



Agilent Technologies

Test your Networking Equipment for its Revenue Potential

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presented by:

John Nakulski

Agenda

Is this Seminar for me?

- **Who should test for revenue potential?**
 - **Network operators**
 - **Equipment evaluation and selection**
 - **Pre-deployment**
 - **Equipment vendors**
 - **R&D, Sales and Marketing**
 - **Third-party test laboratories**
- **What type of equipment are we talking about?**
 - **IP routers and layer 2 or 3 devices**



Agenda

What will I learn?

- **What is “Revenue Testing”**
- **Top 3 Requirements for Revenue Potential**
- **Scalable Performance**
- **Customer Services**
- **High Availability**
- **Developing your Test Plan**



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Revenue Testing

The latest testing wave focus
is **REVENUE**

Packet Testing

Network devices
ability to forward
traffic efficiently

***Bandwidth &
Throughput***

Network Simulation

Networks devices
ability to scale in
multi protocol
environment

***Scalability &
Reliability***

Revenue Testing

Network devices
ability to generate
revenue

***Show me the
\$\$\$\$***



Revenue Potential

Get the most out of your network equipment

- **How many users can be supported?**
- **Which services can be offered?**
- **Can a premium be charged for high availability?**
- **Is your network reducing the operational expenses?**
- **Is your network equipment reliable under stressful conditions?**
- **Can the Service Level Agreements be met?**
- **Is your network equipment being used to its full potential?**



Agenda

What will I learn?

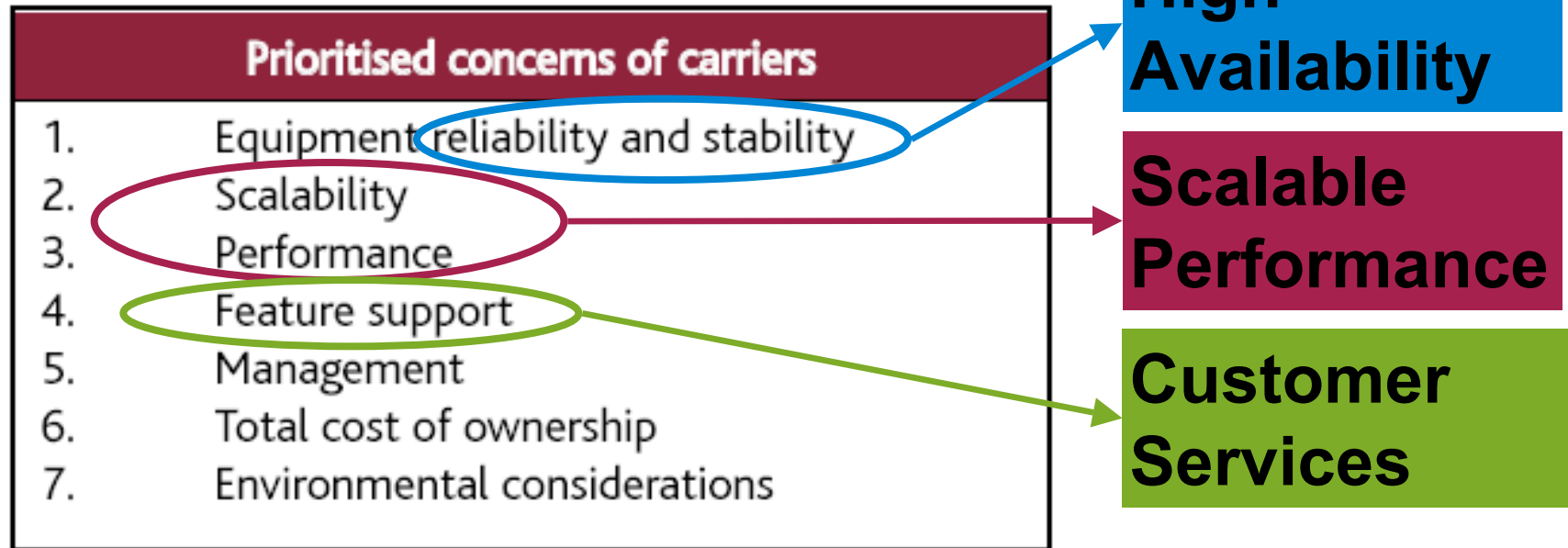
- **What is “Revenue Testing”**
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Top 3 Requirements for Revenue

Survey of Network Operators

- **BTextact survey of requirements for packet network equipment:**



See <http://www.btexact.com/ideas/whitepapers?doc=42267>



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Scalable Performance

What you need to test

Scalable Performance

Traffic Performance

Quality of Service

Routing Scalability

MPLS Traffic Engineering

IPv6 Forwarding



Number of
Supported
Users

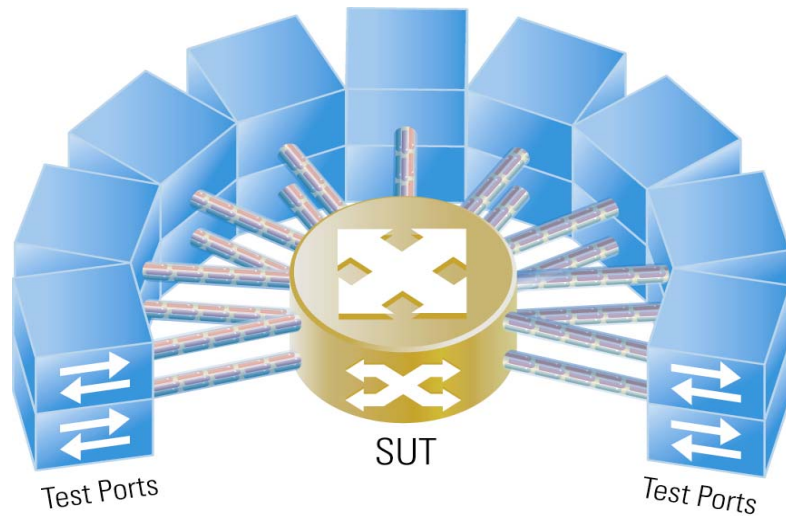


Revenue
Potential



Scalable Performance

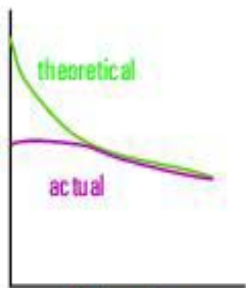
Traffic Performance



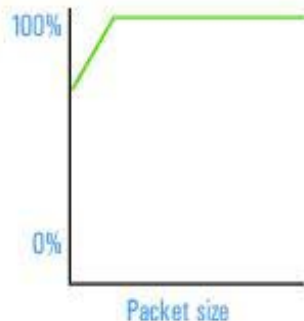
- What do you need to test?
 - Throughput & Latency
 - Packet Loss
 - Quality of Service (traffic prioritization)

