



NETWORKERS 2004

TROUBLESHOOTING LAN PROTOCOLS

SESSION RST-3511

RST-3511
9850_05_2004_c2

© 2004 Cisco Systems, Inc. All rights reserved.

1

Agenda: Troubleshooting

Cisco.com

- **Path of Packet**
- **Spanning Tree Protocol**
- **Multicast**
- **Quality of Service**

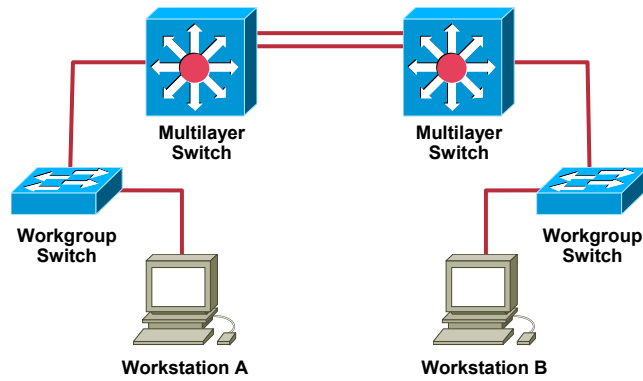
RST-3511
9850_05_2004_c2

© 2004 Cisco Systems, Inc. All rights reserved.

2

Path of Packet Problems

Cisco.com



- Performance: slowness, jitter, packet loss
- Connectivity: link, reachability

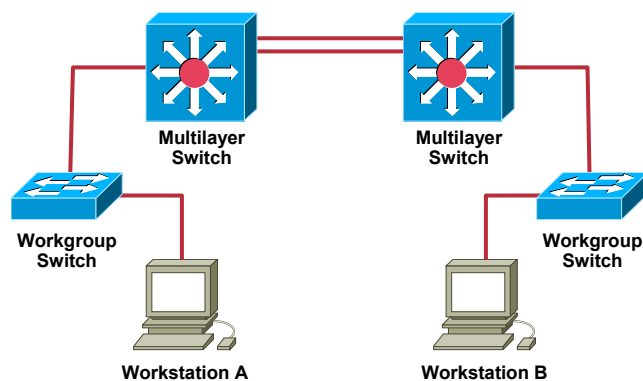
RST-3511
9850_05_2004_c2

© 2004 Cisco Systems, Inc. All rights reserved.

3

Path of Packet Troubleshooting Methodology

Cisco.com



- Define issue between two specific stations
- Determine path of respective packets
- Begin systematic examination of path devices

RST-3511
9850_05_2004_c2

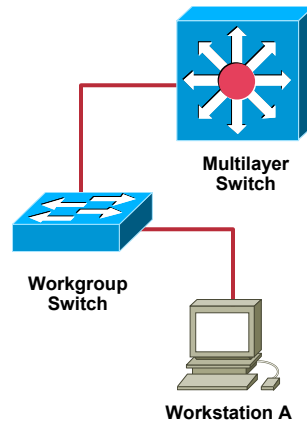
© 2004 Cisco Systems, Inc. All rights reserved.

4

Path of Packet Troubleshooting Layer 1

Cisco.com

- **Connectivity**
 - Do we have link?
- **Traffic**
 - Are packets passing?
 - How many?
- **Speed/duplex**
 - Do both sides match?



RST-3511
9850_05_2004_c2

© 2004 Cisco Systems, Inc. All rights reserved.

5

Path of Packet Troubleshooting Layer 1

Cisco.com

```
IOS> show interface GigabitEthernet 1/1
GigabitEthernet1/1 is up, line protocol is up (connected)
Hardware is Gigabit Ethernet Port, address is 0009.435f.8300 (bia 0009.435f.8)
MTU 1500 bytes, BW 1000000 Kbit, DLY 10 usec,
    reliability 255/255, txload 1/255, rxload 1/255
Encapsulation ARPA, loopback not set
Keepalive set (10 sec)
Full-duplex, 1000Mb/s, link type is auto, media type is SX
output flow-control is off, input flow-control is on
ARP type: ARPA, ARP Timeout 04:00:00
Last input 00:00:00, output never, output hang never
Last clearing of "show interface" counters never
Input queue: 0/2000/0/0 (size/max/drops/flushes); Total output drops: 0
Queueing strategy: fifo
Output queue: 0/40 (size/max)
5 minute input rate 89000 bits/sec, 141 packets/sec
5 minute output rate 23000 bits/sec, 24 packets/sec
 226241448 packets input, 14733424090 bytes, 0 no buffer
Received 224084097 broadcasts (201828280 multicast)
 0 runts, 0 giants, 0 throttles
 0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored
 0 input packets with dribble condition detected
 35622 packets output, 5452233 bytes, 0 underruns
 0 output errors, 0 collisions, 0 interface resets
 0 babbles, 0 late collision, 0 deferred
 0 lost carrier, 0 no carrier
 0 output buffer failures, 0 output buffers swapped out
```

RST-3511
9850_05_2004_c2

© 2004 Cisco Systems, Inc. All rights reserved.

6

Path of Packet Troubleshooting Layer 1

Cisco.com

```

IOS# show cdp neighbors detail
-----
Device ID: TBA04150575
Entry address(es):
  IP address: 1.1.1.2
Platform: WS-C6506, Capabilities: Trans-Bridge Switch IGMP
Interface: GigabitEthernet1/1, Port ID (outgoing port): 1/1
Holdtime : 164 sec

Version :
WS-C6506 Software, Version McpSW: 6.3(3) NmpSW: 6.3(3)
Copyright (c) 1995-2001 by Cisco Systems

advertisement version: 2
VTP Management Domain: 'Networkers'
Native VLAN: 1
Duplex: full

Native#
    
```

RST-3511
9850_05_2004_c2

© 2004 Cisco Systems, Inc. All rights reserved.

7

Path of Packet Troubleshooting Layer 1

Cisco.com

```

CatOS> show port 3/5
Port Name          Status      Vlan      Duplex Speed Type
-----
3/5                connected  1         a-full a-100 10/100BaseTX
Port AuxiliaryVlan AuxVlan-Status      InlinePowered      PowerAllocated
      Admin Oper      Detected mWatt mA @42V
-----
3/5 none           none         auto off   no      0      0
Port Security Violation Shutdown-Time Age-Time Max-Addr Trap      IfIndex
3/5 disabled shutdown      0          0          1 disabled 30
Port Num-Addr Secure-Src-Addr Age-Left Last-Src-Addr Shutdown/Time-Left
-----
3/5 0              -            -            -            -            -
Port Broadcast-Limit Multicast Unicast Total-Drop
-----
3/5 -              -            -            -            0
Port Send FlowControl Receive FlowControl RxPause TxPause
      admin oper      admin oper
-----
3/5 off            off          off          off          0          0
Port Status Channel Admin Ch
      Mode      Group Id
-----
3/5 connected auto silent      7          0
Port Align-Err FCS-Err Xmit-Err Rcv-Err UnderSize
-----
3/5 0              0            0            0            0
Port Single-Col Multi-Coll Late-Coll Excess-Col Carri-Sen Runts Giants
-----
3/5 0              0            0            0            0            0            0
Port Last-Time-Cleared
-----
3/5 Wed May 4 1994, 20:27:49
    
```

RST-3511
9850_05_2004_c2

© 2004 Cisco Systems, Inc. All rights reserved.

8

Path of Packet Troubleshooting Layer 1

Cisco.com

```
CatOS> show mac 3/5

Port      Rcv-Unicast      Rcv-Multicast      Rcv-Broadcast
-----
3/5              2150670             700601520           22246533

Port      Xmit-Unicast      Xmit-Multicast      Xmit-Broadcast
-----
3/5              1344                 78820                23

Port      Rcv-Octet      Xmit-Octet
-----
3/5      46822552687      7238629

MAC      Dely-Exced MTU-Exced  In-Discard Out-Discard
-----
3/5          0          0          0          0

Port      Last-Time-Cleared
-----
3/5      Wed May 4 1994, 20:27:49

CatOS>
```

RST-3511
9850_05_2004_c2

© 2004 Cisco Systems, Inc. All rights reserved.

9

Path of Packet Troubleshooting Layer 1

Cisco.com

```
CatOS> (enable) show cdp neighbor detail

Port (Our Port): 1/1
Device-ID: Native
Device Addresses:
  IP Address: 1.1.1.1
Holdtime: 161 sec
Capabilities: ROUTER SWITCH IGMP
Version:
  Cisco Internetwork Operating System Software
  IOS (tm) c6sup2_rp Software (c6sup2_rp-JSV-M), Version 12.1(13)E9, EARLY DEPL)
  TAC Support: http://www.cisco.com/tac
  Copyright (c) 1986-2003 by cisco Systems, Inc.
  Compiled Sat 12-Jul-03 15:28 by hqluong
Platform: cisco Catalyst 6000
Port-ID (Port on Neighbors's Device): GigabitEthernet1/1
VTP Management Domain: Networkers
Native VLAN: 1
Duplex: full
System Name: unknown
System Object ID: unknown
Management Addresses: unknown
Physical Location: unknown
CatOS> (enable)
```

RST-3511
9850_05_2004_c2

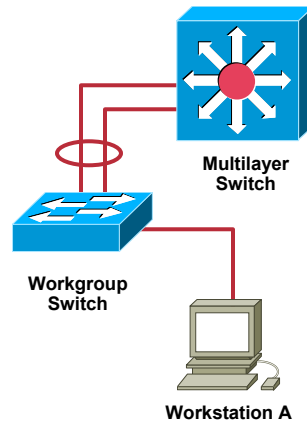
© 2004 Cisco Systems, Inc. All rights reserved.

10

Path of Packet Troubleshooting Layer 2

Cisco.com

- **Trunk**
Desirable | ON?
- **Channel**
Desirable | ON?
- **Bridge table**
MAC learned correctly?
- **Spanning tree**
Ports forwarding as expected?



RST-3511
9850_05_2004_c2

© 2004 Cisco Systems, Inc. All rights reserved.

