# ATM Test Plan, Smart Tests and Traffic Test Applications

Agilent Technologies Broadband Series Test System

Key Features

- ATM Switch Characterization Test Plan and automated software
- SVC Traffic Test Application
- Real-time O.191 Test Application
- ATM Cell Continuity SmartTest
- Traffic Management analysis tools
- Windows™-style navigational aids
- Multi-user sessions
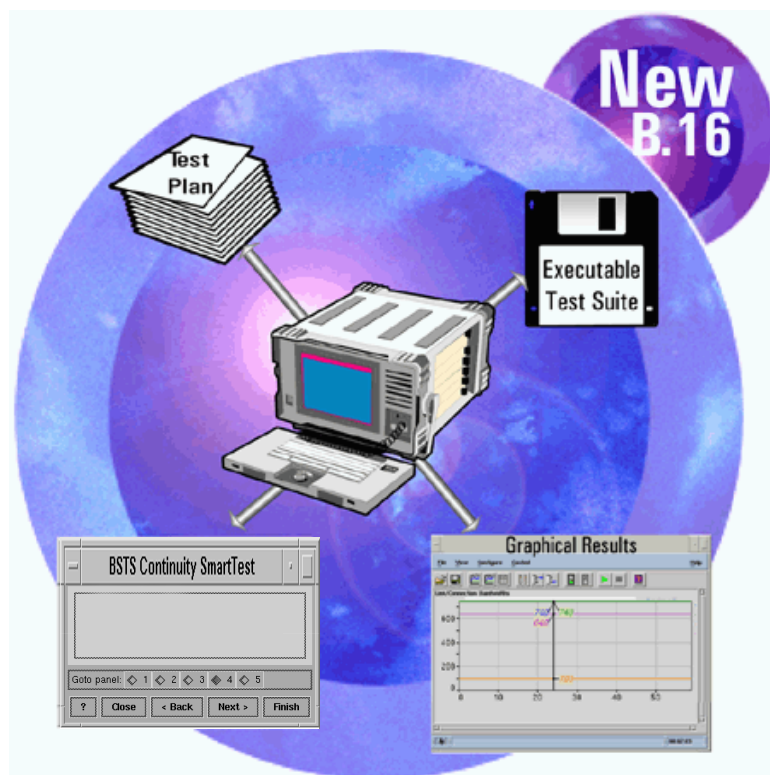
New BSTS Test applications and navigational aids simplify ATM traffic management and switch characterization testing. Test engineers can save over 10 weeks of effort using the new SmartTests, data analysis tools and ATM Switch Characterization Test Plan and automated software. This software leverages the in-depth functional and performance test capability of the E1607/9A ATM Stream Processor and E4209B Cell Protocol Processor.

Intuitive graphical applications, called SmartTests, offer simple 1-2-3 testing for common test scenarios.

Test engineers no longer need to have in-depth understanding of the protocols they are testing to get meaningful results quickly.

Three SmartTest applications are provided:

- SVC Traffic Test Application - provides rapid Traffic Management performance measurements over multiple Switched Virtual Circuits, with automatic UNI call setup and tear down.
- ATM Cell Continuity SmartTest - rapidly performs the most fundamental test in network provisioning by verifying ATM cell continuity through an ATM switch or network.

- Real-time O.191 Test Application - A 1-2-3 Stepped guide to perform real-time QoS analysis. Ideal for testing ATM Service Level Agreements (Traffic Contracts).

A suite of off-line capture analysis tools extends the analysis and diagnostic capability of the E1607/9A ATM Stream Processor and E4209B Cell Protocol Processors. These applications provide performance metrics in both graphical and tabular formats, for AAL-1, ABR Resource Management and UNI signalling negotiation. In addition, a policing and traffic characterization analysis

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application is available for the ATM Stream Processor.

An ATM Switch Characterization Test Plan and test software automates the task of categorizing ATM Switch functionality and performance. NEMs and Service Providers new to ATM testing can use the test plan as a starting point and guide to what needs to be tested, as well as how to test it.

Experienced test engineers can also capitalize on the automated test software by not having to invest the many weeks of development time required to automate the test plan.

