOOPBACK.....	45
<b>ANNEX E: TEST GROUP 3, “PPP OVER ATM” SUBGROUP 3, “PPP AUTHENTICATION” .....</b>	<b>46</b>
GROUP_3_3_TEST_1 / AUTHENTICATION_PAP_SUCCESS .....	47
GROUP_3_3_TEST_2 / AUTHENTICATION_PAP_FAILURE .....	48
GROUP_3_3_TEST_3 / AUTHENTICATION_CHAP_SUCCESS.....	49
GROUP_3_3_TEST_4 / AUTHENTICATION_CHAP_FAILURE.....	50
GROUP_3_3_TEST_5 / REJECT_AUTHENTICATION_METHOD.....	51
GROUP_3_3_TEST_6 / CHOOSE_CHAP_AMONG_CHAP_AND_PAP .....	52
GROUP_3_3_TEST_7 / CHOOSE_PAP_NO_OTHER_CHOICE .....	53
<b>ANNEX F: TEST GROUP 3, “PPP OVER ATM” SUBGROUP 4, “PPP IPCP” .....</b>	<b>54</b>
GROUP_3_4_TEST_1 / REJECT_NCP_TYPE_IP .....	55
GROUP_3_4_TEST_2 / PPP_IPCP_CONFIGURE.....	56
GROUP_3_4_TEST_3 / REJECT_IP-ADDRESS_MUTUALLY_ASSIGNED .....	57
GROUP_3_4_TEST_4 / ACCEPT_IP-COMPRESSION-PROTOCOL .....	58
GROUP_3_4_TEST_5 / REJECT_IP-COMPRESSION-PROTOCOL .....	59
GROUP_3_4_TEST_6 / PPP_IPCP_TERMINATE .....	60
<b>ANNEX G: TEST GROUP 3, “PPP OVER ATM” SUBGROUP 5, “PPP EXTENSIONS” .....</b>	<b>61</b>
G.1 IDENTIFICATION.....	61
G.2 TIME – REMAINING.....	61
G.3 VENDOR-EXTENSION .....	61
G.4 SELF-DESCRIBING PAD (SDP).....	61
G.5 CALLBACK.....	61
G.6 COMPOUND FRAMES .....	61
<b>ANNEX H: PPP FRAME FORWARDING TEST METHODOLOGY .....</b>	<b>62</b>
H.1 INTRODUCTION.....	62
H.2 TEST SETUP .....	62
H.3 REQUIREMENTS.....	62
H.4 UUT SETUP.....	63
H.5 INPUT FRAMES .....	63

# 1. Revision History

Date (M/D/YY)	Version	Major Changes
6/9/00	1	Creation of First draft – Antony Bichon/Scott Valcourt (combining the two contributions: dslforum2000.109.1 and dslforum2000.161)
8/30/00, 9/8/00	2	Editing changes and Scope improvement
11/21/00	3	Added official cover page
12/6/00	4	Editing
3/14/01	5	Editing to reflect the position of this document in relation to the “PPP-based Solutions Static Interoperability Test Plan”
8/01/01	6	Added "PPP Frame Forwarding Test Methodology" as Annex H Removed reference to L2TP as aggregation technology
8/28/01, 9/21/01	7	Alignment with TR-043 Preparation for straw ballot
11/30/01	8	Proposed straw ballot comments resolution
2/25-27/02	TR-045	Added cover page and updated page numbers in TOC; fonts

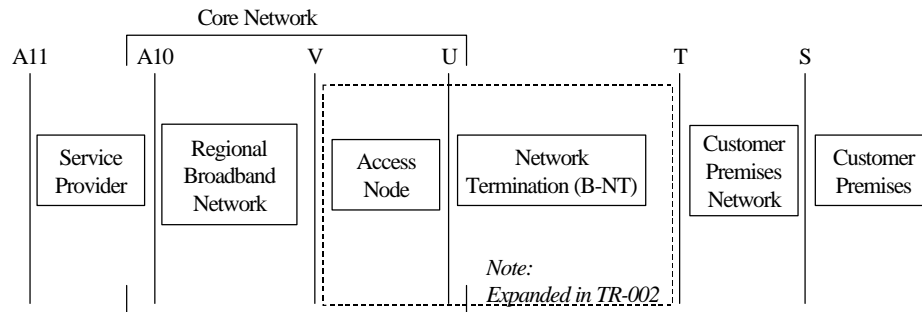
# 2. Introduction

The DSL Forum has made much progress toward full interoperability at the physical layer. The DSL Forum’s TR-023 [1] extended that work toward higher protocol layers testing, and defined three (3) areas of testability: conformance, static interoperability and dynamic interoperability.

This document addresses PPP static interoperability testing. See [4]and [7] for the definition of PPP and its use over ATM and see [1] for the definition of Static Interoperability testing.

The use of PPP over ATM, or Frame Relay, over DSL is critical, as the first major application for DSL has been high speed Internet access. This is key as PPP has been used for narrow band dial-up connections such as V.90 and ISDN. The result is that DSL access can be viewed as a higher speed, always-on connection, while preserving current ISP infrastructure. With its security provisioning, multi-protocol support, IP dynamic address assignment, and its ability to support both asynchronous and synchronous connections, PPP has become the *de facto* standard for Internet access.

## 2.1 Reference Model



NOTE: V, U, S and T correspond to ITU practice  
A10 and A11 are borrowed from DAVIC as there are no ITU equivalents

**Figure 1 - Architectural reference model [3]**

As stated in [3], the U reference point “lies between the B-NT (ATU-R) and the Access Node. PPP-over-ATM-over-ADSL has been identified by TR-012 as the Layer 2 protocol over the U-interface to access legacy data networks.”

For an interoperability point of view, we need to identify the end points involved into the PPP

negotiation. According to [3], we can extend the previous reference model into the following network architectures:

- The transparent ATM core network
- L2TP Access Aggregation (LAA)
- PPP Terminated Aggregation (PTA)

In these three models, the initiation of the PPP session will be located in the customer premises (T or S reference point).

The termination of the PPP session will be located:

- For the “transparent ATM core” and “LAA” models, at the A10 reference point, into the service provider network.
- For the “PTA” model, at the V reference point, into the Regional Broadband Network (in the Broadband Access Server).

See [3], sections 8.2.1 to 8.2.3 for network diagrams.

### 3. Scope of PPP Static Interoperability Testing

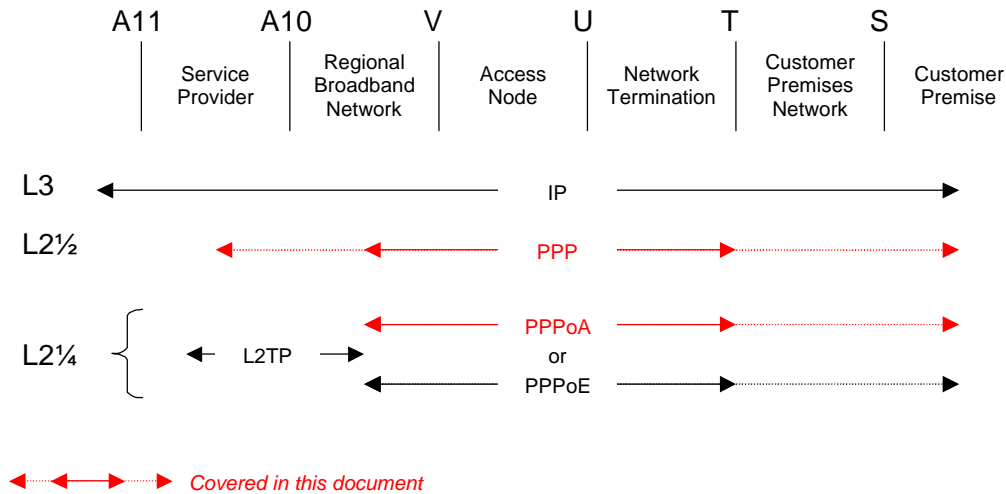
#### 3.1 Scope

PPP over ATM as described in [4] transports PPP frames over AAL5. PPP frames are generated and exchanged from the two end-points (customer premise network and service provider network) as described in [7].

This document specifies static interoperability testing for the Point-to-Point Protocol and also for the specific way it is carried over ATM and DSL.

Recently, PPP over Ethernet was added to the list of protocol supported. It is listed, along with other protocol stacks, in [18] and [19].

These new protocols would suggest future work from the Testing and Interoperability working group as stated in [19].



**Figure 2 – Reference Model, Protocol Stack, Scope**

Figure 2 shows the reference model layered with the main protocols described in [3], [17] and [19]. [17] requires PPP over ATM to be used for end-to-end connectivity between customer premise networks and service provider networks.

#### 3.2 The Point-to-Point Protocol Static Interoperability Testing

PPP, as a protocol, contains three phases: Link, Authentication and Network, which can be viewed as three different protocols.

- The Link phase protocol is called LCP (Link Control Protocol).

- The Authentication phase doesn't have any specific protocol. As described in [7] authentication is recommended but not mandatory. The Challenge Handshake Authentication Protocol, CHAP, is widely used ([12]).
- And finally the Network Phase is called NCP (Network Control Protocol). There is a specific NCP for each network protocol used. IPCP ([11]) is the most commonly used as the Internet Protocol (IP) is widely deployed.

The two protocols, LCP and IPCP have options that can be negotiated. This static interoperability testing will verify the ability of an implementation to negotiate these options and to interact properly with another implementation.

In addition, the specific encapsulation over ATM over DSL will be tested as described in [4].

Static interoperability testing for PPP LCP, Authentication and NCP (IPCP) as well as PPP encapsulation over ADSL will be mostly conformance testing. Test scenarios are detailed in each section.

## 4. Test Groups

### 4.1 Test Group 1 - RFC 2684, "Multi-protocol encapsulation over AAL5"

This test group focuses on the encapsulation of multi-protocols over ATM. As ATM is the technology chosen to carry data over DSL, this test specification covers most of the aspects of this RFC.

### 4.2 Test Group 2 - RFC 2131, "DHCP functionality"

This test group focuses on DHCP functionality of an ATU-R.

### 4.3 Test Group 3 – RFC 1661, RFC 2364, "PPP over ATM"

This test group focuses on the Point-to-Point Protocol. It is split into five subgroups to keep the different stages of PPP isolated from each other.

#### 4.3.1 Subgroup 3.1 – Encapsulation

This test group focuses on the encapsulation of PPP over ATM.

#### 4.3.2 Subgroup 3.2 – PPP LCP

This test group focuses on the Link Control Protocol of PPP.

#### 4.3.3 Subgroup 3.3 – PPP Authentication

This test group focuses on the authentication process in PPP.

#### 4.3.4 Subgroup 3.4 – PPP IPCP

This test group focuses on the IP Control Protocol of PPP

#### 4.3.5 Subgroup 3.5 – PPP extensions

This test group focuses on the extensions of PPP. It lists the possible extensions but does not specify any test cases. Work on this subject will depend on the interest.

## 4.4 PPP Frame Forwarding Test Methodology

This methodology provides details on traffic passing on the above test groups. When applicable, this methodology should be used.

## **5. Test Case Template**

See next page.

<p><b>Test Number / Test Label</b></p> <p>The <i>Test Number</i> specifies the number of the current test and provides a simple global identification system.</p> <p>The <i>Test Label</i> associated with each test follows a hierarchical domain naming algorithm, with subgroups separated by periods. More specific identifiers are located to the left; higher order identifiers are located to the right.</p> <p>For example, the following <i>Test Label</i> identifies the LLC Encapsulation Test:  <i>llc_encap_interoperability_test</i></p>
<p><b>Test Purpose</b></p> <p>The <i>Test Purpose</i> is a short statement that describes what the test hopes to achieve. The purpose is written at the functional level.</p> <p>For example, the following <i>Test Purpose</i> describes the LLC Encapsulation Test:  <i>The purpose of this test is to verify that the packets are transmitted over the link using LLC/SNAP encapsulation</i></p>
<p><b>Last Modification</b></p> <p>The <i>Last Modification</i> section specifies the date of the last modification to this test.</p>
<p><b>References</b></p> <p>The <i>References</i> section lists cross-references to RFC standards and other relevant documentation that might be useful in understanding and evaluating the test and its results.</p>
<p><b>Resource Requirements</b></p> <p>The <i>Resource Requirements</i> section specifies the test equipment, SUT as well as generators/analyzers that will be needed to perform the test.</p>
<p><b>Input Parameters</b></p> <p>The <i>Input Parameters</i> that need to be specified in order to run the test case.</p>
<p><b>Test Procedure and Setup</b></p> <p>The <i>Test Procedure and Setup</i> section lists steps and the network configuration of the test case.</p>
<p><b>Discussion</b></p> <p>The <i>Discussion</i> section describes what should happen during a test, and provides information necessary to understand the test.</p>
<p><b>Success Criteria</b></p> <p>The <i>Success Criteria</i> section explains the “normal” behavior of the two PPP stacks in accordance with RFCs and the entered parameters.</p>
<p><b>Results</b></p> <p>The <i>Results</i> section gives the final state of the equipment used in this test case. Generally, the state of the PPP session on the 2 machines involved.</p>



## 6. References

- [1] DSL Forum TR-023, “*Overview of ADSL Testing*”, May 1999
- [2] DSL Forum TR-017, “*ATM over ADSL Recommendation*”, March 1999
- [3] DSL Forum TR-025, “*Core Network Architecture Recommendations for Access to Legacy Data Networks over ADSL*”, September 1999
- [4] Gross, *et al*, “*PPP Over AAL5*”, RFC 2364, July 1998
- [5] D. Grossman, J. Heinanen, “*Multi-protocol Encapsulation over ATM Adaptation Layer 5*”, RFC 2684, September 1999
- [6] G. Zorn, S. Cobb, 2433 “*Microsoft PPP CHAP Extensions*”, RFC 2433, October 1998
- [7] W. Simpson, Editor, “*The Point-to-Point Protocol (PPP)*”, RFC 1661, July 1994
- [8] W. Simpson, Editor, “*PPP in HDLC-like Framing*”, RFC 1662, July 1994
- [9] W. Simpson, Editor, “*PPP LCP Extensions*”, RFC 1570, January 1994
- [10] G. Zorn, “*PPP LCP Internationalization Configuration Option*”, RFC 2484, January 1999
- [11] G. McGregor, “*The PPP Internet Protocol Control Protocol (IPCP)*”, RFC 1332, May 1992
- [12] W. Simpson, “*PPP Challenge Handshake Authentication Protocol (CHAP)*”, RFC 1994, August 1996
- [13] W. Townsley, *et al*, “*Layer Two Tunneling Protocol “L2TP”*”, RFC 2661, August 1999
- [14] W. Simpson, “*PPP Vendor Extensions*”, RFC 2153, May 1997
- [15] R. Droms, “*Dynamic Host Configuration Protocol*”, RFC 2131, March 1997
- [16] L. Mamakos *et al*, “*Point to Point Protocol over Ethernet*”, RFC 2516, February 1999
- [17] DSL Forum TR-012, “*Broadband Service Architecture for Access to Legacy Data Networks over ADSL Issue 1*”, June 1998
- [18] DSL Forum TR-043, “*Protocols at the U Interface for Accessing Data Networks using ATM/DSL*”, August 2000
- [19] PD-006v5, “*PPP-based Solutions Interoperability Test Plan*”, December 2001

## 7. Acronym List

Acronyms used in this document:

AAL5	ATM Adaptation Layer 5
ACK	Acknowledgement
ATM	Asynchronous Transfer Mode
ATU-C	ADSL Terminate Unit - Central
ATU-R	ADSL Terminate Unit - Remote
ADSL	Asymmetric Digital Subscriber Line
BAS	Broadband Access Server
CHAP	Challenge-Handshake Authentication Protocol
CP	Customer Premises
CPE	Customer Premise Equipment
DSL	Digital Subscriber Line
FR	Frame Relay
HDLC	High-Level Data Link Control
IP	Internet Protocol
IPCP	Internet Protocol Control Protocol
IPX	Internetwork Packet Exchange
ISDN	Integrated Services Digital Network
LAC	L2TP Access Concentrator
LAN	Local Area Network
LCP	Link Control Protocol
LLC	Logical Link Control
LNS	L2TP Network Server
LQR	Link Quality Report
L2TP	Layer Two (2) Tunneling Protocol

MRU	Maximum Receive Unit
NAK	Not-Acknowledged
NCP	Network Control Protocol
NLPID	Network Layer Protocol Identifier
NSP	Network Service Provider
PAP	Password Authentication Protocol
PDU	Protocol Data Unit
PPP	Point-to-Point Protocol
PTA	PPP Termination Aggregation
PVC	Permanent Virtual Circuit
SAP	Service Access Point
SDU	Service Data Unit
SUT	System Under Test
SVC	Switched Virtual Circuit

## 8. Acknowledgments

Thanks to Govindan Nair (Intel), Nabil Damouny (Intel), Scott Valcourt (UNH) and Praveen Reguraman (UNH) for the work on the two initial contributions.

