



Testing of Ethernet Switch

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Why Testing Networks ?

- Keeping the network up and running
- Making the network better
- The cost-effectiveness of testing
- Third-party testing

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Seven Network Subsystems

- File server (S1)
- Workstation (S2)
- Networking operating system: NOS (S3)
- Application, client-server database and workstation desktop software (S4)
- Hubs, switches, bridges and routers (S5)
- Network segment (S6)
- Internetwork (S7)

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Recommended Test Objectives

Network Subsystem	Test Objectives									
	Acceptance	Performance	Reliability	Response Time	Capacity Planning	Functionality	Regression	Configuration	Product Evaluation	Buy/Inspect ID
1. File Server		X			X			X	X	X
2. Workstation		X						X		
3. NOS		X	X			X	X			
4. Application Client Server Database	X	X	X	X	X	X	X	X	X	X
5. Router/Hub/ Switch/Bridge		X	X		X	X	X		X	X
6. Network Segment	X	X	X			X				X
7. Internetwork	X	X	X			X				X

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Test Environment Dimensions

Network Load

Real-world load <i>Emulated network</i>	Real-world load <i>Real-world network</i>
Emulated load <i>Emulated network</i>	Emulated load <i>Real-world network</i>

Test Network Configuration

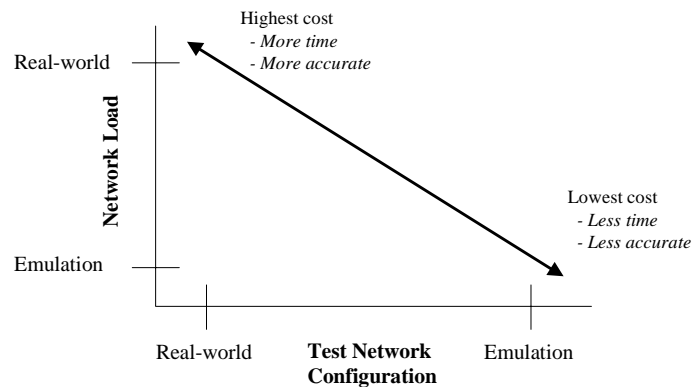
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Emulation vs. Real-World



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Traffic Load Modeling

- What type of loads ?**
 - A Windows client-server application
 - A DOS word processing application
 - A packet generator
- How much load ?**
 - Number of users
 - Network load (%)
- Mixed-case loading**
- Accelerated loading**
 - Used for reliability testing

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Test Philosophy

- Response time
- Feature/Functionality
- Throughput
- Acceptance
- Configuration sizing
- Reliability
- Bottleneck identification and problem isolation

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Test Methodology

- An orderly system of procedures to ensure that the test results meet the test objective.**
- The test results should be**
 - Accurate
 - Reproducible
 - Relevant

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Test Methodology Components

- Planning
- Load modeling
- Test configuration
- Data collection
- Data interpretation (Relevant results)
- Data presentation (Actionable results)

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Test Classification

- Functional Tests**
 - ➔ Verify that the DUT does what the specification says it should or must do
- Negative Tests**
 - ➔ Verify that the DUT behaves appropriately if another device on the network is not functioning according to specifications
- Stress Tests**
 - ➔ Verify that the DUT can perform correctly on busy networks with many devices and a high volume of network traffic

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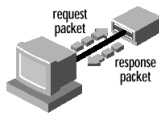
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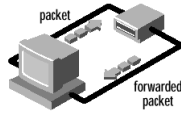


Test Setups

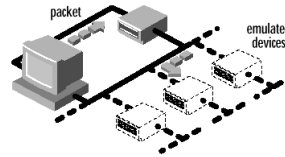
Conversational Testing



Multi-Interface Testing



Virtual Production Network Emulation



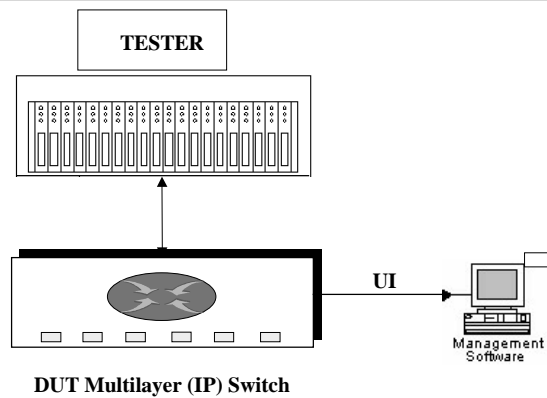
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Multi-Interface Testing



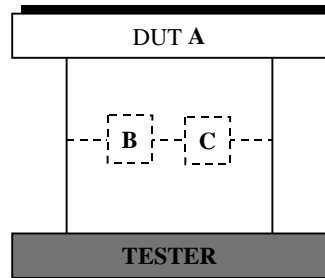
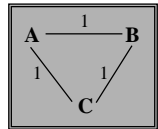
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An Emulated Network (1)