All utilities and applications are integrated into a single Windows^{TM}-style application manager to help test engineers find the applications they need faster and easier. In addition, an unlimited number of users can now remotely log onto the BSTS simultaneously. This allows multi-user lab environments to be more productive to get products to market faster.
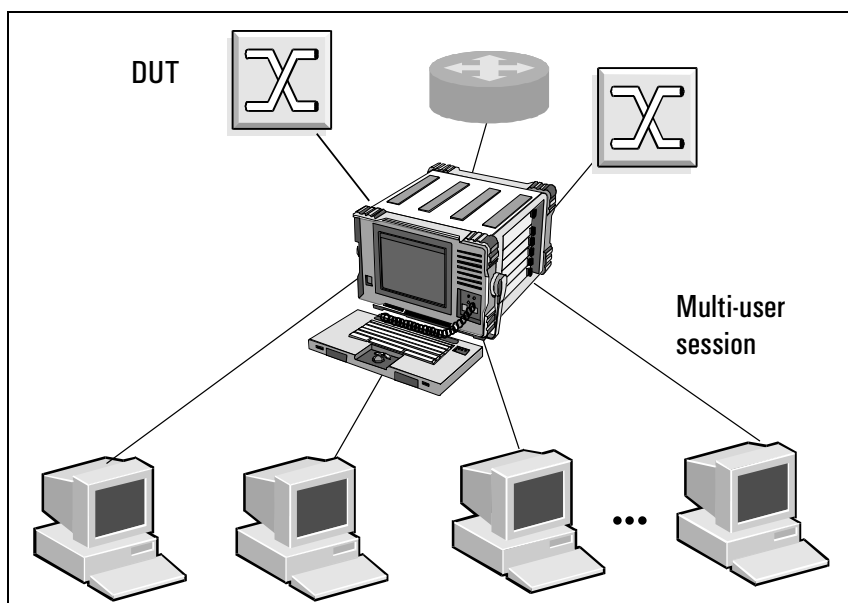
An unlimited number of users can now use the BSTS simultaneously.
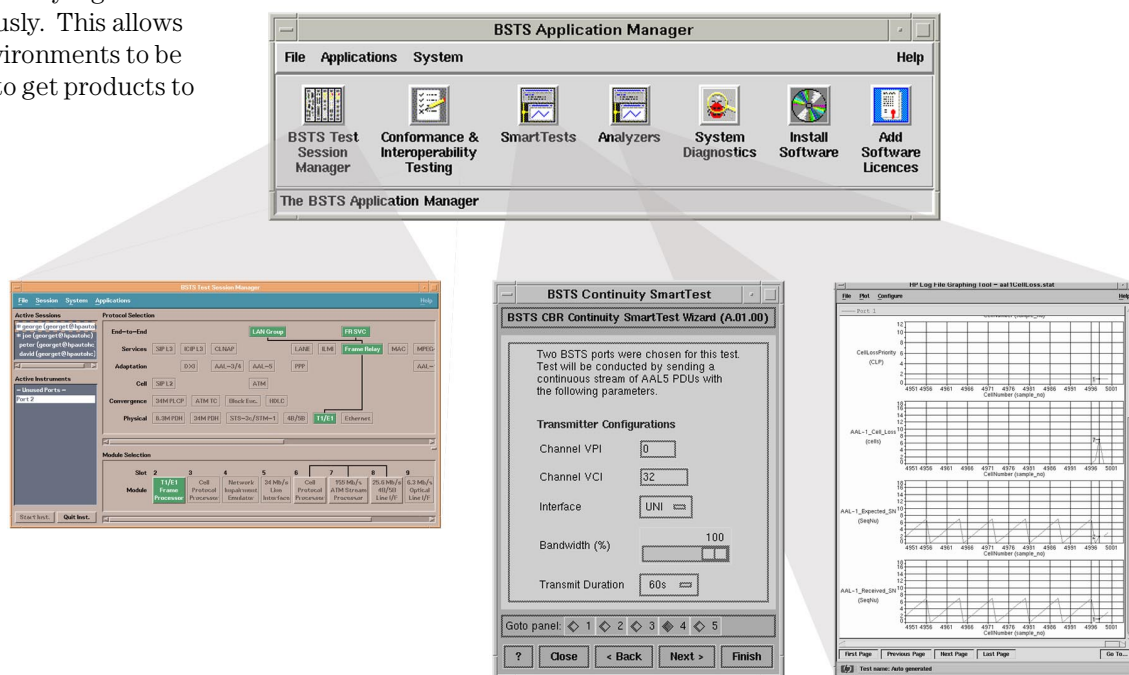
The new Windows^{TM}-style BSTS Application Manager gives you quick and easy access to the all applications you need.

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SmartTests

SVC Traffic Test Application

The SVC Traffic Test Application provides automatic UNI Call establishment to enable rapid traffic performance measurements over SVCs. Service Providers no longer need to understand the complexities of signalling negotiation in order to test service category compliance. Test engineers simply specify the number of SVCs required for testing, as well as the traffic profile types, and the Test application does the rest!
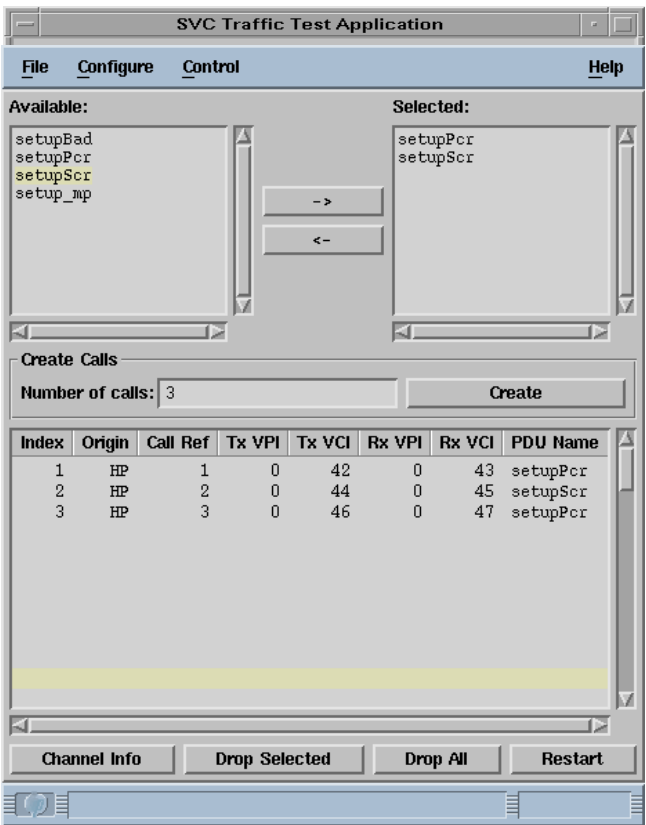
The application will automatically configure the SVCs, and generate conforming test traffic on each individual connection. Traffic performance metrics are derived using the E4223A Traffic and Policing Characterizing Software. The following metrics are provided for each virtual channel connection:

- GCRA policing analysis
- 1-point CDV
- 2-point CDV
- cell interarrival time distributions
- cell loss

The performance metrics are then displayed in a tabular report format to the test engineer.

System Requirements

- E4209B Cell Protocol Processor
- E4214B UNI Signalling Test Software
- E4223A Policing and Traffic Characterization Test Software
- Any ATM Line Interface

The SVC Traffic Test Application automates traffic testing and call setup of multiple SVCs.

Traffic performance metrics are displayed for the channel of interest.
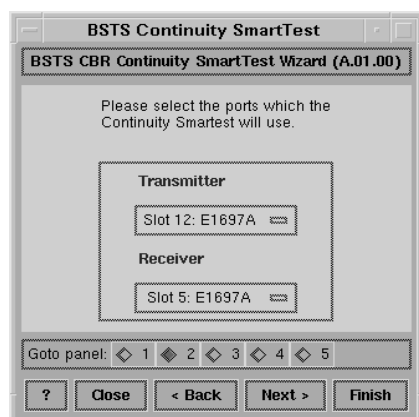
ATM Cell Continuity SmartTest

Verification of path continuity is the most fundamental test in ATM network provisioning. The Continuity SmartTest is designed to quickly verify cell continuity through a switch or network, in either single or dual port. This SmartTest steps users through the test setup, (including VPI/VCI, bandwidth and test duration), and provides a PASS/FAIL result. The Continuity SmartTest is also a great aid to new BSTS users who wish to get fast results.

