Sample Test Plan for Traffic Management

Introduction

Traffic management is one of the test categories described in the *Evaluating ATM Switch Performance* solution note. This solution note provides a sample test plan and expected results for this test category.

This solution note deals with PVC (Permanent Virtual Circuit) connections carrying CBR (Constant Bit Rate) or VBR (Variable Bit Rate) services. All tests described in this paper can be performed by the HP E5200A Broadband Service Analyzer. The service analyzer evaluates Traffic Management performance in an ATM switch by measuring cell loss, cell delay, and cell delay variation under various traffic conditions. There are a number of different aspects that contribute to traffic management:

- **PVC connection management**
  Test the ability of the switch to configure a large number of PVCs and route them correctly.

- **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.

- **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.

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

Service Classes

**CBR Services**

- **PCR** (Peak Cell Rate)

**VBR Services**

- **PCR** (Peak Cell Rate)
- **SCR** (Sustained Cell Rate)
Traffic Management: Example Test Plan

Part A: PVC Connection Management

Description

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

Test Configuration

1. Connect Port 1 (Tx/Rx) of the service analyzer to port 1 (IN/OUT) of the switch.

2. Connect Port 2 (Tx/Rx) of the service analyzer to port 2 (IN/OUT) of the switch.

3. Configure the ATM switch to route PVC#1 and PVC#2...N (multiple PVCs) to switch port 3.

Test Equipment

HP E5200A Broadband Service Analyzer with two interface pods.

Test Procedure

For more information about how to use the simulator, monitor, and SMARTTests, refer to the HP E5200A Broadband Service Analyzer User online help.

PVC#1 Measure cell loss, cell delay, and cell delay variation using CBR traffic on Port 1 of the service analyzer.

PVC#2...N At the same time, generate CBR AAL-1 traffic on multiple VPI/VCI channels from Port 2 of the service analyzer. Monitor all AAL-1 channels for cell loss or sequence number errors on Port 2 of the service analyzer. Monitor the link for unexpected VPI/VCI values.

Total bandwidth for (PVC#1 + PVC#2...N) must be less than MAXBW. For example, PVC#1 = 50% of MAXBW, PVC#2...N = 40% of MAXBW, where MAXBW is the maximum possible cell bandwidth that a particular physical interface can carry (for example OC-3, MAXBW = 149.76 Mb/s).

Repeat the tests with increasing numbers of PVCs on Port 2 of the service analyzer.

Expected Results - PVC Connection Management

<table>
<thead>
<tr>
<th>Test Type</th>
<th>PVC#1</th>
<th>PVC#2...N</th>
</tr>
</thead>
</table>
| Increasing Number of PVCs | PVC #1 is not affected by PVC #2...N. - No cell loss - Constant cell delay. | No cell loss or cell misinsertion - No AAL-1 cell loss. - No AAL-1 sequence number errors. - No unexpected VPI/VCI values.

PVC connection management test configuration
Part B: CBR and VBR Traffic Policing

**Description**

Test the ability of the ATM switch to configure traffic policing parameters for CBR and VBR services on different switch ports.

**Test Configuration**

1. Connect Port 1 (Tx/Rx) of the service analyzer to port 1 (IN/OUT) of the switch.

2. Connect Port 2 (Tx/Rx) of the service analyzer to port 2 (IN/OUT) of the switch.

3. Configure policing parameters for switch port 1 and port 2.

4. Configure the switch to route PVC#1 and PVC#2 to switch port 3.

**Test Equipment**

HP E5200A Broadband Service Analyzer with two interface pods.

**Test Procedure**

See *Testing Traffic Policing Parameters* on page 6 for more information on how to configure PCR and SCR traffic parameters.

**Conforming Port** Perform cell loss, cell delay, and cell delay variation tests using sawtooth profile AAL-1 traffic on Port 1 of the service analyzer. Measure the mean and maximum received bandwidth. Set either the PCR or SCR of the sawtooth profile to exceed policing limits for switch port 2. For example, tester port 2 sawtooth profile traffic with PCR = 80%, SCR = 40% of MAXBW; switch port 2 maximum PCR = 45%, maximum SCR = 35% of MAXBW.