11

Path of Packet Troubleshooting Layer 2: Trunking

Cisco.com

```
IOS# show interfaces gigabitEthernet 1/1 trunk
```

Port	Mode	Encapsulation	Status	Native vlan
Gil/1	desirable	802.1q	trunking	1
Port Vans allowed on trunk				
Gil/1	1-4094			
Port Vans allowed and active in management domain				
Gil/1	1-3,98-99,195,300-301,303			
Port Vans in spanning tree forwarding state and not pruned				
Gil/1	1-3,98-99,195,300-301,303			

RST-3511
9850_05_2004_c2

© 2004 Cisco Systems, Inc. All rights reserved.

12

Path of Packet Troubleshooting Layer 2: Trunking

Cisco.com

```
CatOS> (enable) show trunk 1/1
* - indicates vtp domain mismatch
Port      Mode      Encapsulation  Status      Native vlan
-----
1/1      desirable  isl            trunking    1

Port      Vlans allowed on trunk
-----
1/1      1-1005,1025-4094

Port      Vlans allowed and active in management domain
-----
1/1      1,3,220-221,920-921,1000

Port      Vlans in spanning tree forwarding state and not pruned
-----
1/1      1
CatOS> (enable)
```

RST-3511
9850_05_2004_c2

© 2004 Cisco Systems, Inc. All rights reserved.

13

Path of Packet Troubleshooting Layer 2: EtherChannel

Cisco.com

```
IOS# show interfaces port-channel 1 etherchannel
Age of the Port-channel = 00d:08h:48m:31s
Logical slot/port = 14/1      Number of ports = 2
GC = 0x00010001      HotStandBy port = null
Port state = Port-channel Ag-Inuse
Protocol = PAgP

Ports in the Port-channel:

Index  Load  Port      EC state
-----
0      55    Gi1/1     Desirable-S1
1      AA    Gi2/2     Desirable-S1

Time since last port bundled: 00d:00h:03m:04s  Gi2/2
Time since last port Un-bundled: 00d:01h:04m:22s  Gi2/2
```

RST-3511
9850_05_2004_c2

© 2004 Cisco Systems, Inc. All rights reserved.

14

Path of Packet

Troubleshooting Layer 2: EtherChannel

Cisco.com

```
IOS# show etherchannel load-balance
Source XOR Destination IP address
Native#

IOS-cat6k# remote login switch
Trying Switch ...
Entering CONSOLE for Switch
Type "^C^C^C" to end this session

IOS-cat6k-sp# test etherchannel load-balance interface port-channel 1 ip 1.1.1.1 2.2.2.2
Would select Gi1/1 of Po1

IOS-cat4k# show platform software etherchannel port-channel 1 map ip 1.1.1.1 2.2.2.2
Map port for Ip 1.1.1.1, 2.2.2.2 is Gi1/1(Po1)
NOTE: Software forwarded traffic will use Gi1/1(Po1)
```

RST-3511
9850_05_2004_c2

© 2004 Cisco Systems, Inc. All rights reserved.

15

Path of Packet

Troubleshooting Layer 2: EtherChannel

Cisco.com

```
CatOS> (enable) show port channel
Port Status Channel Admin Ch
      Mode Group Id
-----
1/1 connected desirable silent 19 769
2/2 connected desirable silent 19 769
-----

Port Device-ID Port-ID Platform
-----
1/1 Native Gi1/1 cisco Catalyst 0
2/2 Native Gi2/2 cisco Catalyst 0
-----

CatOS>
CatOS> (enable) show channel 769 info
<...some output deleted...>
Chan Port if- Oper-group Neighbor Chan Oper-Distribution PortSecurity/
id Port Index Oper-group cost Method Dynamic Port
-----
769 1/1 81 49 65537 0 ip both
769 2/2 81 49 65537 0 ip both
<...some output deleted...>

CatOS> (enable)
CatOS> (enable) show channel hash 769 1.1.1.1 2.2.2.2
Selected channel port: 1/1
CatOS> (enable)
```

RST-3511
9850_05_2004_c2

© 2004 Cisco Systems, Inc. All rights reserved.

16

Path of Packet Troubleshooting Layer 2: Bridging

Cisco.com

```
IOS# show mac-address-table dynamic interface port-channel 1
Codes: * - primary entry
```

vlan	mac address	type	learn	qos	ports
* 1	0001.c912.7bff	dynamic	No	--	Pol

```
IOS# show mac-address-table ?
address      address keyword
aging-time   aging-time keyword
count        count keyword
dynamic      dynamic entry type
interface    interface keyword
module       display entries in DFCCard
multicast    multicast info for selected wildcard
static       static entry type
vlan         vlan keyword
|            Output modifiers
<cr>
```

RST-3511
9850_05_2004_c2

© 2004 Cisco Systems, Inc. All rights reserved.

17

Path of Packet Troubleshooting Layer 2: Bridging

Cisco.com

```
CatOS> (enable) show cam dynamic 1/1
* = Static Entry. + = Permanent Entry. # = System Entry. R = Router Entry.
X = Port Security Entry $ = Dot1x Security Entry
```

VLAN	Dest MAC/Route Des	[CoS]	Destination Ports or VCs / [Protocol Type]
1	00-05-74-95-91-0a		1/1,2/2 [ALL]

Total Matching CAM Entries Displayed =1

```
CatOS> (enable)
```

```
CatOS> (enable) show cam ?
agingtime      Show cam aging time
count          Showing cam total entries
dynamic        Show dynamic cam entries
msfc           Show cam Multilayer Switching Router info
permanent      Show permanent cam entries
static         Show static cam entries
system         Show system cam entries
<mac_addr>    MAC address
CatOS> (enable)
```

RST-3511
9850_05_2004_c2

© 2004 Cisco Systems, Inc. All rights reserved.

18

Path of Packet Troubleshooting Layer 2: Bridging

Cisco.com

```
IOS# show spanning interface gigabitEthernet 1/1
```

Vlan	Role	Sts	Cost	Prio.Nbr	Type
VLAN0001	Root	FWD	3	128.833	P2p

```
CatOS> (enable) show spantree 1/1
```

Port	Vlan	Port-State	Cost	Prio	Portfast	Channel_id
1/1,2/2	1	forwarding		3	32 disabled	769

```
CatOS> (enable)
```

RST-3511
9850_05_2004_c2

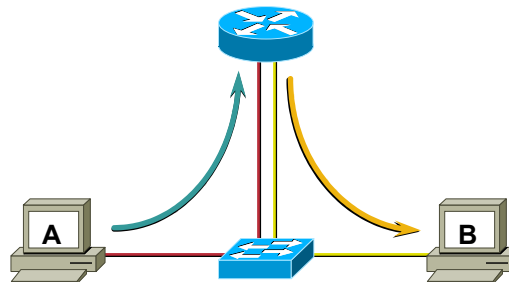
© 2004 Cisco Systems, Inc. All rights reserved.

19

Path of Packet Troubleshooting Layer 3

Cisco.com

- Routing table
Entry present?
- ARP cache
Correct MAC?
- Cisco Express Forwarding (CEF)
Information derived correctly?



RST-3511
9850_05_2004_c2

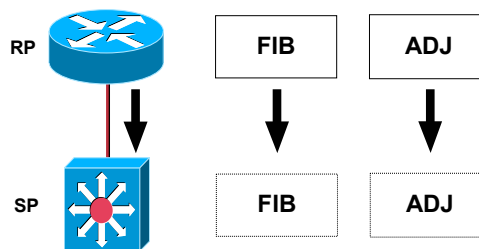
© 2004 Cisco Systems, Inc. All rights reserved.

20

Path of Packet Layer 3 Hardware Forwarding

Cisco.com

- Used on Catalyst 3550, 3750, 4000 Supervisor III/IV/V, and 6000 Supervisor II/720
- The hardware forwarding engine on the switch processor is programmed by the software on the route processor with a copy of the software FIB and adjacency table
- The SP depends on the RP for routing and ARP information corresponding to FIB and adjacency updates



RST-3511
9850_05_2004_c2

© 2004 Cisco Systems, Inc. All rights reserved.

21

Path of Packet Troubleshooting Layer 3: Route/ARP

Cisco.com

```
IOS# show ip route 162.123.74.1
Routing entry for 162.123.74.0/24
  Known via "eigrp 1", distance 170, metric 130816, type external
  Redistributing via eigrp 1
  Last update from 10.1.1.1 on Vlan1, 00:01:13 ago
  Routing Descriptor Blocks:
  * 10.1.1.1, from 10.1.1.1, 00:01:13 ago, via Vlan1
    Route metric is 130816, traffic share count is 1
    Total delay is 5010 microseconds, minimum bandwidth is 1000000 Kbit
    Reliability 255/255, minimum MTU 1500 bytes
    Loading 1/255, Hops 1
```

```
IOS# show ip arp 10.1.1.1
Protocol Address      Age (min)  Hardware Addr  Type   Interface
Internet 10.1.1.1         4         0001.c912.7bfc ARPA   Vlan1
```

RST-3511
9850_05_2004_c2

© 2004 Cisco Systems, Inc. All rights reserved.

22

Path of Packet Troubleshooting Layer 3: CEF

Cisco.com

```
IOS# show ip cef 162.123.74.1
162.123.74.0/24, version 20, epoch 0, cached adjacency 10.1.1.1
0 packets, 0 bytes
  via 10.1.1.1, Vlan1, 0 dependencies
  next hop 10.1.1.1, Vlan1
  valid cached adjacency
```

```
IOS# show adjacency vlan 1 detail
Protocol Interface      Address
IP          Vlan1              10.1.1.1(9)
              0 packets, 0 bytes
              0001C9127BFC
              00057495910A0800
              ARP          03:52:36
              Epoch: 0
```

RST-3511
9850_05_2004_c2

© 2004 Cisco Systems, Inc. All rights reserved.