Throughput Graphs

Packet rate (packets/s)



Maximum packet rate



Latency Graph

Latency (us)



These are the basic parameters that need to be guaranteed in a SLA

....SLAs = \$\$\$



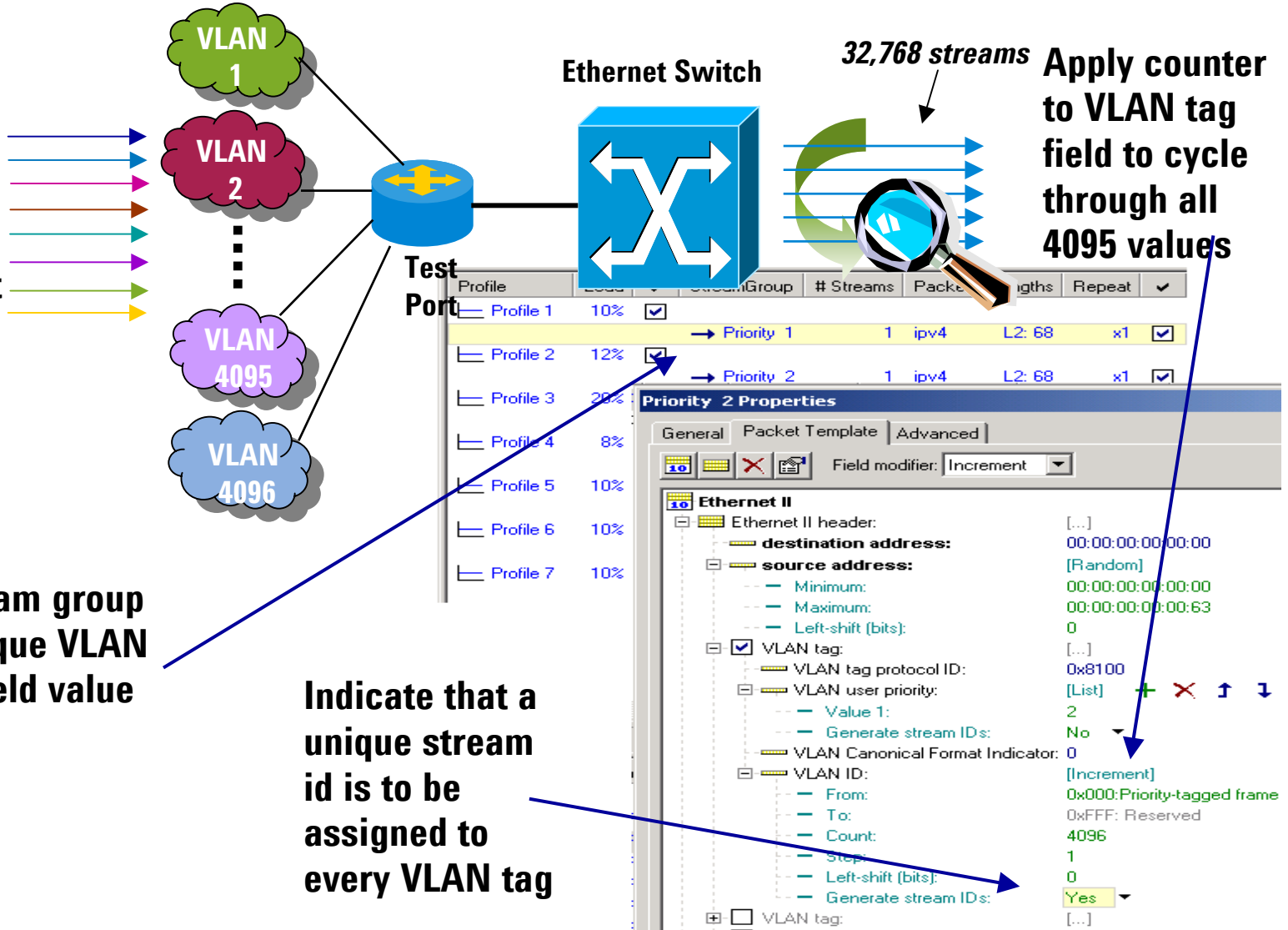
Scalable Performance

QoS over VLAN

Assign a traffic profile for each of the 8 different VLAN priority values

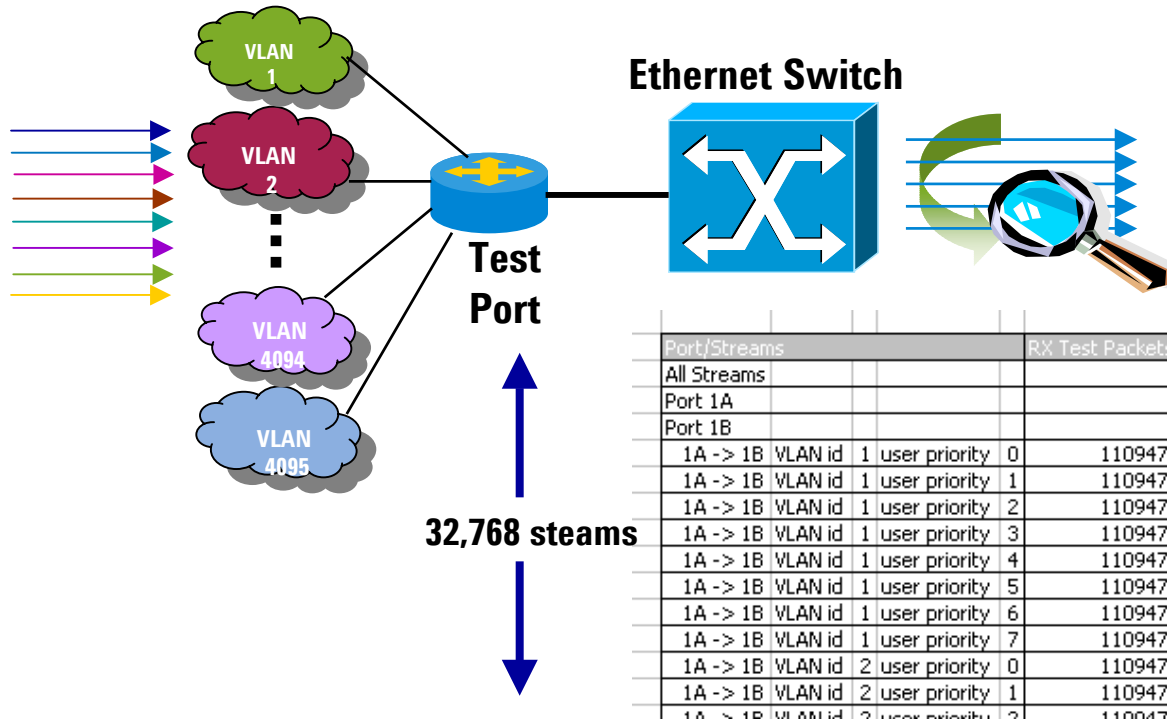
Each stream group has a unique VLAN priority field value

Indicate that a unique stream id is to be assigned to every VLAN tag



Scalable Performance

Measure QoS for each VLAN Priority



Data loss on a high priority traffic stream will cost \$\$\$

Port/Streams	RX Test Packets	RX Test Throughput (Mb/s)	Average Latency (uS)	Seq Errors
All Streams				
Port 1A				
Port 1B				
1A -> 1B VLAN id 1 user priority 0	1109475	10	17	0
1A -> 1B VLAN id 1 user priority 1	1109475	10	17	0
1A -> 1B VLAN id 1 user priority 2	1109475	10	17	0