Two modes of operation are possible:

- a single-port test verifies cell continuity from a single test point by analyzing captured test data
- a dual-port test verifies cell continuity from two test points by comparing total transmit and receive cell counts.

System Requirements

- The E4209B Cell Protocol Processor
- Any ATM Line Interface (0-155Mb/s)

Automatically detects modules available for testing.
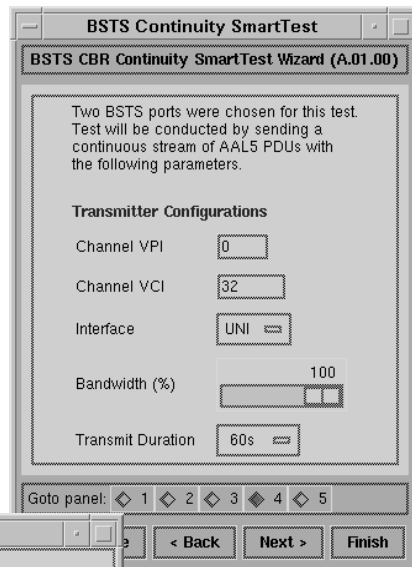
Intuitive configuration dialog.

The Continuity SmartTest reports a pass/fail result as well as supporting measurements.

The ATM Cell Continuity SmartTest rapidly verifies cell continuity through a switch or network.

Real-time O.191 Test Application

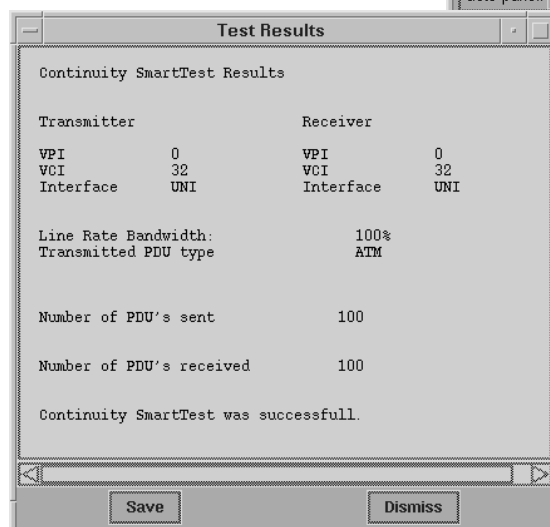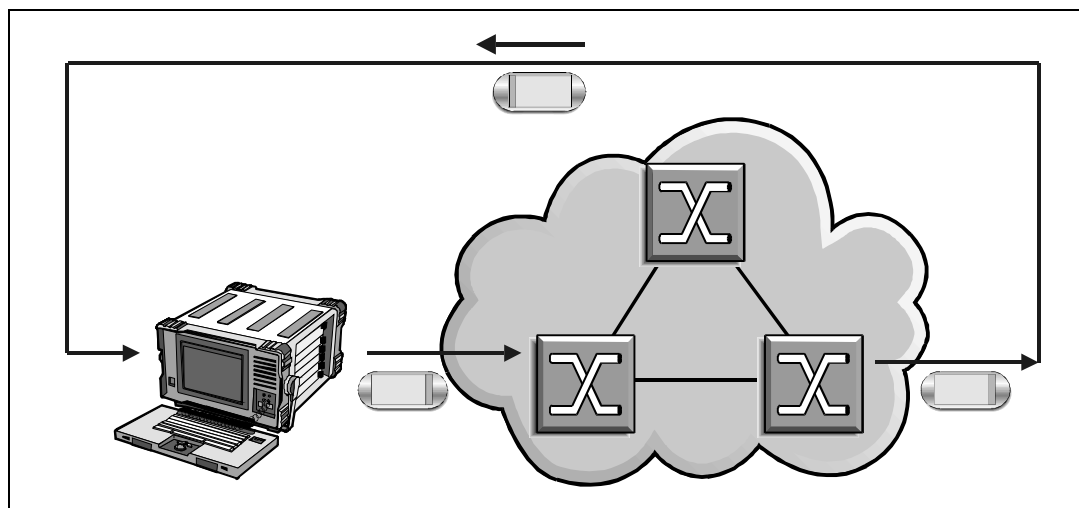The Real-time O.191 Test Application provides a stepped guide to perform real-time traffic contract analysis based on the industry-standard O.191 test cell. Service Providers no longer require an intimate understanding of traffic management specifications in order to test Quality of Service. The Real-time O.191 Test Application provides an intuitive graphical user interface to both generate ITU-T O.191 compliant test traffic, and obtain real-time tabular and graphical QOS measurements.

Two foreground streams can be specified by ATM VPI/VCI, cell or frame payload types, bandwidths, and traffic profile (rtVBR, nrtVBR, CBR, UBR). A further stream can also be enabled to provide additional background loading.

On the receive side, time-correlated cell and frame based measurements are presented graphically or in tables. Two graphical views are provided, an ATM QoS View, and a Frame based view.

ATM Quality of Service metrics viewed in a single graphical display include:

- Total Link transmit and receive bandwidths
- Channel (VC) level receive bandwidth
- Minimum Cell Transfer Delay
- Maximum Cell Transfer Delay
- 2-Point Cell Delay Variation
- Peak-to-Peak 2-point Cell Delay Variation
- Cell Loss
- CLP Converted Cells (tagged cells)
- O.191 Errored Cells

A second frame based view allows AAL-5 Frame metrics to be correlated against ATM layer events. This allows rapid monitoring and diagnosis of proprietary schemes like Early Packet Discard (EPD), Partial Packet Discard (PPD) and Random Early Detection (RED). Measurements include:

- Link connection bandwidths (transmit and receive)
- Channel AAL-5 PDU bandwidths
- AAL-5 Errored PDU Count
- ATM Cell Loss
- O.191 Errored Cells

System Requirements

- E1607/9A ATM Stream Processor
- Any ATM Line Interface (0-622Mb/s)
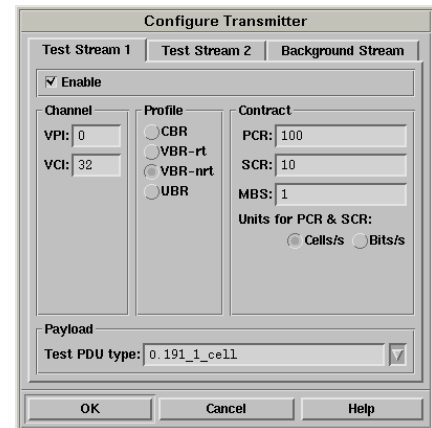
Rapid configuration of traffic contract parameters.

