Evaluating ATM Switch Performance

Using the HP E5200A Broadband Service Analyzer

Introduction

This solution note describes how to use out-of-service tests to evaluate ATM switch performance. It describes the three general test categories and outlines the type of testing capabilities required to perform them.

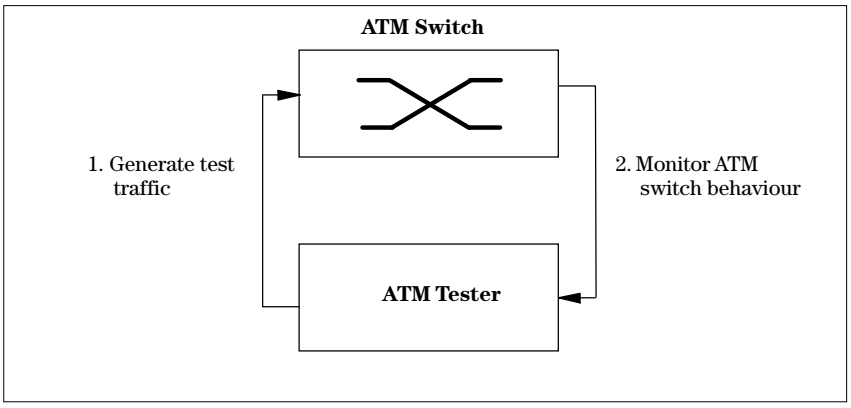
This solution note deals with PVC (Permanent Virtual Circuit) connections carrying CBR (Constant Bit Rate) or VBR (Variable Bit Rate) services. You can perform all tests described in this paper using the HP E5200A Broadband Service Analyzer.

The aim of ATM switch performance testing is to

- compare the performance of various switches
- become familiar with the behavior of the switch under various traffic conditions
- determine the optimum switch configuration settings for the type of traffic the switch will be required to handle
- establish traffic loading limits and configuration guidelines that ensure acceptable switch performance under the expected operating conditions

The out-of-service tests measure the switch performance under various simulated traffic conditions. The concept of out-of-service testing is illustrated below.

HP E5200A Broadband Service Analyzer

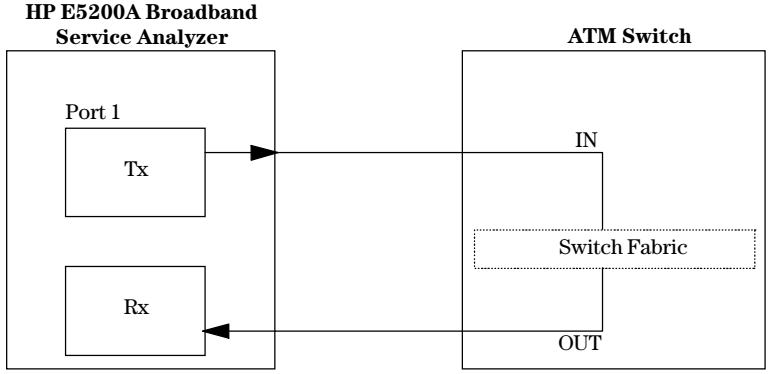


Out-of-service testing

Test Categories

Latency, Jitter, and Throughput

Measure cell delay, cell delay variation, and maximum bandwidth without cell loss across the switch fabric. Determine the amount of *headroom* per port (reserved bandwidth for network management and signaling traffic).



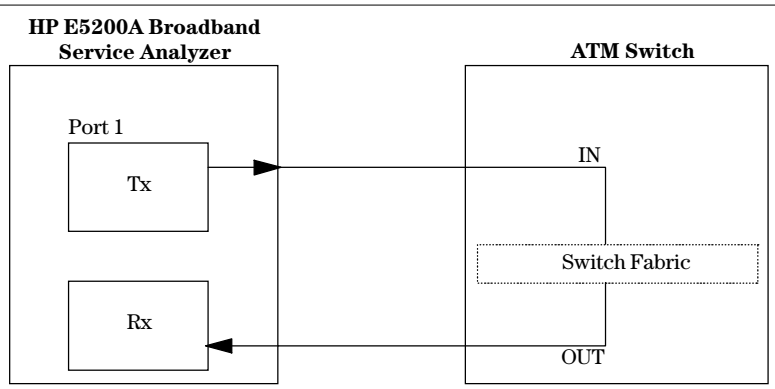
Tx - the service analyzer generates test traffic

Rx - the service analyzer measures cell loss, cell delay, and cell delay variation through the ATM switch

Test catagories - Latency, Jitter, and throughput

Switch Statistics

Test the ability of the switch to report ATM and physical layer alarms and error conditions.