1A -> 1B VLAN id 1 user priority 3	1109475	10	17	0
1A -> 1B VLAN id 1 user priority 4	1109475	10	17	0
1A -> 1B VLAN id 1 user priority 5	1109475	10	17	0
1A -> 1B VLAN id 1 user priority 6	1109475	10	17	0
1A -> 1B VLAN id 1 user priority 7	1109475	10	17	0
1A -> 1B VLAN id 2 user priority 0	1109475	10	17	0
1A -> 1B VLAN id 2 user priority 1	1109475	10	17	0
1A -> 1B VLAN id 2 user priority 2	1109475	10	17	0

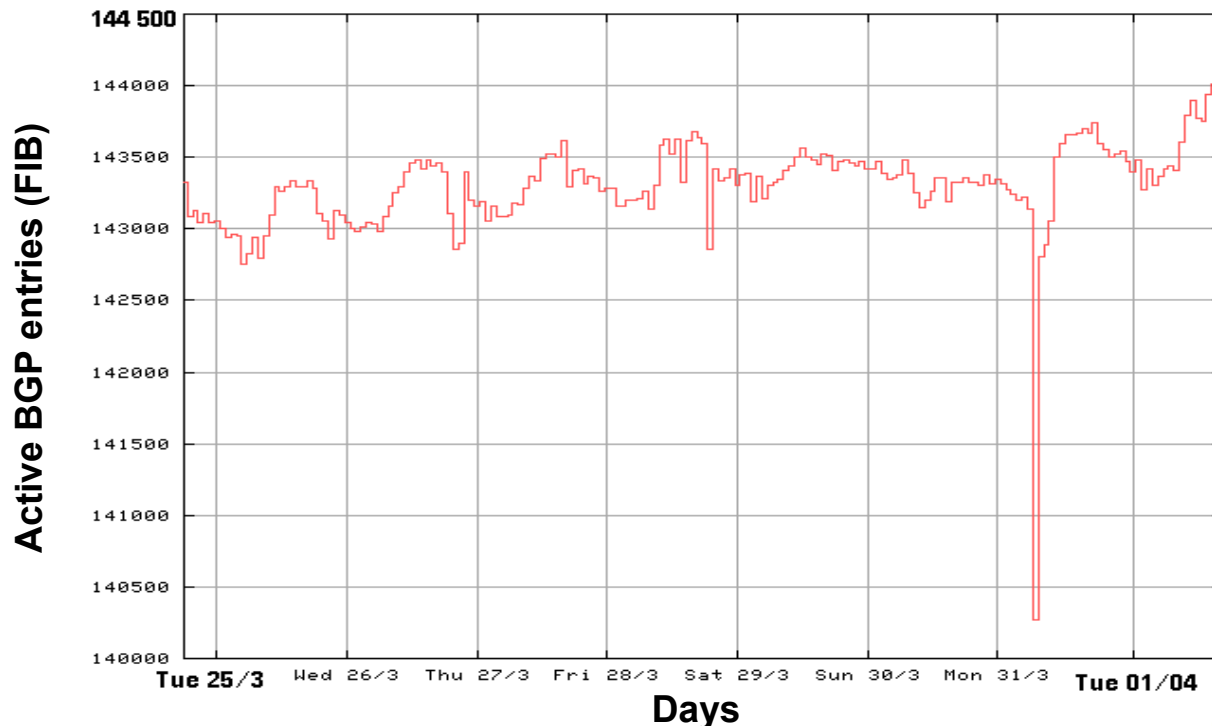
- Measure # of packets received, packet latency through the switch, lost packets, misdirected packets... per priority traffic stream on every user priority level for every VLAN id through an Ethernet switch



Scalable Performance

Why Routing Scalability is important?

- BGP statistic table published by Telstra shows approximately 143 000 entries as on 1st April 2003, compared to 55 000 entries in 1999..increasing scalability



- Fluctuation of active BGP routes within one AS over a week.

