

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



Evaluating ATM Switch Performance

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).



Test catagories - Latency, Jitter, and throughput

Switch Statistics

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







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 nonblocking architecture. Congestion on one port should not affect performance on another noncongested 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.



1X - the service analyzer generates Obit traine on 1 vo#1 and vbit traine on 1 v

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

 \mathbf{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.

	0	Cell De	elay: Te	st		
1. Connect Transmit Receive	1 -	≓ [`	\times	- PI21=	ransmit Receive	
	DS3			?		
2. Enter						
	VPI VCI		Criteria		Traffic	
Transmit Channel:	100	100 100		Cell Delay:		
Receive Channel:	100	100	- 1332 S23	landWidth (I	Mb/S):	20.4
3. Run						
Cells	Received		0	Cell Delay	Max:	0 us
Start Cells	Transmitt	ed:	0	Cell Delay	Mean:	0 us
T Stop				Cell Delay		0 us
Cell D	elay Varia	ation:	0 us	Std. Devia	tion:	0 us
					Close	Help

Cell delay test

	ransmit eceive	1	; ∓⊃	\leq	62 Transr		
		DS3			?		
2. Enter							
Transmit Channel:		VPI	VCI	Criteria		Traffic	
		100	100	C	Cell Loss Ratio:		
Receive Char	nnel: [100	100	M	lean Bandwidth (M	lb/S): 20.	
3. Run —							
Cell	I Loss (Count:		0	Cell Loss Ratio:		
• Start Cell	2 Start		0	Cell Misinsertion	Rate:		
Cell Error Count:			0	0 Cell Error Ratio:			
Cells Received:			0 00:00:0	o cono manomitatoan			

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



Protocol Alarms/Errors: Port 1
Errors Injected: 0 OAM Cells: 0 United to the second secon
Errors OAM Alarms
Continuous OAM Cells: On Off Manual Inject 1 OAM cells Delay between cells: 0.1 Secs
Cell Type: F4 OAM End To End
VPI: 100 VAlarm: AIS V

OAM alarms



Physical layer errors

-				Simulate Traff	ic: Port 1		
Tran	nsmit:	On O	ff				Close
			т	otal used: 94% (142.2	5 Mb/s of 14	19.76 Mb/s)	Help
ID	VPI	VCI	Options	Profile	Mb/s I	Payload	8
0	100	100	More	C Continuous	7 74.88	AAL1 PRE	3823
1	101	100	More	Constant/Continuous	7.485	AAL1 Single C	ell PRBS9
2	102	100	More	Constant/Continuous	0.005	AAL1 Single C	ell PRBS9
3	103	100	More	Constant/Continuous	7.485	AAL1 Single C	ell PRBS9
4	104	100	More	Constant/Continuous	7.485	AAL1 Single C	ell PRBS9
5	105	100	More	Constant/Continuous	7.485	AAL1 Single C	ell PRBS9
6	106	100	More	Constant/Continuous	7.485	AAL1 Single C	ell PRBS9
7	107	100	More	Constant/Continuous	7.485	AAL1 Single C	ell PRBS9
8	108	100	More	Constant/Continuous	<u>1</u> 7.485	AAL1 Single C	ell PRBS9
9	109	100	More	Constant/Continuous	7.485	AAL1 Single C	ell PRBS9
10	<u>110</u>	100	More	Constant/Continuous	7.485	AAL1 Single C	ell PRBS9

Traffic generation on multiple channels

Physical layer alarms



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).

			Simulate	Traffic: Port	1		
Tra	nsmit: _C	On Off				Close	
			Total used: 50% ((74.88 Mb/s of 1	49.76 Mb/s)	Help	
ID	VPI V	/CI Options	Profile	Mb/s	Payload		
0	As defin	ned by sequence	C Continue	ouš 🔽 74.88	SEQUENCE: 3	80_atm_channels	
1	Channe			Ruild Sear	iences: Port	1	
2	Channe			Dulla Sequ		1	
3	Channe	PDUs			Sequences		Close
4	Channe	SPRBS9_10/12 SPRBS9_10/12			+ <u>30_atm_chan</u> SPRBS9_10		Undo
5	Channe	SPRBS9_10/12		Add PDU	SPRBS9 10		
6	Channe	SPRBS9_10/12	· · · · · · · · · · · · · · · · · · ·	to	SPRBS9_10	0/102	Save
7	Channe	SPRBS9_10/12		Sequence	SPRBS9_10		Open
8	Channe	[[ornoos_10/12			SPRBS9_10		Merge
9	0203	SPRBS9_10/12	9 (A IM)		SPRBS9_10	100 X	
	Channe	New	/ر ا		New	Rename	Help
10	Channe	New	Rename		New	Renaute	
-		Сору	Delete		Сору	Delete	
		Edit	View		Encode	Options	
		Encode To:	FM Next				

Traffic generation of cell sequences



Constant traffic profile

- Modify	y Traffic Profile: Test	
Traffic Profile: Burst 🔽 Available Ba	andwidth: 149.76 Mb/s	ок
Mean Bandwidth:		Cancel
74.88 Mb/s		Help
Bandwidth: Mb/s	Mb/s Gap Length	1
Gap:		
Length: Cells		
	Secs	