Tx - the service analyzer stimulates errors and alarms and transmits them to the ATM switch

ATM switch - detects and responds to errors and alarms

Rx - the service analyzer monitors errors and alarms returned by the ATM switch

Test catagories - Switch statistics

Traffic Management

There are four sub-categories of traffic management tests:

1. PVC connection management

Test the ability of the switch to configure a large number of PVCs and route them correctly.

2. CBR and VBR traffic policing

Test the ability of the switch to configure traffic policing parameters for CBR and VBR services on different switch ports. Determine the accuracy and resolution of the switch's bandwidth measurements.

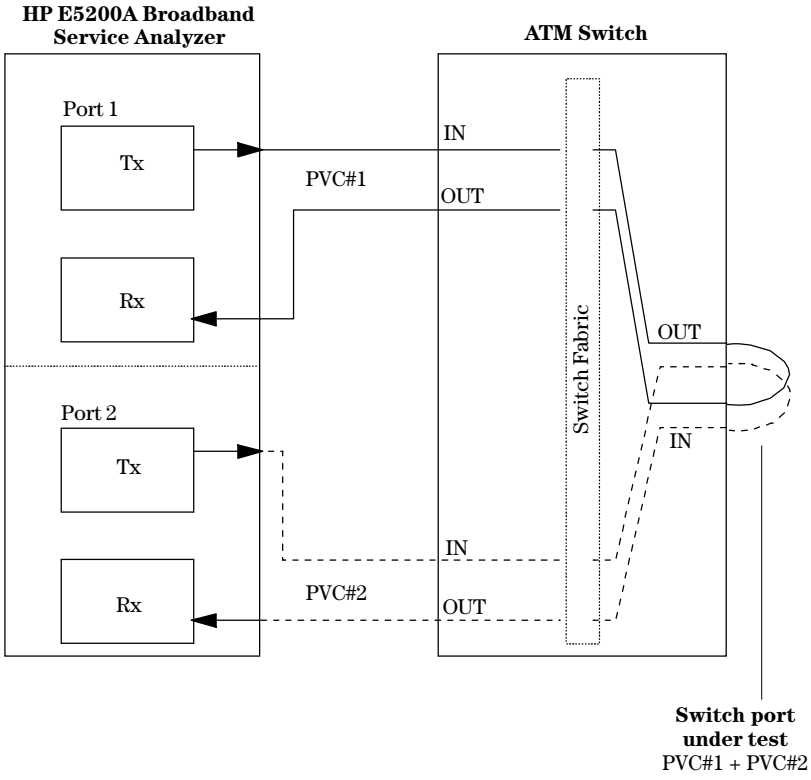
3. QoS management

Test the ability of the switch to configure QoS (Quality of Service) parameters and correctly prioritize delay-sensitive and loss-sensitive traffic on different PVCs.

4. Congestion management

Test that the switch has a non-blocking architecture. Congestion on one port should not affect performance on another non-congested port.

A tester with two transmit ports and two receive ports is required for most traffic management tests. An example of a typical traffic management test configuration is shown below.



