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Let's go

The bridge to possible

Overview of Packet Capturing Tools in Cisco Switches and Routers

Frank Li, Solutions Engineer – Enterprise Networking

BRKTRS-2811

"Reconciliation"- Dustin Koa Art

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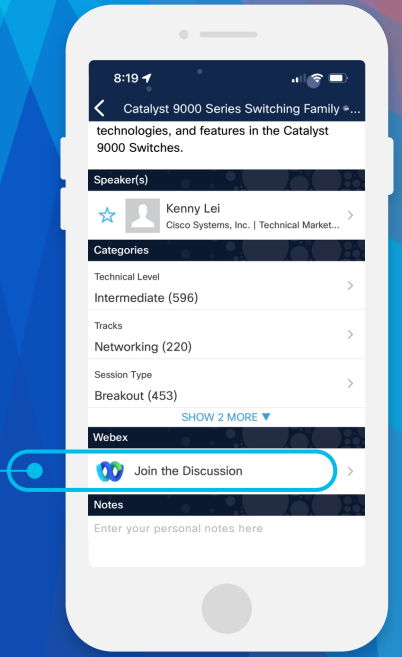

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Additional Breakout Sessions and Labs

For more info...

LABTRS-2456 Packet Capturing Tools in Routing Environments
LABTRS-2048 Packet Trace and Conditional Debugger on IOS-XE Routers

LABCRT-2452 CCNP ENCOR – Core Enterprise Network Technologies Practice Lab
LABCRT-2460 CCNP ENARSI – Implementing Cisco Enterprise Advanced Routing and Services Practice Lab
LABCRT-2464 Troubleshoot like a CCNP – Basic
LABCRT-2465 Troubleshoot like a CCNP - Intermediate
LABCRT-2466 Troubleshoot like a CCNP - Advanced

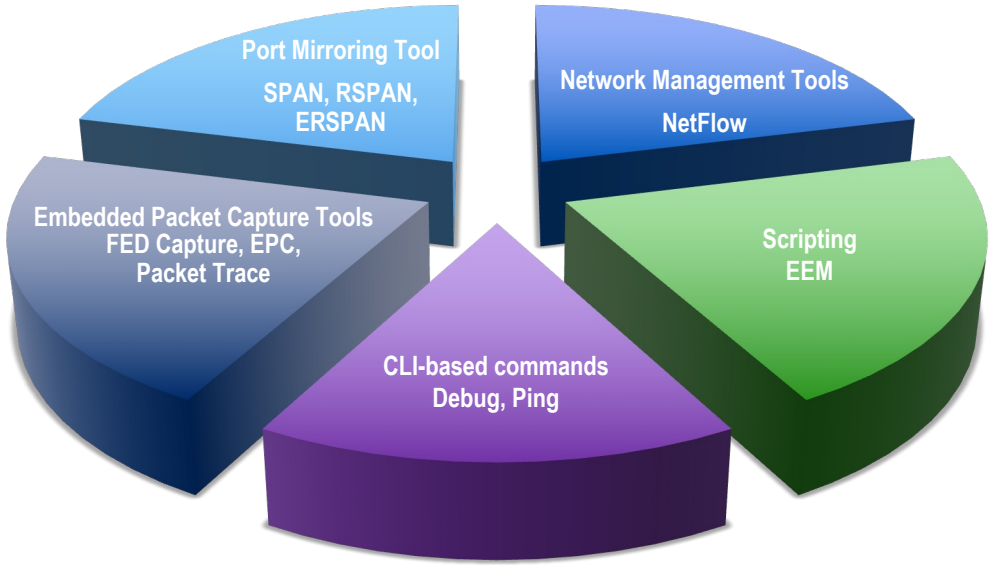
BRKTRS-3475 Automation and In-Depth Troubleshooting of Cisco Catalyst 8000, ASR 1000, ISR and SD-WAN Edge