The Real-time O.191 Test Application tests and monitors traffic contracts in real-time.

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ATM Switch Characterization Test Plan and Software

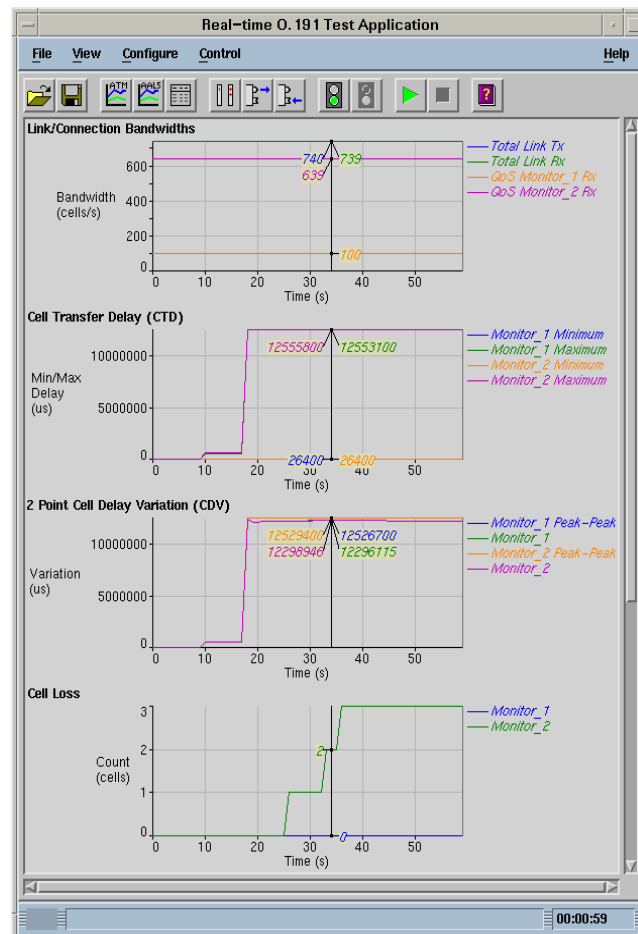An ATM Switch Characterization Test Plan and test software automates the task of categorizing ATM switch functionality and performance. The test plan captures an in-depth understanding of ATM traffic specifications and test methods. NEMs and Service Providers new to ATM testing can use the test plan as a starting point and guide to what needs to be tested, as well as how to test it. Experienced test engineers can also capitalize on the automated test software by not having to invest weeks of development time required to automate the test plan.

The test cases are designed to operate using two to four port configurations. Nine test cases are provided, including CBR, VBR and multicast throughput, traffic policing, port fairness and starvation, tail packet discard, head of line blocking, and a cell loss priority discard test. Additional test cases can be added by customizing the source code.

System requirements

- The E4209B Cell Protocol Processor
- The E1697A 155 Mb/s Optical Line Interface

Test Cases

The test plan documents the test purpose and method of each test case in detail.

Test 1: GCRA

The GCRA Test can be used to validate the policing function of an ATM switch. This test case generates VBR traffic and measures conformance with the policer both enabled and disabled. A result table is produced.

Test 2: CBR Throughput

The CBR throughput test case cycles through eight different traffic loads with a physical port configuration of up to 4 x 4 ports. Measurements provided are throughput (peak lossless cell rate), cell delay and CDV.

Test 3: VBR Throughput

The VBR throughput test can be used to verify whether an ATM switch can deliver wire speed throughput across the switching fabric under various circumstances. Measurements provided are throughput, loss ratio, cells received, PDUs received and PDU errors.

Test 4: Port Fairness

Port fairness under congestion is tested by generating bursts of large packets on multiple input ports and a periodic stream of short packets on another port, all destined for the same output port. The latency of the short PDU traffic stream is measured while varying the load on the congested port with multiple data streams.

Test 5: Port Starvation

Congestion control tests measure an ATM switch's ability to minimize loss when output port contention occurs.

Output port contention arises when multiple input ports are sending traffic simultaneously to a common output port. However congestion on one or more ports should not affect the traffic flow on the uncongested ports.