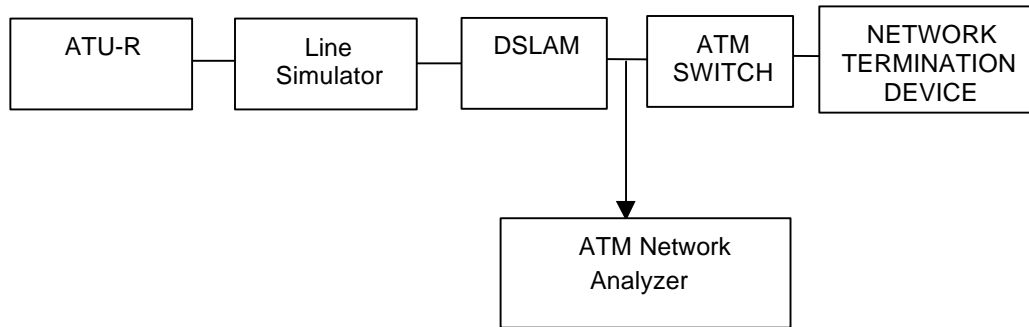
We would like to thank Benjamin Ellis from Virtual Access and Kadir Ozdemir from WindRiver for their comments on the initial contribution dslforum2000.109.

We also would like to thank Jim Finnegan from Basis Communications Corporations for his help with the test cases.

Finally, thank you to Antony Bichon, submitter and editor of this document.

We would like to thank also Fred Kaudel from Fluke Networks and chairman of the Testing & Interoperability working group of the DSL Forum for his help in guiding this document.

## ANNEX A: Test Group 1, “*Multi-protocol encapsulation over AAL5*”



<b>Group_1_Test_1 / llc_snap_encapsulation</b>
<b>Test Purpose</b>
The purpose of this test is to verify that traffic is passed over the link using LLC/SNAP encapsulation.
<b>Last Modification</b>
December 5, 2001
<b>References</b>
RFC 2684
<b>Resource Requirements</b>
<ul style="list-style-type: none"><li>• ATU-R unit (NT equipment)</li><li>• ATU-C unit (DSLAM)</li><li>• ATM switch</li><li>• Device capable of traffic generation</li><li>• ATM network analyzer</li><li>• Network Termination device</li></ul>
<b>Input Parameters</b>
Encapsulation: LLC/SNAP
<b>Test Procedure and Setup</b>
<ul style="list-style-type: none"><li>• Connect the ATU-R to the ATU-C with the line simulator with a length of 9 Kft.</li><li>• Verify that the system is able to establish a link.</li><li>• Power on the ATM network analyzer and capture transmitted packets.</li><li>• Transmit traffic over the link.</li></ul>
<b>Discussion</b>
This test is designed to verify the encapsulation of packets over the link using LLC/SNAP header. Multi-protocol data units are transmitted over ATM links using LLC/SNAP encapsulation or VC multiplexing. LLC/SNAP encapsulation has a protocol identifier filed to indicate the type of protocol data units transmitted.
<b>Success Criteria</b>
The system should initialize and should then be able to transmit traffic. The captured packets should have a valid LLC/SNAP header.
<b>Results</b>
Traffic should be received as sent

<b>Group_1_Test_2 / vc_multiplexing_encapsulation</b>
<b>Test Purpose</b>
The purpose of this test is to verify that traffic is passed over the link using VC multiplexing encapsulation.
<b>Last Modification</b>
December 5, 2001
<b>References</b>
RFC 2684
<b>Resource Requirements</b>
<ul style="list-style-type: none"><li>• ATU-R unit (NT equipment)</li><li>• ATU-C unit (DSLAM)</li><li>• ATM switch</li><li>• Device capable of traffic generation</li><li>• ATM network analyzer</li><li>• Network Termination device</li></ul>
<b>Input Parameters</b>
Encapsulation: VC Multiplexing
<b>Test Procedure and Setup</b>
<ul style="list-style-type: none"><li>• Connect the ATU-R to the ATU-C with the line simulator with a length of 9 Kft</li><li>• Verify that the system is able to establish a link.</li><li>• Power on the ATM network analyzer and capture transmitted packets.</li><li>• Transmit traffic over the link.</li></ul>
<b>Discussion</b>
This test is designed to verify the encapsulation of packets over the link using VC multiplexing. Multi-protocol data units are transmitted over ATM links using LLC/SNAP encapsulation or VC multiplexing. VC multiplexing assigns a specific VC value for each type of protocol data unit to be transmitted over the link.
<b>Success Criteria</b>
The system should initialize and should then be able to transmit traffic. The captured packets with a specific VC value should be data units of a specific protocol.
<b>Results</b>
Traffic should be received as sent

## Group\_1\_Test\_3 / llc\_snap\_ethernet\_bridged\_encapsulation

### Test Purpose

The purpose of this test is to verify that bridged protocol data units are transmitted over the link using RFC 2684 using LLC/SNAP encapsulation.

### Last Modification

December 5, 2001

### References

RFC 2684

### Resource Requirements

- ATU-R unit (NT equipment)
- ATU-C unit (DSLAM)
- ATM switch
- Device capable of traffic generation
- ATM network analyzer
- Network Termination device

### Input Parameters

Encapsulation: LLC/SNAP

### Test Procedure and Setup

- Connect the ATU-R to the ATU-C with the line simulator with a length of 9 Kft.
- Verify that the system is able to establish a link.
- Power on the ATM network analyzer and capture transmitted packets.
- Transmit Ethernet bridged PDUs over the link.

### Discussion

This test is designed to verify the encapsulation of bridged protocol data units over the link using LLC/SNAP header. Multi-protocol data units are transmitted over ATM links using LLC/SNAP encapsulation or VC multiplexing. LLC/SNAP encapsulation has a protocol identifier field to indicate the type of protocol data units transmitted. The LLC/SNAP header for bridged PDUs is:

LLC	0xAA-AA-03
OUI	0x00-80-C2
PID	0x00-01 or 0x00-07
PAD	0x00-00
MAC Dest. Address	
Remainder of MAC frame	
LAN FCS (if PID is 0x00-01)	

### Success Criteria

The system should initialize and should then be able to transmit traffic.  
The captured packets should have a valid LLC/SNAP header.  
The LLC/SNAP header should have the specific values as shown above.

### Results

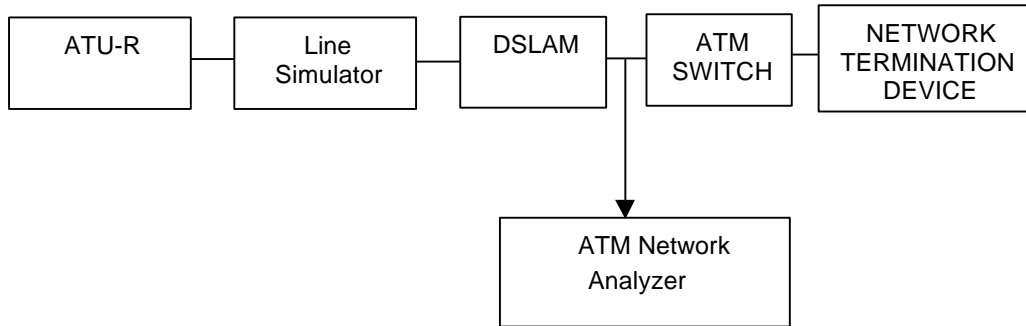
Traffic should be received as sent

<b>Group_1_Test_4 / llc_snap_ethernet_bridged_fcs_encapsulation</b>															
<b>Test Purpose</b>															
The purpose of this test is to verify that Ethernet bridged protocol data units are transmitted over the link preserving FCS using RFC 2684 using LLC/SNAP encapsulation.															
<b>Last Modification</b>															
December 5, 2001															
<b>References</b>															
RFC 2684															
<b>Resource Requirements</b>															
<ul style="list-style-type: none"> <li>• ATU-R unit (NT equipment)</li> <li>• ATU-C unit (DSLAM)</li> <li>• ATM switch</li> <li>• Device capable of traffic generation</li> <li>• ATM network analyzer</li> <li>• Network Termination device</li> </ul>															
<b>Input Parameters</b>															
Encapsulation: LLC/SNAP with FCS															
<b>Test Procedure and Setup</b>															
<ul style="list-style-type: none"> <li>• Connect the ATU-R to the ATU-C with the line simulator with a length of 9 Kft.</li> <li>• Verify that the system is able to establish a link.</li> <li>• Power on the ATM network analyzer and capture transmitted packets.</li> <li>• Transmit Ethernet bridged PDUs over the link.</li> </ul>															
<b>Discussion</b>															
<p>This test is designed to verify the encapsulation of bridged protocol data units with preserved FCS over the link using LLC/SNAP header. Multi-protocol data units are transmitted over ATM links using LLC/SNAP encapsulation or VC multiplexing. LLC/SNAP encapsulation has a protocol identifier field to indicate the type of protocol data units transmitted. The bridged encapsulation with preserved FCS must include padding. The LLC/SNAP header for bridged PDUs with preserved FCS is:</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td>LLC</td> <td>0xAA-AA-03</td> </tr> <tr> <td>OUI</td> <td>0x00-80-C2</td> </tr> <tr> <td>PID</td> <td>0x00-01</td> </tr> <tr> <td>PAD</td> <td>0x00-00</td> </tr> <tr> <td>MAC Dest. Address</td> <td></td> </tr> <tr> <td>Remainder of MAC frame</td> <td></td> </tr> <tr> <td>LAN FCS (if PID is 0x00-01)</td> <td></td> </tr> </table>		LLC	0xAA-AA-03	OUI	0x00-80-C2	PID	0x00-01	PAD	0x00-00	MAC Dest. Address		Remainder of MAC frame		LAN FCS (if PID is 0x00-01)	
LLC	0xAA-AA-03														
OUI	0x00-80-C2														
PID	0x00-01														
PAD	0x00-00														
MAC Dest. Address															
Remainder of MAC frame															
LAN FCS (if PID is 0x00-01)															
<b>Success Criteria</b>															
<p>The system should initialize and should then be able to transmit traffic.  The captured packets should have a valid LLC/SNAP header.  The LLC/SNAP header should have the specific values as shown above.  The LLC/SNAP header must include a PAD field.</p>															
<b>Results</b>															
Traffic should be received as sent															

<b>Group_1_Test_5 / llc_snap_vpn_encapsulation</b>																			
<b>Test Purpose</b>																			
The purpose of this test is to verify that packets are transmitted over the link using RFC 2684 using VPN encapsulation header using LLC/SNAP encapsulation.																			
<b>Last Modification</b>																			
December 5, 2001																			
<b>References</b>																			
RFC 2684																			
<b>Resource Requirements</b>																			
<ul style="list-style-type: none"> <li>• ATU-R unit (NT equipment)</li> <li>• ATU-C unit (DSLAM)</li> <li>• ATM switch</li> <li>• Device capable of traffic generation</li> <li>• ATM network analyzer</li> <li>• Network Termination device</li> </ul>																			
<b>Input Parameters</b>																			
Encapsulation: LLC/SNAP																			
<b>Test Procedure and Setup</b>																			
<ul style="list-style-type: none"> <li>• Connect the ATU-R to the ATU-C with the line simulator with a length of 9 Kft as shown above.</li> <li>• Verify that the system is able to establish a link.</li> <li>• Establish a VPN with a particular identifier value.</li> <li>• Power on the ATM network analyzer and capture transmitted packets.</li> <li>• Transmit bridged PDUs across the VPN.</li> </ul>																			
<b>Discussion</b>																			
<p>This test is designed to verify the encapsulation of packets over a VPN over the link using LLC/SNAP header. Multi-protocol data units are transmitted over ATM links using LLC/SNAP encapsulation or VC multiplexing. LLC/SNAP encapsulation uses a specific encapsulation header for VPNs according to RFC 2685, which specifies an identifier for the VPN. The LLC/SNAP header for VPN encapsulated LLC/SNAP encapsulation is:</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <tbody> <tr> <td>LLC</td> <td>0xAA-AA-03</td> </tr> <tr> <td>OUI</td> <td>0x00-00-5E</td> </tr> <tr> <td>PID</td> <td>0x00-08</td> </tr> <tr> <td>PAD</td> <td>0x00</td> </tr> <tr> <td>VPN related OUI</td> <td></td> </tr> <tr> <td>VPN index (4 Octets)</td> <td></td> </tr> <tr> <td>OUI</td> <td>0x00-80-C2</td> </tr> <tr> <td>PID</td> <td>0x00-01 or 0x00-07</td> </tr> <tr> <td>Remainder of PDU</td> <td></td> </tr> </tbody> </table>		LLC	0xAA-AA-03	OUI	0x00-00-5E	PID	0x00-08	PAD	0x00	VPN related OUI		VPN index (4 Octets)		OUI	0x00-80-C2	PID	0x00-01 or 0x00-07	Remainder of PDU	
LLC	0xAA-AA-03																		
OUI	0x00-00-5E																		
PID	0x00-08																		
PAD	0x00																		
VPN related OUI																			
VPN index (4 Octets)																			
OUI	0x00-80-C2																		
PID	0x00-01 or 0x00-07																		
Remainder of PDU																			
<b>Success Criteria</b>																			
<p>The system should initialize and should then be able to transmit traffic.  The captured packets should have a valid LLC/SNAP header.  The LLC/SNAP header should have the specific values as shown above.</p>																			
<b>Results</b>																			
Traffic should be received as sent																			



## ANNEX B: Test Group 2, “DHCP Functionality”

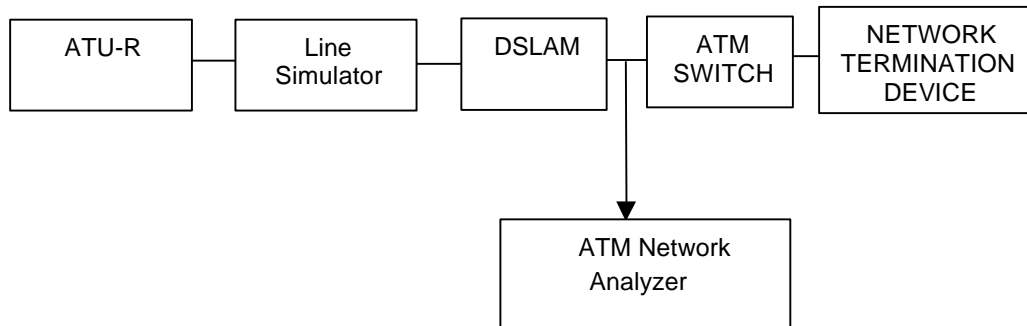


<b>Group_2_Test_1 / atu-r_dhcp_direct</b>
<b>Test Purpose</b>
The purpose of this test is to verify that the ATU-R is able to support DHCP functionality (without NAT/PAT).
<b>Last Modification</b>
December 5, 2001
<b>References</b>
RFC 2684, RFC 2131
<b>Resource Requirements</b>
<ul style="list-style-type: none"><li>• ATU-R unit (NT equipment) with DHCP server</li><li>• ATU-C unit (DSLAM)</li><li>• ATM switch</li><li>• Device capable of traffic generation</li><li>• Network Termination device</li></ul>
<b>Input Parameters</b>
<b>Test Procedure and Setup</b>
<ul style="list-style-type: none"><li>• Connect the ATU-R to the ATU-C with the line simulator with a length of 9 Kft</li><li>• Verify that the system is able to establish a link.</li><li>• Configure the PC connected to the ATU-R to request its IP address using DHCP.</li><li>• Configure the ATU-R as a DHCP server (the pool of addresses is provided by the network termination device).</li><li>• Observe if an IP address was obtained by the PC's DHCP client.</li><li>• Send traffic (ping, ftp, web, <i>etc.</i>)</li></ul>
<b>Discussion</b>
This test is designed to verify the DHCP server functionality of the ATU-R without NAT/PAT. ATU-Rs may be capable of supporting DHCP either themselves by Network address translation or from the network termination device.
<b>Success Criteria</b>
The system must initialize and must then transmit traffic using the IP address provided by the ATU-R's DHCP server.
<b>Results</b>
Traffic should be received as sent