**Non-conforming Port** Perform cell loss, cell delay, and cell delay variation tests using sawtooth profile AAL-1 traffic on Port 2 of the service analyzer. Measure the mean and maximum received bandwidth. Set either the PCR or SCR of the sawtooth profile to exceed policing limits for switch port 2. For example, tester port 2 sawtooth profile traffic with PCR = 80%, SCR = 40% of MAXBW; switch port 2 maximum PCR = 45%, maximum SCR = 35% of MAXBW.

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**Expected Results - CBR and VBR Traffic Policing**

<table>
<thead>
<tr>
<th>Test Type</th>
<th>Tester Port 1 Measurement PVC#1 via conforming port</th>
<th>Tester Port 2 Measurement PVC#2 via non-conforming port</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CBR Traffic Policing</strong></td>
<td>Not affected by non-conformance on PVC #2. - No cell loss. - Constant cell delay. - Constant cell delay variation.</td>
<td>When maximum PCR is exceeded. - Cell loss occurs. - Cell delay might increase. - Cell delay variation might increase. - Maximum bandwidth through the switch is reduced to the PCR limit.</td>
</tr>
<tr>
<td><strong>VBR Traffic Policing</strong></td>
<td>Not affected by non-conformance on PVC #2. - No cell loss. - Constant cell delay. - Constant cell delay variation.</td>
<td>When maximum PCR or SCR is exceeded. - Cell loss occurs. - Cell delay might increase. - Cell delay variation might increase. - Maximum bandwidth through the switch is reduced to the PCR limit.</td>
</tr>
</tbody>
</table>

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Sample Test Plan for Traffic Management
Part C: QoS Management

Description

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

Test Configuration

1. Connect Port 1 (Tx/Rx) of the service analyzer to port 1 (IN/OUT) of the switch.

2. Connect Port 2 (Tx/Rx) of the service analyzer to port 2 (IN/OUT) of the switch.

3. Configure PVC#1 QoS parameters for minimum cell delay and cell delay variation. Configure PVC#2 QoS parameters for minimum cell loss.

4. Configure the ATM switch to route PVC#1 and PVC#2 to switch port 3 (Port Under Test).

Test Equipment

HP E5200A Broadband Service Analyzer with two interface pods.

Test Procedure

For more information about how to use the simulator, monitor, and SMARTTests, refer to the HP E5200A Broadband Service Analyzer User online help.

Cell Delay Management: Generate VBR traffic on tester Port 2. At the same time, perform cell loss, cell delay, and cell delay variation tests using CBR traffic on tester Port 1.

Cell Loss Management: Generate CBR traffic on tester Port 1. At the same time, perform cell loss, cell delay, and cell delay variation tests using VBR traffic on tester Port 2. Repeat the tests with increasing total peak bandwidth for PVC#1 + PVC#2. For example, (PVC#1 + PVC#2) = 10%, 20%,...120% of MAXBW, where MAXBW is the maximum possible cell bandwidth that a particular physical interface can carry (for example OC-3, MAXBW = 149.76 Mb/s).

Expected Results - QoS Management

<table>
<thead>
<tr>
<th>Test Type</th>
<th>Tester Port 1 Measurement</th>
<th>Tester Port 2 Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>PVC#1 CBR (delay sensitive)</td>
<td>When (PVC #1 + PVC #2) exceeds 100% of MAXBW, cell loss occurs</td>
<td>Not affected by increasing bandwidth on PVC #1: no cell loss occurs</td>
</tr>
<tr>
<td>PVC#2 VBR (loss sensitive)</td>
<td>Not affected by increasing bandwidth on PVC #2. -Constant cell delay. -Constant cell delay variation.</td>
<td>When (PVC #1 + PVC #2) exceeds 100% of MAXBW, -Cell delay might increase. -Cell delay variation might increase.</td>
</tr>
</tbody>
</table>

QoS management test configuration
Part D: Congestion Management

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

Test Configuration
1. Connect Port 1 (Tx/Rx) of the service analyzer to port 1 (IN/OUT) of the switch.