The port starvation test case congests a port by generating periodic bursts of cells from multiple input ports, destined for a single output port. The average aggregate cell rate will exceed the
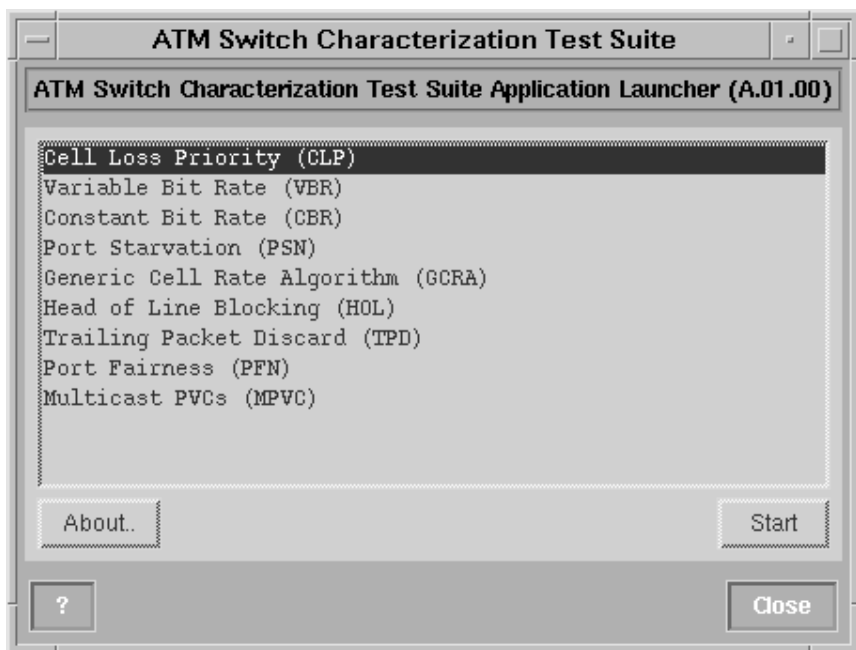
The ATM Switch Characterization Test Plan and automated test software can save test engineers weeks of development time.
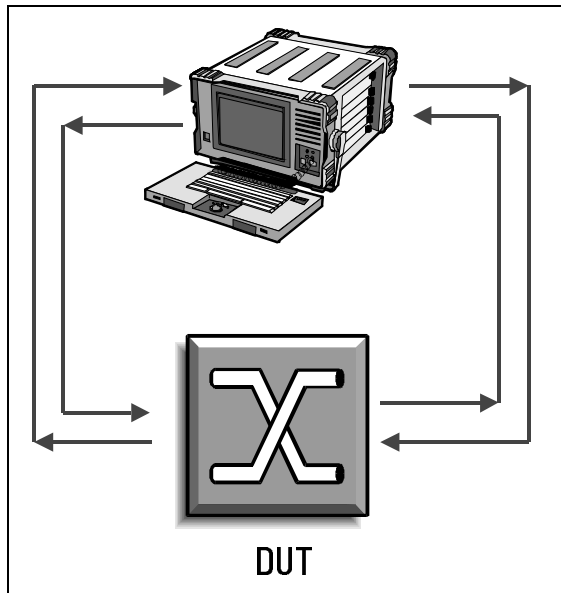
The test plan and software supports 2x2 through to 4x4 test port configurations.

The ATM Switch Characterization Test Plan and software provides test engineers with a complete solution - from design and implementation through to automation, execution and reporting.

line rate of the output port by 50%. This congestion should not effect a CBR traffic flow on another output port.

Test 6: Cell Loss Priority

During heavy congestion periods, an ATM switch must discard first those cells whose CLP bit is set to a low priority (CLP=1), indicating that they should be discarded in preference to those cells with high priority (CLP=0).

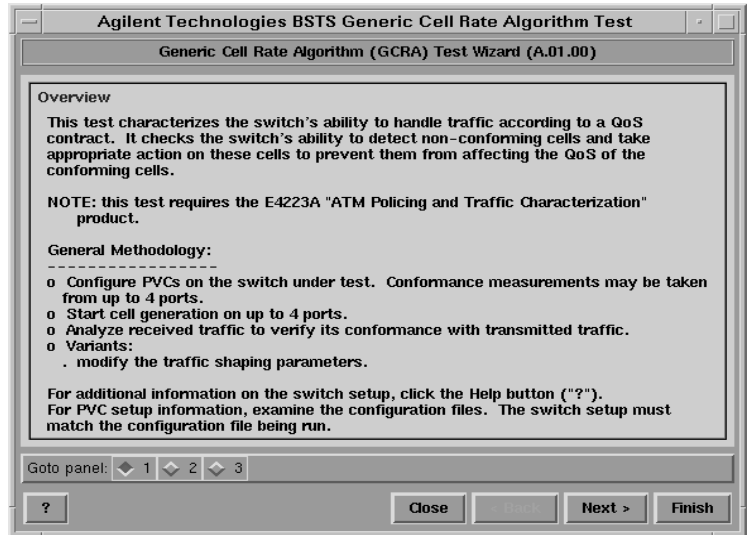Congestion on an output port can be caused by generating periodic bursts of cells on multiple input ports and destined for a single output port. By monitoring the traffic on the output port, we can confirm that the low priority cells are discarded first.

Test 7: Tail Packet Discard

Testing a switch's ability to support tail packet discard is accomplished by creating a congestion situation, where multiple input ports are contending for a single output port. The aggregate traffic sent to the output port should exceed the capacity of the output port, thereby causing cell loss due to buffer overflow. The test is run by monitoring packet goodput, with and without tail packet discard enabled.

Test 8: Multicast Throughput

The ability of a switch to handle multicast connections will be tested by generating CBR and VBR traffic sent on a single input port and destined for multiple output ports.

As the multicast fanout increases, there should not be a significant increase in the cell loss, cell delay, and CDV.

Test 9: Head of Line Blocking

The ability of a switch to handle HOL blocking is tested by generating two data streams from a single input source each destined for a different output port and causing congestion on one of the output ports by adding background traffic to that port.

Analysis Tools

A group of post-processing data applications are provided to extend the already rich feature set of the BSTS products.

Capture Data Traffic Analyzer

The Capture Data Traffic Analyzer brings policing verification and traffic characterization analysis to the E1607/9A ATM Stream Processor. Policing can be verified by comparing the conformance of a user traffic stream to user-defined GCRA parameters. A large sample of up to 262,144 cells is used to accurately characterize traffic. ATM Traffic characterization metrics are reported in both tabular and graphical formats. Key metrics include:

- VPI, VCI, CLP distributions
- cell arrival times
- cell interarrival time distributions
- GCRA conformance and non-conformance distributions
- 1-point cell delay variation
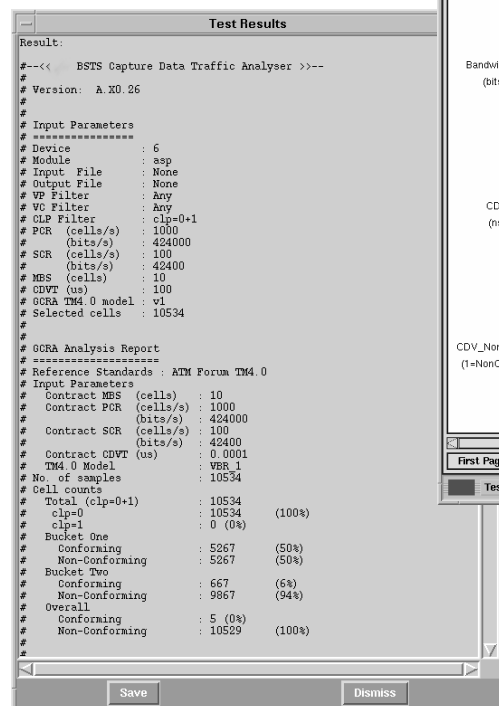
System Requirements

- E1607/9A ATM Stream Processor

OR

- E4209B Cell Protocol Processor
- Any ATM Line Interface (0-622Mb/s)

Dialog for specifying traffic contract parameters.