23

Path of Packet Troubleshooting Layer 3: Hardware

Cisco.com

- Commands vary per platform due to hardware architecture differences

```
IOS-3750# session 1
IOS-3750-1# show platform forward gig 1/0/3 0009.43a7.bb0 000d.bd5c.16c1 ip 172.1.1.2 172.1.3.2 255
```

```
IOS-cat4k> show platform software ip route network 14.18.2.0 255.255.255.0
```

```
CatOS> (enable) sh mls entry cef ip 192.168.50.0/24
```

OR

```
IOS-cat6k# sho mls cef ip 10.1.1.5
```

RST-3511
9850_05_2004_c2

© 2004 Cisco Systems, Inc. All rights reserved.

24

Path of Packet Troubleshooting Layer 3: Hardware

Cisco.com

- See RST-3507 (Catalyst 35xx), RST-3508 (Catalyst 4000), RST-3509 (Catalyst 6000) for platform specific hardware forwarding information
- Use Sniffer, Extended Ping, ACL, etc. to troubleshoot packet forwarding
- If you need assistance, CALL TAC

RST-3511
9850_05_2004_c2

© 2004 Cisco Systems, Inc. All rights reserved.

25

Path of Packet Troubleshooting: Useful Tools

Cisco.com

```
IOS# ping
Protocol [ip]:
Target IP address: 10.1.1.1
Repeat count [5]: 1
Datagram size [100]:
Timeout in seconds [2]:
Extended commands [n]: y
Source address or interface: 10.1.1.2
Type of service [0]:
Set DF bit in IP header? [no]:
Validate reply data? [no]:
Data pattern [0xABCD]:
Loose, Strict, Record, Timestamp, Verbose[none]: r
Number of hops [ 9 ]: 3
Loose, Strict, Record, Timestamp, Verbose[RV]:
Sweep range of sizes [n]:
Type escape sequence to abort.
Sending 1, 100-byte ICMP Echos to 10.1.1.1, timeout is 2 seconds:
Packet has IP options: Total option bytes= 15, padded length=16
Record route: <*>
(0.0.0.0)
(0.0.0.0)
(0.0.0.0)

Reply to request 0 (1 ms). Received packet has options
Total option bytes= 16, padded length=16
Record route:
(10.1.1.2)
(10.1.1.1)
(10.1.1.1)
<*>
End of list

Success rate is 100 percent (1/1), round-trip min/avg/max = 1/1/1 ms
```

RST-3511
9850_05_2004_c2

© 2004 Cisco Systems, Inc. All rights reserved.

26

Path of Packet Troubleshooting: Useful Tools

Cisco.com

```
IOS-cat4k# ping 14.18.3.200

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 14.18.3.200, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/2/4 ms
IOS-cat4k# traceroute mac ip 14.18.3.20 14.18.3.200
Translating IP to mac .....
14.18.3.20 => 0009.435f.86ff
14.18.3.200 => 0003.6b73.9aff

Source 0009.435f.86ff found on IOS-cat4k
IOS-cat4k      (14.18.3.20      ) :      V11 => Gi1/1
Destination 0003.6b73.9aff found on IOS-cat4k
Layer2 trace completed.
IOS-cat4k#
IOS-cat4k# traceroute ?
WORD          Trace route to destination address or hostname
appletalk     AppleTalk Trace
cns           ISO CLNS Trace
ip            IP Trace
ipx           IPX Trace
mac           Trace Layer2 path between 2 endpoints ← Not available on Cat6k at present
oldvines      Vines Trace (Cisco)
vines         Vines Trace (Banyan)
<cr>
```

RST-3511
9850_05_2004_c2

© 2004 Cisco Systems, Inc. All rights reserved.

27

Path of Packet Troubleshooting: Useful Tools

Cisco.com

```
CatOS> (enable) l2trace 00-01-c9-12-7b-ff 00-01-c9-12-7b-fc detail
Starting L2 Trace

l2trace vlan number is 1.

00-01-c9-12-7b-ff found in WS-C6506 on port sc0
WS-C6506 : : 10.1.1.5: sc0 -> 15/1 1000MB full duplex
Destination 00-01-c9-12-7b-fc found in WS-C6506 on port 15/1 1000MB full duplex
CatOS> (enable)
CatOS> (enable) l2trace
Usage: l2trace <src_mac_addr> <dest_mac_addr> [vlan] [detail]
       l2trace <src-ip-addr> <dest-ip-addr> [detail]
       (src-ip-addr, dest-ip-addr: IP alias or IP address)
CatOS> (enable)
```

RST-3511
9850_05_2004_c2

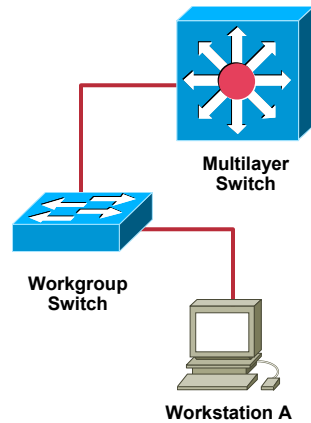
© 2004 Cisco Systems, Inc. All rights reserved.

28

Path of Packet Troubleshooting Summary

Cisco.com

- **Baseline applications**
 - Define end points
 - Map expected path
 - Know features in path
- **Change control**
- **Apply methodical process**



RST-3511
9850_05_2004_c2

© 2004 Cisco Systems, Inc. All rights reserved.

29

Agenda: Troubleshooting

Cisco.com

- **Path of Packet**
- **Spanning Tree Protocol**
- **Multicast**
- **Quality of Service**

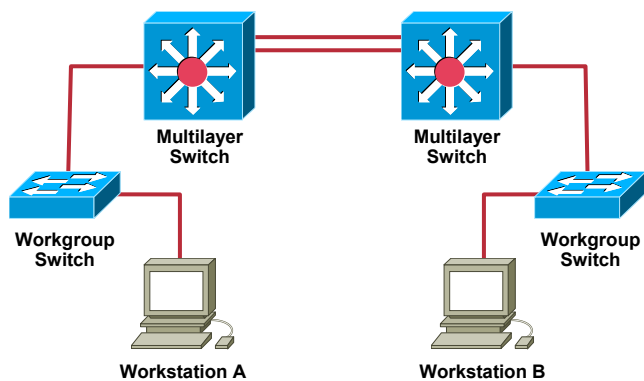
RST-3511
9850_05_2004_c2

© 2004 Cisco Systems, Inc. All rights reserved.

30

Spanning Tree Protocol Problems

Cisco.com



- Outages: spanning tree loops
- Performance: spanning tree recalculations

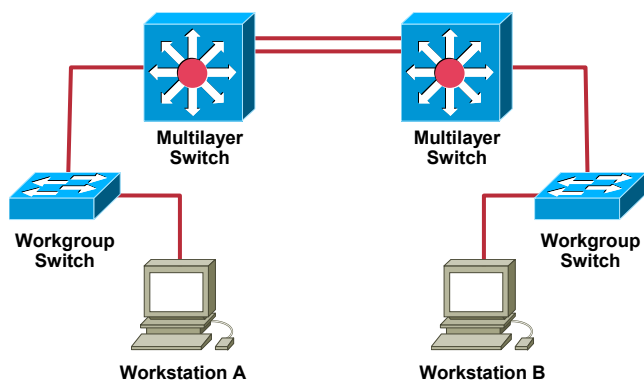
RST-3511
9850_05_2004_c2

© 2004 Cisco Systems, Inc. All rights reserved.

31

Spanning Tree Protocol Troubleshooting Methodology

Cisco.com



- Start now! Be proactive
- Divide and conquer

RST-3511
9850_05_2004_c2

© 2004 Cisco Systems, Inc. All rights reserved.

32

Spanning Tree Protocol Proactive Troubleshooting Steps

Cisco.com

- Document spanning tree topology
- Implement spanning tree enhancement features
- Develop recovery plan to include data collection for root cause analysis

RST-3511
9850_05_2004_c2

© 2004 Cisco Systems, Inc. All rights reserved.

33

Spanning Tree Protocol Documenting Spanning Tree Topology

Cisco.com

- For each VLAN
- Where is root?
- Which ports are blocking?
- CPU utilization per switch

RST-3511
9850_05_2004_c2

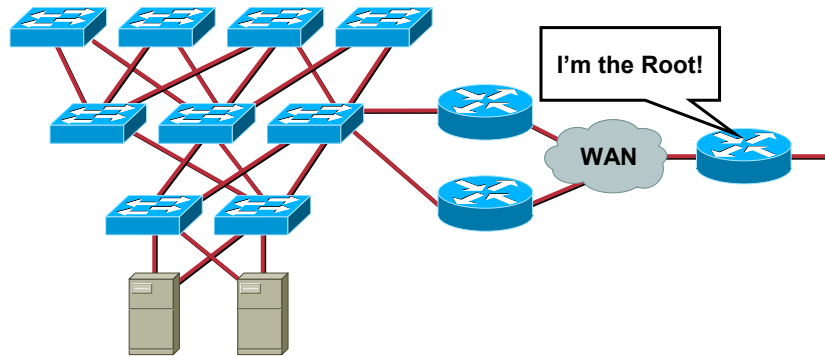
© 2004 Cisco Systems, Inc. All rights reserved.

34

Spanning Tree Protocol Documenting Spanning Tree Topology

Cisco.com

- It is important to know the location of root



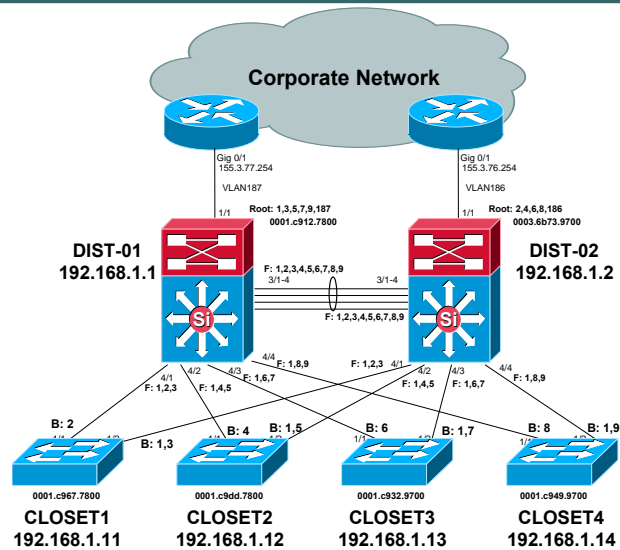
RST-3511
9850_05_2004_c2

© 2004 Cisco Systems, Inc. All rights reserved.