2. Connect Port 2 (Tx/Rx) of the service analyzer to port 2 (IN/OUT) of the switch.

3. Configure the ATM switch to route PVC#3 to switch port 3 (Non-congested port).

4. Configure the ATM switch to route PVC#1 and PVC#2 to switch port 4 (Congested port).

Test Equipment
HP E5200A Broadband Service Analyzer with two interface pods.

Test Procedure
For more information about how to use the simulator, monitor, and SMARTtests, refer to the HP E5200A Broadband Service Analyzer User online help.

Non-congested Port: Generate CBR AAL-1 traffic on PVC#1 and PVC#3 from Port 1 of the service analyzer. Monitor PVC#3 for AAL-1 cell loss or sequence number errors.

Congested Port: At the same time, generate CBR AAL-1 traffic on PVC#2 from Port 2 of the service analyzer. Monitor PVC#1 and PVC#2 for AAL-1 cell loss or sequence number errors. Perform the tests with increasing total bandwidth for (PVC#1 + PVC#2). For example, (PVC#1 + PVC#2) = 150% of MAXBW (Congested) and (PVC#3) = 50% of MAXBW (Non-congested), where MAXBW is the maximum possible cell bandwidth that a particular physical interface can carry (for example OC-3, MAXBW = 149.76 Mb/s).

<table>
<thead>
<tr>
<th>Test Type</th>
<th>Tester Port 1 Measurement</th>
<th>Tester Port 2 Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Head-of-line Blocking</td>
<td>Congested port causes cell loss in PVC #1. Note PVC #3 is not affected</td>
<td>Congested port causes cell loss in PVC #2. Note PVC #3 is not affected</td>
</tr>
</tbody>
</table>

Congestion management test configuration
Test Equipment Features

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

- **Traffic generation on multiple channels** Use the traffic simulator to create traffic on up to 11 VPI/VCI channels with individually assigned bandwidths.

- **Traffic generation of cell sequences** You can also transmit sequence cells on 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.

- **The sawtooth profile** is useful for testing traffic policing parameters such as PCR and 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.

- **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 how to use the simulator and monitor, and SMARTtests refer to the HP E5200A Broadband Service Analyzer User online help.

Testing Traffic Policing Parameters

You can simulate CBR and VBR services using the traffic profiles provided by the HP E5200A Broadband Service Analyzer. The table below shows you how to set the traffic parameters (PCR and SCR).

**Note:** Mean bandwidth is a read only parameter. It is automatically calculated after you set other parameters such as Gap and Length.

<table>
<thead>
<tr>
<th>Traffic Profile</th>
<th>User Defined Settings</th>
<th>Equivalent Policing Parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>Bandwidth</td>
<td>PCR</td>
</tr>
</tbody>
</table>
| Burst           | Bandwidth
|                 | Mean Bandwidth * which is a function of
|                 | - Gap
|                 | - Length
|                 | - Bandwidth
|                 | PCR
|                 | SCR                  |
| Sawtooth        | Maximum Bandwidth     | PCR                             |
|                 | Mean Bandwidth * which is a function of
|                 | - Gap
|                 | - Length
|                 | - Minimum Bandwidth   |
|                 | max Bandwidth
|                 | PCR
|                 | SCR                  |
| Poisson         | Mean Bandwidth *      | SCR                             |
|                 | which is a function of
|                 | - Interdeparture Time  |

Conclusions

This solution note provides examples of the types of parameters that can be varied as the traffic management capability of an ATM switch is evaluated.

For information on evaluating other ATM switch characteristics, refer to the Sample Test Plan solution notes for

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

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).
Sample Test Plan for Traffic Management

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For more information, call your local HP sales office listed in your telephone directory or an HP regional office listed below for the location of your nearest sales office.

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