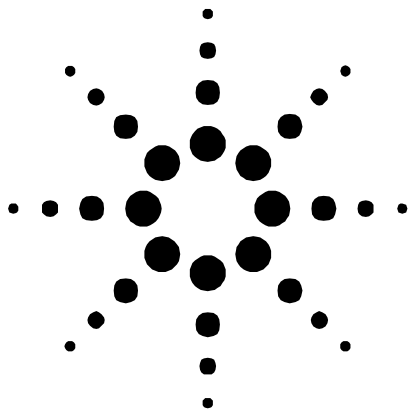# xDSL Testing on the BSTS

Agilent Technologies Broadband Series Test System
Application Note

Introduction

xDSL technology is becoming a very popular access technology. Many businesses and individuals require a way to help cater for their ever-increasing bandwidth needs without the cost associated with laying expensive new fiber links. xDSL offers end users downstream rates between 10-40 times better than would be available through a normal dial up modem.

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Network Architecture

The end users of xDSL connect to a DSLAM via several methods. Two common methods, of connecting to the network are via 10/100 Base-T Ethernet or 25.6Mb ATM to an xDSL modem or NTU (Network Termination Unit) Figure 1

Applications

xDSL NTUs can be used not only for data but also for fax/telephone, audio and video. Advances in video compression mean that ADSL is now capable of transporting video, data and phone/fax at the same time. Video over the Internet is now a reality and manufacturers and Service Providers will need to be aware of their equipment's ability to handle video traffic using the MPEG-2 standard. (Figure 2)
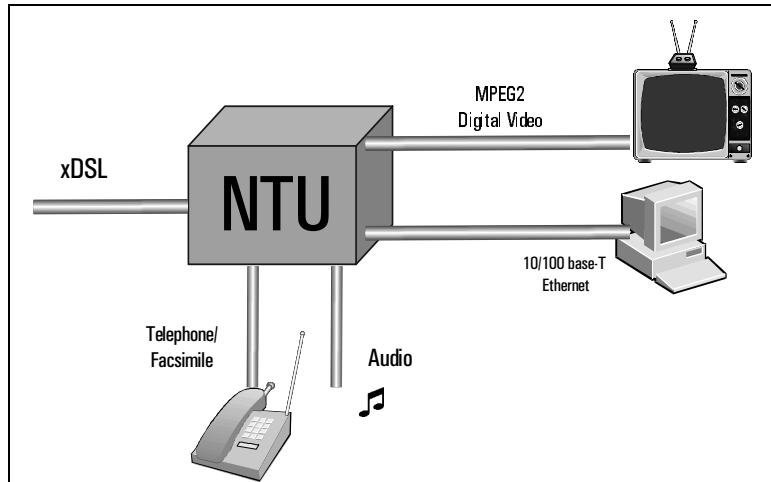