Tx - the service analyzer generates CBR traffic on PVC#1 and VBR traffic on PVC#2

ATM switch - manages cell delay on PVC#1 and cell loss on PVC#2

Rx - the service analyzer measures cell loss, cell delay, and cell delay variation on PVC#1 and PVC#2

Test categories - Traffic management

Test Equipment Features

Latency, Jitter, and Throughput

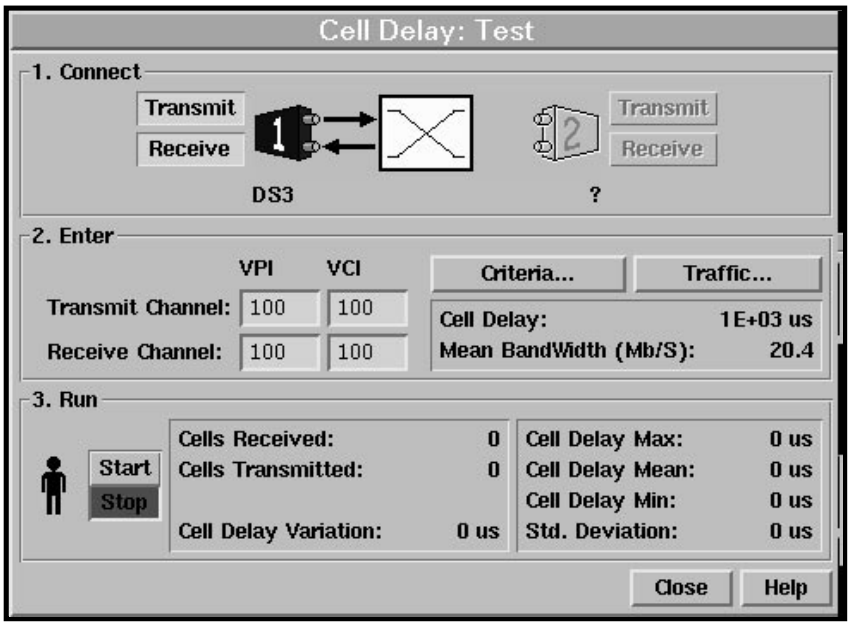
Use the following features of the HP E5200A Broadband Service Analyzer to test latency, jitter, and throughput switch performance.

1. Cell delay SMARTtest

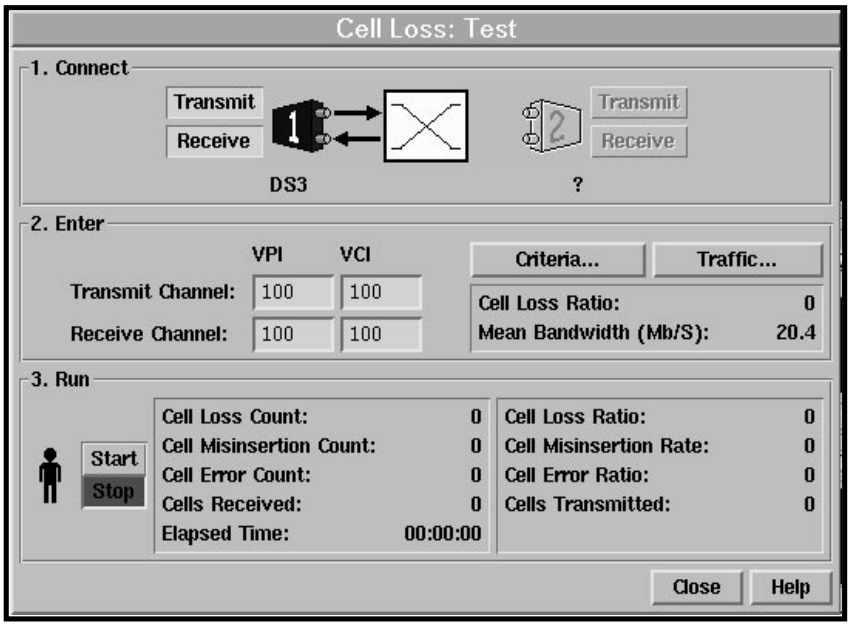
This test transmits then receives timestamped cells. It inserts a departure timestamp into the payload of the transmitted cells, and tags the received cells with an arrival timestamp. The cell delay is calculated by subtracting the departure timestamp from the arrival timestamp.

2. Cell loss SMARTtest

This test transmits AAL-1 cells that contain sequence number (SN) information in the first byte of the payload. The analyzer checks the SN continuity of the received cells to determine whether any cells are lost.