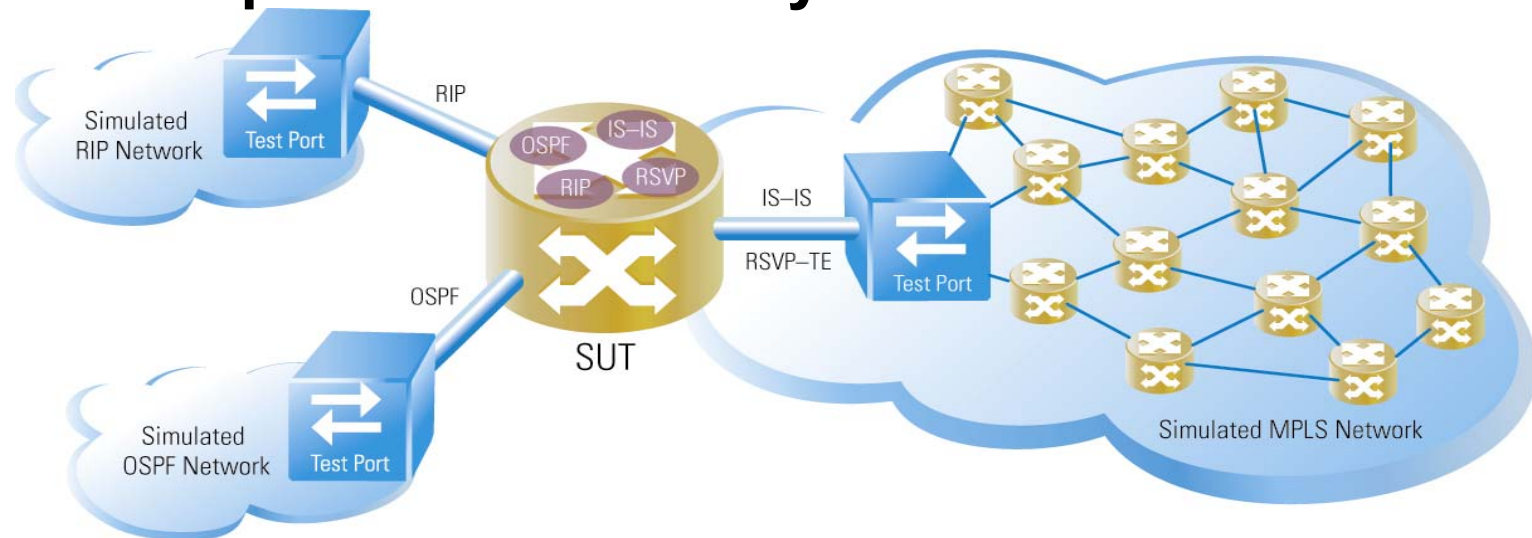
Source: Telstra AS 1221 – <http://bgp.potaroo.net/as1221/bgp-active.html>



Scalable Performance

Routing Scalability

- **What do you need to test?**
 - **Number of concurrent protocol sessions**
 - **Maximum forwarding table size**
 - **Route convergence time**
 - **Performance impact of route flapping**
 - **Multi-protocol scalability**



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Customer Services

What you need to test

Service Performance & Scalability

BGP MPLS VPNs

L2oMPLS VPNs

VPLS

IP Multicast

Access Services



**Customer
Services**



**Revenue
Potential**



Customer Services

- **IP VPN** service revenues are growing faster than most service providers' other networking services' revenues.

Forecast of US IP VPN Services Revenues: 2002 – 2006 (US\$ M)

	2001	2002	2003	2004	2005	2006	CAGR
Revenues	\$1,968	\$2,565	\$3,385	\$4,570	\$6,307	\$8,200	33%
Growth Rate		30%	32%	35%	38%	30%	

Source: In-Stat/MDR, 7/02

- **Multicast** services is way of the future with as we get more demand for applications such streaming media, video conferencing, distance learning...etc



Customer Services

MPLS VPN Options:

- **L3 VPN**

- IP only
- Difficult migration for F/R, ATM or Ethernet customers
- Scaling issues of VRF model
 - N*FIBs
 - Stability
 - New Control Plane