<b>Group_2_Test_2 / atu-r_dhcp_natpat</b>
<b>Test Purpose</b>
The purpose of this test is to verify that the ATU-R is able to support DHCP functionality using NAT/PAT.
<b>Last Modification</b>
December 5, 2001
<b>References</b>
RFC 2684, RFC 2131
<b>Resource Requirements</b>
<ul style="list-style-type: none"> <li>• ATU-R unit (NT equipment) with DHCP server and NAT/PAT</li> <li>• ATU-C unit (DSLAM)</li> <li>• ATM switch</li> <li>• Device capable of traffic generation</li> <li>• Network Termination device</li> </ul>
<b>Input Parameters</b>
The internal and external NAT/PAT pools (external pool will be configured by DHCP)
<b>Test Procedure and Setup</b>
<ul style="list-style-type: none"> <li>• Connect the ATU-R to the ATU-C with the line simulator with a length of 9 Kft</li> <li>• Verify that the system is able to establish a link.</li> <li>• Configure the PC connected to the ATU-R to request its IP address using DHCP.</li> <li>• Configure the ATU-R as a DHCP server (the pool of addresses is provided by the network termination device).</li> <li>• Observe if an IP address was obtained by the PC's DHCP client.</li> <li>• Send traffic (ping, ftp, web, etc.)</li> </ul>
<b>Discussion</b>
This test is designed to verify the DHCP server functionality of the ATU-R without NAT/PAT. ATU-Rs may be capable of supporting DHCP either themselves by Network address translation or from the network termination device.
<b>Success Criteria</b>
The system must initialize and must then transmit traffic using: <ul style="list-style-type: none"> <li>• At the T/S interface, the internal IP address provided by the ATU-R's DHCP server.</li> <li>• At the U interface, the external IP address and NAT/PAT information.</li> </ul>
<b>Results</b>
Traffic should be received as sent

## **ANNEX C: Test Group 3, “PPP over ATM”**

### **Subgroup 1, “Encapsulation”**



<b>Group_3_1_Test_1 / llc_snap_ppp_encapsulation</b>						
<b>Test Purpose</b>						
The purpose of this test is to verify that PPP packets are transmitted over the link using RFC 2684 using LLC/SNAP encapsulation.						
<b>Last Modification</b>						
December 5, 2001						
<b>References</b>						
RFC 1661, RFC 2364, RFC 2684						
<b>Resource Requirements</b>						
<ul style="list-style-type: none"> <li>• ATU-R unit (NT equipment) – <i>Local implementation</i></li> <li>• ATU-C unit (DSLAM)</li> <li>• ATM switch</li> <li>• Device capable of traffic generation</li> <li>• ATM network analyzer</li> <li>• Network Termination device – <i>Peer implementation</i></li> </ul>						
<b>Input Parameters</b>						
Encapsulation: LLC/SNAP						
<b>Test Procedure and Setup</b>						
<ul style="list-style-type: none"> <li>• Connect the ATU-R to the ATU-C with the line simulator with a length of 9 Kft.</li> <li>• Verify that the system is able to establish a DSL link.</li> <li>• Power on the ATM network analyzer and capture transmitted packets.</li> <li>• Initiate a PPP session between the network termination device and the ATU-R.</li> </ul>						
<b>Discussion</b>						
<p>This test is designed to verify the encapsulation of PPP packets over the link using LLC/SNAP header. Multi-protocol data units are transmitted over ATM links using LLC/SNAP encapsulation or VC multiplexing. LLC/SNAP encapsulation has a protocol identifier field to indicate the type of protocol data units transmitted. The LLC header for PPP packets is,</p> <table border="1" data-bbox="594 1247 959 1354"> <tbody> <tr> <td>LLC</td> <td>0xFE-FE-03</td> </tr> <tr> <td>NLPID</td> <td>0xCF</td> </tr> <tr> <td>PPP PDU</td> <td></td> </tr> </tbody> </table>	LLC	0xFE-FE-03	NLPID	0xCF	PPP PDU	
LLC	0xFE-FE-03					
NLPID	0xCF					
PPP PDU						
<b>Success Criteria</b>						
<p>The system should initialize and should then be able to transmit traffic.  The captured packets should have a valid LLC header.  The LLC header should have the specific values as shown above.</p>						
<b>Results</b>						
LCP is in open state						

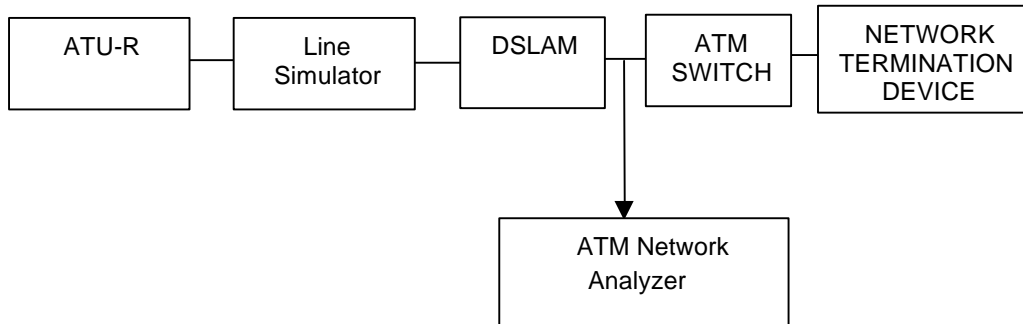
<b>Group_3_1_Test_2 / vc_multiplexed_ppp_encapsulation</b>
<b>Test Purpose</b>
The purpose of this test is to verify that PPP packets are transmitted over the link using RFC 2684 using VC Multiplexed encapsulation.
<b>Last Modification</b>
December 5, 2001
<b>References</b>
RFC 1661, RFC 2364, RFC 2684
<b>Resource Requirements</b>
<ul style="list-style-type: none"> <li>• ATU-R unit (NT equipment) – <i>Local implementation</i></li> <li>• ATU-C unit (DSLAM)</li> <li>• ATM switch</li> <li>• Device capable of traffic generation</li> <li>• ATM network analyzer</li> <li>• Network Termination device – <i>Peer implementation</i></li> </ul>
<b>Input Parameters</b>
Encapsulation: VC Multiplexed
<b>Test Procedure and Setup</b>
<ul style="list-style-type: none"> <li>• Connect the ATU-R to the ATU-C with the line simulator with a length of 9 Kft.</li> <li>• Verify that the system is able to establish a link.</li> <li>• Power on the ATM network analyzer and capture transmitted packets.</li> <li>• Initiate a PPP session between the network termination device and the ATU-R.</li> </ul>
<b>Discussion</b>
<p>This test is designed to verify the encapsulation of PPP packets over the link using VC Multiplexed header. Multi-protocol data units are transmitted over ATM links using LLC/SNAP encapsulation or VC multiplexing. VC Multiplexed encapsulation has no specific header or trailer, the PPP PDU is directly carried in the AAL5 CPCS-PDU. Henceforth, the CPCS-PDU for a PPP packets is,</p> <div style="border: 1px solid black; width: fit-content; margin: 0 auto; padding: 2px 10px;">PPP PDU</div>
<b>Success Criteria</b>
<p>The system should initialize and should then be able to transmit traffic. The captured packets should not have any specific header.</p>
<b>Results</b>
LCP is in open state

<b>Group_3_1_Test_3 / recovery_vc_multiplexed_to_llc</b>	
<b>Test Purpose</b>	The purpose of this test is to verify an implementation detection and recovery capability from PPP encapsulation transitions - VC-multiplexed to LLC. This is not a realistic scenario but is included due to the requirement of RFC 2364 section 8.
<b>Last Modification</b>	December 5, 2001
<b>References</b>	RFC 2364, RFC 2684
<b>Resource Requirements</b>	<ul style="list-style-type: none"> <li>• ATU-R unit (NT equipment) – <i>Local implementation</i></li> <li>• ATU-C unit (DSLAM)</li> <li>• ATM switch</li> <li>• Device capable of traffic generation</li> <li>• ATM network analyzer</li> <li>• Network Termination device – <i>Peer implementation</i></li> </ul>
<b>Input Parameters</b>	Encapsulation: VC Multiplexed, LLC/SNAP Local Machine: Set encapsulation to VC multiplexed Peer Machine: Set encapsulation to VC multiplexed
<b>Test Procedure and Setup</b>	<ul style="list-style-type: none"> <li>• Connect the ATU-R to the ATU-C with the line simulator with a length of 9 Kft.</li> <li>• From the local machine, initiate the establishment of the PPP session.</li> <li>• Wait until NCP is in open state.</li> <li>• Local Machine: Set encapsulation to LLC.</li> <li>• Power on the ATM network analyzer and capture transmitted packets.</li> <li>• Generate traffic.</li> </ul>
<b>Discussion</b>	This test is designed to verify ability to handle an encapsulation transition.
<b>Success Criteria</b>	<p>The peer's NCP must be closed, enter termination state as specified in RFC 2364 section 8:</p> <p>Once PPP has entered the Network-layer Protocol phase, and successfully negotiated a particular NCP for a PPP Protocol, if a frame arrives using an alternate but equivalent data encapsulation as defined in [4], then the PPP Link MUST:</p> <p>For a SVC, immediately clear the call with the cause value 111, "protocol error, unspecified".</p> <p>For a PVC: tear down the active NCPs, SHOULD generate an error message, enter the Termination state, and silently drop all received packets.</p>
<b>Results</b>	Peer's implementation is down

<b>Group_3_1_Test_4 / recovery_llc_to_vc_multiplexed</b>
<p><b>Test Purpose</b></p> <p>The purpose of this test is to verify an implementation detection and recovery capability from PPP encapsulation transitions - LLC to VC-multiplexed. This is not a realistic scenario but is included due to the requirement of RFC 2364 section 8.</p>
<p><b>Last Modification</b></p> <p>December 5, 2001</p>
<p><b>References</b></p> <p>RFC 1661, RFC 2364, RFC 2684</p>
<p><b>Resource Requirements</b></p> <ul style="list-style-type: none"> <li>• ATU-R unit (NT equipment) – <i>Local implementation</i></li> <li>• ATU-C unit (DSLAM)</li> <li>• ATM switch</li> <li>• Device capable of traffic generation</li> <li>• ATM network analyzer</li> <li>• Network Termination device – <i>Peer implementation</i></li> </ul>
<p><b>Input Parameters</b></p> <p>Encapsulation: VC Multiplexed, LLC/SNAP Local Machine: Set encapsulation to LLC Peer Machine: Set encapsulation to LLC</p>
<p><b>Test Procedure and Setup</b></p> <ul style="list-style-type: none"> <li>• Connect the ATU-R to the ATU-C with the line simulator with a length of 9 Kft.</li> <li>• From the local machine, initiate the establishment of the PPP session.</li> <li>• Wait until NCP is in open state.</li> <li>• Local Machine: Set encapsulation to VC-multiplexed.</li> <li>• Power on the ATM network analyzer and capture transmitted packets.</li> <li>• Generate traffic.</li> </ul>
<p><b>Discussion</b></p> <p>This test is designed to verify ability to handle an encapsulation transition.</p>
<p><b>Success Criteria</b></p> <p>The peer's NCP must be closed, enter termination state as specified in RFC 2364 section 8:</p> <p>Once PPP has entered the Network-layer Protocol phase, and successfully negotiated a particular NCP for a PPP Protocol, if a frame arrives using an alternate but equivalent data encapsulation as defined in [4], then the PPP Link MUST:</p> <p>For a SVC, immediately clear the call with the cause value 111, "protocol error, unspecified".</p> <p>For a PVC: tear down the active NCPs, SHOULD generate an error message, enter the Termination state, and silently drop all received packets.</p>
<p><b>Results</b></p> <p>Peer's implementation is down</p>



## **ANNEX D: Test Group 3, “PPP over ATM” Subgroup 2, “PPP LCP”**



<b>Group_3_2_Test_1 / ppp_lcp</b>										
<b>Test Purpose</b>										
The purpose of this test is to verify that LCP packets are transmitted for PPP link configuration and establishment.										
<b>Last Modification</b>										
December 5, 2001December 5, 2001										
<b>References</b>										
RFC 1661, RFC 2364, RFC 2684										
<b>Resource Requirements</b>										
<ul style="list-style-type: none"> <li>• ATU-R unit (NT equipment) – <i>Local implementation</i></li> <li>• ATU-C unit (DSLAM)</li> <li>• ATM switch</li> <li>• Device capable of traffic generation</li> <li>• ATM network analyzer</li> <li>• Network Termination device – <i>Peer implementation</i></li> </ul>										
<b>Input Parameters</b>										
<b>Test Procedure and Setup</b>										
<ul style="list-style-type: none"> <li>• Connect the ATU-R to the ATU-C with the line simulator with a length of 9 Kft.</li> <li>• Verify that the system is able to establish a link.</li> <li>• Power on the ATM network analyzer and capture transmitted packets.</li> <li>• Initiate a PPP session between the network termination device and the ATU-R.</li> </ul>										
<b>Discussion</b>										
<p>This test is designed to verify the transmission of LCP packets for link configuration. LCP is the Link Control Protocol used to configure the options for establishing a PPP session. The link is established by sending a configure-request packet and receiving a proper configure-ack packet. The packet format for LCP link configuration is,</p> <table border="1" data-bbox="597 1188 959 1367"> <tr> <td>PPP PID</td> <td>0xC021</td> </tr> <tr> <td>LCP Code</td> <td></td> </tr> <tr> <td>LCP Identifier</td> <td></td> </tr> <tr> <td>LCP Length</td> <td></td> </tr> <tr> <td>Configuration Options</td> <td></td> </tr> </table> <p>The values for LCP code field are</p> <ol style="list-style-type: none"> <li>1. Configure Request</li> <li>2. Configure Ack</li> <li>3. Configure Nak</li> <li>4. Configure Reject</li> </ol>	PPP PID	0xC021	LCP Code		LCP Identifier		LCP Length		Configuration Options	
PPP PID	0xC021									
LCP Code										
LCP Identifier										
LCP Length										
Configuration Options										
<b>Success Criteria</b>										
<p>The system should initialize and should then be able to transmit traffic. The captured packets should have value corresponding to LCP in the PPP protocol ID field. The LCP code value should correspond to values given above for configuration packets and all these packets should have the same value in the identifier field. The LCP configuration packets are exchanged and the PPP link is established or rejected.</p>										
<b>Results</b>										
LCP should be in the open state										

<b>Group_3_2_Test_2 / accept_magic_number_pap</b>										
<b>Test Purpose</b>										
The purpose of this test is to verify that an implementation can accept LCP options Magic Number and PAP.										
<b>Last Modification</b>										
December 5, 2001										
<b>References</b>										
RFC 1661, RFC 2364, RFC 2684										
<b>Resource Requirements</b>										
<ul style="list-style-type: none"> <li>• ATU-R unit (NT equipment) – <i>Local implementation</i></li> <li>• ATU-C unit (DSLAM)</li> <li>• ATM switch</li> <li>• Device capable of traffic generation</li> <li>• ATM network analyzer</li> <li>• Network Termination device – <i>Peer implementation</i></li> </ul>										
<b>Input Parameters</b>										
LCP options: Magic Number and PAP Local Machine: Set LCP options to Magic Number and PAP Peer Machine: Set LCP options to Magic Number and PAP										
<b>Test Procedure and Setup</b>										
<ul style="list-style-type: none"> <li>• Connect the ATU-R to the ATU-C with the line simulator with a length of 9 Kft.</li> <li>• Verify that the system is able to establish a link.</li> <li>• Power on the ATM network analyzer and capture transmitted packets.</li> <li>• Initiate a PPP session between the network termination device and the ATU-R.</li> </ul>										
<b>Discussion</b>										
This test is designed to verify the transmission of LCP packets for link configuration. LCP is the Link Control Protocol used to configure the options for establishing a PPP session. The link is established by sending a configure-request packet and receiving a proper configure-ack packet. The packet format for LCP link configuration is,										
<table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td>PPP PID</td> <td>0xC021</td> </tr> <tr> <td>LCP Code</td> <td></td> </tr> <tr> <td>LCP Identifier</td> <td></td> </tr> <tr> <td>LCP Length</td> <td></td> </tr> <tr> <td>Configuration Options</td> <td></td> </tr> </table>	PPP PID	0xC021	LCP Code		LCP Identifier		LCP Length		Configuration Options	
PPP PID	0xC021									
LCP Code										
LCP Identifier										
LCP Length										
Configuration Options										
The values for LCP code field are <ol style="list-style-type: none"> <li>1. Configure request</li> <li>2. Configure Ack</li> <li>3. Configure Nak</li> <li>4. Configure Reject</li> </ol>										
<b>Success Criteria</b>										
For local machine's <i>config-request</i> , peer must send a <i>config-ack</i>										
<b>Results</b>										
LCP should be in the open state										