35

Spanning Tree Protocol Documenting Spanning Tree Topology

Cisco.com



RST-3511
9850_05_2004_c2

© 2004 Cisco Systems, Inc. All rights reserved.

36

Spanning Tree Protocol Troubleshooting Commands

Cisco.com

CatOS> (enable) **show spantree 1**

VLAN 1

Spanning tree mode PVST+
Spanning tree type ieee
Spanning tree enabled

Designated Root 00-60-83-55-7b-00
Designated Root Priority 100
Designated Root Cost 100
Designated Root Port 3/1
Root Max Age 20 sec Hello Time 2 sec Forward Delay 15 sec

Bridge ID MAC ADDR 00-d0-06-24-6c-00
Bridge ID Priority 32768
Bridge Max Age 20 sec Hello Time 2 sec Forward Delay 15 sec

Port	Vlan	Port-State	Cost	Prio	Portfast	Channel_id
1/1	1	not-connected	4	32	disabled	0
3/1	1	forwarding	100	32	enabled	0

RST-3511
9850_05_2004_c2

© 2004 Cisco Systems, Inc. All rights reserved.

37

Spanning Tree Protocol Troubleshooting Commands

Cisco.com

IOS#**show spanning-tree vlan 1 brief**

VLAN0001

Spanning tree enabled protocol ieee

Root ID Priority 1
Address 0060.8355.7b00
Cost 23
Port 1 (GigabitEthernet1/1)
Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec

Bridge ID Priority 32769 (priority 32768 sys-id-ext 1)
Address 0007.0e8f.0880
Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec
Aging Time 300

Interface Name	Port ID	Prio	Cost	Sts	Designated Cost	Designated Bridge ID	Port ID
GigabitEthernet1/1	128.1	128	4	FWD	67	32768 0005.5f33.dc01	128.1
FastEthernet3/48	128.176	128	19	FWD	48	32768 0030.7bdd.5080	128.16

RST-3511
9850_05_2004_c2

© 2004 Cisco Systems, Inc. All rights reserved.

38

Spanning Tree Protocol Troubleshooting Commands

Cisco.com

```
CatOS> (enable) show spantree summary
MAC address reduction: disabled
Root switch for vlans: 1.
Global loopguard is disabled on the switch.
Global portfast is disabled on the switch.
BPDU skewing detection disabled for the bridge.
BPDU skewed for vlans: none.
Portfast bpdu-guard enabled for bridge.
Portfast bpdu-filter disabled for bridge.
Uplinkfast disabled for bridge.
Backbonefast enabled for bridge.
```

Summary of connected spanning tree ports by vlan

VLAN	Blocking	Listening	Learning	Forwarding	STP Active
1	0	0	0	4	4
Blocking Listening Learning Forwarding STP Active					
Total	0	0	0	4	4

RST-3511
9850_05_2004_c2

© 2004 Cisco Systems, Inc. All rights reserved.

39

Spanning Tree Protocol Troubleshooting Commands

Cisco.com

```
IOS#show spanning-tree summary
Root bridge for: VLAN0010.
Extended system ID is enabled
PortFast BPDU Guard is enabled
EtherChannel misconfiguration guard is disabled
UplinkFast is disabled
BackboneFast is enabled
Default pathcost method used is short
```

Name	Blocking	Listening	Learning	Forwarding	STP Active
VLAN0001	0	0	0	2	2
VLAN0010	0	0	0	1	1
VLAN1002	0	0	0	1	1
VLAN1003	0	0	0	1	1
VLAN1004	0	0	0	1	1
VLAN1005	0	0	0	1	1
6 VLANs	0	0	0	7	7

RST-3511
9850_05_2004_c2

© 2004 Cisco Systems, Inc. All rights reserved.

40

Spanning Tree Protocol Logical Ports and STP Instances

Cisco.com

= (# of non-ATM trunks
* # of vlans on trunk)

+ (# of ATM trunks
* vlans on trunk *2)

+ # of non-trunking ports

***VTP Pruning Does Not Remove
STP from Trunks**

**See Respective Platform Release
Notes for More Details**

	Max Recommended Instances
2950	64 VLANs
3550	128 VLANs
4000 Sup I or II	1,500
4000 Sup III or IV	3,000
5000 Sup I	400
5000 Sup II	1,500
5000 Sup IIG/ IIIG	1,800
5000 Sup III	4,000
6000 Sup I	4,000
6000 Sup II	14,000

RST-3511
9850_05_2004_c2

© 2004 Cisco Systems, Inc. All rights reserved.

41

Spanning Tree Protocol Troubleshooting Commands

Cisco.com

```
IOS-cat6k# show proc cpu
CPU utilization for five seconds: 1%/0%; one minute: 2%; five minutes: 2%
PID Runtime(ms)   Invoked    uSecs   5Sec   1Min   5Min  TTY Process
  1         0         1          0  0.00%  0.00%  0.00%  0 Chunk Manager
<...some output removed...>
 79         0         256          0  0.00%  0.00%  0.00%  0 mls-msc Process
 80       30508      461976         66  0.40%  0.43%  0.44%  0 Spanning Tree
 81         108      27024          3  0.00%  0.00%  0.00%  0 Ethchnl
<...some output removed...>
162         12         41        292  0.00%  0.01%  0.00%  1 Virtual Exec
```

```
IOS-cat6k> show spanning-tree summary
<...some output removed...>
Name                    Blocking Listening Learning Forwarding STP Active
-----
VLAN0001                1         0         0         1         2
<...some output removed...>
VLAN1005                0         0         0         1         1
-----
282 vlans                1         0         0        282        283
```

RST-3511
9850_05_2004_c2

© 2004 Cisco Systems, Inc. All rights reserved.

42

Spanning Tree Protocol Troubleshooting Commands

Cisco.com

```
CatOS> (enable) show proc cpu

CPU utilization for five seconds: 2.56%
                             one minute: 3.00%
                             five minutes: 3.00%

PID Runtime(ms) Invoked  uSecs  5Sec  1Min  5Min  TTY Process
-----
```

PID	Runtime(ms)	Invoked	uSecs	5Sec	1Min	5Min	TTY	Process
1	0	0	0	97.44%	97.00%	97.00%	-2	Kernel and Idle
2	2	199	1000	0.00%	0.00%	0.00%	-2	Flash MIB Updat
<...some output removed...>								
49	1394729	695957	4000	0.30%	0.00%	0.00%	-2	SptTimer
50	81881	429331	1000	0.00%	0.00%	0.00%	-2	SptBpduRx
51	1539627	694886	17000	1.56%	1.00%	1.00%	-2	SptBpduTx
52	8350	696436	1000	0.00%	0.00%	0.00%	-2	VtpTimer
<...some output removed...>								
145	97	1093	5000	0.00%	0.00%	0.00%	-2	VtpRx
191	951	55	138000	0.00%	0.00%	0.00%	-2	AcIManager

```
CatOS> (enable)
```

```
CatOS> (enable) show spantree summary
<...some output removed...>

VLAN Blocking Listening Learning Forwarding STP Active
-----
```

VLAN	Blocking	Listening	Learning	Forwarding	STP Active
1	0	0	0	3	3
<...some output removed...>					
	Blocking	Listening	Learning	Forwarding	STP Active
Total	0	0	0	280	280

```
CatOS> (enable)
```

RST-3511
9850_05_2004_c2

© 2004 Cisco Systems, Inc. All rights reserved.

43

Spanning Tree: Commands Unidirectional Link Detection (UDLD)

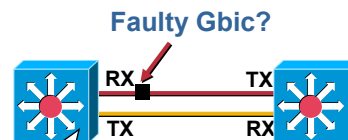
Cisco.com

- What is UDLD?

Detects one-way **logical** connectivity

Physical-layer errors are detected by auto-negotiation and FEFI*

Detects faults at Layer-2



```
6500-1>sh int g2/1
GigabitEthernet2/1 is up, line protocol is up
```

*FEFI: Far End Fault Indication

RST-3511
9850_05_2004_c2

© 2004 Cisco Systems, Inc. All rights reserved.

44

Spanning Tree: Commands Set/Show UDLD

Cisco.com

- UDLD is a global configuration, but aggressive mode is configured per port

```
CatOS> (enable) set udld enable
UDLD enabled globally
CatOS > (enable) set udld aggressive-mode enable 1/1
Aggressive UDLD enabled on port 1/1.
CatOS > (enable) sh udld port
UDLD                : enabled
Message Interval    : 15 seconds
Port  Admin Status  Aggressive Mode    Link State
-----  -
1/1    enabled        enabled             undetermined
1/2    enabled        disabled            undetermined
```

RST-3511
9850_05_2004_c2

© 2004 Cisco Systems, Inc. All rights reserved.

45

Spanning Tree: Commands UDLD Enable/Aggressive

Cisco.com

- Native can have standard or aggressive configured globally and per port exceptions

```
IOS(config)#udld enable
IOS(config)#interface gigabitEthernet 1/1
IOS(config-if)#udld aggressive
```

RST-3511
9850_05_2004_c2

© 2004 Cisco Systems, Inc. All rights reserved.