Both graphical and tabular reports facilitate rapid diagnosis and correlation of problems.

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AAL-1 Cell Loss Capture Data Analyzer

The AAL-1 Cell Loss Data analyzer adds AAL-1 Cell Loss measurements to the E1607/9A ATM Stream Processor. This application analyzes captured AAL-1 data and generates a test report. The report specifies both input parameters and derived measurements including:

- lost cell counts
- received cell counts
- loss ratio
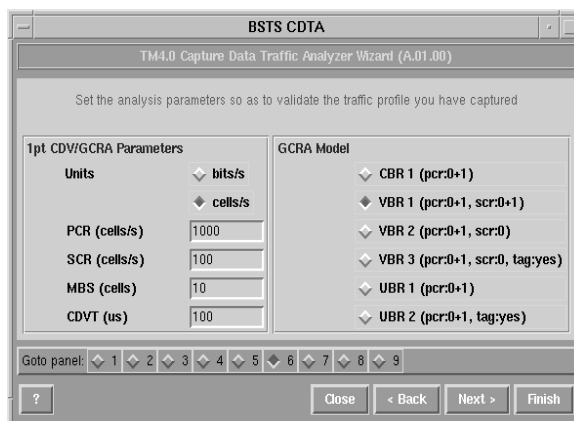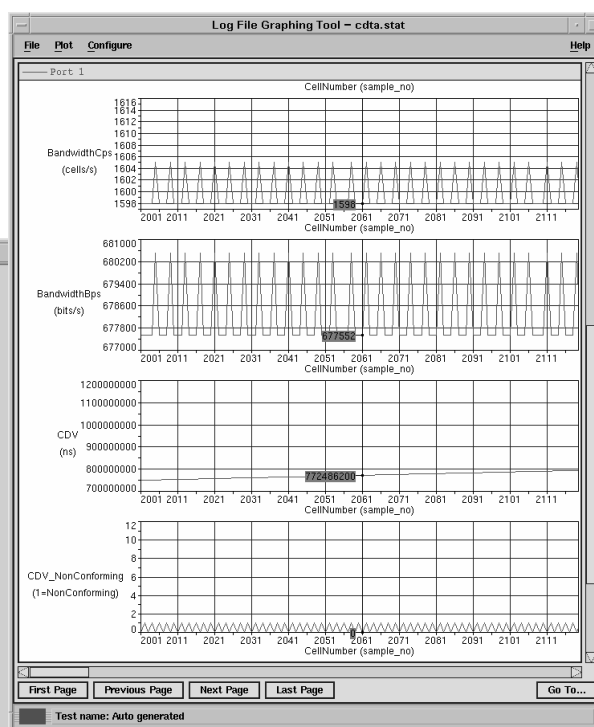- VPI/VCI distribution analysis

The powerful LogFile Graphing Tool can also be automatically launched at the completion of the analysis. This allows key metrics to be correlated to the cell event, by a simple click of the mouse.

The following measurements are graphically displayed allowing cell event correlation:

- VPI Utilization
- VCI Utilization
- cell loss priority
- cell loss counts
- expected sequence number
- received (actual) sequence number

System Requirements

- E1607/9A ATM Stream Processor
- Any ATM Line Interface (0-622Mb/s)


```
                     Test Results
Using command:

  /usr/broadband/util/run_aspAal1CellLoss  -d 6 -p 0 -n 15000

Result:

#--<< HP BSTS E1607A/E1609A ASP - AAL-1 Cell Loss Analyser >
#
# Version:  A.X0.01
#
#
# Input Parameters
# ================
# Device          : 6
# Module          : asp
# VP Filter       : 0
# VC Filter       : Any
# CLP Filter      : clp=0+1
# Selected cells  : 5289
#
#
# AAL-1 Cell Loss Analysis Report
# ===============================
# No. of samples  : 5289
# Cell Loss
#    Lost                (cells) : 29
#    Received            (cells) : 5289
#    Sent  = Lost+Received (cells) : 5318
#    Ratio = Lost/Sent           : 0.005   (1%)
#
#
# VPCI Distribution Analysis Report
# =================================
# No. of samples : 5289
# No. of VPIs    : 1
# No. of VPCIs   : 1
#
#  VPI    VCI    No. of Cells
# ------ ------  ------------
#   0     33      5289
```


Sequence number errors can be correlated quickly and efficiently through the graphical view.

Signalling Performance Capture Data

The signalling performance data analyzer derives detailed performance statistics from captured signalling traffic. The time-consuming task of diagnosing signalling performance bottlenecks is simplified with the use of both summary and detailed reports generated by this analyser.

A broad range of report types are available including:

- summary of call statistics including inter-message delays, counts and performance estimates
- detailed call statistics for all inbound and outbound calls per port
- table of individual call records showing timestamps of each signalling message for each signalling exchange.

The analyzer works with all BSTS signalling modules including the E4209B Cell Protocol Processor, and E1600A Multiport UNI Signalling Performance Test Solution.