<b>Group_3_2_Test_3 / accept_magic_number_chap</b>										
<b>Test Purpose</b>										
The purpose of this test is to verify that an implementation can accept LCP options Magic Number and CHAP.										
<b>Last Modification</b>										
December 5, 2001										
<b>References</b>										
RFC 1661, RFC 2364, RFC 2684										
<b>Resource Requirements</b>										
<ul style="list-style-type: none"> <li>• ATU-R unit (NT equipment) – <i>Local implementation</i></li> <li>• ATU-C unit (DSLAM)</li> <li>• ATM switch</li> <li>• Device capable of traffic generation</li> <li>• ATM network analyzer</li> <li>• Network Termination device – <i>Peer implementation</i></li> </ul>										
<b>Input Parameters</b>										
LCP options: Magic Number and CHAP Local Machine: Set LCP options to Magic Number and CHAP Peer Machine: Set LCP options to Magic Number and CHAP										
<b>Test Procedure and Setup</b>										
<ul style="list-style-type: none"> <li>• Connect the ATU-R to the ATU-C with the line simulator with a length of 9 Kft.</li> <li>• Verify that the system is able to establish a link.</li> <li>• Power on the ATM network analyzer and capture transmitted packets.</li> <li>• Initiate a PPP session between the network termination device and the ATU-R.</li> </ul>										
<b>Discussion</b>										
This test is designed to verify the transmission of LCP packets for link configuration. LCP is the Link Control Protocol used to configure the options for establishing a PPP session. The link is established by sending a configure-request packet and receiving a proper configure-ack packet. The packet format for LCP link configuration is,										
<table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td>PPP PID</td> <td>0xC021</td> </tr> <tr> <td>LCP Code</td> <td></td> </tr> <tr> <td>LCP Identifier</td> <td></td> </tr> <tr> <td>LCP Length</td> <td></td> </tr> <tr> <td>Configuration Options</td> <td></td> </tr> </table>	PPP PID	0xC021	LCP Code		LCP Identifier		LCP Length		Configuration Options	
PPP PID	0xC021									
LCP Code										
LCP Identifier										
LCP Length										
Configuration Options										
The values for LCP code field are <ol style="list-style-type: none"> <li>1. Configure Request</li> <li>2. Configure Ack</li> <li>3. Configure Nak</li> <li>4. Configure Reject</li> </ol>										
<b>Success Criteria</b>										
For local machine's <i>config-request</i> , peer must send a <i>config-ack</i>										
<b>Results</b>										
LCP should be in the open state										

<b>Group_3_2_Test_4 / accept_magic_number_mru</b>										
<b>Test Purpose</b>										
The purpose of this test is to verify that an implementation can accept LCP options Magic Number and MRU.										
<b>Last Modification</b>										
December 5, 2001										
<b>References</b>										
RFC 1661, RFC 2364, RFC 2684										
<b>Resource Requirements</b>										
<ul style="list-style-type: none"> <li>• ATU-R unit (NT equipment) – <i>Local implementation</i></li> <li>• ATU-C unit (DSLAM)</li> <li>• ATM switch</li> <li>• Device capable of traffic generation</li> <li>• ATM network analyzer</li> <li>• Network Termination device – <i>Peer implementation</i></li> </ul>										
<b>Input Parameters</b>										
LCP options: Magic Number and MRU Local Machine: Set LCP options to Magic Number and MRU Peer Machine: Set LCP options to Magic Number and MRU										
<b>Test Procedure and Setup</b>										
<ul style="list-style-type: none"> <li>• Connect the ATU-R to the ATU-C with the line simulator with a length of 9 Kft.</li> <li>• Verify that the system is able to establish a link.</li> <li>• Power on the ATM network analyzer and capture transmitted packets.</li> <li>• Initiate a PPP session between the network termination device and the ATU-R.</li> </ul>										
<b>Discussion</b>										
This test is designed to verify the transmission of LCP packets for link configuration. LCP is the Link Control Protocol used to configure the options for establishing a PPP session. The link is established by sending a configure-request packet and receiving a proper configure-ack packet. The packet format for LCP link configuration is,										
<table border="1"> <tr> <td>PPP PID</td> <td>0xC021</td> </tr> <tr> <td>LCP Code</td> <td></td> </tr> <tr> <td>LCP Identifier</td> <td></td> </tr> <tr> <td>LCP Length</td> <td></td> </tr> <tr> <td>Configuration Options</td> <td></td> </tr> </table>	PPP PID	0xC021	LCP Code		LCP Identifier		LCP Length		Configuration Options	
PPP PID	0xC021									
LCP Code										
LCP Identifier										
LCP Length										
Configuration Options										
The values for LCP code field are <ol style="list-style-type: none"> <li>1. Configure Request</li> <li>2. Configure Ack</li> <li>3. Configure Nak</li> <li>4. Configure Reject</li> </ol>										
<b>Success Criteria</b>										
For local machine's <i>config-request</i> , peer must send a <i>config-ack</i>										
<b>Results</b>										
LCP should be in the open state										

<b>Group_3_2_Test_5 / accept_magic_number_mru_pap</b>										
<b>Test Purpose</b>										
The purpose of this test is to verify that an implementation can accept LCP options Magic Number, MRU, and PAP.										
<b>Last Modification</b>										
December 5, 2001										
<b>References</b>										
RFC 1661, RFC 2364, RFC 2684										
<b>Resource Requirements</b>										
<ul style="list-style-type: none"> <li>• ATU-R unit (NT equipment) – <i>Local implementation</i></li> <li>• ATU-C unit (DSLAM)</li> <li>• ATM switch</li> <li>• Device capable of traffic generation</li> <li>• ATM network analyzer</li> <li>• Network Termination device – <i>Peer implementation</i></li> </ul>										
<b>Input Parameters</b>										
LCP options: Magic Number, MRU, and PAP Local Machine: Set LCP options to Magic Number, MRU and PAP Peer Machine: Set LCP options to Magic Number, MRU, and PAP										
<b>Test Procedure and Setup</b>										
<ul style="list-style-type: none"> <li>• Connect the ATU-R to the ATU-C with the line simulator with a length of 9 Kft.</li> <li>• Verify that the system is able to establish a link.</li> <li>• Power on the ATM network analyzer and capture transmitted packets.</li> <li>• Initiate a PPP session between the network termination device and the ATU-R.</li> </ul>										
<b>Discussion</b>										
This test is designed to verify the transmission of LCP packets for link configuration. LCP is the Link Control Protocol used to configure the options for establishing a PPP session. The link is established by sending a configure-request packet and receiving a proper configure-ack packet. The packet format for LCP link configuration is,										
<table border="1"> <tr> <td>PPP PID</td> <td>0xC021</td> </tr> <tr> <td>LCP Code</td> <td></td> </tr> <tr> <td>LCP Identifier</td> <td></td> </tr> <tr> <td>LCP Length</td> <td></td> </tr> <tr> <td>Configuration Options</td> <td></td> </tr> </table>	PPP PID	0xC021	LCP Code		LCP Identifier		LCP Length		Configuration Options	
PPP PID	0xC021									
LCP Code										
LCP Identifier										
LCP Length										
Configuration Options										
The values for LCP code field are <ol style="list-style-type: none"> <li>1. Configure Request</li> <li>2. Configure Ack</li> <li>3. Configure Nak</li> <li>4. Configure Reject</li> </ol>										
<b>Success Criteria</b>										
For local machine's <i>config-request</i> , peer must send a <i>config-ack</i>										
<b>Results</b>										
LCP should be in the open state										

<b>Group_3_2_Test_6 / accept_magic_number_mru_chap</b>										
<b>Test Purpose</b>										
The purpose of this test is to verify that an implementation can accept LCP options Magic Number, MRU and CHAP.										
<b>Last Modification</b>										
December 5, 2001										
<b>References</b>										
RFC 1661, RFC 2364, RFC 2684										
<b>Resource Requirements</b>										
<ul style="list-style-type: none"> <li>• ATU-R unit (NT equipment) – <i>Local implementation</i></li> <li>• ATU-C unit (DSLAM)</li> <li>• ATM switch</li> <li>• Device capable of traffic generation</li> <li>• ATM network analyzer</li> <li>• Network Termination device – <i>Peer implementation</i></li> </ul>										
<b>Input Parameters</b>										
LCP options: Magic Number, MRU and CHAP Local Machine: Set LCP options to Magic Number, MRU and CHAP Peer Machine: Set LCP options to Magic Number, MRU and CHAP										
<b>Test Procedure and Setup</b>										
<ul style="list-style-type: none"> <li>• Connect the ATU-R to the ATU-C with the line simulator with a length of 9 Kft.</li> <li>• Verify that the system is able to establish a link.</li> <li>• Power on the ATM network analyzer and capture transmitted packets.</li> <li>• Initiate a PPP session between the network termination device and the ATU-R.</li> </ul>										
<b>Discussion</b>										
This test is designed to verify the transmission of LCP packets for link configuration. LCP is the Link Control Protocol used to configure the options for establishing a PPP session. The link is established by sending a configure-request packet and receiving a proper configure-ack packet. The packet format for LCP link configuration is,										
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PPP PID	0xC021									
LCP Code										
LCP Identifier										
LCP Length										
Configuration Options										
The values for LCP code field are <ol style="list-style-type: none"> <li>1. Configure Request</li> <li>2. Configure Ack</li> <li>3. Configure Nak</li> <li>4. Configure Reject</li> </ol>										
<b>Success Criteria</b>										
For local machine's <i>config-request</i> , peer must send a <i>config-ack</i>										
<b>Results</b>										
LCP should be in the open state										

<b>Group_3_2_Test_7 / reject_mru</b>										
<b>Test Purpose</b>										
The purpose of this test is to verify that an implementation can accept LCP options Magic Number and reject MRU.										
<b>Last Modification</b>										
December 5, 2001										
<b>References</b>										
RFC 1661, RFC 2364, RFC 2684										
<b>Resource Requirements</b>										
<ul style="list-style-type: none"> <li>• ATU-R unit (NT equipment) – <i>Local implementation</i></li> <li>• ATU-C unit (DSLAM)</li> <li>• ATM switch</li> <li>• Device capable of traffic generation</li> <li>• ATM network analyzer</li> <li>• Network Termination device – <i>Peer implementation</i></li> </ul>										
<b>Input Parameters</b>										
LCP options: Magic Number and MRU Local Machine: Set LCP options to Magic Number Peer Machine: Set LCP options to Magic Number and MRU										
<b>Test Procedure and Setup</b>										
<ul style="list-style-type: none"> <li>• Connect the ATU-R to the ATU-C with the line simulator with a length of 9 Kft.</li> <li>• Verify that the system is able to establish a link.</li> <li>• Power on the ATM network analyzer and capture transmitted packets.</li> <li>• Initiate a PPP session between the network termination device and the ATU-R.</li> </ul>										
<b>Discussion</b>										
<p>This test is designed to verify the transmission of LCP packets for link configuration. LCP is the Link Control Protocol used to configure the options for establishing a PPP session. The link is established by sending a configure-request packet and receiving a proper configure-ack packet. The packet format for LCP link configuration is,</p> <table border="1" data-bbox="594 1276 959 1455"> <tr> <td>PPP PID</td> <td>0xC021</td> </tr> <tr> <td>LCP Code</td> <td></td> </tr> <tr> <td>LCP Identifier</td> <td></td> </tr> <tr> <td>LCP Length</td> <td></td> </tr> <tr> <td>Configuration Options</td> <td></td> </tr> </table> <p>The values for LCP code field are</p> <ol style="list-style-type: none"> <li>1. Configure Request</li> <li>2. Configure Ack</li> <li>3. Configure Nak</li> <li>4. Configure Reject</li> </ol>	PPP PID	0xC021	LCP Code		LCP Identifier		LCP Length		Configuration Options	
PPP PID	0xC021									
LCP Code										
LCP Identifier										
LCP Length										
Configuration Options										
<b>Success Criteria</b>										
For local machine's <i>config-request</i> , peer must send a <i>config-reject</i> for MRU										
<b>Results</b>										
LCP should be down										



<b>Group_3_2_Test_8 / reject_magic_number</b>										
<b>Test Purpose</b>										
The purpose of this test is to verify that an implementation can reject LCP options Magic Number.										
<b>Last Modification</b>										
December 5, 2001										
<b>References</b>										
RFC 1661, RFC 2364, RFC 2684										
<b>Resource Requirements</b>										
<ul style="list-style-type: none"> <li>• ATU-R unit (NT equipment) – <i>Local implementation</i></li> <li>• ATU-C unit (DSLAM)</li> <li>• ATM switch</li> <li>• Device capable of traffic generation</li> <li>• ATM network analyzer</li> <li>• Network Termination device – <i>Peer implementation</i></li> </ul>										
<b>Input Parameters</b>										
LCP options: Magic Number Local Machine: Set LCP options to Magic Number (same as peer) Peer Machine: Set LCP options to Magic Number (same as local)										
<b>Test Procedure and Setup</b>										
<ul style="list-style-type: none"> <li>• Connect the ATU-R to the ATU-C with the line simulator with a length of 9 Kft.</li> <li>• Verify that the system is able to establish a link.</li> <li>• Power on the ATM network analyzer and capture transmitted packets.</li> <li>• Initiate a PPP session between the network termination device and the ATU-R.</li> </ul>										
<b>Discussion</b>										
This test is designed to verify the transmission of LCP packets for link configuration. LCP is the Link Control Protocol used to configure the options for establishing a PPP session. The link is established by sending a configure-request packet and receiving a proper configure-ack packet. The packet format for LCP link configuration is, <table border="1" data-bbox="594 1220 959 1398" style="margin-left: auto; margin-right: auto;"> <tr> <td>PPP PID</td> <td>0xC021</td> </tr> <tr> <td>LCP Code</td> <td></td> </tr> <tr> <td>LCP Identifier</td> <td></td> </tr> <tr> <td>LCP Length</td> <td></td> </tr> <tr> <td>Configuration Options</td> <td></td> </tr> </table>	PPP PID	0xC021	LCP Code		LCP Identifier		LCP Length		Configuration Options	
PPP PID	0xC021									
LCP Code										
LCP Identifier										
LCP Length										
Configuration Options										
The values for LCP code field are <ol style="list-style-type: none"> <li>1. Configure Request</li> <li>2. Configure Ack</li> <li>3. Configure Nak</li> <li>4. Configure Reject</li> </ol>										
<b>Success Criteria</b>										
For local machine's <i>config-request</i> , peer must send a <i>config-nak</i> . Local machine renegotiates with new Magic Number. If the local machine is not able to give a new one, then the link should be terminated after specified number of times.										
<b>Results</b>										
LCP link should be in the open state or down depending if whether or not the local implementation is able to choose another Magic Number										

<b>Group_3_2_Test_9 / reject_pap</b>										
<b>Test Purpose</b>										
The purpose of this test is to verify that an implementation can accept LCP options Magic Number and reject PAP.										
<b>Last Modification</b>										
December 5, 2001										
<b>References</b>										
RFC 1661, +RFC 2364, RFC 2684										
<b>Resource Requirements</b>										
<ul style="list-style-type: none"> <li>• ATU-R unit (NT equipment) – <i>Local implementation</i></li> <li>• ATU-C unit (DSLAM)</li> <li>• ATM switch</li> <li>• Device capable of traffic generation</li> <li>• ATM network analyzer</li> <li>• Network Termination device – <i>Peer implementation</i></li> </ul>										
<b>Input Parameters</b>										
LCP options: Magic Number and PAP Local Machine: Set LCP options to Magic Number Peer Machine: Set LCP options to Magic Number and PAP										
<b>Test Procedure and Setup</b>										
<ul style="list-style-type: none"> <li>• Connect the ATU-R to the ATU-C with the line simulator with a length of 9 Kft.</li> <li>• Verify that the system is able to establish a link.</li> <li>• Power on the ATM network analyzer and capture transmitted packets.</li> <li>• Initiate a PPP session between the network termination device and the ATU-R.</li> </ul>										
<b>Discussion</b>										
This test is designed to verify the transmission of LCP packets for link configuration. LCP is the Link Control Protocol used to configure the options for establishing a PPP session. The link is established by sending a configure-request packet and receiving a proper configure-ack packet. The packet format for LCP link configuration is,										
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PPP PID	0xC021									
LCP Code										
LCP Identifier										
LCP Length										
Configuration Options										
The values for LCP code field are <ol style="list-style-type: none"> <li>1. Configure Request</li> <li>2. Configure Ack</li> <li>3. Configure Nak</li> <li>4. Configure Reject</li> </ol>										
<b>Success Criteria</b>										
For local machine's <i>config-request</i> , peer must send a <i>config-reject</i> for PAP										
<b>Results</b>										
LCP should be down										