46

Spanning Tree: Commands Show UDLD

Cisco.com

```
IOS# sh udld gigabitEthernet 1/1
Interface Gi1/1
---
Port enable administrative configuration setting: Enabled / in aggressive mode
Port enable operational state: Enabled / in aggressive mode
Current bidirectional state: Bidirectional
Current operational state: Advertisement - Single neighbor detected
Message interval: 15
Time out interval: 5

Entry 1
---
Expiration time: 35
Device ID: 1
Current neighbor state: Bidirectional
Device name: SAL06090FCJ
Port ID: Gi1/1
Neighbor echo 1 device: SAD044204Y8
Neighbor echo 1 port: Gi1/1

Message interval: 5
CDP Device name: Is-7603-16a
```

RST-3511
9850_05_2004_c2

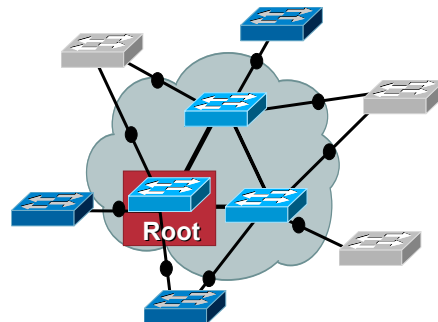
© 2004 Cisco Systems, Inc. All rights reserved.

47

Spanning Tree: Solution Root Guard

Cisco.com

- Root Guard forces a Layer 2 LAN interface to be a designated port, and if any device accessible through the interface becomes the root bridge, root guard puts the interface into the root-inconsistent (blocked) state



RST-3511
9850_05_2004_c2

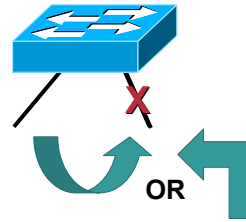
© 2004 Cisco Systems, Inc. All rights reserved.

48

Spanning Tree: Solution BPDU Guard

Cisco.com

- PortFast BPDU guard can prevent loops by moving PortFast-configured interfaces that receive BPDUs to errdisable, rather than running spanning tree across that port
- This keeps ports configured with portfast from being incorrectly connected to another switch



RST-3511
9850_05_2004_c2

© 2004 Cisco Systems, Inc. All rights reserved.

49

Spanning Tree Protocol IEEE 802.1s

Cisco.com

802.1s—Multiple Spanning-Tree (MST)

- Runs logical instances of STP
- Maps many VLANs to an instance
- Reduces complexity of running a unique STP instance for every VLAN in the network

RST-3511
9850_05_2004_c2

© 2004 Cisco Systems, Inc. All rights reserved.

50

Spanning Tree Protocol Troubleshooting Topology Change

Cisco.com

- Track down source of changes
TCN, logs, network mgmt
- Protect against the changes
UDLD, PortFast, network mgmt

RST-3511
9850_05_2004_c2

© 2004 Cisco Systems, Inc. All rights reserved.

52

Spanning Tree Protocol Troubleshooting Topology Change

Cisco.com

```
IOS#show spanning-tree vlan 1 detail
```

```
VLAN0001 is executing the ieee compatible Spanning Tree protocol  
Bridge Identifier has priority 32768, address 0005.7495.9101  
Configured hello time 2, max age 20, forward delay 15  
Current root has priority 32768, address 0001.c912.7800  
Root port is 70 (GigabitEthernet2/6), cost of root path is 4  
Topology change flag not set, detected flag not set  
Number of topology changes 4 last change occurred 02:17:20 ago  
from Port-channell  
Times: hold 1, topology change 35, notification 2  
hello 2, max age 20, forward delay 15  
Timers: hello 0, topology change 0, notification 0, aging 300  
  
Port 70 (GigabitEthernet2/6) of VLAN0001 is forwarding  
Port path cost 4, Port priority 128, Port Identifier 128.70.  
Designated root has priority 32768, address 0001.c912.7800  
Designated bridge has priority 32768, address 0001.c912.7800  
Designated port id is 128.70, designated path cost 0  
Timers: message age 2, forward delay 0, hold 0  
Number of transitions to forwarding state: 1  
Link type is point-to-point by default  
BPDU: sent 7, received 4162  
  
Port 833 (Port-channell) of VLAN0001 is blocking  
Port path cost 4, Port priority 128, Port Identifier 128.833.  
Designated root has priority 32768, address 0001.c912.7800  
Designated bridge has priority 32768, address 0001.c912.7800  
Designated port id is 128.769, designated path cost 0  
Timers: message age 1, forward delay 0, hold 0  
Number of transitions to forwarding state: 1  
Link type is point-to-point by default  
BPDU: sent 4, received 134836
```

RST-3511
9850_05_2004_c2

© 2004 Cisco Systems, Inc. All rights reserved.

53

Spanning Tree Protocol Troubleshooting Topology Change

Cisco.com

```
CatOS> show spantree statistics 1/1 1
<...some output removed...>

          PORT based information & statistics
config bpdu's xmitted (port/VLAN)  134968(256265)
config bpdu's received (port/VLAN) 2(2295)
tcn bpdu's xmitted (port/VLAN)     0(3)
tcn bpdu's received (port/VLAN)    2(3)
forward trans count                 1
<...some output removed...>

          Vlan based information & statistics
spanningtree type                   ieee
spanningtree multicast address      01-80-c2-00-00-00
bridge priority                     32768
bridge mac address                  00-01-c9-12-78-00
bridge hello time                   2 sec
bridge forward delay                15(15) sec
topology change initiator:          2/6
last topology change occurred:      Thu May 12 2004, 20:59:06
topology change                     FALSE
topology change time                35
topology change detected             FALSE
topology change count               9
topology change last recvd. from    00-02-7e-27-72-61
<...some output removed...>
CatOS>
```

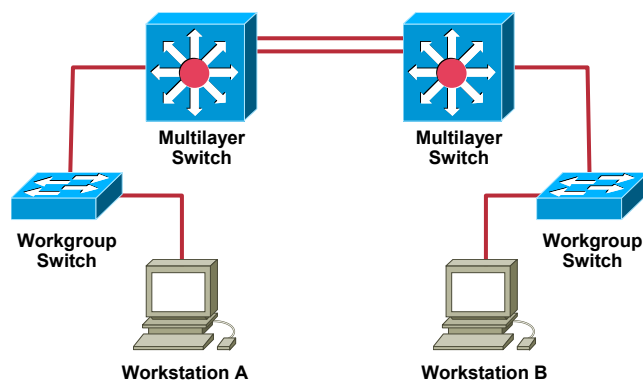
RST-3511
9850_05_2004_c2

© 2004 Cisco Systems, Inc. All rights reserved.

54

Spanning Tree Protocol Troubleshooting Summary

Cisco.com



- Start now! Document, Develop Recovery Plan, Don't Reboot
- Have modem access to key devices, CALL TAC!

RST-3511
9850_05_2004_c2

© 2004 Cisco Systems, Inc. All rights reserved.

55

Agenda: Troubleshooting

Cisco.com

- Path of Packet
- Spanning Tree Protocol
- **Multicast**
- Quality of Service

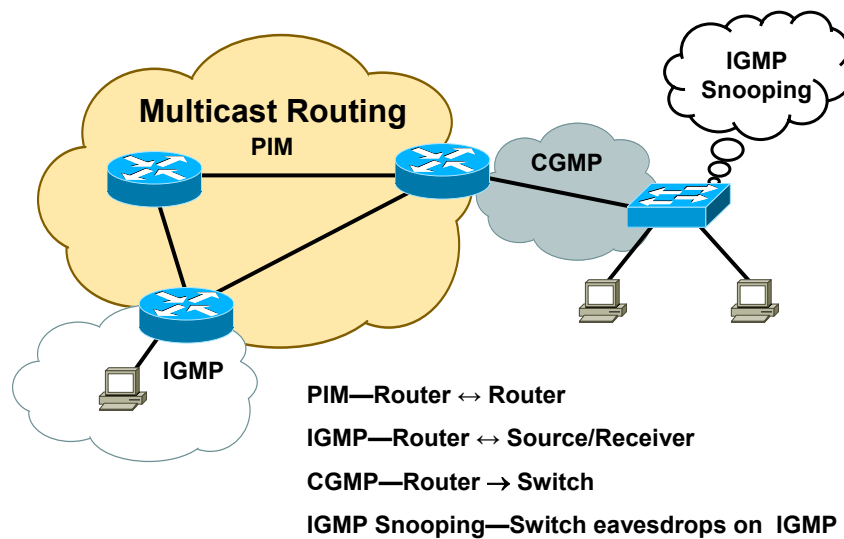
RST-3511
9850_05_2004_c2

© 2004 Cisco Systems, Inc. All rights reserved.

56

Multicast IP Multicast Protocols

Cisco.com



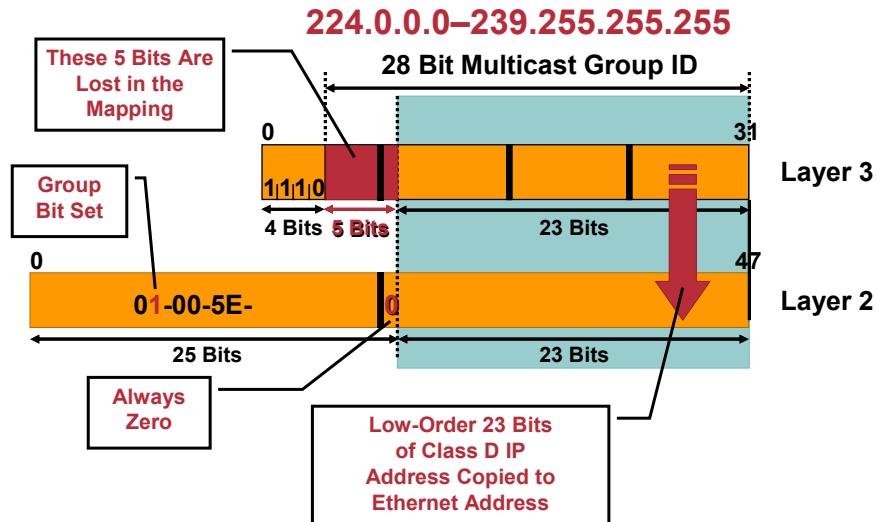
RST-3511
9850_05_2004_c2

© 2004 Cisco Systems, Inc. All rights reserved.

57

Multicast Mapping IP to Ethernet Multicast Addresses

Cisco.com



RST-3511
9850_05_2004_c2

© 2004 Cisco Systems, Inc. All rights reserved.