Cell delay test



Cell loss test

Switch statistics

Use the following features of the HP E5200A Broadband Service Analyzer to carry out switch statistics performance tests.

1. ATM errors and OAM alarms

Use the simulation capability of the service analyzer to inject ATM errors into cell header or payload bytes and activate F4 and F5 OAM alarms.

2. Physical layer errors and alarms

Use the service analyzer's simulation capability to inject physical layer errors and alarms. The type of errors and alarms available depends on which interface pods are installed in the service analyzer.

3. Interface pods

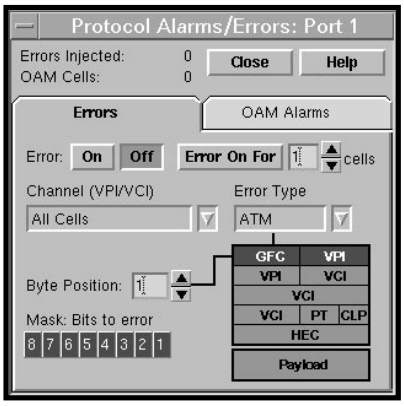
Each interface pod has a single transmit and single receive port. Up to two interface pods can be installed in the service analyzer at one time. A range of interface pods are available including E3 (34 Mb/s), DS1/DS3 (1.5 Mb/s and 45 Mb/s), OC-3/STM-1 (155 Mb/s) single mode and multimode optical, and STM-1 Electrical (155 Mb/s).

Traffic Management

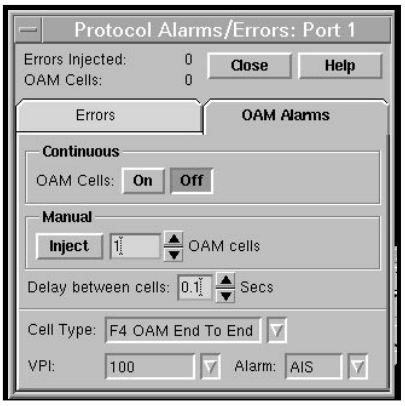
Use the traffic generation capability of the HP E5200A Broadband Service Analyzer to carry out traffic management tests.

1. Traffic generation on multiple channels

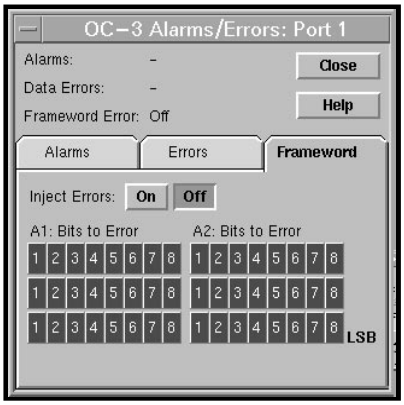
Use the traffic simulator to create traffic on up to 11 VPI/VCI channels with individually assigned bandwidths.