<b>Group_3_2_Test_10 / reject_chap</b>										
<b>Test Purpose</b>										
The purpose of this test is Verify that an implementation can accept LCP options Magic Number and reject CHAP.										
<b>Last Modification</b>										
December 5, 2001										
<b>References</b>										
RFC 1661, RFC 2364, RFC 2684										
<b>Resource Requirements</b>										
<ul style="list-style-type: none"> <li>• ATU-R unit (NT equipment) – <i>Local implementation</i></li> <li>• ATU-C unit (DSLAM)</li> <li>• ATM switch</li> <li>• Device capable of traffic generation</li> <li>• ATM network analyzer</li> <li>• Network Termination device – <i>Peer implementation</i></li> </ul>										
<b>Input Parameters</b>										
LCP options: Magic Number and CHAP Local Machine: Set LCP options to Magic Number Peer Machine: Set LCP options to Magic Number and CHAP										
<b>Test Procedure and Setup</b>										
<ul style="list-style-type: none"> <li>• Connect the ATU-R to the ATU-C with the line simulator with a length of 9 Kft.</li> <li>• Verify that the system is able to establish a link.</li> <li>• Power on the ATM network analyzer and capture transmitted packets.</li> <li>• Initiate a PPP session between the network termination device and the ATU-R.</li> </ul>										
<b>Discussion</b>										
This test is designed to verify the transmission of LCP packets for link configuration. LCP is the Link Control Protocol used to configure the options for establishing a PPP session. The link is established by sending a configure-request packet and receiving a proper configure-ack packet. The packet format for LCP link configuration is,										
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PPP PID	0xC021									
LCP Code										
LCP Identifier										
LCP Length										
Configuration Options										
The values for LCP code field are <ol style="list-style-type: none"> <li>1. Configure Request</li> <li>2. Configure Ack</li> <li>3. Configure Nak</li> <li>4. Configure Reject</li> </ol>										
<b>Success Criteria</b>										
For local machine's <i>config-request</i> , peer must send a <i>config-reject</i> for CHAP										
<b>Results</b>										
LCP should be down										

<b>Group_3_2_Test_11 / reject_magic_number_mru</b>										
<p><b>Test Purpose</b></p> <p>The purpose of this test is to verify that an implementation can reject LCP options Magic Number and MRU.</p>										
<p><b>Last Modification</b></p> <p>December 5, 2001</p>										
<p><b>References</b></p> <p>RFC 2364, RFC 2684</p>										
<p><b>Resource Requirements</b></p> <ul style="list-style-type: none"> <li>• ATU-R unit (NT equipment)</li> <li>• ATU-C unit (DSLAM)</li> <li>• ATM switch</li> <li>• Device capable of traffic generation</li> <li>• ATM network analyzer</li> <li>• Network Termination device</li> </ul>										
<p><b>Input Parameters</b></p> <p>LCP options: Magic Number and MRU  Local Machine: Set LCP options to Magic Number  Peer Machine: Set LCP options to MRU</p>										
<p><b>Test Procedure and Setup</b></p> <ul style="list-style-type: none"> <li>• Connect the ATU-R to the ATU-C with the line simulator with a length of 9 Kft.</li> <li>• Verify that the system is able to establish a link.</li> <li>• Power on the ATM network analyzer and capture transmitted packets.</li> <li>• Initiate a PPP session between the network termination device and the ATU-R.</li> </ul>										
<p><b>Discussion</b></p> <p>This test is designed to verify the transmission of LCP packets for link configuration. LCP is the Link Control Protocol used to configure the options for establishing a PPP session. The link is established by sending a configure-request packet and receiving a proper configure-ack packet. The packet format for LCP link configuration is,</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <tbody> <tr> <td>PPP PID</td> <td>0xC021</td> </tr> <tr> <td>LCP Code</td> <td></td> </tr> <tr> <td>LCP Identifier</td> <td></td> </tr> <tr> <td>LCP Length</td> <td></td> </tr> <tr> <td>Configuration Options</td> <td></td> </tr> </tbody> </table> <p>The values for LCP code field are</p> <ol style="list-style-type: none"> <li>1. Configure Request</li> <li>2. Configure Ack</li> <li>3. Configure Nak</li> <li>4. Configure Reject</li> </ol>	PPP PID	0xC021	LCP Code		LCP Identifier		LCP Length		Configuration Options	
PPP PID	0xC021									
LCP Code										
LCP Identifier										
LCP Length										
Configuration Options										
<p><b>Success Criteria</b></p> <p>For local machine's <i>config-request</i>, peer must send a <i>config-reject</i>  For peer's <i>config-request</i>, local machine must send a <i>config-reject</i></p>										
<p><b>Results</b></p> <p>LCP should be in the open state</p>										

<b>Group_3_2_Test_12 / accept_pap</b>										
<b>Test Purpose</b> The purpose of this test is to verify that an implementation can accept the LCP option PAP.										
<b>Last Modification</b> June 8th, 2000										
<b>References</b> RFC 2364, RFC 2684										
<b>Resource Requirements</b> <ul style="list-style-type: none"> <li>• ATU-R unit (NT equipment) – <i>Local implementation</i></li> <li>• ATU-C unit (DSLAM)</li> <li>• ATM switch</li> <li>• Device capable of traffic generation</li> <li>• ATM network analyzer</li> <li>• Network Termination device – <i>Peer implementation</i></li> </ul>										
<b>Input Parameters</b> LCP options: PAP Local Machine: Set LCP options to PAP Peer Machine: Set LCP options to PAP										
<b>Test Procedure and Setup</b> <ul style="list-style-type: none"> <li>• Connect the ATU-R to the ATU-C with the line simulator with a length of 9 Kft.</li> <li>• Verify that the system is able to establish a link.</li> <li>• Power on the ATM network analyzer and capture transmitted packets.</li> <li>• Initiate a PPP session between the network termination device and the ATU-R.</li> </ul>										
<b>Discussion</b> This test is designed to verify the transmission of LCP packets for link configuration. LCP is the Link Control Protocol used to configure the options for establishing a PPP session. The link is established by sending a configure-request packet and receiving a proper configure-ack packet. The packet format for LCP link configuration is, <table border="1" style="margin-left: auto; margin-right: auto;"> <tr><td>PPP PID</td><td>0xC021</td></tr> <tr><td>LCP Code</td><td></td></tr> <tr><td>LCP Identifier</td><td></td></tr> <tr><td>LCP Length</td><td></td></tr> <tr><td>Configuration Options</td><td></td></tr> </table> <p>The values for LCP code field are</p> <ol style="list-style-type: none"> <li>1. Configure Request</li> <li>2. Configure Ack</li> <li>3. Configure Nak</li> <li>4. Configure Reject</li> </ol>	PPP PID	0xC021	LCP Code		LCP Identifier		LCP Length		Configuration Options	
PPP PID	0xC021									
LCP Code										
LCP Identifier										
LCP Length										
Configuration Options										
<b>Success Criteria</b> For local machine's <i>config-request</i> , peer must send a <i>config-ack</i>										
<b>Results</b> LCP should be in the open state										

<b>Group_3_2_Test_13 / accept_chap</b>										
<b>Test Purpose</b> The purpose of this test is to verify that an implementation can accept the LCP option CHAP.										
<b>Last Modification</b> December 5, 2001										
<b>References</b> RFC 1661, RFC 2364, RFC 2684										
<b>Resource Requirements</b> <ul style="list-style-type: none"> <li>• ATU-R unit (NT equipment) – <i>Local implementation</i></li> <li>• ATU-C unit (DSLAM)</li> <li>• ATM switch</li> <li>• Device capable of traffic generation</li> <li>• ATM network analyzer</li> <li>• Network Termination device – <i>Peer implementation</i></li> </ul>										
<b>Input Parameters</b> LCP option: CHAP Local Machine: Set LCP options to CHAP Peer Machine: Set LCP options to CHAP										
<b>Test Procedure and Setup</b> <ul style="list-style-type: none"> <li>• Connect the ATU-R to the ATU-C with the line simulator with a length of 9 Kft.</li> <li>• Verify that the system is able to establish a link.</li> <li>• Power on the ATM network analyzer and capture transmitted packets.</li> <li>• Initiate a PPP session between the network termination device and the ATU-R.</li> </ul>										
<b>Discussion</b> This test is designed to verify the transmission of LCP packets for link configuration. LCP is the Link Control Protocol used to configure the options for establishing a PPP session. The link is established by sending a configure-request packet and receiving a proper configure-ack packet. The packet format for LCP link configuration is, <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td>PPP PID</td> <td>0xC021</td> </tr> <tr> <td>LCP Code</td> <td></td> </tr> <tr> <td>LCP Identifier</td> <td></td> </tr> <tr> <td>LCP Length</td> <td></td> </tr> <tr> <td>Configuration Options</td> <td></td> </tr> </table> <p>The values for LCP code field are</p> <ol style="list-style-type: none"> <li>1. Configure Request</li> <li>2. Configure Ack</li> <li>3. Configure Nak</li> <li>4. Configure Reject</li> </ol>	PPP PID	0xC021	LCP Code		LCP Identifier		LCP Length		Configuration Options	
PPP PID	0xC021									
LCP Code										
LCP Identifier										
LCP Length										
Configuration Options										
<b>Success Criteria</b> For local machine's <i>config-request</i> , peer must send a <i>config-ack</i>										
<b>Results</b> LCP should be in the open state										

<b>Group_3_2_Test_14 / message_echo_reply</b>										
<p><b>Test Purpose</b></p> <p>The purpose of this test is to verify that an implementation can reply to a LCP message Echo Request.</p>										
<p><b>Last Modification</b></p> <p>December 5, 2001</p>										
<p><b>References</b></p> <p>RFC 1661, RFC 2364, RFC 2684</p>										
<p><b>Resource Requirements</b></p> <ul style="list-style-type: none"> <li>• ATU-R unit (NT equipment) – <i>Local implementation</i></li> <li>• ATU-C unit (DSLAM)</li> <li>• ATM switch</li> <li>• Device capable of traffic generation</li> <li>• ATM network analyzer</li> <li>• Network Termination device – <i>Peer implementation</i></li> </ul>										
<p><b>Input Parameters</b></p> <p>LCP options: Magic Number  Local Machine: Set LCP options to Magic Number  Peer Machine: Set LCP options to Magic Number</p>										
<p><b>Test Procedure and Setup</b></p> <ul style="list-style-type: none"> <li>• Connect the ATU-R to the ATU-C with the line simulator with a length of 9 Kft.</li> <li>• Verify that the system is able to establish a link.</li> <li>• Power on the ATM network analyzer and capture transmitted packets.</li> <li>• Initiate a PPP session between the network termination device and the ATU-R.</li> </ul>										
<p><b>Discussion</b></p> <p>This test is designed to verify the transmission of LCP packets for link configuration. LCP is the Link Control Protocol used to configure the options for establishing a PPP session. The link is established by sending a configure-request packet and receiving a proper configure-ack packet. The packet format for LCP link configuration is,</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <tbody> <tr> <td>PPP PID</td> <td>0xC021</td> </tr> <tr> <td>LCP Code</td> <td></td> </tr> <tr> <td>LCP Identifier</td> <td></td> </tr> <tr> <td>LCP Length</td> <td></td> </tr> <tr> <td>Configuration Options</td> <td></td> </tr> </tbody> </table> <p>The values for LCP code field are</p> <ol style="list-style-type: none"> <li>1. Configure Request</li> <li>2. Configure Ack</li> <li>3. Configure Nak</li> <li>4. Configure Reject</li> </ol>	PPP PID	0xC021	LCP Code		LCP Identifier		LCP Length		Configuration Options	
PPP PID	0xC021									
LCP Code										
LCP Identifier										
LCP Length										
Configuration Options										
<p><b>Success Criteria</b></p> <p>For peer machine's <i>echo-request</i>, the local machine must send an <i>echo-reply</i></p>										
<p><b>Results</b></p> <p>LCP should be in the open state</p>										

<b>Group_3_2_Test_15 / message_code_reject</b>										
<b>Test Purpose</b>										
The purpose of this test is to verify that an implementation can send the LCP message <i>code-reject</i> .										
<b>Last Modification</b>										
December 5, 2001										
<b>References</b>										
RFC 1661, RFC 2364, RFC 2684										
<b>Resource Requirements</b>										
<ul style="list-style-type: none"> <li>• ATU-R unit (NT equipment) – <i>Local implementation</i></li> <li>• ATU-C unit (DSLAM)</li> <li>• ATM switch</li> <li>• Device capable of traffic generation</li> <li>• ATM network analyzer</li> <li>• Network Termination device – <i>Peer implementation</i></li> </ul>										
<b>Input Parameters</b>										
LCP option: Local Machine: Set LCP options to Magic Number and MRU Peer Machine: Set LCP options to Magic Number and MRU										
<b>Test Procedure and Setup</b>										
<ul style="list-style-type: none"> <li>• Connect the ATU-R to the ATU-C with the line simulator with a length of 9 Kft.</li> <li>• Verify that the system is able to establish a link.</li> <li>• Power on the ATM network analyzer and capture transmitted packets.</li> <li>• Initiate a PPP session between the network termination device and the ATU-R.</li> <li>• Once the session is up, send a LCP message with an unknown code (different from 1 to 11)</li> </ul>										
<b>Discussion</b>										
This test is designed to verify the transmission of LCP packets for link configuration. LCP is the Link Control Protocol used to configure the options for establishing a PPP session. The link is established by sending a configure-request packet and receiving a proper configure-ack packet. The packet format for LCP link configuration is, <table border="1" style="margin-left: auto; margin-right: auto;"> <tbody> <tr> <td>PPP PID</td> <td>0xC021</td> </tr> <tr> <td>LCP Code</td> <td></td> </tr> <tr> <td>LCP Identifier</td> <td></td> </tr> <tr> <td>LCP Length</td> <td></td> </tr> <tr> <td>Configuration Options</td> <td></td> </tr> </tbody> </table>	PPP PID	0xC021	LCP Code		LCP Identifier		LCP Length		Configuration Options	
PPP PID	0xC021									
LCP Code										
LCP Identifier										
LCP Length										
Configuration Options										
The values for LCP code field are <ol style="list-style-type: none"> <li>1. Configure Request</li> <li>2. Configure Ack</li> <li>3. Configure Nak</li> <li>4. Configure Reject</li> </ol>										
<b>Success Criteria</b>										
For local machine's LCP message, peer must send a <i>code-reject</i>										
<b>Results</b>										
LCP should be down										



<b>Group_3_2_Test_16 / message_discard_request</b>										
<b>Test Purpose</b>										
The purpose of this test is to verify that an implementation can accept the LCP message <i>discard-request</i> .										
<b>Last Modification</b>										
December 5, 2001										
<b>References</b>										
RFC 1661, RFC 2364, RFC 2684										
<b>Resource Requirements</b>										
<ul style="list-style-type: none"> <li>• ATU-R unit (NT equipment) – <i>Local implementation</i></li> <li>• ATU-C unit (DSLAM)</li> <li>• ATM switch</li> <li>• Device capable of traffic generation</li> <li>• ATM network analyzer</li> <li>• Network Termination device – <i>Peer implementation</i></li> </ul>										
<b>Input Parameters</b>										
LCP option: Local Machine: Set LCP options to Magic Number and MRU Peer Machine: Set LCP options to Magic Number and MRU										
<b>Test Procedure and Setup</b>										
<ul style="list-style-type: none"> <li>• Connect the ATU-R to the ATU-C with the line simulator with a length of 9 Kft.</li> <li>• Verify that the system is able to establish a link.</li> <li>• Power on the ATM network analyzer and capture transmitted packets.</li> <li>• Initiate a PPP session between the network termination device and the ATU-R.</li> <li>• Once the session is up, send a LCP <i>discard-request</i></li> </ul>										
<b>Discussion</b>										
This test is designed to verify the transmission of LCP packets for link configuration. LCP is the Link Control Protocol used to configure the options for establishing a PPP session. The link is established by sending a configure-request packet and receiving a proper configure-ack packet. The packet format for LCP link configuration is, <table border="1" data-bbox="594 1276 959 1457" style="margin-left: auto; margin-right: auto;"> <tr> <td>PPP PID</td> <td>0xC021</td> </tr> <tr> <td>LCP Code</td> <td></td> </tr> <tr> <td>LCP Identifier</td> <td></td> </tr> <tr> <td>LCP Length</td> <td></td> </tr> <tr> <td>Configuration Options</td> <td></td> </tr> </table>	PPP PID	0xC021	LCP Code		LCP Identifier		LCP Length		Configuration Options	
PPP PID	0xC021									
LCP Code										
LCP Identifier										
LCP Length										
Configuration Options										
The values for LCP code field are <ol style="list-style-type: none"> <li>1. Configure Request</li> <li>2. Configure Ack</li> <li>3. Configure Nak</li> <li>4. Configure Reject</li> </ol>										
<b>Success Criteria</b>										
For local machine's LCP <i>discard-request</i> , the peer must discard any discard any packet received										
<b>Results</b>										
LCP should be in the open state										