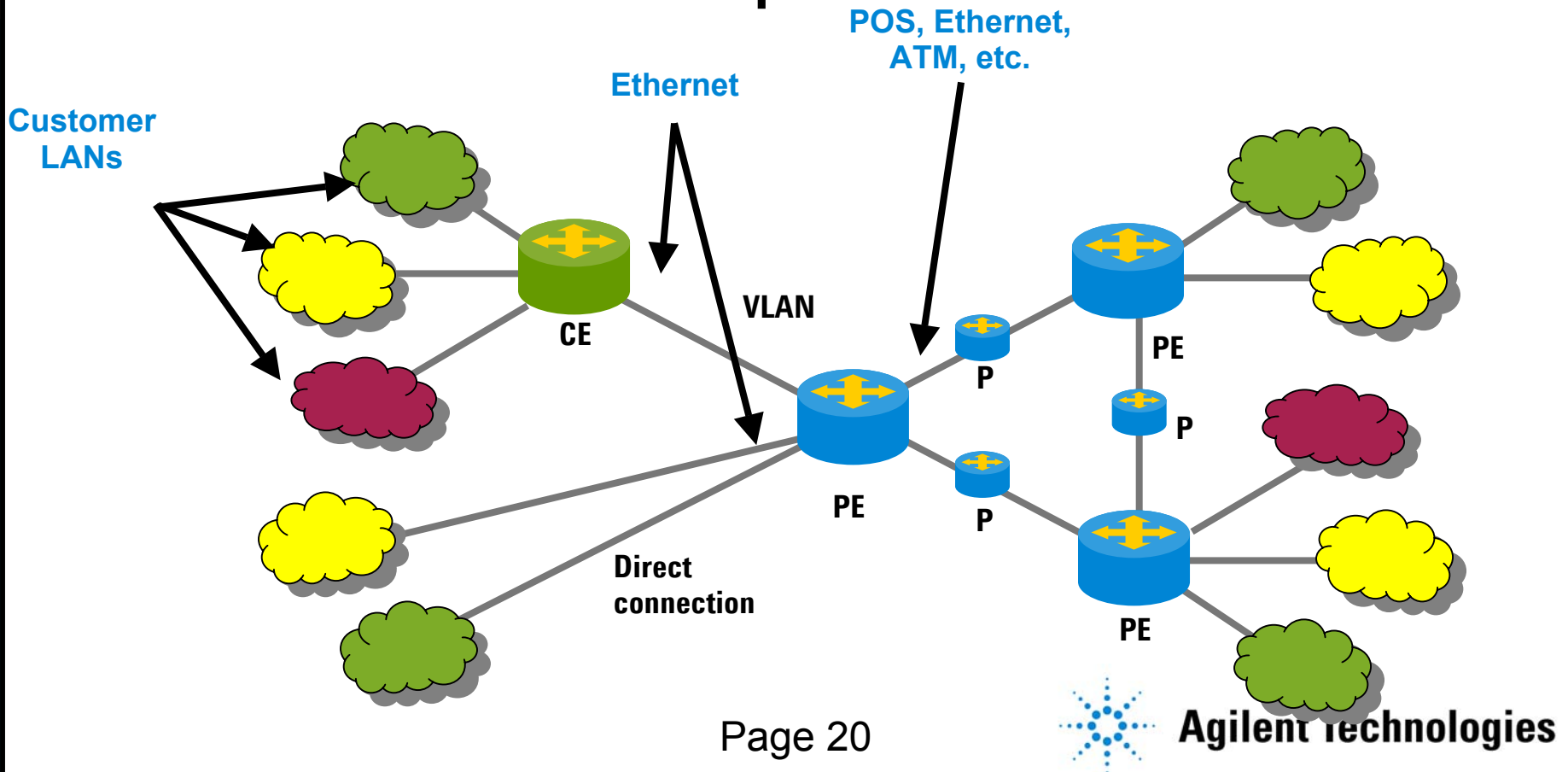
- **L2 VPN**

- Protocol Agnostic
- Simple ATM or F/R L2-VPN to MPLS L2-VPN
- Scaling based on
 - LSPs for large VPNs
 - MAC Addresses



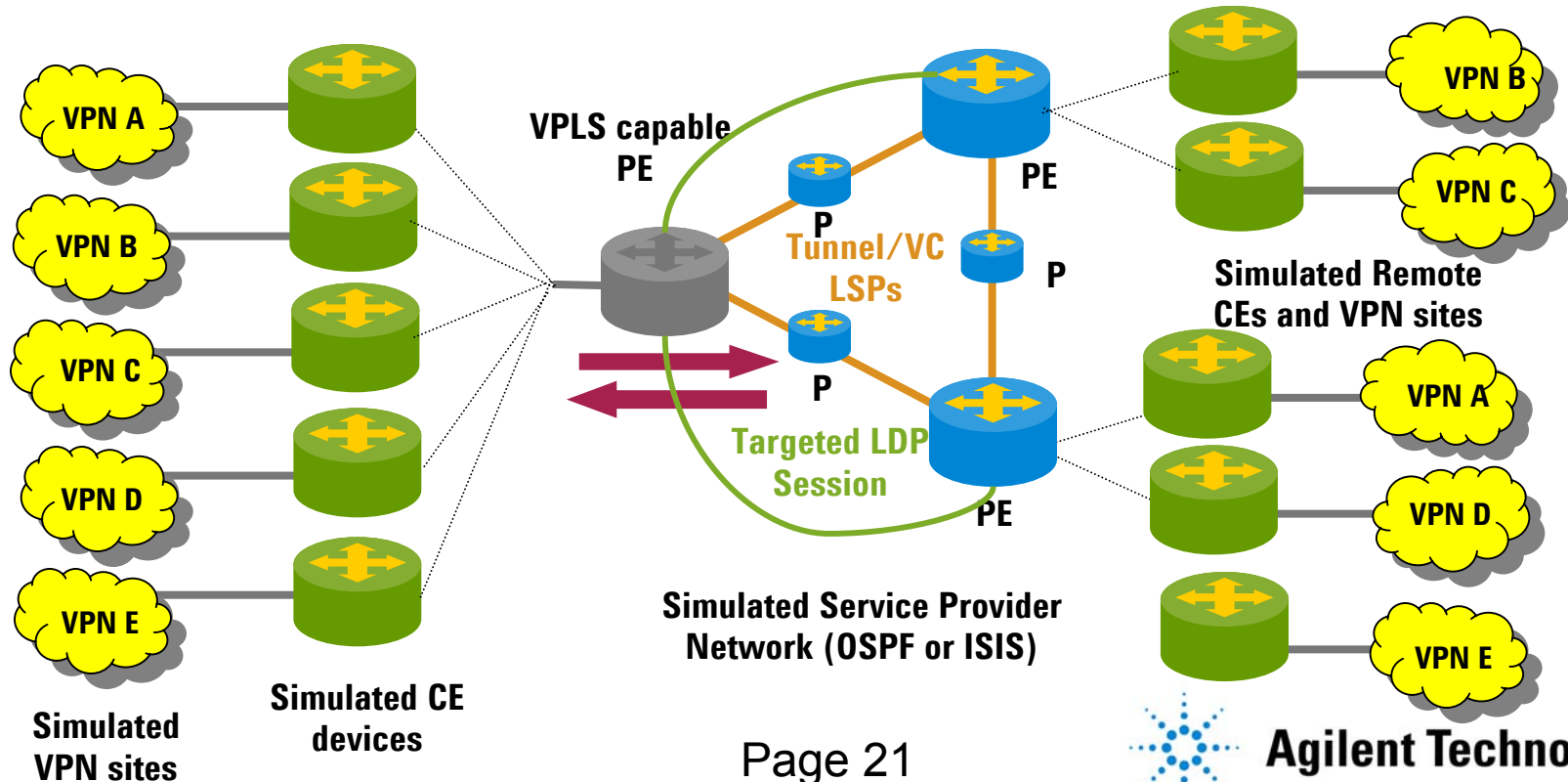
Customer Services

- L2 VPNs are implemented using L2oMPLS
- VPLS = “Virtual Private LAN Service”
- VPLS is the Ethernet implementation of L2oMPLS