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

Monitor Link Simulate AAL Close Help AAL AAL Simulate AAL Simulate AAL Simulate AAL I 3/4 Simulate Help AAL I Simulate AAL I Simulate Help AAL I Simulate Help AAL I Simulate I	-		HP B	roadband	Service A	Analyz	er	_	_		
Beceiver Alarm/Error Status Port 1 OC-3 ATM AAL OAM Port 2 DS3 ATM AAL OAM Monitor Link Simulate AAL OAM Port 2 DS3 ATM AAL OAM 10 Highest Mb/s AAL Usage Total Mb/s AAL Status: Port 1 OAM VPI = 100 VCI = 100 1 142.252 Mb/s Frored Channels: 10 0 0 Active Channels Total Channels = 11 O 0 0 0 VPI = VCI Mb/s AAL = 1 Io0 100 2 283 100 100 7.487 AAL = 1 101 100 2 283 101 100 7.487 AAL = 1 101 100 2 283 103 100 7.487 AAL = 1 101 100 0 8	File Co	nfigure	Test <u>M</u> or	nitor <u>S</u> imu	ilate M <u>a</u>	cro I	lelp				
Port 1 OC-3 ATM AAL OAM Port 2 DS3 ATM AAL OAM Monitor Link Simulate AAL OAM AAL OAM	SMARTtes	t: Cell Lo	iss 🔽		Start	St	ip Re	set 0	0:35:22		
Monitor Link Simulate AAL Close Help AAL Iterrored Channels Iterrored Channels Iterrored Channels Iterrored Channels Iterrored Channels Iterrored Count Vel VCI Mb/s AAL VPI VCI Mb/s AAL VPI VVI VI </th <th>R</th> <th>eceiver Alar</th> <th>m/Error Status</th> <th>3</th> <th></th> <th>Receiv</th> <th>/er Alarm/</th> <th>Error Sta</th> <th>atus</th> <th></th> <th></th>	R	eceiver Alar	m/Error Status	3		Receiv	/er Alarm/	Error Sta	atus		
ID Highest Mb/s AAL Usage Total Mb/s AAL Close Help VPI = 100 VCI = 100 1 142.252 Mb/s AAL 1 3/4 5 Null VPI = 100 VCI = 100 1 Total Channels = 11 0 0 0 Active Channels 100 74.852 AAL = 1 1 0 0 101 100 7.487 AAL = 1 1 100 100 2 28 103 100 7.487 AAL = 1 100 0 8 109 100 0 8	Port 1	0C-3 A	TM AAL	. OAM	Port 2	DS	AT	M	VAL	OAM	
VPI = 100 VCI = 100 Total Channels = 11 ALL: 1 3/4 5 Null VPI = 100 VCI = 100 1 142.252 Mb/s Image: Channels = 10 0	Monitor L	ink	Simul	ate	`[<u> </u>	A	AL Stat	us: Po	ort 1		
VPI = 100 VCI = 100 Total Channels = 11 Errored Channels: 10 0 0 Active Channels Total Channels = 11 0	10 Highest M	b/s AAL	Usage	Total Mb/s				Close	1	Help	
VPI = 100 VCI = 100 1 142.252 Mb/s Total Channels: 11 0 0 Active Channels Total Channels = 11 Image: Construct of the second s						AAL	. 1	3/4	5	Null	
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Active Channels Total Channels = 11 Errored AAL-1 Channels Count Count VPI VCI Mb/s AAL VPI VCI SN/SNP Errors Cells Lost VPI VOI SN/SNP Errors Cells Lost VPI VI 100 100 2 288 100 100 2 288 101 100 0 8 101 100 0 8 3 3 100 7.487 AAL-1 101 100 0 8 3 3 3 3 3 3 4 4 109 100 0 9 3 3 3 3 3 3 3 4			1	142.252 Mb/s	Total (Channels	: 11	0)	C
VPI VCI Mb/s AAL 100 100 74.882 AAL-1 101 100 7.487 AAL-1 109 100 7.487 AAL-1 103 100 7.487 AAL-1 103 100 7.487 AAL-1		els	Total C	hannels = 11	Errored A		hannole			ount	
100 7.487 AAL-1 100 100 2 28 109 100 7.487 AAL-1 100 100 2 28 103 100 7.487 AAL-1 101 100 0 8 103 100 7.487 AAL-1 109 100 0 9	VPI	VCI	Mb/s	AAL 🛆					-		100
109 100 7.492 AAL-1 101 100 0 8 103 100 7.487 AAL-1 109 100 0 9	100	100	74.882	AAL-1	VPI	VCI	SN/SNP	Errors	Cells I	ost	2
103 100 7.487 AAL-1 109 100 0 9	101	100	7.487	AAL-1	100			2		28	
	109	100	7.492	AAL-1	101	100		0		8	1
104 100 7.487 AAL-1 103 100 0 9	103	100	7.487	AAL-1						100	
	104	100	7.487	AAL-1						101	
105 100 7.487 AAL-1 104 100 0 8	105	100	7.487	AAL-1						2002	
106 100 7.487 AAL-1 1 105 100 0 7	106	100	7.487	AAL-1 🔽	105	100		0		7	M
Monitor Channel Capture Monitor Channel Capture	Monitor (hannel	Captur	re	Monito	r Chann	el	Cap	oture		

AAL-1 status monitor



Evaluating ATM Switch Performance

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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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