Figure 2: Soon many homes will use an NTU to connect a home entertainment console. End users will user their NTU for video, music, telephone/fax, games and general web browsing.
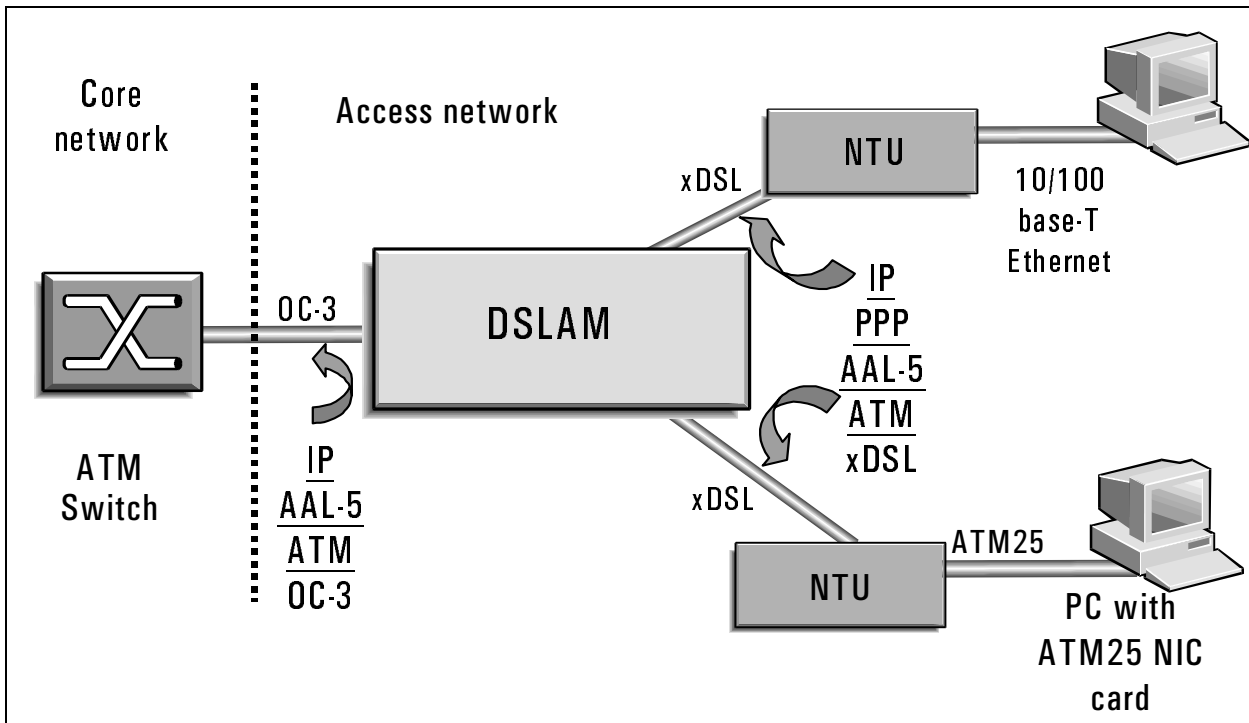

Figure 1: xDSL makes use of existing copper wire use by most analogue telephones. xDSL offers a cheap alternative to laying new fiber links. The NTU is connected to the PC via 25.6Mb ATM or 10Mb Ethernet. The DSLAM is connected to the Access Server with an OC-3 connection also running ATM

Test Requirements

It is important for both DSLAM manufacturers and Service Providers to ensure that their equipment will work to specification when users attempt to connect to their network and while end-users are using the network.

When testing the performance of an xDSL network there are several points to consider. The main purpose of performance tests is to ensure that the equipment meets its specifications. Manufacturers of DSLAMs and NTUs will need to be sure that the products that they release work, as specified. Service Providers will need to know how their equipment will perform under various loads, and with different hardware and software configurations. It is also useful for Service Providers to evaluate equipment before they make a purchase and to see how it performs with their existing equipment. (Figure 3)

Consider a simple xDSL network that consists of an NTU and a DSLAM. How can you verify the operation and measure the performance of the DSLAM and NTU together? How will you be sure that the DSLAM correctly implements the standards required to work with other equipment?

The BSTS

Using the Agilent Technologies BSTS (Broadband Series Test System), an xDSL network can be tested with downstream, upstream, and bi-directional traffic. The traffic profile can also be altered, changing the rate at which we send traffic and the traffic distribution. The BSTS can gather performance statistics on the network and also perform independent conformance testing for ATM Forum standards. (Figure 4)

The BSTS offers all required interfaces for testing an xDSL network including:

- 10/100 base-T Ethernet
- OC3 and OC12 ATM
- 25.6Mb/s ATM
- The BSTS has applications for testing the following services:
- ATM
- AAL-2 for VoATM/DSL
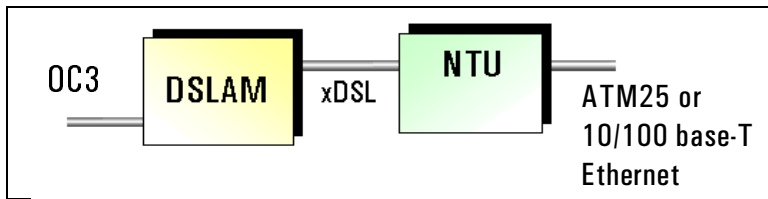- IP
- MPEG-2 digital video