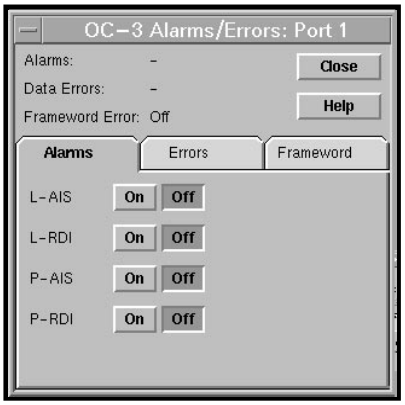
ATM errors



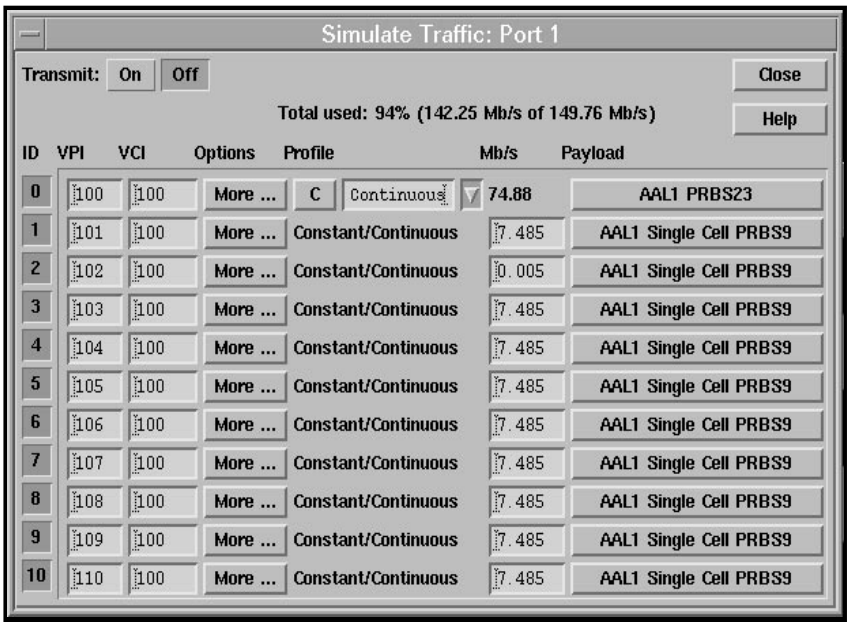
OAM alarms



Physical layer errors



Physical layer alarms



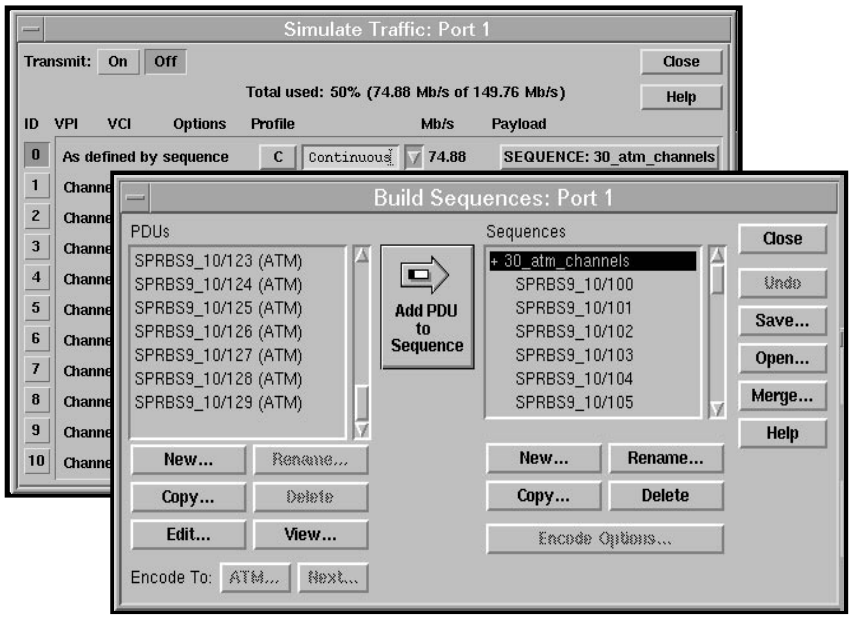
Traffic generation on multiple channels

2. Traffic generation of cell sequences

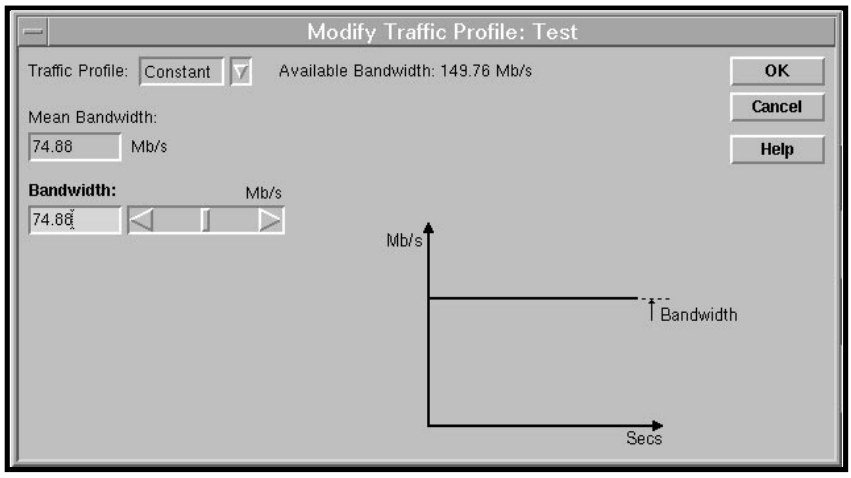
You can also transmit a *sequence* of cells with multiple VPI/VCI values. The bandwidth and traffic profile is assigned for the entire sequence of cells. Four traffic profiles are available: constant, burst, sawtooth, and poisson.