Customer Services

- **What do you need to test for VPLS?**
 - **Can a VPLS-enabled PE router set up a full mesh of VPLS VC LSPs over pre-established tunnel LSPs**
 - **Learn MAC addresses and populate a VPLS FIB table**
 - **Correctly encapsulate and forward (or flood) VPLS traffic**



Customer Services

MPLS VPNs

- **Revenue generation is a three way balancing act**
 - **Number of VPNs supported**
 - **Number of customer locations within a VPN**
 - **Scalability of the VPN forwarding table**

Crucial \$\$\$ depend on the right balance

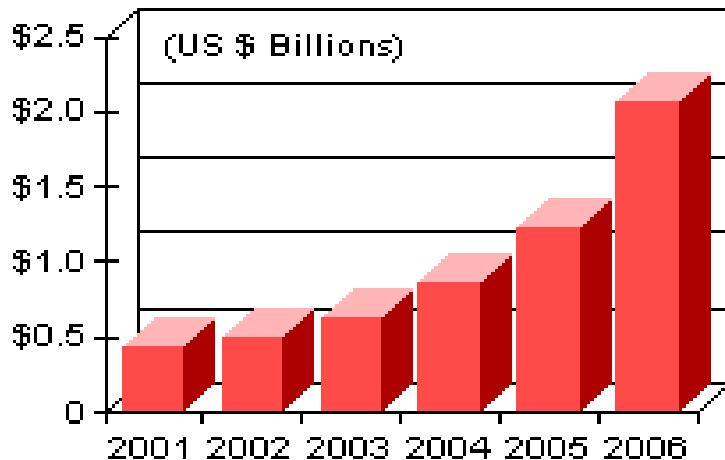


Customer Services

Multicast Services

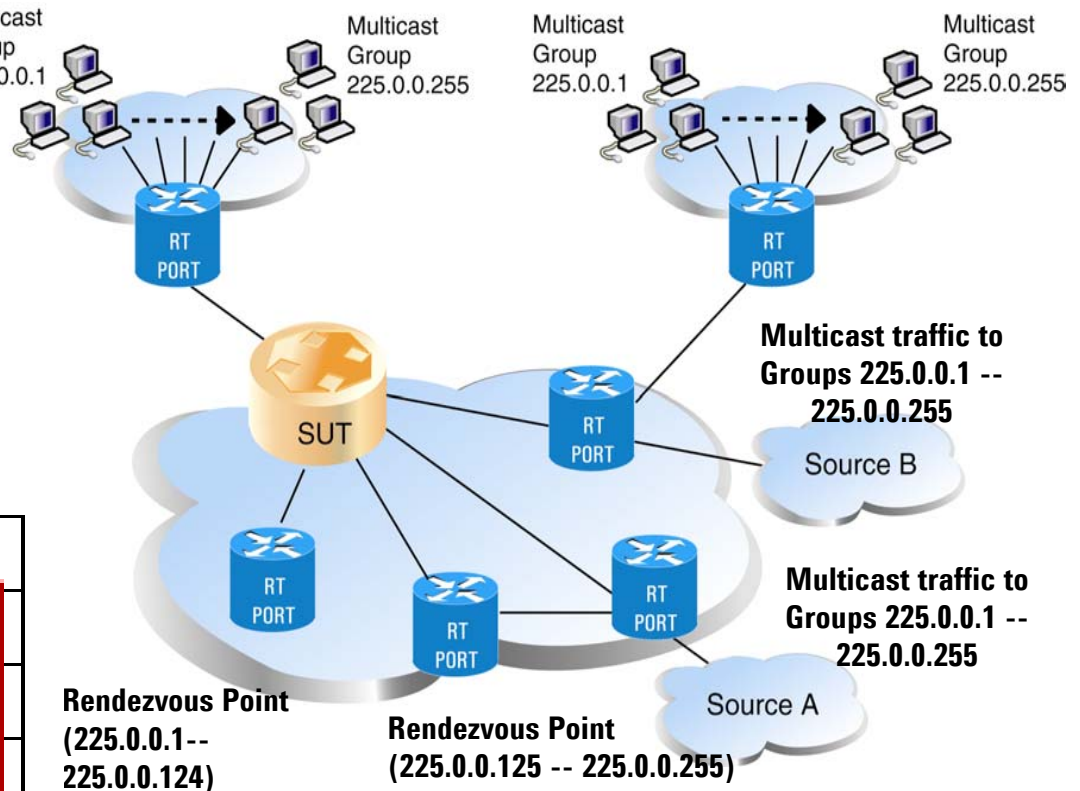
As multicast becomes scalable across the internet, there are opportunities for new applications and substantial growth in revenue