<b>Group_3_2_Test_17 / message_termination</b>										
<b>Test Purpose</b>										
The purpose of this test is to verify that LCP packets are transmitted for PPP link termination.										
<b>Last Modification</b>										
December 5, 2001										
<b>References</b>										
RFC 1661, RFC 2364, RFC 2684										
<b>Resource Requirements</b>										
<ul style="list-style-type: none"> <li>• ATU-R unit (NT equipment) – <i>Local implementation</i></li> <li>• ATU-C unit (DSLAM)</li> <li>• ATM switch</li> <li>• Device capable of traffic generation</li> <li>• ATM network analyzer</li> <li>• Network Termination device – <i>Peer implementation</i></li> </ul>										
<b>Input Parameters</b>										
LCP options:										
<b>Test Procedure and Setup</b>										
<ul style="list-style-type: none"> <li>• Connect the ATU-R to the ATU-C with the line simulator with a length of 9 Kft.</li> <li>• Verify that the system is able to establish a link.</li> <li>• Power on the ATM network analyzer and capture transmitted packets.</li> <li>• Initiate a PPP session between the network termination device and the ATU-R.</li> </ul>										
<b>Discussion</b>										
<p>This test is designed to verify the transmission of LCP packets for link termination. LCP is the Link Control Protocol used to terminate a PPP session. Sending a terminate-request packet and receiving a proper terminate-ack packet terminates the link or if the time-out value for waiting for terminate-ack expires. The packet format for LCP link termination is,</p> <table border="1" data-bbox="594 1188 959 1367"> <tr> <td>PPP PID</td> <td>0xC021</td> </tr> <tr> <td>LCP Code</td> <td></td> </tr> <tr> <td>LCP Identifier</td> <td></td> </tr> <tr> <td>LCP Length</td> <td></td> </tr> <tr> <td>Configuration Options</td> <td></td> </tr> </table> <p>The values for LCP code field are</p> <ol style="list-style-type: none"> <li>1. Terminate Request</li> <li>2. Terminate Ack</li> </ol>	PPP PID	0xC021	LCP Code		LCP Identifier		LCP Length		Configuration Options	
PPP PID	0xC021									
LCP Code										
LCP Identifier										
LCP Length										
Configuration Options										
<b>Success Criteria</b>										
<p>The system should initialize and should then be able to transmit traffic. The captured packets should have value corresponding to LCP in the PPP protocol ID field. The LCP code value should correspond to values given above for termination packets and all these packets should have the same value in the identifier field. The LCP terminate request is responded with a terminate-ack packet or the time-out value for waiting for a terminate-ack expires. The Link is terminated.</p>										
<b>Results</b>										
LCP should be down										

<b>Group_3_2_Test_18 / mru_matches_mtu</b>
<b>Test Purpose</b>
The purpose of this test is to verify the Maximum Receive Unit size of the PPP session.
<b>Last Modification</b>
December 5, 2001
<b>References</b>
RFC 1661, RFC 2364, RFC 2684
<b>Resource Requirements</b>
<ul style="list-style-type: none"> <li>• ATU-R unit (NT equipment) – <i>Local implementation</i></li> <li>• ATU-C unit (DSLAM)</li> <li>• ATM switch</li> <li>• Device capable of traffic generation</li> <li>• ATM network analyzer</li> <li>• Network Termination device – <i>Peer implementation</i></li> </ul>
<b>Input Parameters</b>
LCP options: MRU
<b>Test Procedure and Setup</b>
<ul style="list-style-type: none"> <li>• Connect the ATU-R to the ATU-C with the line simulator with a length of 9 Kft.</li> <li>• Verify that the system is able to establish a link.</li> <li>• Establish a PPP link with a specified MRU or the default MRU.</li> <li>• Disable fragmentation in IP packets.</li> <li>• Power on the ATM network analyzer and capture transmitted packets.</li> <li>• Generate traffic with different packet size using traffic generator.</li> <li>• Capture the packets using the ATM network analyzer.</li> <li>• Observe the packet length field in the PPP header and also if the packets are discarded or not.</li> </ul>
<b>Discussion</b>
<p>This test is designed to verify the Maximum Receive Unit (MRU) size of the PPP session. MRU is the maximum size of the information field of the PPP packet and has a default value of 1500 octets. But it could also be negotiated for any other value during link configuration. Any packet with information field greater in length to the MRU should be silently discarded. The implementation should reject LCP option MRU negotiated to a larger size than the maximum CPDSDU, as specified in the VC's traffic contract</p>
<b>Success Criteria</b>
<p>The system should initialize and should then be able to transmit traffic.  A PPP session should be established.  Packets lesser in size than MRU are transmitted and those greater than MRU size are discarded silently.  If local machine's <i>config-request</i> sends this MRU value, then peer must send a <i>config-nak</i></p>
<b>Results</b>
LCP should be in the open state

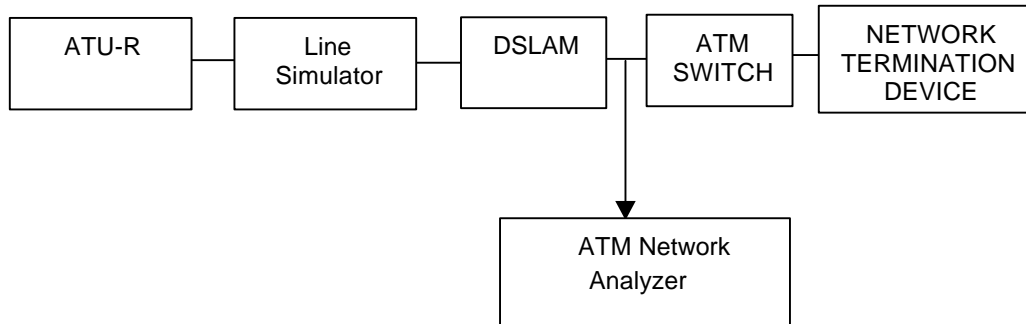
<b>Group_3_2_Test_19 / pfc_not_recommended</b>										
<b>Test Purpose</b>										
The purpose of this test is to verify that an implementation rejects LCP options Protocol Field Compression.										
<b>Last Modification</b>										
December 5, 2001										
<b>References</b>										
RFC 1661, RFC 2364, RFC 2684										
<b>Resource Requirements</b>										
<ul style="list-style-type: none"> <li>• ATU-R unit (NT equipment) – <i>Local implementation</i></li> <li>• ATU-C unit (DSLAM)</li> <li>• ATM switch</li> <li>• Device capable of traffic generation</li> <li>• ATM network analyzer</li> <li>• Network Termination device – <i>Peer implementation</i></li> </ul>										
<b>Input Parameters</b>										
LCP options: Protocol Field Compression Local Machine: Set LCP options to Protocol Field Compression Peer Machine: Set LCP options not to Protocol Field Compression										
<b>Test Procedure and Setup</b>										
<ul style="list-style-type: none"> <li>• Connect the ATU-R to the ATU-C with the line simulator with a length of 9 Kft.</li> <li>• Verify that the system is able to establish a link.</li> <li>• Power on the ATM network analyzer and capture transmitted packets.</li> <li>• Initiate a PPP session between the network termination device and the ATU-R.</li> </ul>										
<b>Discussion</b>										
This test is designed to verify the transmission of LCP packets for link configuration. LCP is the Link Control Protocol used to configure the options for establishing a PPP session. The link is established by sending a configure-request packet and receiving a proper configure-ack packet. The packet format for LCP link configuration is,										
<table border="1"> <tr> <td>PPP PID</td> <td>0xC021</td> </tr> <tr> <td>LCP Code</td> <td></td> </tr> <tr> <td>LCP Identifier</td> <td></td> </tr> <tr> <td>LCP Length</td> <td></td> </tr> <tr> <td>Configuration Options</td> <td></td> </tr> </table>	PPP PID	0xC021	LCP Code		LCP Identifier		LCP Length		Configuration Options	
PPP PID	0xC021									
LCP Code										
LCP Identifier										
LCP Length										
Configuration Options										
The values for LCP code field are <ol style="list-style-type: none"> <li>1. Configure Request</li> <li>2. Configure Ack</li> <li>3. Configure Nak</li> <li>4. Configure Reject</li> </ol>										
<b>Success Criteria</b>										
For local machine's <i>config-request</i> , peer must send a <i>config-rej</i>										
<b>Results</b>										
LCP should be in the open state										

<b>Group_3_2_Test_20 / fcs_acfc_accm_forbidden</b>
<p><b>Test Purpose</b></p> <p>The purpose of this test is verify that an implementation rejects LCP options Field Check Sequence Alternatives, Address-and-Control-Field-Compression, Asynchronous-Control-Character-Map.</p>
<p><b>Last Modification</b></p> <p>December 5, 2001</p>
<p><b>References</b></p> <p>RFC 1661, RFC 2364, RFC 2684</p>
<p><b>Resource Requirements</b></p> <ul style="list-style-type: none"> <li>• ATU-R unit (NT equipment) – <i>Local implementation</i></li> <li>• ATU-C unit (DSLAM)</li> <li>• ATM switch</li> <li>• Device capable of traffic generation</li> <li>• ATM network analyzer</li> <li>• Network Termination device – <i>Peer implementation</i></li> </ul>
<p><b>Input Parameters</b></p> <p>LCP options: Field Check Sequence Alternatives, Address-and-Control-Field-Compression, Asynchronous-Control-Character-Map  Local Machine: Set LCP options to Field Check Sequence Alternatives, Address-and-Control-Field-Compression, Asynchronous-Control-Character-Map  Peer Machine: Set LCP options to Field Check Sequence Alternatives, Address-and-Control-Field-Compression, Asynchronous-Control-Character-Map</p>
<p><b>Test Procedure and Setup</b></p> <ul style="list-style-type: none"> <li>• Connect the ATU-R to the ATU-C with the line simulator with a length of 9 Kft.</li> <li>• Verify that the system is able to establish a link.</li> <li>• Power on the ATM network analyzer and capture transmitted packets.</li> <li>• Initiate a PPP session between the network termination device and the ATU-R.</li> </ul>
<p><b>Discussion</b></p> <p>These three specific options are forbidden by RFC 2364. Any implementation requesting or answering with these options should not be able to establish a PPP link</p>
<p><b>Success Criteria</b></p> <p>If local machine's <i>config-request</i> sends these 3 options, then peer must send a <i>config-reject</i></p>
<p><b>Results</b></p> <p>LCP should be in the open state</p>

<b>Group_3_2_Test_21 / link_loopback</b>
<p><b>Test Purpose</b></p> <p>The purpose of this test is to check for looped back links in PPP sessions.</p>
<p><b>Last Modification</b></p> <p>December 5, 2001</p>
<p><b>References</b></p> <p>RFC 1661, RFC 2364, RFC 2684</p>
<p><b>Resource Requirements</b></p> <ul style="list-style-type: none"> <li>• ATU-R unit (NT equipment) – <i>Local implementation</i></li> <li>• ATU-C unit (DSLAM)</li> <li>• ATM switch</li> <li>• Device capable of traffic generation</li> <li>• ATM network analyzer</li> <li>• Network Termination device – <i>Peer implementation</i></li> </ul>
<p><b>Input Parameters</b></p> <p>LCP options: Set LCP options to MRU</p>
<p><b>Test Procedure and Setup</b></p> <ul style="list-style-type: none"> <li>• Connect the ATU-R to the ATU-C with the line simulator with a length of 9 Kft.</li> <li>• Verify that the system is able to establish a link.</li> <li>• Configure a PPP session between the network termination device and the ATU-R enabling the Magic Number option.</li> <li>• Capture the packets transmitted using the ATM network sniffer.</li> <li>• Observe the packets and compare the magic number field of any configure packets exchanged.</li> <li>• Verify that the magic number field is not the same for any continuous set of Configure-Request and Configure-Nak packets exchanged.</li> </ul>
<p><b>Discussion</b></p> <p>This test is designed to check for looped back links during configuration of PPP links. Looped back links may occur due to repeated transmission of Configure-Request and Configure-Nak packets during link configuration using LCP. This is eliminated using the Magic Number option in LCP. This is a unique number chosen in the most random way possible and attached to a configure-request packet. If the magic number field is the same in Configure Request and Configure Nak packets then it is detected to be a looped back link.</p>
<p><b>Success Criteria</b></p> <p>The system should initialize and should then be able to transmit traffic.  The Magic number option is enabled between the PPP link.  The magic number field of the configure packets diverge if the link is not looped back.  Otherwise they are seen to be the same.</p>
<p><b>Results</b></p> <p>LCP should be in the open state or down depending of the loop</p>

## **ANNEX E: Test Group 3, “PPP over ATM”**

### **Subgroup 3, “PPP Authentication”**



<b>Group_3_3_Test_1 / authentication_pap_success</b>										
<p><b>Test Purpose</b></p> <p>The purpose of this test is to verify that an implementation can authenticate a user with PAP.</p>										
<p><b>Last Modification</b></p> <p>December 5, 2001</p>										
<p><b>References</b></p> <p>RFC 1661, RFC 1334, RFC 2364</p>										
<p><b>Resource Requirements</b></p> <ul style="list-style-type: none"> <li>• ATU-R unit (NT equipment) – <i>Local Implementation</i></li> <li>• ATU-C unit (DSLAM)</li> <li>• ATM switch</li> <li>• Device capable of traffic generation</li> <li>• ATM network analyzer</li> <li>• Network Termination device – <i>Peer Implementation</i></li> </ul>										
<p><b>Input Parameters</b></p> <p>LCP options: PAP  User Name 1 and Password 1  Local Machine: Set LCP options PAP and set a User Name 1 and Password 1  Peer Machine: Set LCP options PAP and set a User Name 1 and Password 1</p>										
<p><b>Test Procedure and Setup</b></p> <ul style="list-style-type: none"> <li>• Connect the ATU-R to the ATU-C with the line simulator with a length of 9 Kft.</li> <li>• Verify that the system is able to establish a link.</li> <li>• Initiate a PPP session between the network termination device and the ATU-R.</li> <li>• Power on the ATM network analyzer and capture transmitted packets.</li> <li>• Let the PPP session reach the authentication phase.</li> </ul>										
<p><b>Discussion</b></p> <p>This test is designed to verify the transmission of PAP packets for PPP Authentication. PPP session authentication is done using Password Authentication Protocol (PAP). An ID/Password pair is repeatedly sent to the authenticator until authentication is acknowledged or the connection is terminated. The PPP packet format for PAP is,</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <tbody> <tr> <td>PPP PID</td> <td>0xC023</td> </tr> <tr> <td>PAP Code</td> <td></td> </tr> <tr> <td>PAP Identifier</td> <td></td> </tr> <tr> <td>PAP Length</td> <td></td> </tr> <tr> <td>Data</td> <td></td> </tr> </tbody> </table> <p>The values for PAP code field are</p> <ol style="list-style-type: none"> <li>1. Authenticate-Request</li> <li>2. Authenticate-Ack</li> <li>3. Authenticate-Nak</li> </ol>	PPP PID	0xC023	PAP Code		PAP Identifier		PAP Length		Data	
PPP PID	0xC023									
PAP Code										
PAP Identifier										
PAP Length										
Data										
<p><b>Success Criteria</b></p> <p>The system should initialize and should then be able to transmit traffic.  The PPP session should be established with PAP as the authentication protocol.  The captured packets should have value corresponding to PAP in the PPP protocol ID field.  The PAP code value should correspond to values given above for packets and all these packets should have the same value in the identifier field.  For local machine's <i>PAP-request</i>, the peer must send a <i>PAP-Ack</i>  The captured packets should have a valid LLC/SNAP header.</p>										
<p><b>Results</b></p> <p>Authentication phase succeeded</p>										