The **constant** profile represents a CBR service such as voice or video. CBR traffic is usually sensitive to cell delay and cell delay variation.

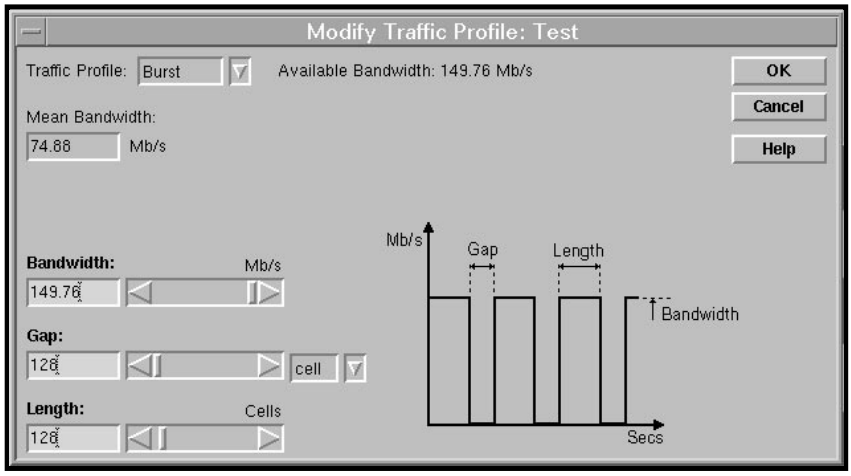
The **burst** profile represents a VBR service such as LAN traffic. VBR traffic is usually sensitive to cell loss. Use the *Bandwidth* parameter to set the PCR (Peak Cell Rate). Use the *Gap* and *Length* parameters to set the *Mean Bandwidth* and the SCR (Sustained Cell Rate).



Traffic generation of cell sequences



Constant traffic profile



Burst traffic profile

The sawtooth profile is useful for testing traffic policing parameters such as PCR and SCR. Use the *Maximum Bandwidth* parameter to set the PCR. Use the *Gap*, *Length*, *Minimum Bandwidth*, *and Maximum Bandwidth* parameters to set the *Mean Bandwidth* and the SCR.

The **poisson** distribution represents a random traffic distribution. A combination of CBR and VBR services operating over a link will result in a random traffic distribution. Use the *Interdeparture Time* parameter to set the *Mean bandwidth*.

AAL-1 status monitor Cell loss can be monitored on up to 1023 AAL-1 channels simultaneously. This is useful for evaluating how the switch manages congestion, quality of service and traffic policing.

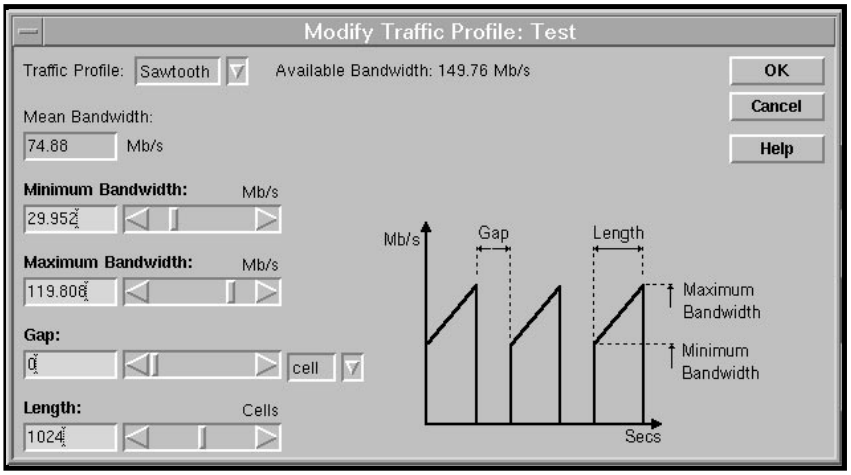
For more information about these features, refer to the HP E5200A Broadband Service Analyzer *User* online help.