58

Multicast IP to Ethernet Address Aliasing

Cisco.com

Watch Out for 32-to-1 Overlap of IP Multicast Addresses to Multicast MAC Addresses

32 IP Multicast Addresses

224.1.1.1
224.129.1.1
225.1.1.1
225.129.1.1
⋮
238.1.1.1
238.129.1.1
239.1.1.1
239.129.1.1

Five Bits Lost in Mapping
 $2^5 = 32$

1 Multicast MAC Address

01-00-5E-01-01-01

RST-3511
9850_05_2004_c2

© 2004 Cisco Systems, Inc. All rights reserved.

59

Multicast Dynamic Multicast Control

Cisco.com

Two Most Common Options for Constraining Multicast Traffic on Catalyst Switches:

- **IGMP Snooping**
Internet Group Management Protocol Snooping
- **CGMP**
Cisco Group Management Protocol

RST-3511
9850_05_2004_c2

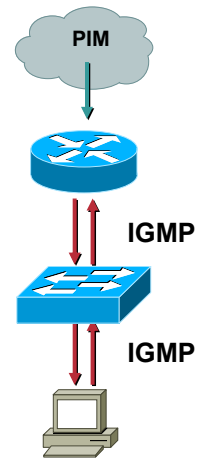
© 2004 Cisco Systems, Inc. All rights reserved.

60

Multicast IGMP Snooping

Cisco.com

- Have ASICs that recognize IGMP packets and redirect them to switch CPU
- Act on contents of IGMP membership reports and leave messages
- Dynamically learn about multicast routers and multicast sources
- Suffer no performance penalty in hardware
- Can interoperate with switches using CGMP



RST-3511
9850_05_2004_c2

© 2004 Cisco Systems, Inc. All rights reserved.

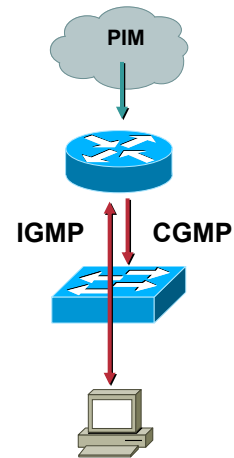
61

Multicast CGMP

Cisco.com

Cisco Group Management Protocol

- Client/server protocol between switches and routers
- Router sends CGMP packets to the switch
- Switch uses CGMP packet info to add and remove multicast (L2) group entries and ports
- Dynamically programs switches with multicast forwarding information based on info from IGMP reports and leaves



RST-3511
9850_05_2004_c2

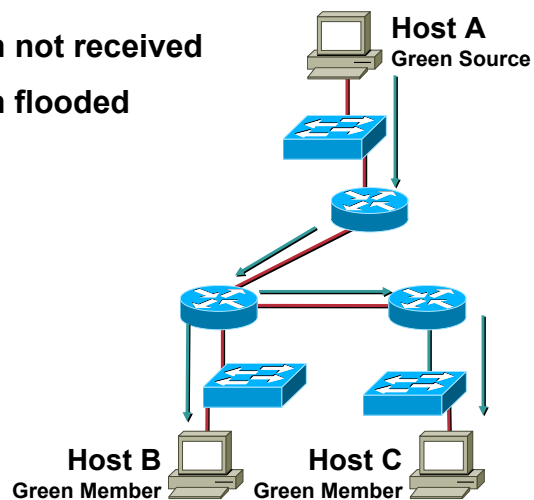
© 2004 Cisco Systems, Inc. All rights reserved.

62

Multicast Problems

Cisco.com

- Multicast stream not received
- Multicast stream flooded to all



RST-3511
9850_05_2004_c2

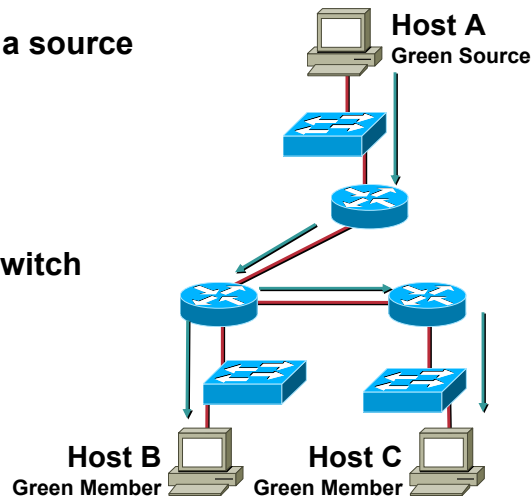
© 2004 Cisco Systems, Inc. All rights reserved.

63

Multicast Troubleshooting Methodology

Cisco.com

- Narrow issue to a source and receiver
- Verify multicast routing path
- Verify multicast constraints on switch



RST-3511
9850_05_2004_c2

© 2004 Cisco Systems, Inc. All rights reserved.

64

Multicast Troubleshooting Multicast Routing

Cisco.com

```
IOS# show ip mroute 234.92.4.1
IP Multicast Routing Table

(*, 234.92.4.1), 00:01:04/stopped, RP 10.92.8.253, flags: SJC
  Incoming interface: Null, RPF nbr 0.0.0.0
  Outgoing interface list:
    Vlan902, Forward/Sparse-Dense, 00:01:04/00:02:23

(10.92.4.1, 234.92.4.1), 00:00:19/00:02:59, flags: T
  Incoming interface: Vlan901, RPF nbr 0.0.0.0, RPF-MFD
  Outgoing interface list:
    Vlan902, Forward/Sparse-Dense, 00:00:19/00:02:40, H
```

```
IOS# show ip igmp group
IGMP Connected Group Membership
Group Address    Interface    Uptime      Expires     Last Reporter
224.0.1.40      Vlan2       00:30:40   00:02:42   10.1.2.1
224.1.1.1       Vlan2       00:00:10   00:02:49   10.1.2.5
234.92.4.1     Vlan902     00:20:04   00:02:55   10.81.2.1
```

RST-3511
9850_05_2004_c2

© 2004 Cisco Systems, Inc. All rights reserved.

65

Multicast

Troubleshooting Multicast Routing

Cisco.com

```
IOS# show ip mroute 234.92.4.1 count
IP Multicast Statistics
122 routes using 64882 bytes of memory
115 groups, 0.06 average sources per group
Forwarding Counts: Pkt Count/Pkts per second/Avg Pkt Size/Kilobits per sec
Other counts: Total/RPF failed/Other drops(OIF-null, rate-limit etc)

Group: 234.92.4.1, Source count: 2, Packets forwarded: 78307
RP-tree: Forwarding: 0/0/0/0, Other: 0/0/0
Source: 10.92.4.1/32, Forwarding: 78008/249/550/1101, Other: 78008/0/0
Source: 10.92.8.1/32, Forwarding: 299/1/68/0, Other: 299/0/0
```

RST-3511
9850_05_2004_c2

© 2004 Cisco Systems, Inc. All rights reserved.

66

Multicast

Troubleshooting Multicast Constraints

Cisco.com

```
CatOS> (enable) show multicast router
```

Port	Vlan
3/45	1,10
15/1	2

Total Number of Entries = 2

'*' - Configured

'+' - RGMP-capable

```
CatOS> (enable) show multicast group
```

VLAN	Dest MAC/Route Des	[CoS]	Destination Ports or VCs / [Protocol Type]
2	01-00-5e-00-01-28		15/1

Total Number of Entries = 1

RST-3511
9850_05_2004_c2

© 2004 Cisco Systems, Inc. All rights reserved.

68

Multicast

Useful Native Troubleshooting Commands

Cisco.com

```
IOS#show ip igmp snooping mrouter
```

Vlan	ports
-----	-----
1	Gi1/1(dynamic)
13	Gi1/1(static)

```
IOS#show ip igmp groups
```

```
IGMP Connected Group Membership
```

Group Address	Interface	Uptime	Expires	Last Reporter
224.0.1.40	Vlan10	02:26:48	00:02:25	192.168.1.13

RST-3511
9850_05_2004_c2

© 2004 Cisco Systems, Inc. All rights reserved.

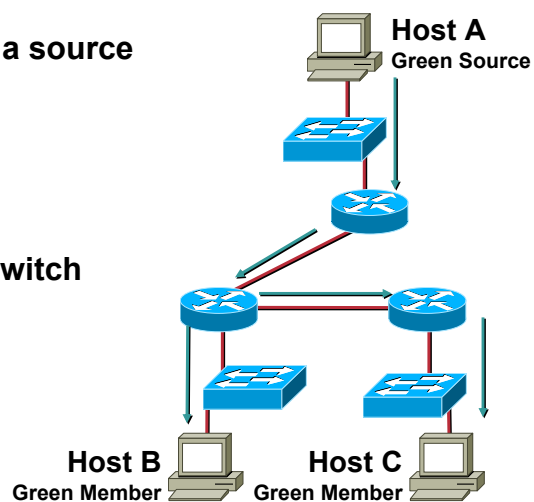
69

Multicast

Troubleshooting Summary

Cisco.com

- Narrow issue to a source and receiver
- Verify multicast routing path
- Verify multicast constraints on switch



RST-3511
9850_05_2004_c2

© 2004 Cisco Systems, Inc. All rights reserved.

70

Agenda: Troubleshooting

Cisco.com

- Path of Packet
- Spanning Tree Protocol
- Multicast
- **Quality of Service**

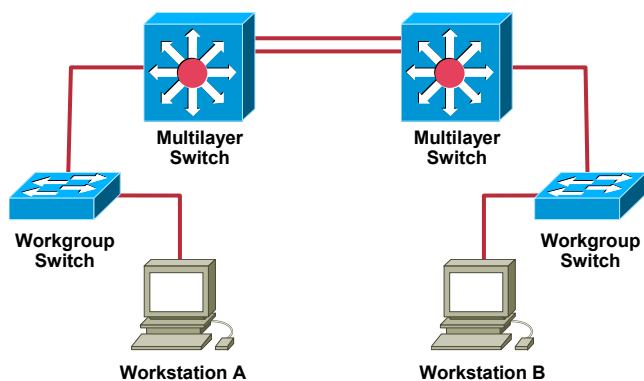
RST-3511
9850_05_2004_c2

© 2004 Cisco Systems, Inc. All rights reserved.