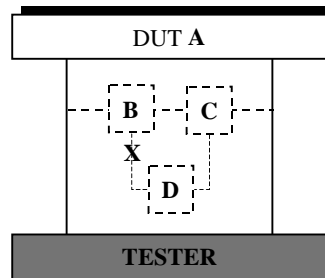
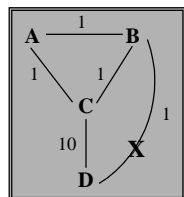
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An Emulated Network (2)



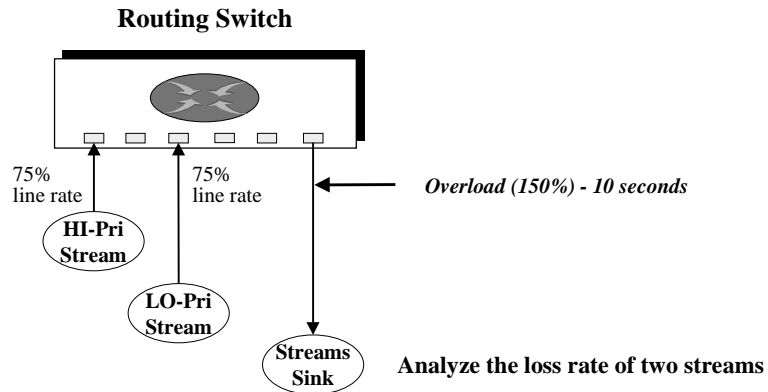
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Prioritization



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System Test Plan (1)

- Product Overview
- Test Equipment and Test Platform
- Basic Function Test (10/100/1000 Mbps)
 - More than 30 test items
- Protocol Conformance Test
 - GVRP/GARP
 - GMRP
 - Spanning Tree Protocol
 - IGMP2
 - RIP2
 - OSPF2
 - DVMRP3
 - MOSPF
 - Self-Developed

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System Test Plan (2)

Performance/Reliability Test

→ Refer to IETF RFC-2330: Framework for IP Performance Metrics

→ About 15 test items

- SMB-AST (Advanced Switch Test): Max throughput, HOL blocking, X-stream
- Ixia Communications: Mesh peak load test
- Self-developed: BX-stream, EBX-stream, MCAST X-stream, mixed class X-stream

Multivendor Interoperability Test

→ Use different vendors' router equipment to build real-world (tree or star Topology) operation

- Cisco, Bay Accelar, Xylan, Ascend, etc.

MIB Verification Test

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System Test Plan (3)

IP Multicast Test

→ Refer to IETF Draft: draft-thaler-multicast-interop-03

→ Refer to IETF RFC-2432: Terminology for IP Multicast Benchmarking

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IP Multicast Test (1)

- ❑ **Multicast Speedup Index (MSI)**
 - ➔ The ratio of unicast latency (d) to multicast latency (D), i.e., (d/D) .
 - In the best case, $D = d \rightarrow MSI = 1$
 - In the worst case, $D = n*d \rightarrow MSI = 1/n$, where n depends on the destination multicast ports
- ❑ **Multicast Latency (ML)**
 - ➔ The set of individual latencies from a single input port on the DUT to all tested ports (*more than two ports*) belonging to the destination multicast group
- ❑ **Group Join Delay (GJD)**
 - ➔ Time duration when an IGMP report has been issued to a DUT until the DUT starts forwarding multicast packets
- ❑ **Group Leave Delay (GLD)**
 - ➔ Time duration when an IGMP "Leave Group" message has been offered to a DUT until the DUT ceases forwarding multicast packets

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IP Multicast Test (2)

• X-Stream

1	2	3	4	2	3	4	...
2	3	4	1	3	4	1	...
3	4	1	2	4	1	2	...
4	1	2	3	1	2	3	...

• MCAST X-Stream (k) /* input line load = $1/k$ and $k=2$ (typical value) */

1	b	c	d	b	c	d	...
2	c	d	a	c	d	a	...
3	d	a	b	d	a	b	...
4	a	b	c	a	b	c	...

Multicast groups for $k=2$
 $a=\{1, 2\}$
 $b=\{2, 3\}$
 $c=\{3, 4\}$
 $d=\{4, 1\}$

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IP Multicast Test (3)

- **Mixed Class X-Stream ($k + 1$)** /* input line load = $1/(k + 1)$ */

1	2	b	3	c	4	d	2	b	3	c	4	d ...
2	3	c	4	d	1	a	3	c	4	d	1	a ...
3	4	d	1	a	2	b	4	d	1	a	2	b ...
4	1	a	2	b	3	c	1	a	2	b	3	c ...



Useful Information

Protocol Conformance/Interoperability Lab

→ <http://www.iol.unh.edu/>

Performance Evaluation

→ <http://www.tolly.com/>

Testing Tools

→ SmartBits: <http://www.netcomsystems.com/>

→ ANVL: <http://www.midnight.com/>

Standards

→ RFCs: <http://www.ietf.cnri.reston.va.us/>

→ IEEE802.1: <http://grouper.ieee.org/groups/802/1/>

→ IEEE802.3: <http://grouper.ieee.org/groups/802/3/>



Summary

□ The value of testing = risk versus cost

→ Risk includes

- productivity loss
- support cost
- lost sales

→ Cost includes

- facility cost
- personnel cost