System Requirements

- E1600A Multiport UNI Signalling Test Solution

  or

- E4209B Cell Protocol Processor

Summary of Call Statistics

Inbound and outbound	• inter-message delays (min, max, average)
	• message counts
	• performance estimates, including: avg call attempt rate, avg call establishment rate, burst call establishment time, avg clear attempt rate, avg clearing rate, burst call clearing time

Detailed multi-port call statistics

| Individual call statistics for all ports (inbound and outbound calls) | • setup to connect, conn to conn ack, conn-to-rel, rel-to-rel comp |
| | • distribution by time bucket; setup to connect, conn to conn ack, conn-to-rel, rel-to-rel comp |

Call data records

| Detailed record of all calls in chronological order (timestamp) | • Port, CRef, timestamp for setup, call proc, conn, connack, Rel, RelComp |

```
                              Test Results

#----------------------------------------------------------------
# Statistics Summary Report for 'All Ports' (50 CDRs)
#----------------------------------------------------------------

  --<Outbound Call Statistics>--

    Inter-message delays              MIN (us)    MAX (us)    AVG (us)
    ------------------------------    ----------  ----------  ----------
    Setup   to Call_Proceeding :            0           0           0
    Setup   to Connect         :          242         372       270.7
    Connect to Connect_Ack     :         2642       97677     9551.56
    Connect to Release         :            0           0           0
    Release to Rel_Complete    :            0           0           0

    Message counts
    ------------------------------
    Setup               : 50
    Call Proceeding     : 0
    Connect             : 50
    Connect Acknowledge : 50
    Release             : 0
    Release Complete    : 0

    Performance Estimates
    ----------------------------------------------------
    Avg   call attempt rate      (calls/s): 85.2839
    Avg   call establishment rate (calls/s): 85.245
    Burst call establishment time     (us): 586544
    Avg   clear attempt rate     (calls/s): 0
    Avg   clearing rate          (calls/s): 0
    Burst call clearing time          (us): 0

  --<Inbound  Call Statistics>--

    Inter-message delays              MIN (us)    MAX (us)    AVG (us)
    ------------------------------    ----------  ----------  ----------
    Setup   to Call_Proceeding :            0           0           0
    Setup   to Connect         :            0           0           0
    Connect to Connect_Ack     :            0           0           0
    Connect to Release         :            0           0           0
    Release to Rel_Complete    :            0           0           0

    Message counts
    ----------------------------
    Setup               : 0
    Call Proceeding     : 0
    Connect             : 0
    Connect Acknowledge : 0
    Release             : 0
    Release Complete    : 0

    Performance Estimates
    ----------------------------------------------------
    Avg   call attempt rate      (calls/s): 0
    Avg   call establishment rate (calls/s): 0
    Burst call establishment time     (us): 0
    Avg   clear attempt rate     (calls/s): 0
    Avg   clearing rate          (calls/s): 0
    Burst call clearing time          (us): 0
```

                    Save   Dismiss

ABR Resource Management Capture Data Analyzer

The ABR capture data analyzer extracts ABR information from ABR resource management cells captured by the CPP. Separate analyses are performed for the forward and backward RM cells.
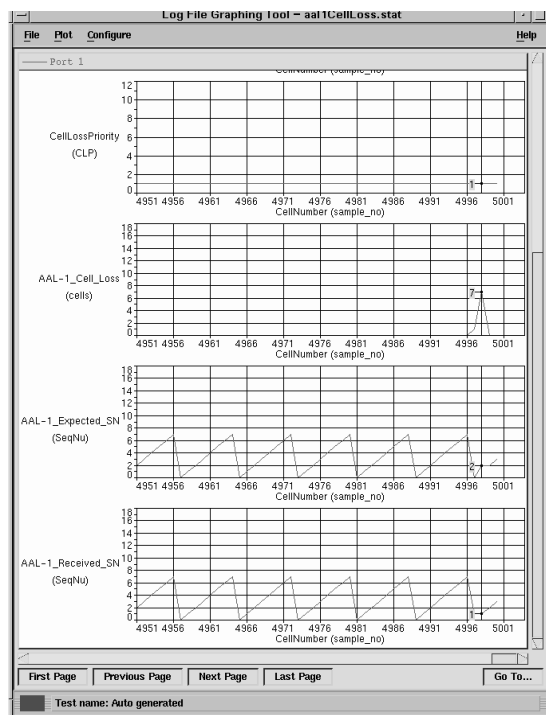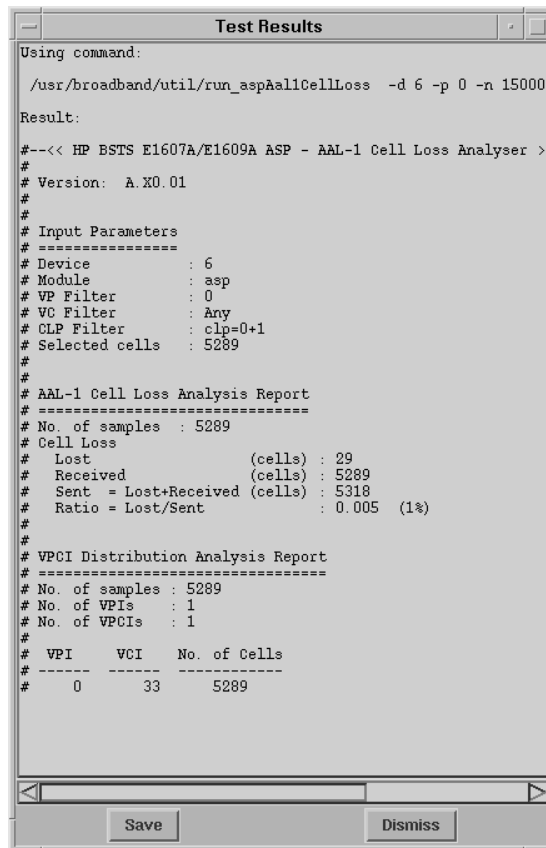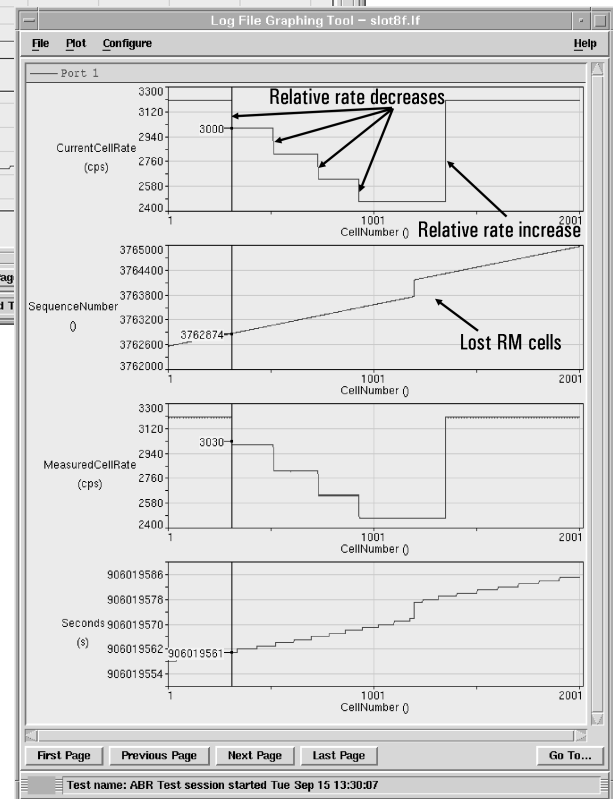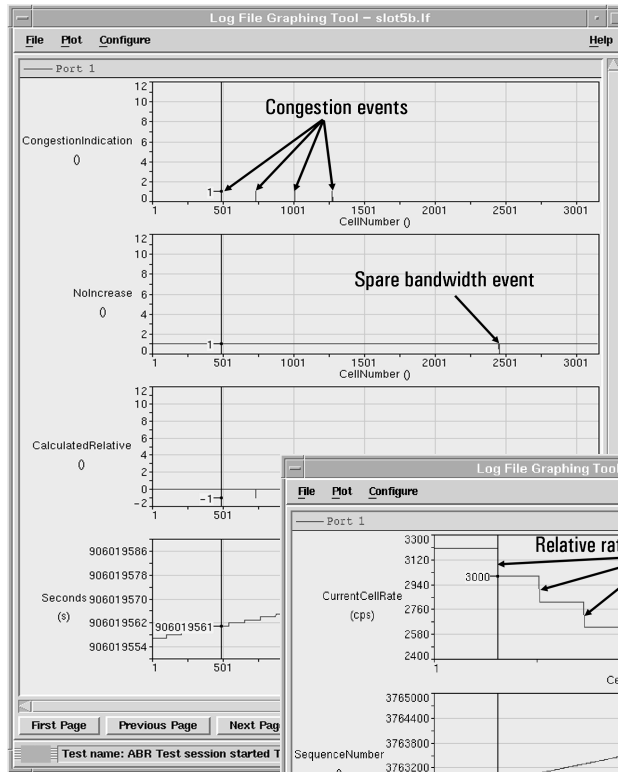
The powerful LogFile Graphing Tool can also be automatically launched at the completion of the analysis. This allows key metrics to be correlated to the cell event, by a simple click of the mouse.