Figure 3: A DSLAM and NTU connected over xDSL link with 25.6 Mb/s ATM or 10/100 Base-T Ethernet out one side and OC3 out the other.
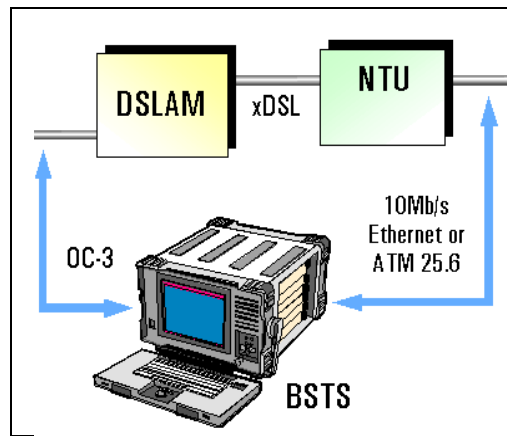

Figure 4: The BSTS can test performance and independently verify ATM forum conformance. The BSTS also can be used to test MPEG-2 video over ATM.
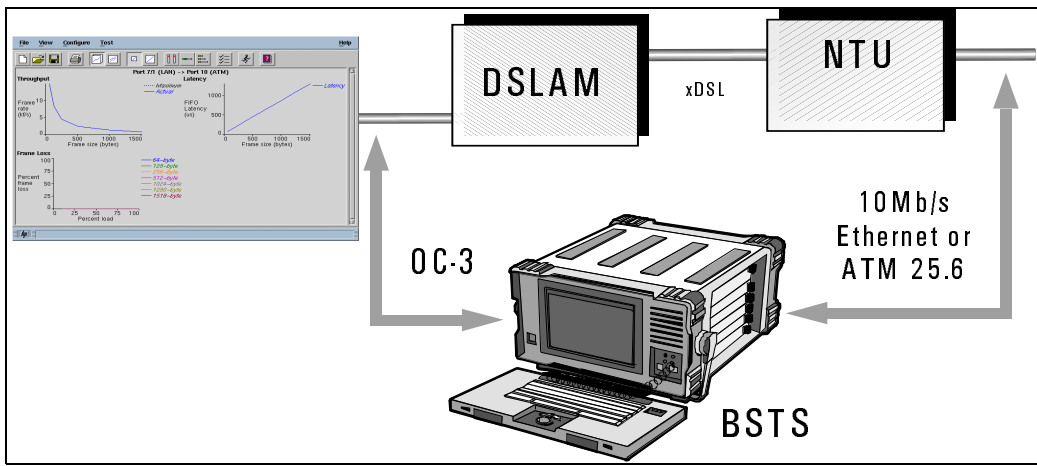

Broadband Series Test System

Figure 5: With two fully functional 10/100 base-T Ethernet ports per module, the BSTS can be used to easily test multiple NTUs connected to the one DSLAM. The results of the performance tests can be easily seen with the Packet Performance Application displaying them in both graphical and tabular form.

Test Scenarios

Conformance Testing

Manufactures of NTUs and DSLAMs need to develop equipment that can interact with other equipment. Service providers need to be sure that equipment they purchase will interact with any existing equipment they haveas well as with the core network that they will be using. Interoperability testing helps to ensure that the equipment will work with other compliant equipment once it is deployed in the field. A DSLAM will need to interact with ATM networks and different NTUs.