<b>Group_3_3_Test_2 / authentication_pap_failure</b>										
<b>Test Purpose</b>										
The purpose of this test is to verify that an implementation can reject an unknown user with PAP.										
<b>Last Modification</b>										
December 5, 2001										
<b>References</b>										
RFC 1661, RFC 1334, RFC 2364										
<b>Resource Requirements</b>										
<ul style="list-style-type: none"> <li>• ATU-R unit (NT equipment) – <i>Local Implementation</i></li> <li>• ATU-C unit (DSLAM)</li> <li>• ATM switch</li> <li>• Device capable of traffic generation</li> <li>• ATM network analyzer</li> <li>• Network Termination device – <i>Peer Implementation</i></li> </ul>										
<b>Input Parameters</b>										
LCP options: PAP User Name 1 and Password 1 User Name 2 and Password 2 Local Machine: Set LCP options PAP and set a User Name 1 and Password 1 Peer Machine: Set LCP options PAP and set a User Name 2 and Password 2										
<b>Test Procedure and Setup</b>										
<ul style="list-style-type: none"> <li>• Connect the ATU-R to the ATU-C with the line simulator with a length of 9 kft as shown above.</li> <li>• Verify that the system is able to establish an ADSL link.</li> <li>• Power on the ATM network analyzer and capture transmitted packets.</li> <li>• Initiate a PPP session between the network termination device and the ATU-R.</li> <li>• Let the PPP session reach the authentication phase.</li> <li>•</li> </ul>										
<b>Discussion</b>										
This test is designed to verify the transmission of PAP packets for PPP Authentication. PPP session authentication is done using Password Authentication Protocol (PAP). An ID/Password pair is repeatedly sent to the authenticator until authentication is acknowledged or the connection is terminated. The PPP packet format for PAP is,										
<table border="1"> <tr> <td>PPP PID</td> <td>0xC023</td> </tr> <tr> <td>PAP Code</td> <td></td> </tr> <tr> <td>PAP Identifier</td> <td></td> </tr> <tr> <td>PAP Length</td> <td></td> </tr> <tr> <td>Data</td> <td></td> </tr> </table>	PPP PID	0xC023	PAP Code		PAP Identifier		PAP Length		Data	
PPP PID	0xC023									
PAP Code										
PAP Identifier										
PAP Length										
Data										
The values for PAP code field are <ol style="list-style-type: none"> <li>1. Authenticate-Request</li> <li>2. Authenticate-Ack</li> <li>3. Authenticate-Nak</li> </ol>										
<b>Success Criteria</b>										
The system should initialize and should then be able to transmit traffic. The PPP session should be established with PAP as the authentication protocol. The captured packets should have value corresponding to PAP in the PPP protocol ID field. The PAP code value should correspond to values given above for packets and all these packets should have the same value in the identifier field. For local machine's <i>PAP-request</i> , the peer must send a <i>PAP-nak</i> The captured packets should have a valid LLC/SNAP header.										
<b>Results</b>										
Authentication phase failed and LCP link should be down										

<b>Group_3_3_Test_3 / authentication_chap_success</b>										
<b>Test Purpose</b>										
The purpose of this test is to verify that an implementation can authenticate a user with CHAP.										
<b>Last Modification</b>										
December 5, 2001										
<b>References</b>										
RFC 1661, RFC 1994, RFC 2364										
<b>Resource Requirements</b>										
<ul style="list-style-type: none"> <li>• ATU-R unit (NT equipment) – <i>Local Implementation</i></li> <li>• ATU-C unit (DSLAM)</li> <li>• ATM switch</li> <li>• Device capable of traffic generation</li> <li>• ATM network analyzer</li> <li>• Network Termination device – <i>Peer Implementation</i></li> </ul>										
<b>Input Parameters</b>										
LCP options: CHAP User Name 1 and Password 1 Local Machine: Set LCP options CHAP and set User Name 1 and password 1 Peer Machine: Set LCP options CHAP and set User Name 1 and password 1										
<b>Test Procedure and Setup</b>										
<ul style="list-style-type: none"> <li>• Connect the ATU-R to the ATU-C with the line simulator with a length of 9 Kft.</li> <li>• Verify that the system is able to establish a link.</li> <li>• Power on the ATM network analyzer and capture transmitted packets.</li> <li>• Initiate a PPP session between the network termination device and the ATU-R.</li> <li>• Let the PPP session reach the authentication phase.</li> </ul>										
<b>Discussion</b>										
<p>This test is designed to verify the transmission of CHAP packets for PPP Authentication. PPP session authentication is done using Challenge Handshake Authentication Protocol (CHAP). A Challenge is send by the authenticator and is replied with a Response message calculated using a one-way hashing algorithm and thus authenticated if the response is correct by sending a Success message. The PPP packet format for CHAP is,</p> <table border="1" data-bbox="597 1224 959 1402"> <tr> <td>PPP PID</td> <td>0xC223</td> </tr> <tr> <td>CHAP Code</td> <td></td> </tr> <tr> <td>CHAP Identifier</td> <td></td> </tr> <tr> <td>CHAP Length</td> <td></td> </tr> <tr> <td>Data</td> <td></td> </tr> </table> <p>The values for CHAP code field are</p> <ol style="list-style-type: none"> <li>1. Challenge</li> <li>2. Response</li> <li>3. Success</li> <li>4. Failure</li> </ol>	PPP PID	0xC223	CHAP Code		CHAP Identifier		CHAP Length		Data	
PPP PID	0xC223									
CHAP Code										
CHAP Identifier										
CHAP Length										
Data										
<b>Success Criteria</b>										
<p>The system should initialize and should then be able to transmit traffic. The PPP session should be established with CHAP as the authentication protocol. The captured packets should have value corresponding to CHAP in the PPP protocol ID field. The CHAP code value should correspond to values given above for packets and all these packets should have the same value in the identifier field. CHAP Challenge and Response packets are exchanged and the PPP link authentication is successful or failed indicated by a Success message or a Failure message. The captured packets should have a valid LLC/SNAP header.</p>										
<b>Results</b>										
Authentication phase succeeded										

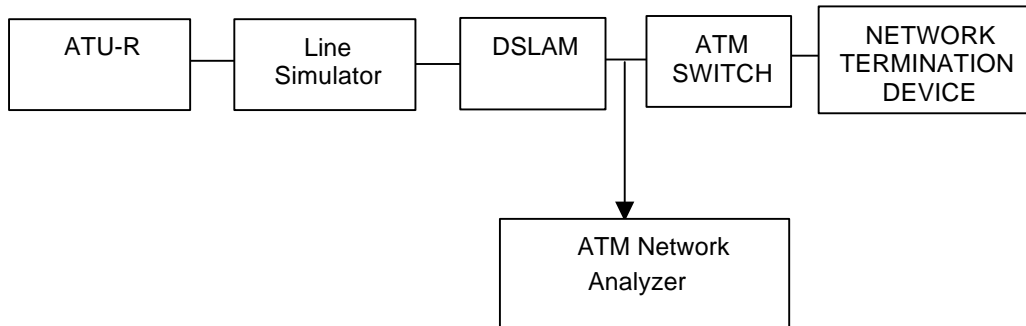
<b>Group_3_3_Test_4 / authentication_chap_failure</b>										
<b>Test Purpose</b>										
The purpose of this test is to verify that an implementation can reject an unknown user with CHAP.										
<b>Last Modification</b>										
December 5, 2001										
<b>References</b>										
RFC 1661, RFC 1994, RFC 2364										
<b>Resource Requirements</b>										
<ul style="list-style-type: none"> <li>• ATU-R unit (NT equipment) – <i>Local Implementation</i></li> <li>• ATU-C unit (DSLAM)</li> <li>• ATM switch</li> <li>• Device capable of traffic generation</li> <li>• ATM network analyzer</li> <li>• Network Termination device – <i>Peer Implementation</i></li> </ul>										
<b>Input Parameters</b>										
LCP options: CHAP User Name and Password (2 different sets) Local Machine: Set LCP options CHAP and set a User Name 1 and Password 1 Peer Machine: Set LCP options CHAP and set a User Name 2 and Password 2										
<b>Test Procedure and Setup</b>										
<ul style="list-style-type: none"> <li>• Connect the ATU-R to the ATU-C with the line simulator with a length of 9 Kft.</li> <li>• Verify that the system is able to establish a link.</li> <li>• Power on the ATM network analyzer and capture transmitted packets.</li> <li>• Initiate a PPP session between the network termination device and the ATU-R.</li> </ul> Let the PPP session reach the authentication phase.										
<b>Discussion</b>										
This test is designed to verify the transmission of CHAP packets for PPP Authentication. PPP session authentication is done using Challenge Handshake Authentication Protocol (CHAP). A Challenge is send by the authenticator and is replied with a Response message calculated using a one-way hashing algorithm and thus authenticated if the response is correct by sending a Success message. The PPP packet format for CHAP is,										
<table border="1"> <tr> <td>PPP PID</td> <td>0xC223</td> </tr> <tr> <td>CHAP Code</td> <td></td> </tr> <tr> <td>CHAP Identifier</td> <td></td> </tr> <tr> <td>CHAP Length</td> <td></td> </tr> <tr> <td>Data</td> <td></td> </tr> </table>	PPP PID	0xC223	CHAP Code		CHAP Identifier		CHAP Length		Data	
PPP PID	0xC223									
CHAP Code										
CHAP Identifier										
CHAP Length										
Data										
The values for CHAP code field are <ol style="list-style-type: none"> <li>1. Challenge</li> <li>2. Response</li> <li>3. Success</li> <li>4. Failure</li> </ol>										
<b>Success Criteria</b>										
The system should initialize and should then be able to transmit traffic. The PPP session should be established with CHAP as the authentication protocol. The captured packets should have value corresponding to CHAP in the PPP protocol ID field. The CHAP code value should correspond to values given above for packets and all these packets should have the same value in the identifier field. CHAP Challenge and Response packets are exchanged and the PPP link authentication is successful or failed indicated by a Success message or a Failure message. For local machine's <i>CHAP-response</i> , the peer must send a <i>CHAP-failure</i> . The captured packets should have a valid LLC/SNAP header.										
<b>Results</b>										
Authentication phase failed and LCP link should be down.										

<b>Group_3_3_Test_5 / reject_authentication_method</b>
<p><b>Test Purpose</b></p> <p>The purpose of this test is to verify that an implementation can reject an unknown authentication protocol.</p>
<p><b>Last Modification</b></p> <p>December 5, 2001</p>
<p><b>References</b></p> <p>RFC 1334, RFC 1661, RFC 1994, RFC 2364</p>
<p><b>Resource Requirements</b></p> <ul style="list-style-type: none"> <li>• ATU-R unit (NT equipment) – <i>Local Implementation</i></li> <li>• ATU-C unit (DSLAM)</li> <li>• ATM switch</li> <li>• Device capable of traffic generation</li> <li>• ATM network analyzer</li> <li>• Network Termination device – <i>Peer Implementation</i></li> </ul>
<p><b>Input Parameters</b></p> <p>LCP options: CHAP, PAP  User Name and Password  Local Machine: Set LCP options CHAP  Peer Machine: Set LCP options PAP</p>
<p><b>Test Procedure and Setup</b></p> <ul style="list-style-type: none"> <li>• Connect the ATU-R to the ATU-C with the line simulator with a length of 9 Kft.</li> <li>• Verify that the system is able to establish a link.</li> <li>• Power on the ATM network analyzer and capture transmitted packets.</li> <li>• Initiate a PPP session between the network termination device and the ATU-R.</li> <li>• Let the PPP session reach the authentication phase.</li> </ul>
<p><b>Discussion</b></p> <p>As the authentication is often mandatory from the NSP side (peer), the rejection of the authentication protocols will bring the two implementations in the terminate phase.</p>
<p><b>Success Criteria</b></p> <p>For local machine's <i>config-request</i>, the peer should send a <i>config-nak</i>, and for peer machine's <i>config-request</i>, the local machine should send a <i>config-nak</i></p>
<p><b>Results</b></p> <p>LCP should be down</p>

<b>Group_3_3_Test_6 / choose_chap_among_chap_and_pap</b>
<b>Test Purpose</b>
The purpose of this test is to verify that an implementation will choose CHAP as the best authentication protocol when there are other choices.
<b>Last Modification</b>
December 5, 2001
<b>References</b>
RFC 1334, RFC 1661, RFC 1994, RFC 2364
<b>Resource Requirements</b>
<ul style="list-style-type: none"> <li>• ATU-R unit (NT equipment) – <i>Local Implementation</i></li> <li>• ATU-C unit (DSLAM)</li> <li>• ATM switch</li> <li>• Device capable of traffic generation</li> <li>• ATM network analyzer</li> <li>• Network Termination device – <i>Peer Implementation</i></li> </ul>
<b>Input Parameters</b>
LCP options: CHAP, PAP User Name and Password Local Machine: Set LCP options CHAP, PAP Peer Machine: Set LCP options CHAP, PAP
<b>Test Procedure and Setup</b>
<ul style="list-style-type: none"> <li>• Connect the ATU-R to the ATU-C with the line simulator with a length of 9 Kft.</li> <li>• Verify that the system is able to establish a link.</li> <li>• Power on the ATM network analyzer and capture transmitted packets.</li> <li>• Initiate a PPP session between the network termination device and the ATU-R.</li> </ul>
<b>Discussion</b>
If both authentication protocols are offered, the implementations should choose the most secured one, <i>i.e.</i> , CHAP as it used a hash encryption for the ID and password (see RFC 1334 and RFC 1994).
<b>Success Criteria</b>
For local machine's <i>config-request</i> , the peer should send a <i>config-nak</i> for CHAP, and for peer machine's <i>config-request</i> , the local machine should send a <i>config-ack</i> for PAP
<b>Results</b>
LCP should be in the open state

<b>Group_3_3_Test_7 / choose_pap_no_other_choice</b>
<b>Test Purpose</b>
The purpose of this test is to verify that an implementation will choose PAP as the only possible choice
<b>Last Modification</b>
December 5, 2001
<b>References</b>
RFC 1334, RFC 1661, RFC 1994, RFC 2364
<b>Resource Requirements</b>
<ul style="list-style-type: none"> <li>• ATU-R unit (NT equipment) – <i>Local Implementation</i></li> <li>• ATU-C unit (DSLAM)</li> <li>• ATM switch</li> <li>• Device capable of traffic generation</li> <li>• ATM network analyzer</li> <li>• Network Termination device – <i>Peer Implementation</i></li> </ul>
<b>Input Parameters</b>
LCP options: CHAP, PAP Local Machine: Set LCP options CHAP, PAP Peer Machine: Set LCP options PAP
<b>Test Procedure and Setup</b>
<ul style="list-style-type: none"> <li>• Connect the ATU-R to the ATU-C with the line simulator with a length of 9 Kft.</li> <li>• Verify that the system is able to establish a link.</li> <li>• Power on the ATM network analyzer and capture transmitted packets.</li> <li>• Initiate a PPP session between the network termination device and the ATU-R.</li> </ul>
<b>Discussion</b>
In this test, the authenticator has the least secure authentication protocol. Even if the client (authenticated) has both, and as the authentication is often mandatory by the NSP (authenticator), then PAP will be chosen.
<b>Success Criteria</b>
For local machine's <i>config-request</i> , the peer should send a <i>config-ack</i> for CHAP, and for peer machine's <i>config-request</i> , the local machine should send a <i>config-ack</i> for CHAP
<b>Results</b>
LCP should be in the open state

## **ANNEX F: Test Group 3, “PPP over ATM” Subgroup 4, “PPP IPCP”**



<b>Group_3_4_Test_1 / reject_ncp_type_IP</b>											
<b>Test Purpose</b>	The purpose of this test is to verify that an implementation can reject the NCP type IP.										
<b>Last Modification</b>	December 5, 2001										
<b>References</b>	RFC 1332, RFC 1661, RFC 2364										
<b>Resource Requirements</b>	<ul style="list-style-type: none"> <li>• ATU-R unit (NT equipment) – <i>Local implementation</i></li> <li>• ATU-C unit (DSLAM)</li> <li>• ATM switch</li> <li>• Device capable of traffic generation</li> <li>• ATM network analyzer</li> <li>• Network Termination device – <i>Peer implementation</i></li> </ul>										
<b>Input Parameters</b>	NCP type: IPCP and other than IPCP Local Machine: Set NCP type to IP Peer Machine: Set NCP type to another type than IP										
<b>Test Procedure and Setup</b>	<ul style="list-style-type: none"> <li>• Connect the ATU-R to the ATU-C with the line simulator with a length of 9 Kft.</li> <li>• Verify that the system is able to establish a link.</li> <li>• Power on the ATM network analyzer and capture transmitted packets.</li> <li>• Establish a PPP session between the network termination device and the ATU-R.</li> <li>• Let the PPP session reach the network control phase.</li> </ul>										
<b>Discussion</b>	<p>This test is designed to verify that an implementation can reject the NCP type IP. IPCP is the Internet Protocol Control Protocol used to configure the PPP session to transmit IP datagrams. Sending a configure-request packet and receiving a proper configure-ack packet configures the link. The packet format for IPCP configuration is,</p> <table border="1" data-bbox="597 1306 959 1486"> <tbody> <tr> <td>PPPID</td> <td>0x8021</td> </tr> <tr> <td>IPCP Code</td> <td></td> </tr> <tr> <td>IPCP Identifier</td> <td></td> </tr> <tr> <td>IPCP Length</td> <td></td> </tr> <tr> <td>Configuration Options</td> <td></td> </tr> </tbody> </table> <p>The values for IPCP code field are</p> <ol style="list-style-type: none"> <li>1. Configure request</li> <li>2. Configure-Ack</li> <li>3. Configure-Nak</li> <li>4. Configure-Reject</li> </ol>	PPPID	0x8021	IPCP Code		IPCP Identifier		IPCP Length		Configuration Options	
PPPID	0x8021										
IPCP Code											
IPCP Identifier											
IPCP Length											
Configuration Options											
<b>Success Criteria</b>	For local machine's IPCP <i>config-request</i> , peer must send a <i>protocol-reject</i> .										
<b>Results</b>	IPCP should be closed and the link should go down										