System Requirements

• E4209B Cell Protocol Processor

ABR Statistics Provided

Statistic	Description
Congestion Indication	The value of the CI bit in the RM cell
No Increase	The value of the NI bit in the RM cell
Explicit Rate	The value of the ER field in the RM cell
Current cell rate	The value of the CCR field in the RM cell
Queue Length	The value of the QL field in the RM cell
Measured Cell Rate	Derived statistic to indicate instantaneous cell rate
Interarrival Time	The time between two successive RM cells
Minimum Cell Rate	The value of the MCR field in the RM cell
Relative Rate Movement	+1 indicates a relative rate increase, 0 indicates no change, and -1 indicates a relative rate decrease

Software Update Service

The Agilent Software Update Subscription Service ensures that you receive the latest software and documentation as it becomes available. You can subscribe to the service by purchasing one of three products:

- an annual update license: E4200B/E4210B +UAF +U00
- a one-time update purchase: E4229A options 001
- or a combination of telephone support and an annual update license: E4200B/E4210B +HCF +U00

Configuration and Use With Other BSTS Modules and Applications

These test applications may require the following BSTS modules and software:

- **E1607/9A** ATM Stream Processor
- **E4209B** Cell Protocol Processor
- **E1600A** Multiport UNI Signalling Performance Test Solution
- **E4223A** ATM Policing and Traffic Characterization Software
- **E4214B** UNI Signalling Test Software
- **E4200B** BSTS Form-7 Transportable Chassis
- **E4210B** BSTS Form-13 Mainframe Chassis

Applicable Standards

ATM Cells	• ITU-T I.361 B-ISDN ATM Layer Specification 1995
ATM Forum TM4.0	• Traffic Management Specification Version 4.0 af-tm-0056.000 4/1996
ITU-T I.356	• B-ISDN ATM Layer Cell Performance 11/1993
ITU-T I.357	• B-ISDN Semipermanent Connection Availability 8/1996
ITU-T I.371	• Traffic Control and Congestion Control in B-ISDN 11/1995
ITU-T I.150	• B-ISDN Asynchronous Transfer Mode Characteristics 3/1993
ATM Test Cell	• ITU-T Recommendation O.191 — Specifications of Measuring Equipment – Equipment to Assess ATM Layer Cell Transfer Performance 12/96
Performance Testing	• ATM Forum Performance Testing (Draft Specification)

Acronyms

AAL-5	ATM Adaptation Layer
ABR	Available Bit Rate
ASP	Agilent E1607/9A ATM Stream Processor
ATM	Asynchronous Transfer Mode
BSTS	Agilent Broadband Series Test System
BW	Bandwidth
CLP	Cell Loss Priority
CPP	Agilent E4209A/B Cell Protocol Processor
EPD	Early Packet Discard
nrt-VBR	Non-real-time Variable Bit Rate
OAM	Operations, Administration and Maintenance
PDU	Protocol Data Unit
PPD	Partial Packet Discard
PTI	Payload Type Indicator
PVC	Permanent Virtual Circuit
QoS	Quality of Service
RED	Random Early Detection
rt-VBR	Real-time Variable Bit Rate
Rx	Receive
SDH	Synchronous Digital Hierarchy
SONET	Synchronous Optical Network
STM	Synchronous Transfer Mode
SVC	Switched Virtual Circuit
Tx	Transmit
UNI	User Network Interface
VBR	Variable Bit Rate
VC	Virtual Circuit
VCI	Virtual Circuit Identifier
VP	Virtual Path
VPI	Virtual Path Identifier
UBR	Unspecified Bit Rate

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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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5968-8782E 03/00 Rev B

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