Conformance testing on the BSTS automates protocol compliance testing. Service provides and manufactures of ATM equipment globally recognize test suites developed by the ATM Forum. The BSTS provides several independent ATM Forum conformance test suites including UNI signalling. The E7844A ATM Forum UNI 4.0 Signalling Conformance Network Side test suite gives clear Pass or Fail verdicts on each test case used during the test.

In order to test PNNI signalling, the E6282A PNNI Signalling Test Software allows developers to observe and track PNNI signalling, massages and routing messages and, to evaluate the correct behavior and implementation of PNNI protocols.

Performance Testing

Both service providers and manufacturers need to test the performance of their equipment. Service providers who wish to purchase new equipment need to perform benchmark testing in order to be sure that the system they intend to purchase meets their requirements and to compare the competing products. Combinations of DSLAMs and NTUs need to be tested with both upstream and downstream traffic.(Figure 5)

The DSLAM is connected to several NTUs. In this case the NTUs are connected to the Agilent Technologies E6282A EFP (Ethernet Frame Processor). Each EFP module has two fully functional 10/100Base-T ports, and may be connected to two separate NTUs. The EFP can perform Layer 2 and Layer 3 testing, and has powerful capabilities that can exercise diffserve and real time traffic handling features of the DSLAM. The DSLAM is then connected back to the BSTS via an Agilent Technologies E1697A OC-3 LIF (Line Interface).

The Agilent Technologies E6283A Packet Performance Application (PPA) software is used to perform the performance tests. From either LAN to ATM, ATM to ATM or ATM to LAN. This gives the ability to test between the DSLAM and the end user for performance statistics such as latency, throughput, jitter and packet loss. The PPA will display the results obtained during testing in both graphical and tabular forms.

The traffic profiles can be varied in order to simulate real world traffic. The traffic load can also be varied so the DSLAM under test can be tested to see how much the system performance will vary under differing loads and profiles. (Figure 6)
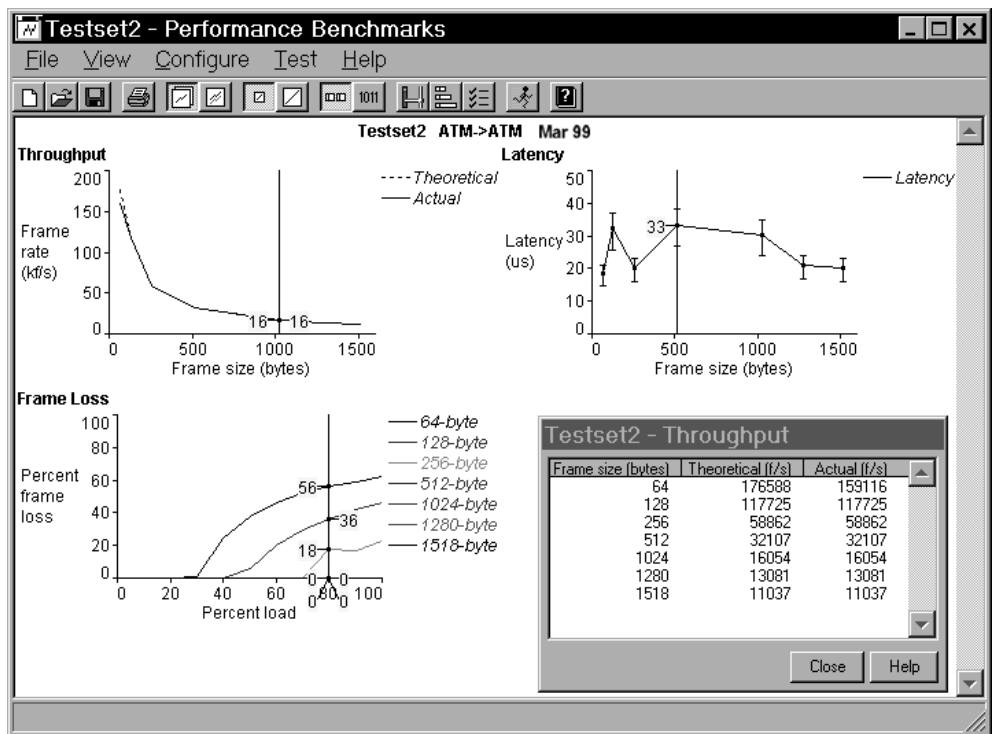

Figure 6: A screenshot from the PPA software clearly shows the graphical results of the performance tests with the tabular results included.