Worldwide Streaming Media Market Revenue Forecast*



* All business oriented streaming media authoring software and services

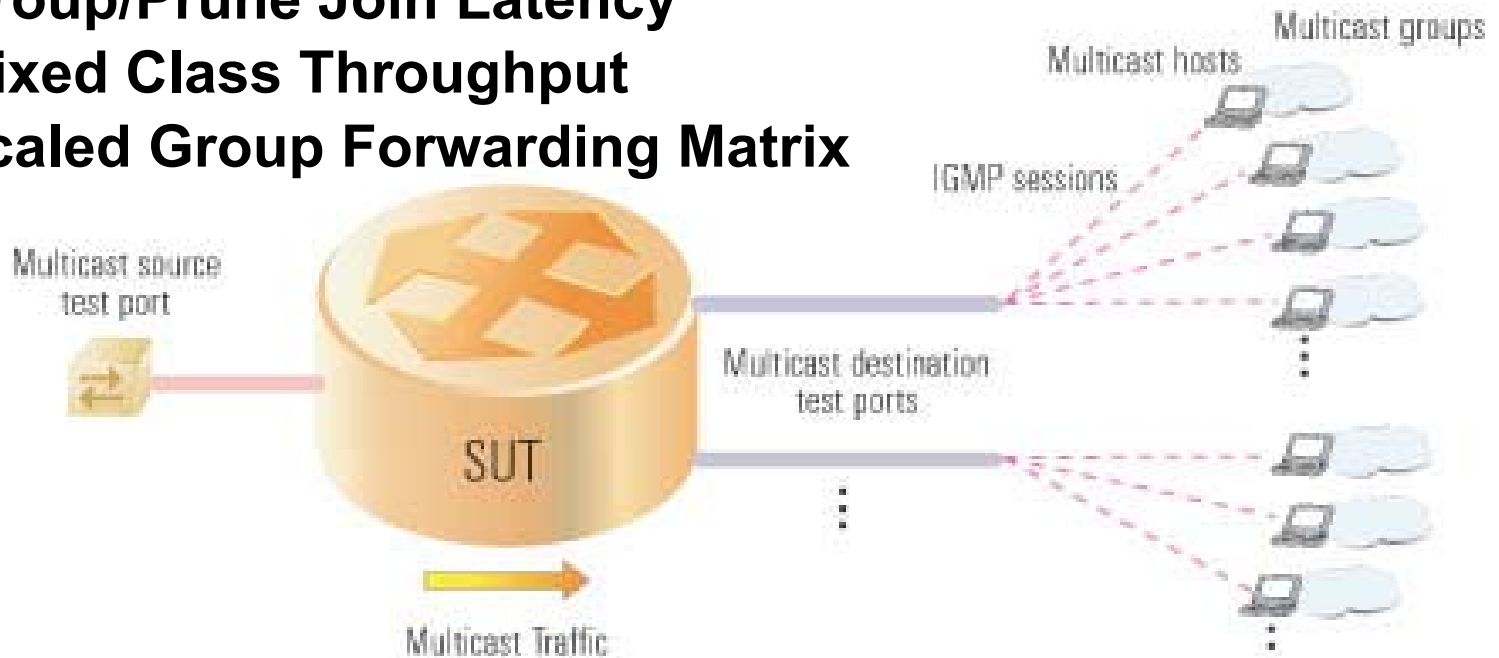
Source: In-Stat/MOR 8/02



Customer Services

Multicast Services

- **What do you need to test?**
 - **Multicast Latency**
 - **Aggregated Multicast Throughput**
 - **Multicast Group Capacity**
 - **Group/Prune Join Latency**
 - **Mixed Class Throughput**
 - **Scaled Group Forwarding Matrix**



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High Availability

What you need to test

High Availability

Router Resiliency

Routing Stability

Security

Access Lists

Denial of Service



Premium Services

Service Level Agreements

Guaranteed Services



Revenue
Potential



Importance of Router Resiliency

- **Telephony services: 99.999% availability (5 min/yr)**
 - **Considered an essential service**
- **Use of redundant routers in every POP/CO is costly**
 - **Potential 30-40% cost savings if single router could be used**



Network outages cost

- **Enterprises**
 - **U.S. companies lost \$100 billion due to outages in 1999**
- **Carriers**
 - **AT&T, 1998: Route update storm causes 2nd outage following fiber cut**
 - **Routers were too busy relearning routes to forward traffic!**
 - **Telstra, 2000: Routing loops in core routers lead to 10 hour outage**
 - **Initial cause: Australia-Singapore fiber cut**
 - **Worldcom, Oct 2002: Border router software upgrade causes 8 hour outage**
 - **Route table issue?**



High Availability

Testing New Router Resiliency Capabilities

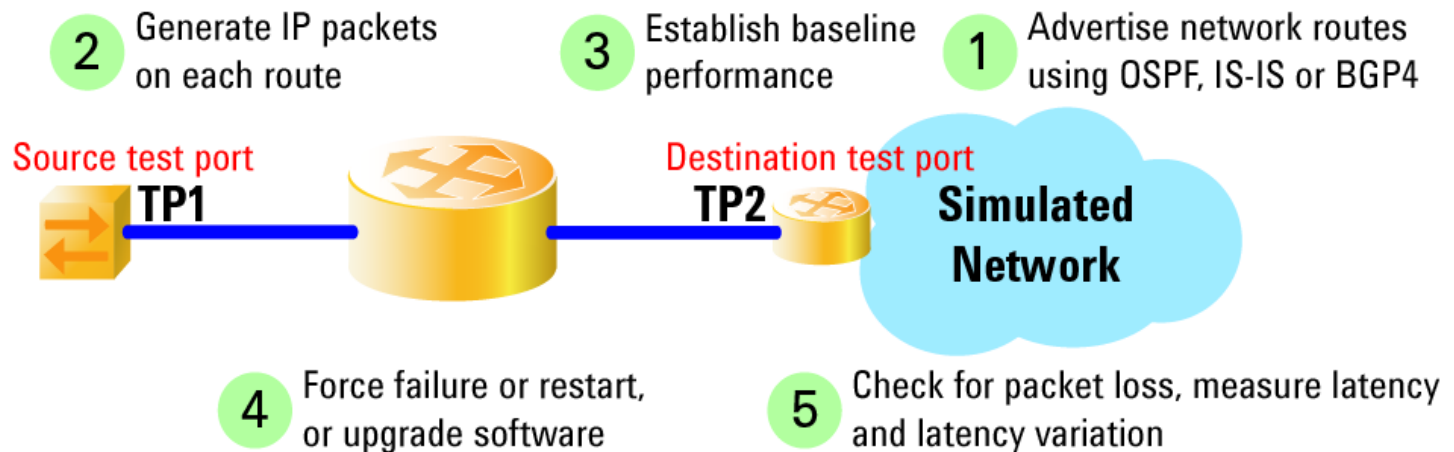
- **MPLS Fast Reroute**
- **Non-stop Forwarding**
- **Graceful / Hitless Restart**
- **Non-stop Routing**

- **What do you need to test?**
 - **Failover Performance (recovery time)**
 - **Hitless Upgrade**
 - **Control Plane Stability**



Non-Stop Forwarding

- What do you need to test?
 - Verifies continuity of forwarding
 - Measures impact of a failure on forwarding performance



Unacceptable amount of packet loss could be a violation of any service level agreements.....



