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.

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
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™-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™-style BSTS Application Manager gives you quick and easy access to all the applications you need.
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

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)
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)

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

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.

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

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
- 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**

- 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**

- Port, CRef, timestamp for setup, call proc, conn, connack, Rel, RelComp

---

**Test Results**

---

<table>
<thead>
<tr>
<th>Statistics Summary Report for 'All Ports' (NO OIDs)</th>
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```
---<Outbound Call Statistics>---

<table>
<thead>
<tr>
<th>Inter-message delays</th>
<th>MIN (us)</th>
<th>MAX (us)</th>
<th>AVG (us)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Setup to Call Proceeding</td>
<td>0</td>
<td>0</td>
<td>840</td>
</tr>
<tr>
<td>Connect to Connect Ack</td>
<td>0</td>
<td>0</td>
<td>701</td>
</tr>
<tr>
<td>Connect to Release</td>
<td>0</td>
<td>0</td>
<td>9655</td>
</tr>
<tr>
<td>Release to Ref Complete</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Message counts

| Setup Proceeding | 50 |
| Connect         | 50 |
| Connect Ack     | 50 |
| Release         | 0  |
| Release Complete| 0  |

Performance Estimates

- Avg call attempt rate: 2 calls/s, 0.372, 0.788
- Avg call establishment rate: 0.55, 0.45
- Avg burst call establishment time: 245, 245
- Avg call clear attempt rate: 0
- Avg clear time: 0
- Avg clear rate: 0

---<Inbound Call Statistics>---

<table>
<thead>
<tr>
<th>Inter-message delays</th>
<th>MIN (us)</th>
<th>MAX (us)</th>
<th>AVG (us)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Setup to Call Proceeding</td>
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<td>0</td>
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<td>0</td>
<td>9655</td>
</tr>
<tr>
<td>Release to Ref Complete</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Message counts

| Setup Proceeding | 0  |
| Connect         | 0  |
| Connect Ack     | 0  |
| Release         | 0  |
| Release Complete| 0  |

Performance Estimates

- Avg call attempt rate: 0
- Avg call establishment rate: 0
- Avg burst call establishment time: 0
- Avg call clear attempt rate: 0
- Avg clear time: 0
- Avg clear rate: 0

```

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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

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

<table>
<thead>
<tr>
<th>Standards Type</th>
<th>Standards</th>
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<tbody>
<tr>
<td>ITU-T I.357</td>
<td>B-ISDN Semipermanent Connection Availability 9/1996</td>
</tr>
<tr>
<td>Performance Testing</td>
<td>ATM Forum Performance Testing (Draft Specification)</td>
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</table>

### Acronyms

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

www.Agilent.com/comms/BSTS