Conclusions

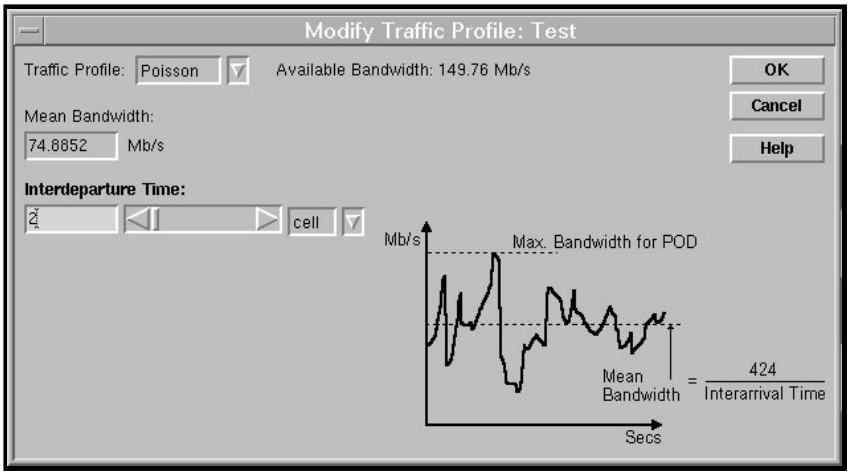
This solution note provides an outline of the various tests that you should consider when evaluating the performance of an ATM switch. For more detailed descriptions of these tests, refer to the *Sample Test Plan* solution notes for

- latency, jitter, and throughput (P/N 5965-6205E)
- switch statistics (P/N 5965-6204E)
- traffic management (P/N 5965-6206E)

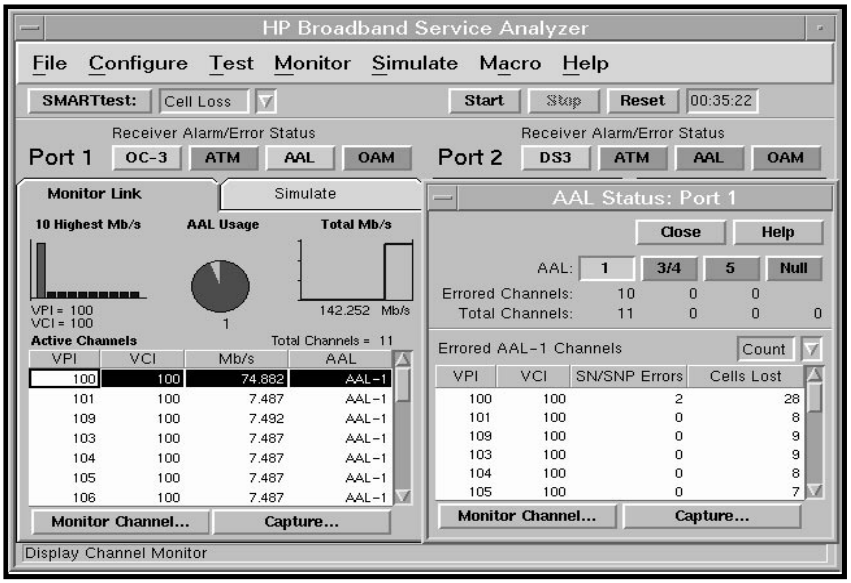
Other solution notes in this series deal with the end-to-end testing requirements for ATM networks including topics such as Quality of Service (QoS).



Sawtooth traffic profile



Poisson traffic profile



AAL-1 status monitor

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