Broadband Series Test System

Network Management System Testing (NMS)

While testing the performance of the DSLAM provides useful information about the xDSL network, there are other things to consider. When the DSLAM makes connections to other network devices, it uses ILMI (Integrated Local Management Interface) to query the MIB (Management Information Base) of the other devices. ILMI allows the exchange of management information with a local peer. ILMI is a flexible SNMP like protocol applied to ATM interfaces, and is often used to exchange and assigned interfaces.

In some cases can be used to configure the DSLAM or NTU. ILMI can also be used to allow the user of the NTU to select which service provider, QoS or traffic profile they would like to use. These advanced features allow the end user to customize the cost and quality of service to their needs. It is vital that the MIB in your DSLAM works with other devices.

Failure to be compliant will result in interoperability problems. It is also important to be aware of the MIBs ability to deal with invalid requests. This type of testing is called negative testing. Test equipment should be able to get and set all the elements of the DSLAM or NTU MIB, it should also allow the operator to emulate the MIB of a DSLAM or NTU.

The solution should be flexible enough to represent valid and invalid MIB contents, and get or set valid and invalid MIB elements.

Agilent Technologies provide the E6273B ILMI Emulation Test Software. This software provides independent testing of the ATM Forum's ILMI. The ILMI Emulation Test Software will emulate an ATM Forum compliant MIB. Elements in the emulated MIB can be customized to the test application's needs. The E6273B software also allows a remote MIB to be walked, or modified. The system under test will involve the BSTS connecting to the OC-3 connection on the DSLAM.

The ILMI Emulation Test Software will also perform negative tests on a MIB. During a test it can make illegal queries to a MIB and monitor its response to see that it responds correctly to the illegal query.

The E7842A and E7843A test suites verify conformance to the ATM Forum UNI 3.0/3.1 Integrated Local Management Interface (ILMI) Address Registration procedures, that is, the ILMI procedures for exchanging address information, which are essential in an SVC environment.
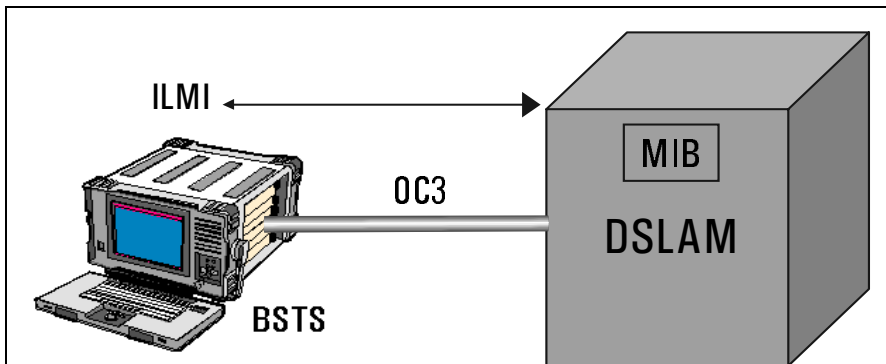

Figure 7: The BSTS with the E6273B ILMI Emulation Test Software can query a MIB in a DSLAM and provide independent ATM Forum compliance testing for your MIB

TM4.1 Traffic Testing

The DSLAM inter-works with an ATM network. It is important to know how the DSLAM will interact with the ATM network it is connected. The ATM Forum has now released the TM4.1 specification (Traffic Management). TM4.1 introduced a new service category called GFR (Guaranteed Frame Rate).