71

QoS Problems

Cisco.com



- Design/implementation: where? How?
- Performance: behavior not as expected

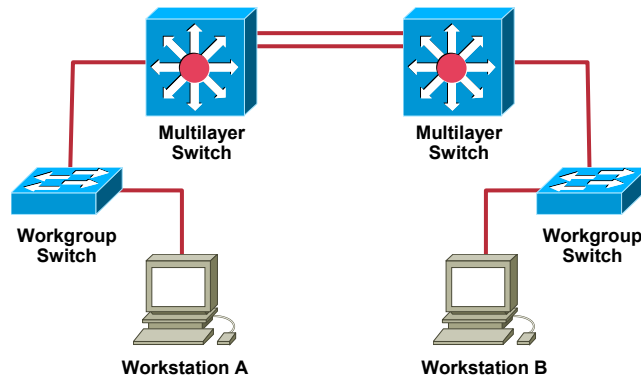
RST-3511
9850_05_2004_c2

© 2004 Cisco Systems, Inc. All rights reserved.

72

QoS Troubleshooting Methodology

Cisco.com



- Define desired/expected behavior against network baseline
- Begin systematic examination of device behavior—end to end

RST-3511
9850_05_2004_c2

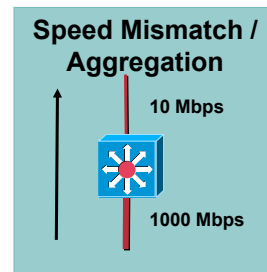
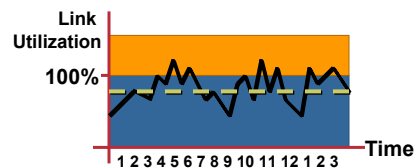
© 2004 Cisco Systems, Inc. All rights reserved.

73

QoS Concepts

Cisco.com

- Do we need more bandwidth?
- Do we need more buffers?
- What is QoS?

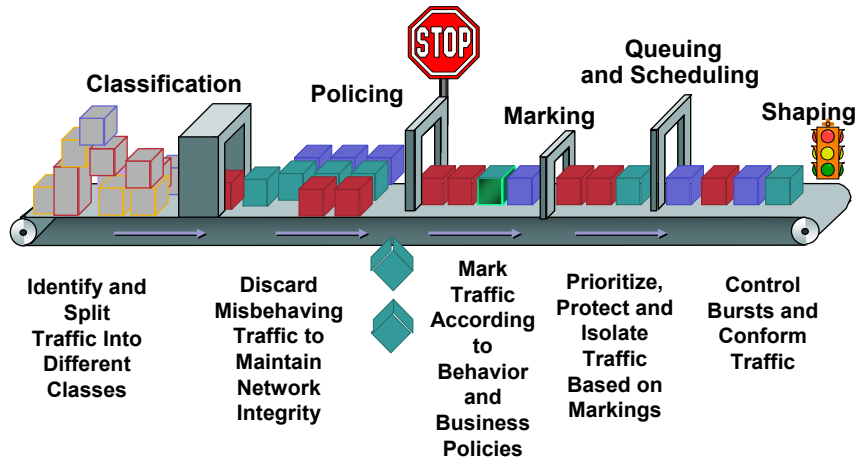


RST-3511
9850_05_2004_c2

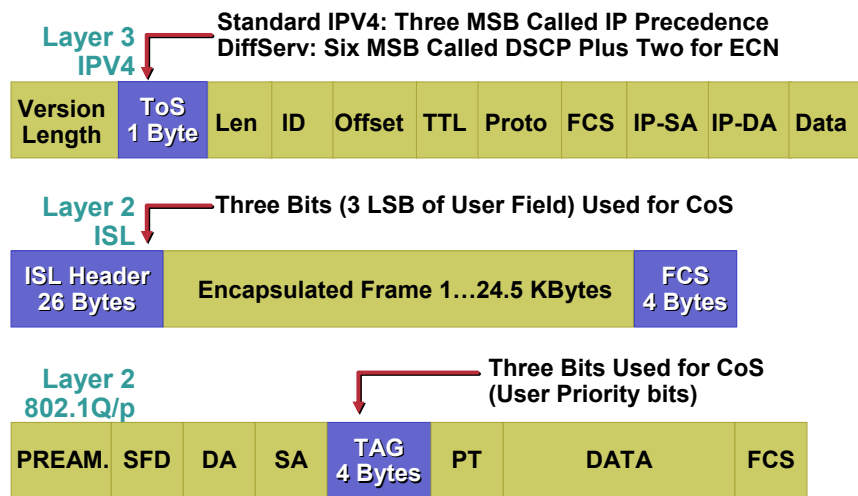
© 2004 Cisco Systems, Inc. All rights reserved.

74

QoS Concepts



QoS Concepts: Marking and Classification



QoS

Troubleshooting: Marking and Classification

Cisco.com

```
IOS# show qos maps dscp cos
DSCP-CoS Mapping Table (dscp = d1d2)
d1 : d2 0 1 2 3 4 5 6 7 8 9
-----
0 :    00 00 00 00 00 00 00 00 01 01
1 :    01 01 01 01 01 01 02 02 02 02
2 :    02 02 02 02 03 03 03 03 03 03
3 :    03 03 04 04 04 04 04 04 04 04
4 :    05 05 05 05 05 05 05 05 06 06
5 :    06 06 06 06 06 06 07 07 07 07
6 :    07 07 07 07
```

RST-3511
9850_05_2004_c2

© 2004 Cisco Systems, Inc. All rights reserved.

77

QoS

Troubleshooting: Marking and Classification

Cisco.com

```
IOS# show policy-map interface gigabitEthernet 2/6

GigabitEthernet2/6

service-policy input: FirstPolicy

class-map: FirstClass (match-all)
  1044 packets
  5 minute offered rate 0 pps
  match: access-group 101
  police :
    0 bps 0 limit 0 extended limit
  aggregate-forwarded 1044 packets action: set-dscp-transmit
  exceeded 0 packets action: policed-dscp-transmit
  aggregate-forward 0 pps exceed 0 pps
```

RST-3511
9850_05_2004_c2

© 2004 Cisco Systems, Inc. All rights reserved.

78

QoS Troubleshooting Classification and Marking

Cisco.com

Use Ping/Extended Ping and debug with ACLs

Vlan3 (SRC)

```
3640b>ping 1.1.1.4
```

Vlan1 (DST)

```
3640a#sh ip access-lists 110
Extended IP access list 110
    permit ip host 3.3.3.4 host 1.1.1.4 dscp cs4
3640a#deb ip packet det 110
IP packet debugging is on (detailed) for access list 110
3640a#
01:04:02: IP: s=3.3.3.4 (Ethernet0/0), d=1.1.1.4
(Ethernet0/0), len 100, rcvd 3
01:04:02:      ICMP type=8, code=0
... 4 identical lines removed
```

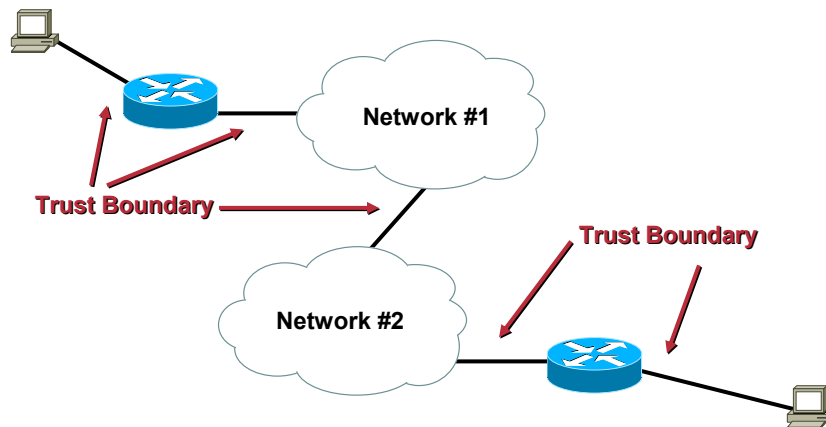
RST-3511
9850_05_2004_c2

© 2004 Cisco Systems, Inc. All rights reserved.

79

QoS Concepts: Trust

Cisco.com



RST-3511
9850_05_2004_c2

© 2004 Cisco Systems, Inc. All rights reserved.

80

QoS

Troubleshooting: Trust

Cisco.com

```

IOS# show qos interface gigabitEthernet 1/1
QoS is enabled globally
Port QoS is enabled
Administrative Port Trust State: 'untrusted'
Operational Port Trust State: 'untrusted'
Trust device: none
Default DSCP: 0 Default CoS: 0
Appliance trust: none
Tx-Queue   Bandwidth   ShapeRate   Priority   QueueSize
          (bps)         (bps)
1          250000000  disabled   N/A        1920
2          250000000  disabled   N/A        1920
3          250000000  disabled   normal     1920
4          250000000  disabled   N/A        1920
    
```

RST-3511
9850_05_2004_c2

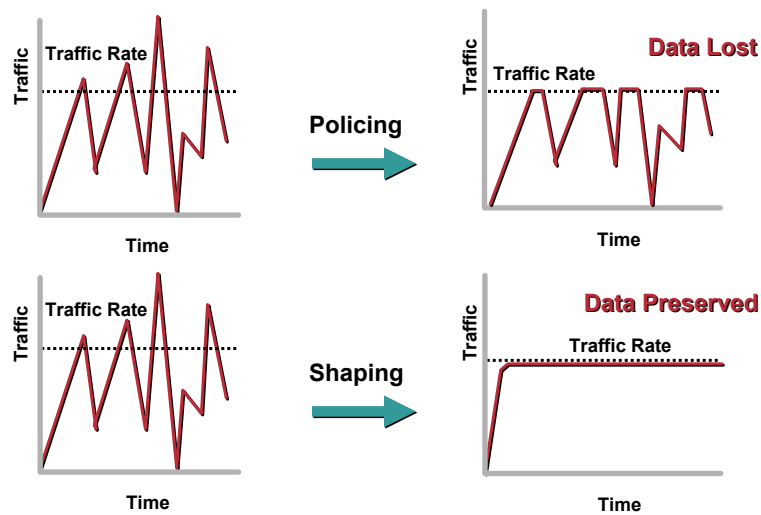
© 2004 Cisco Systems, Inc. All rights reserved.