<b>Group_3_4_Test_2 / ppp_ipcp_configure</b>											
<b>Test Purpose</b>											
The purpose of this test is to verify that IPCP packets are transmitted for PPP network layer protocol configuration and establishment.											
<b>Last Modification</b>											
December 5, 2001											
<b>References</b>											
RFC 1332, RFC 1661, RFC 2364											
<b>Resource Requirements</b>											
<ul style="list-style-type: none"> <li>• ATU-R unit (NT equipment) – <i>Local implementation</i></li> <li>• ATU-C unit (DSLAM)</li> <li>• ATM switch</li> <li>• Device capable of traffic generation</li> <li>• ATM network analyzer</li> <li>• Network Termination device – <i>Peer implementation</i></li> </ul>											
<b>Input Parameters</b>											
Encapsulation: LLC											
<b>Test Procedure and Setup</b>											
<ul style="list-style-type: none"> <li>• Connect the ATU-R to the ATU-C with the line simulator with a length of 9 Kft.</li> <li>• Verify that the system is able to establish a link.</li> <li>• Power on the ATM network analyzer and capture transmitted packets.</li> <li>• Establish a PPP session between the network termination device and the ATU-R.</li> <li>• Let the PPP session reach the network control phase.</li> <li>• Initiate the configuration for sending IP datagrams using IPCP.</li> </ul>											
<b>Discussion</b>											
<p>This test is designed to verify the transmission of IPCP packets for link configuration. IPCP is the Internet Protocol Control Protocol used to configure the PPP session to transmit IP datagrams. Sending a configure-request packet and receiving a proper configure-ack packet configures the link. The packet format for IPCP configuration is,</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <tbody> <tr> <td>PPPID</td> <td>0x8021</td> </tr> <tr> <td>IPCP Code</td> <td></td> </tr> <tr> <td>IPCP Identifier</td> <td></td> </tr> <tr> <td>IPCP Length</td> <td></td> </tr> <tr> <td>Configuration Options</td> <td></td> </tr> </tbody> </table> <p>The values for IPCP code field are</p> <ol style="list-style-type: none"> <li>1. Configure request</li> <li>2. Configure-Ack</li> <li>3. Configure-Nak</li> <li>4. Configure-Reject</li> </ol>		PPPID	0x8021	IPCP Code		IPCP Identifier		IPCP Length		Configuration Options	
PPPID	0x8021										
IPCP Code											
IPCP Identifier											
IPCP Length											
Configuration Options											
<b>Success Criteria</b>											
<p>The system should initialize and should then be able to transmit traffic. The captured packets should have value corresponding to IPCP in the PPP protocol ID field. The IPCP code value should correspond to values given above for configuration packets and all these packets should have the same value in the identifier field. The IPCP configuration packets are exchanged and the PPP link is configured or rejected for IP datagrams.</p>											
<b>Results</b>											
IPCP is in open state											

<b>Group_3_4_Test_3 / reject_ip-address_mutually_assigned</b>
<p><b>Test Purpose</b></p> <p>The purpose of this test is to verify that both implementations cannot accept the IPCP option IP address set to their mutual addresses.</p>
<p><b>Last Modification</b></p> <p>December 5, 2001</p>
<p><b>References</b></p> <p>RFC 1332, RFC 1661, RFC 2364</p>
<p><b>Resource Requirements</b></p> <ul style="list-style-type: none"> <li>• ATU-R unit (NT equipment) – <i>Local implementation</i></li> <li>• ATU-C unit (DSLAM)</li> <li>• ATM switch</li> <li>• Device capable of traffic generation</li> <li>• ATM network analyzer</li> <li>• Network Termination device – <i>Peer implementation</i></li> </ul>
<p><b>Input Parameters</b></p> <p>IPCP options: IP address of peer and local  Local Machine: Set IPCP option IP address to peer machine's IP address  Peer Machine: Set IPCP option IP address to local machine's IP address</p>
<p><b>Test Procedure and Setup</b></p> <ul style="list-style-type: none"> <li>• Connect the ATU-R to the ATU-C with the line simulator with a length of 9 Kft.</li> <li>• Verify that the system is able to establish a link.</li> <li>• Power on the ATM network analyzer and capture transmitted packets.</li> <li>• From the local machine, initiate the establishment of the PPP session.</li> <li>• Let the PPP session reach the network control phase.</li> <li>• Initiate the configuration for sending IP datagrams using IPCP.</li> </ul>
<p><b>Discussion</b></p> <p>This test is designed to verify that an implementation cannot accept its own IP address as the peer IP address.  There are three IPCP options:</p> <ol style="list-style-type: none"> <li>1. IP-Addresses</li> <li>2. IP-Compression-Protocol</li> <li>3. IP-Address</li> </ol>
<p><b>Success Criteria</b></p> <p>For local machine's <i>config-request</i>, peer should send <i>config-nak</i> and for peer's <i>config-request</i>, local machine should send <i>config-nak</i>.</p>
<p><b>Results</b></p> <p>IPCP is in "close" state.</p>

<b>Group_3_4_Test_4 / accept_ip-compression-protocol</b>
<p><b>Test Purpose</b></p> <p>The purpose of this test is to verify that both implementations can accept the IPCP option IP-Compression-Protocol.</p>
<p><b>Last Modification</b></p> <p>December 5, 2001</p>
<p><b>References</b></p> <p>RFC 1332, RFC 1661, RFC 2364</p>
<p><b>Resource Requirements</b></p> <ul style="list-style-type: none"> <li>• ATU-R unit (NT equipment) – <i>Local implementation</i></li> <li>• ATU-C unit (DSLAM)</li> <li>• ATM switch</li> <li>• Device capable of traffic generation</li> <li>• ATM network analyzer</li> <li>• Network Termination device – <i>Peer implementation</i></li> </ul>
<p><b>Input Parameters</b></p> <p>IPCP options: IP-Compression-Protocol  Local Machine: Set IPCP options IP-Compression-Protocol to enable  Peer Machine: Set IPCP options IP-Compression-Protocol to enable</p>
<p><b>Test Procedure and Setup</b></p> <ul style="list-style-type: none"> <li>• Connect the ATU-R to the ATU-C with the line simulator with a length of 9 Kft.</li> <li>• Verify that the system is able to establish a link.</li> <li>• Power on the ATM network analyzer and capture transmitted packets.</li> <li>• From the local machine, initiate the establishment of the PPP session.</li> <li>• Let the PPP session reach the network control phase.</li> <li>• Initiate the configuration for sending IP datagrams using IPCP.</li> </ul>
<p><b>Discussion</b></p> <p>This test is designed to verify that an implementation cannot accept it's own IP address as the peer IP address.  There are three IPCP options:</p> <ol style="list-style-type: none"> <li>1. IP-Addresses</li> <li>2. IP-Compression-Protocol</li> <li>3. IP-Address</li> </ol>
<p><b>Success Criteria</b></p> <p>Both need to acknowledge for compression</p>
<p><b>Results</b></p> <p>IPCP should be in the open state</p>

<b>Group_3_4_Test_5 / reject_ip-compression-protocol</b>
<b>Test Purpose</b>
The purpose of this test is to verify that an implementation can reject the IPCP option IP-Compression-Protocol.
<b>Last Modification</b>
December 5, 2001
<b>References</b>
RFC 1332, RFC 1661, RFC 2364
<b>Resource Requirements</b>
<ul style="list-style-type: none"> <li>• ATU-R unit (NT equipment) – <i>Local implementation</i></li> <li>• ATU-C unit (DSLAM)</li> <li>• ATM switch</li> <li>• Device capable of traffic generation</li> <li>• ATM network analyzer</li> <li>• Network Termination device – <i>Peer implementation</i></li> </ul>
<b>Input Parameters</b>
IPCP options: IP-Compression-Protocol Local Machine: Set IPCP options IP-Compression-Protocol to enable Peer Machine: Set IPCP options IP-Compression-Protocol to disable
<b>Test Procedure and Setup</b>
<ul style="list-style-type: none"> <li>• Connect the ATU-R to the ATU-C with the line simulator with a length of 9 Kft.</li> <li>• Verify that the system is able to establish a link.</li> <li>• Power on the ATM network analyzer and capture transmitted packets.</li> <li>• From the local machine, initiate the establishment of the PPP session.</li> <li>• Let the PPP session reach the network control phase.</li> <li>• Initiate the configuration for sending IP datagrams using IPCP.</li> </ul>
<b>Discussion</b>
This test is designed to verify that an implementation cannot accept it's own IP address as the peer IP address. There are three IPCP options: <ol style="list-style-type: none"> <li>1. IP-Addresses</li> <li>2. IP-Compression-Protocol</li> <li>3. IP-Address</li> </ol>
<b>Success Criteria</b>
For local machines <i>config-request</i> , peer should send <i>config nak</i>
<b>Results</b>
IPCP should be in the open state

<b>Group_3_4_Test_6 / ppp_ipcp_terminate</b>										
<b>Test Purpose</b>										
The purpose of this test is to verify that IPCP packets are transmitted for PPP network layer protocol configuration and establishment.										
<b>Last Modification</b>										
December 5, 2001										
<b>References</b>										
RFC 1332, RFC 1661, RFC 2364										
<b>Resource Requirements</b>										
<ul style="list-style-type: none"> <li>• ATU-R unit (NT equipment) – <i>Local implementation</i></li> <li>• ATU-C unit (DSLAM)</li> <li>• ATM switch</li> <li>• Device capable of traffic generation</li> <li>• ATM network analyzer</li> <li>• Network Termination device – <i>Peer implementation</i></li> </ul>										
<b>Input Parameters</b>										
IPCP options: IP-Compression-Protocol Local Machine: Set IPCP options IP-Compression-Protocol to enable Peer Machine: Set IPCP options IP-Compression-Protocol to disable										
<b>Test Procedure and Setup</b>										
<ul style="list-style-type: none"> <li>• Connect the ATU-R to the ATU-C with the line simulator with a length of 9 Kft.</li> <li>• Verify that the system is able to establish a link.</li> <li>• Power on the ATM network analyzer and capture transmitted packets.</li> <li>• Establish a PPP session between the network termination device and the ATU-R.</li> <li>• Let the PPP session reach the network control phase.</li> <li>• Configure the PPP link for sending IP datagrams using IPCP.</li> <li>• Initiate the "close" of IP network layer phase.</li> </ul>										
<b>Discussion</b>										
<p>This test is designed to verify the transmission of IPCP packets for link configuration. IPCP is the Internet Protocol Control Protocol used to configure the PPP session to transmit IP datagrams. Sending a terminate-request packet and receiving a proper terminate-ack packet terminates the link or till the time-out value expires. The packet format for IPCP configuration is,</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <tbody> <tr> <td>PPPID</td> <td>0x8021</td> </tr> <tr> <td>IPCP Code</td> <td></td> </tr> <tr> <td>IPCP Identifier</td> <td></td> </tr> <tr> <td>IPCP Length</td> <td></td> </tr> <tr> <td>Configuration Options</td> <td></td> </tr> </tbody> </table> <p>The values for IPCP code field are</p> <ol style="list-style-type: none"> <li>1. Terminate request</li> <li>2. Terminate-Ack</li> </ol>	PPPID	0x8021	IPCP Code		IPCP Identifier		IPCP Length		Configuration Options	
PPPID	0x8021									
IPCP Code										
IPCP Identifier										
IPCP Length										
Configuration Options										
<b>Success Criteria</b>										
<p>The system should initialize and should then be able to transmit traffic. The captured packets should have value corresponding to IPCP in the PPP protocol ID field. The IPCP code value should correspond to values given above for termination packets and all these packets should have the same value in the identifier field. The IPCP termination packets are exchanged and the PPP link configuration for transmitting for IP datagrams is closed and no more IP packets could be transmitted in the link.</p>										
<b>Results</b>										
IPCP should be closed and the link should go down.										

## **ANNEX G: Test Group 3, “PPP over ATM”**

### **Subgroup 5, “PPP Extensions”**

The PPP extensions as described in [9] and [14] are presented here rapidly and are for further study depending on needs.

#### **G.1 Identification**

This kind of packet may be sent at any time, even before LCP reached open state.  
No negotiation and response is required.  
Message field length should not exceed the default MRU minus eight.  
It is recommended to send identification packet whenever a config-reject send or received.

#### **G.2 Time – Remaining**

No negotiation and response is required.  
Message field length should not exceed the default MRU minus twelve.  
This is useful for link maintenance purposes.  
If the second-remaining field is 0xffffffff, then there is no time out during the lifetime of the link.

#### **G.3 Vendor-Extension**

This kind of packet may be sent at any time  
Value field length should not exceed the default MRU minus twelve  
Before accepting this, verify OUI and kind field.

#### **G.4 Self-Describing Pad (SDP)**

This option is used to append pad at the end of the PPP information fields.  
This option might be used by some network layer protocol or compression protocols.

#### **G.5 Callback**

This option is used to indicate that the link needs to be terminated by the other end after authentication. The link establishes by the peer without negotiating call back.

#### **G.6 Compound Frames**

This option is used to send multiple PPP encapsulated packets within the same frame.

## ANNEX H: PPP Frame Forwarding Test Methodology

### H.1 Introduction

This section describes a reference test methodology for verifying end-to-end frame transmission of PPP based traffic over the DSL network. The procedures described in ANNEX A – G call for traffic generation to verify interoperability between multiple devices. These tests can benefit from a more consistent approach as to how end-to-end frame transmission is verified. Additionally, a method for measurable test results provides for conclusive pass/fail criteria.

### H.2 Test Setup

This test methodology is implemented with a traffic generator/analyzer that has a transmitting port and a receiving port. The traffic generator/analyzer both sends test traffic and receives it back. After the traffic has been forwarded by the UUT, the traffic generator/analyzer will determine if all of the transmitted packets were received and verify that the correct packets were received. See *Figure-1* for Test setup.

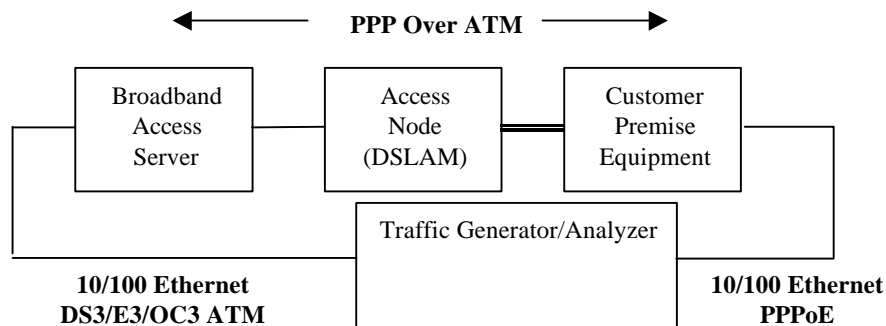


Figure 3 - Test setup

The traffic generator/analyzer will transmit test frames with a unique signature tag within the payload. The traffic generator/analyzer will discard any received frames without the signature tag and all other frames during a test run that are not forwarded test frames. For example, keep-alive and routing update frames will not increment the receive counter.

The traffic generator/analyzer will include sequence numbers in the transmitted frames and check for these numbers on the received frames. The test results will include, in addition to the number of frames dropped, the number of out of sequence frames received.

### H.3 Requirements

The following features are required for the traffic generator/analyzer:

#### Supported Protocols:

- RFC 2684 - Multi-protocol encapsulation over AAL5
- RFC 2131 - DHCP functionality
- RFC 2516 - PPPoE (PPP Over Ethernet)
- RFC 1661 / RFC 2364 - PPP over ATM
- Encapsulation - encapsulation of PPP over ATM
- PPP LCP - Link Control Protocol of PPP
- PPP Authentication – PAP and CHAP

- PPP IPCP - IP Control Protocol of PPP

**Supported Interfaces:**

- 10/100 Ethernet
- DS3/E3/OC3 ATM

**H.4 UUT Setup**

It is expected that all of the supported protocols will be configured and enabled during this set up. It is also expected that all of the tests will be executed without changing the configuration or setup of the UUT, unless required by the specific test. For example, changing protocol encapsulation from LLC SNAP to VC MUX is acceptable.

**H.5 Input Frames**

It is imperative that tests be performed at a number of frame sizes. This will exercise the UUT's ability to handle fragmented frames. Specifically, the sizes should include the maximum and minimum legitimate sizes related to PPP and enough sizes in between to verify protocol conformance by the UUT. The recommended frame sizes, frames rate and test duration is shown in the table below.

Frame Size (bytes)	Frame Rate (FPS)	Test Duration (sec.)
64	100	60
128	90	60
256	80	60
512	70	60
1024	60	60
1518	50	60