The BSTS with an E1607A ASP (ATM Stream Processor) will provide the ability to test to the ATM Forum's TM4.1 specification.

- The ASP is used to test:
- Policing
- Traffic shaping
- Congestion management
- AAL-5 performance
- ATM QoS

CoS (Class of Service) Contract Testing

Class of Service relates to providing different service classes at the IP layer. Many customers now demand high quality service from their service providers. Customers with VoIP, and live video applications need a guaranteed level of service. Service providers will need to test their networks to be sure that their equipment is capable of meeting its CoS contracts.

When performing CoS contract verification there are several issues that should be taken into account:

Handling of multiple IP traffic steams with different CoS requirements

Effect of congestion on low and high priority traffic streams

Effects of buffer sizing and queuing algorithms on system throughput and latency

The Agilent Technologies E6282A Ethernet Frame Processor has two fully featured Ethernet ports, each port can be configured with up to 8 foreground traffic streams each with different Differentiated Service categories. Each traffic stream supports multiple TCP/UDP, IP flows, MAC addresses and PDU lengths.

AAL-2 Testing for Voice over DSL

Many companies are currently looking at using VoATM (Voice over ATM) as a solution for VoDSL (Voice over DSL). VoATM reduces the jitter that can cause delays in voice traffic and is sometime associated with VoIP (Voice over IP). Agilent Technologies offer the E4212B AAL Test software with AAL-2 support, to help test VoATM.

The E4212B AAL software can be used up to full line rate, with real-time and post processing of incoming data. The AAL software also has a built in editor for simple creation of ATM cell sequences.

Product Information

E4200/E4200B Option #600

E4200B or E4210B	BSTS Base Platform
E4209B	Cell Protocol Processor
E1697A	OC-3 Line Interface
E6282A	Ethernet Frame Processor
E6283A	Packet Performance Application
E4212B	AAL Test Software with AAL-2 support

Broadband Series Test System

Acronyms

AAL	ATM Adaptation Layer
ADSL	Advanced Digital Subscriber Loop
ATM	Asynchronous Transfer Mode
ASP	ATM Stream Processor
BSTS	Broadband Series Test System
CPP	Cell Protocol Processor
DSL	Digital Subscriber Loop
DSLAM	Digital Subscriber Loop Access Multiplexer
EFP	Ethernet Frame Processor
HDSL	High speed Digital Subscriber Loop
ILMI	Integrated (formerly Interim) Local Management Interface
IP	Internet Protocol
LAN	Local Area Network
LIF	Line Interface
MAC	Medium Access Control
MIB	Management Information Base
MPEG	Moving Picture Expert Group
NIC	Network Interface Card
NMS	Network Management System
NTU	Network Termination Unit
OC	Optical Carrier
PC	Personal Computer
PDU	Protocol Data Unit
PNNI	Private Network to Network Interface

PPA	Packet Performance Application
PPP	Point-to-Point Protocol
QoS	Quality of Service
RFC	Request For Comment
SNMP	Simple Network Management Protocol
SVC	Switched Virtual Connection
TIMS	Transmission Impairment Measurement Set
TM	Traffic Management
TR	Technical Reference
UDP	User Datagram Protocol
UNI	User Network Interface
VoATM	Voice over ATM
VoDSL	Voice over DSL
VoIP	Voice over IP
xDSL	any form of Digital Subscriber Loop

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Agilent Technologies Broadband Series Test System

The Agilent Technologies BSTS is the industry-standard ATM/BISDN test system for R&D engineering, product development, field trials and QA testing. The latest leading edge, innovative solutions help you lead the fast-packet revolution and reshape tomorrow's networks. It offers a wide range of applications:

- ATM traffic management and signalling
- Packet over SONET/SDH (POS)
- switch/router interworking and performance
- third generation wireless tesing
- complete, automated conformance testing

The BSTS is modular to grow with your testing needs. Because we build all BSTS products without shortcuts according to full specifications, you'll catch problems other test equipment may not detect.

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