81

QoS

Concepts: Policing vs. Shaping

Cisco.com



RST-3511
9850_05_2004_c2

© 2004 Cisco Systems, Inc. All rights reserved.

82

QoS Troubleshooting: Policing

Cisco.com

```
class-map match-all FirstClass
  match access-group 101
  !
  !
policy-map FirstPolicy
  class FirstClass
    police 64000 1000 1000 conform-action transmit exceed-action drop
  !

IOS#show policy-map interface gigabitEthernet 2/6

GigabitEthernet2/6

  service-policy input: FirstPolicy

    class-map: FirstClass (match-all)
      4334 packets
      5 minute offered rate 10 pps
      match: access-group 101
      police :
        64000 bps 1000 limit 1000 extended limit
        aggregate-forwarded 2200 packets action: transmit
        exceeded 2134 packets action: drop
        aggregate-forward 0 pps exceed 0 pps
```

RST-3511
9850_05_2004_c2

© 2004 Cisco Systems, Inc. All rights reserved.

83

QoS Troubleshooting: Policing

Cisco.com

```
CatOS-cat6k> (enable) show qos policer runtime all
Warning: Runtime information may differ from user configured setting due to h
QoS microflow policers:
QoS aggregate policers:
Aggregate name          Avg. rate (kbps) Burst size (kb) Normal
action
-----
-
POL1                    64                32 policed-dscp
  Excess rate (kbps) Excess action
  -----
  64 drop
  ACL attached
  -----
  ACL1

CatOS-cat6k> (enable)
CatOS-cat6k> (enable) show qos statistics aggregate POL1
QoS aggregate-policer statistics:
Aggregate policer      Allowed packet  Packets exceed  Packets exceed
count                 normal rate    excess rate
-----
POL1                   560            6228            6228
```

RST-3511
9850_05_2004_c2

© 2004 Cisco Systems, Inc. All rights reserved.

84

QoS

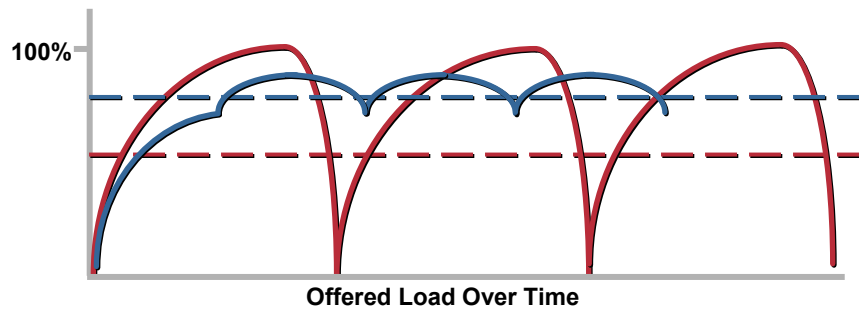
Concepts: Random Early Discard (RED)

Cisco.com

Uncontrolled Congestion

Managed Congestion

- Maximize goodput
- Fairness to small users
- Reduces global synchronization
- Minimize delay



RST-3511
9850_05_2004_c2

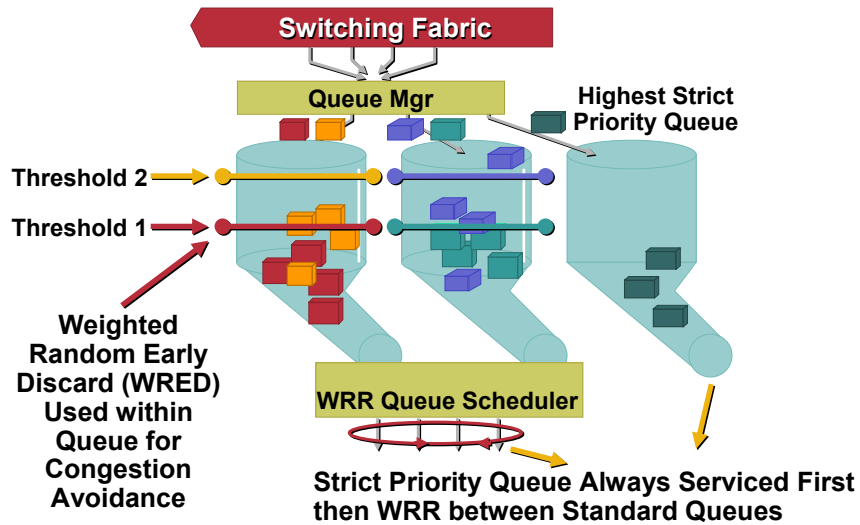
© 2004 Cisco Systems, Inc. All rights reserved.

85

QoS

Concepts: Queuing and Scheduling

Cisco.com



RST-3511
9850_05_2004_c2

© 2004 Cisco Systems, Inc. All rights reserved.

86

QoS

Troubleshooting: Queuing and Scheduling

Cisco.com

```
IOS-cat4k# show interfaces gigabitEthernet 1/1 counters all

Port          InBytes      InUcastPkts  InMcastPkts  InBcastPkts
Gi1/1         25173304    17834        320453       2008
<...some output removed...>

Port          Tx-Bytes-Queue-1  Tx-Bytes-Queue-2  Tx-Bytes-Queue-3  Tx-Bytes-Queue-4
Gi1/1         1180788          0                  1664              3658568

Port          Tx-Drops-Queue-1  Tx-Drops-Queue-2  Tx-Drops-Queue-3  Tx-Drops-Queue-4
Gi1/1         0                 0                  0                  0

Port          Dbl-Drops-Queue-1  Dbl-Drops-Queue-2  Dbl-Drops-Queue-3  Dbl-Drops-Queue-4
Gi1/1         0                 0                  0                  0

<...some output removed...>
IOS-cat4k#
```

```
IOS-cat4k# show qos interface gigabitEthernet 1/1
QoS is enabled globally
Port QoS is enabled
Administrative Port Trust State: 'untrusted'
Operational Port Trust State: 'untrusted'
Trust device: none
Default DSCP: 0 Default Cos: 0
Appliance trust: none
Tx-Queue  Bandwidth  ShapeRate  Priority  QueueSize
          (bps)      (bps)      N/A       (packets)
1         250000000  disabled   N/A       1920
2         250000000  disabled   N/A       1920
3         250000000  disabled   normal    1920
4         250000000  disabled   N/A       1920
```

RST-9850_05_2004_c2

© 2004 Cisco Systems, Inc. All rights reserved.

87

QoS

Troubleshooting: Queuing and Scheduling

Cisco.com

```
CatOS-cat6k> (enable) show qos statistics 2/6
Tx port type of port 2/6 : lp2q2t
Q3T1 statistics are included in Q2T2.
Q # Threshold #:Packets dropped
-----
1 1:0 pkts, 2:0 pkts
2 1:0 pkts, 2:0 pkts

Rx port type of port 2/6 : lp1q4t
For untrusted ports all the packets are sent to the same queue,
Rx thresholds are disabled, tail drops are reported instead.
Q2T1 statistics are included in Q1T4.
Q # Threshold #:Packets dropped
-----
1 1:0 pkts, 2:0 pkts, 3:0 pkts, 4:0 pkts
```

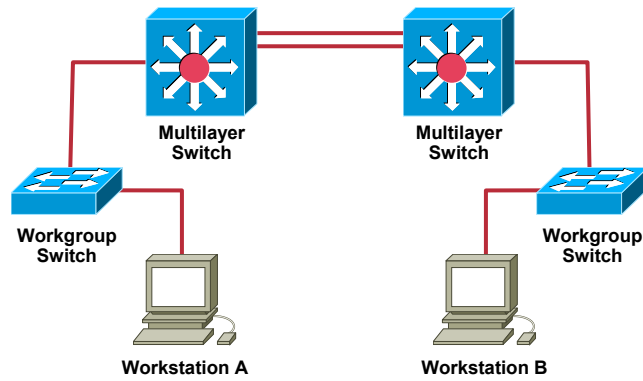
RST-3511
9850_05_2004_c2

© 2004 Cisco Systems, Inc. All rights reserved.

88

QoS Troubleshooting Summary

Cisco.com



- Understand Desired Behavior compared to Switch Capabilities
- Use Correct Tools for Performance Testing.

RST-3511
9850_05_2004_c2

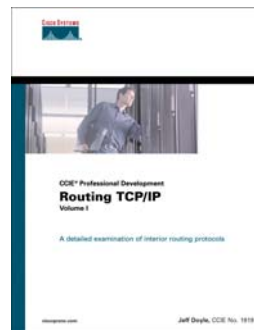
© 2004 Cisco Systems, Inc. All rights reserved.

89

Recommended Reading

Cisco.com

- Continue your Networkers learning experience with further reading for this session from Cisco Press.
- Check the Recommended Reading flyer for suggested books.



Available on-site at the Cisco Company Store

RST-3511
9850_05_2004_c2

© 2004 Cisco Systems, Inc. All rights reserved.

90

Complete Your Online Session Evaluation!

Cisco.com

- WHAT:** Complete an online session evaluation and your name will be entered into a daily drawing
- WHY:** Win fabulous prizes! Give us your feedback!
- WHERE:** Go to the Internet stations located throughout the Convention Center
- HOW:** Winners will be posted on the onsite Networkers Website; four winners per day

RST-3511
9850_05_2004_c2

© 2004 Cisco Systems, Inc. All rights reserved.

91

CISCO SYSTEMS



RST-3511
9850_05_2004_c2

© 2004 Cisco Systems, Inc. All rights reserved.

92