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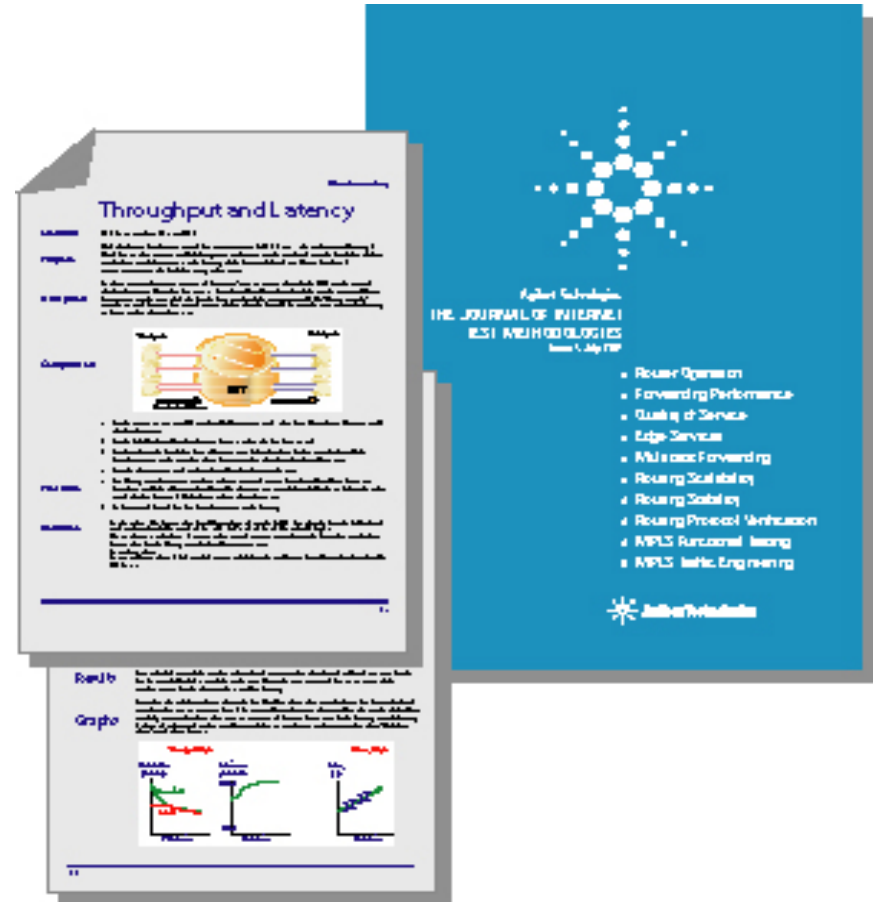
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Developing your Test Plan

The Journal of Internet Test Methodologies

- Over 80 common but complex test cases
 - The building blocks for your test plan
- Save six man-months of effort
- Free download
- Subscribe to updates



<http://www.agilent.com/comms/TheJournal>



Developing your Test Plan

Journal Test Case Categories

Services

BGP MPLS VPNs

L2oMPLS VPNs

VPLS

IP Multicast

Access Services

Scalable Performance

Traffic Performance

Quality of Service

Routing Scalability

MPLS Traffic Engineering

IPv6 Forwarding

High Availability

Router Resiliency

Routing Stability

Security

Access Lists

Denial of Service

General

Protocol Conformance

Multi Protocol Label Switching (MPLS)

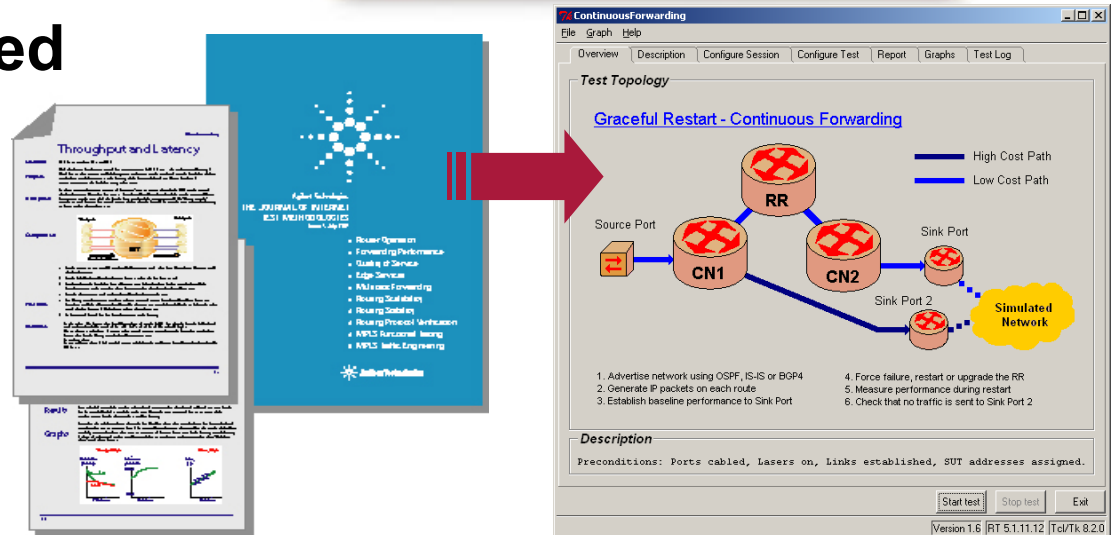


Developing your Test Plan

Automate your Test Plan with QuickTests

- QuickTests implement almost all of the test cases in The Journal, plus more
- Over 100 Automated Applications and Tools, free with RouterTester

RouterTester 900



<http://www.agilent.com/comms/RouterTester>



Cost effective Test Tool

- **RouterTester 900 is industry's most scalable and realistic multi-port layer 2 & 3 traffic generation, protocol emulation, and performance analysis test system.**
 - **Capable of simultaneous measurement of packet performance on more than 32,000 individual customer services per test port**
 - **Enables developers and operators to verify the number of revenue-generating customers and services such as VPLS that can be supported per device**

RouterTester 900





Conclusion

Bandwidth & Throughput

+

Scalability & Reliability

are important factors....

but the new test focus is ***REVENUE***

Revenue is not just the a bottom line –
it's is a game of survival