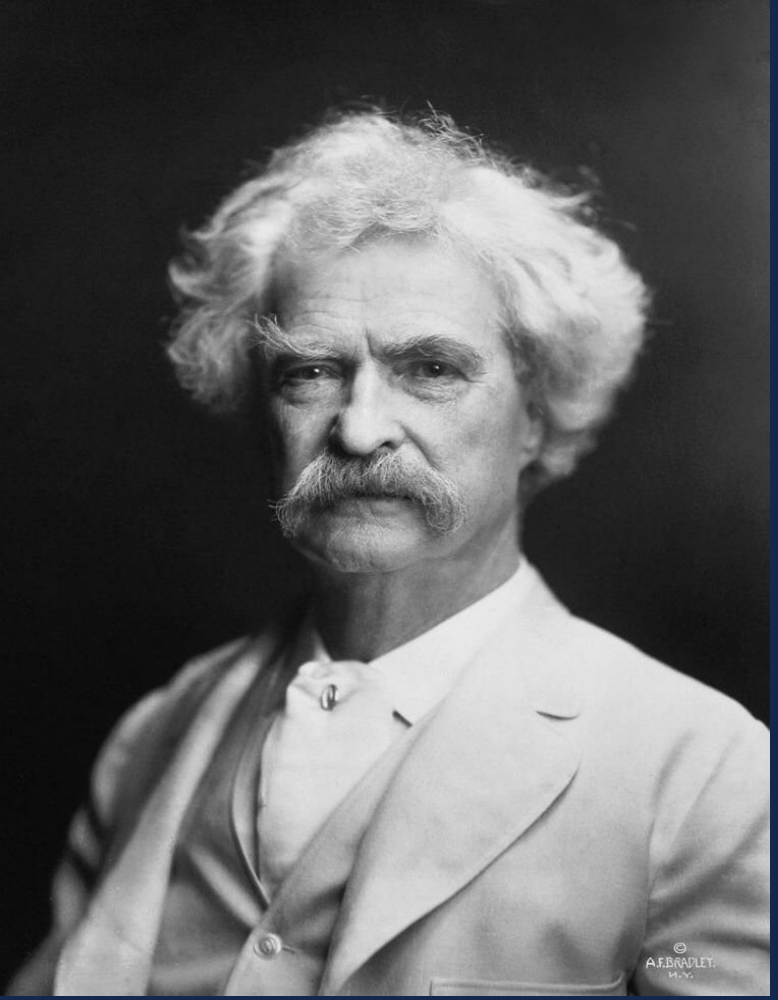
Agenda

- Introduction
- Port Mirror Tool
- Embedded Packet Capture
- FED Capture
- Packet Trace
- Event Triggered Captures
- Putting it All Together

Goal of this Session...

- Create an awareness of the packet capturing tools that are available
- Learn how to use the tools through real-world examples
- Help you understand the capabilities and features of each tool



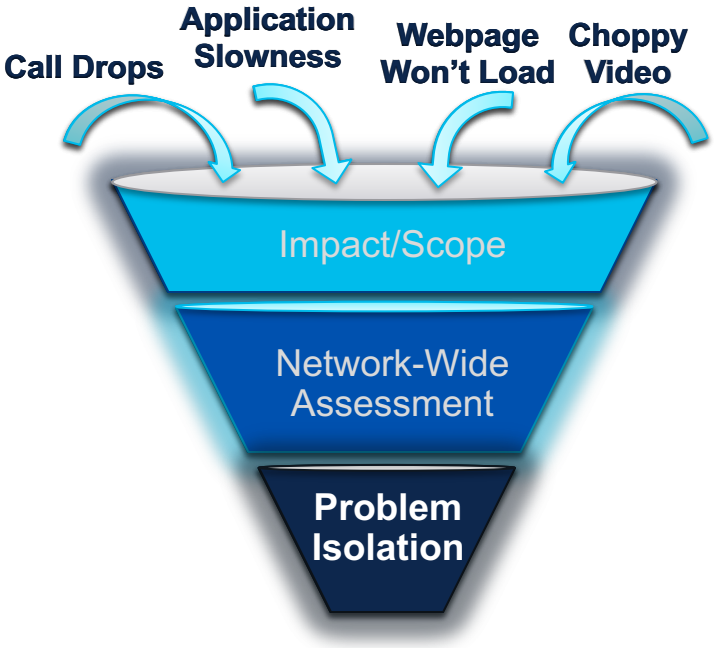


“What gets us into trouble is not what we don't know. It's what we know for sure that just ain't so.”

Mark Twain

A Troubleshooting Methodology

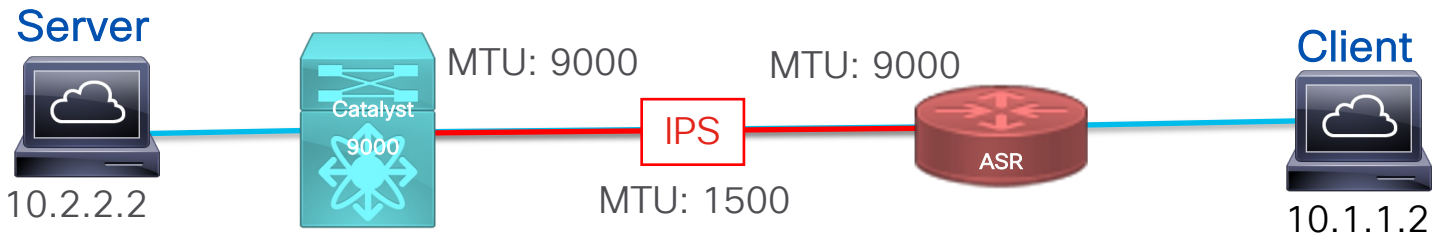
- Define the problem, impact, and scope based on facts, user reports, and considering recent changes
  - E.g. Application slowness after recent migration, When does the issue occur? Are all users impacted?
- Assess what you know from network monitoring
  - E.g. SNMP, Syslogs, NetFlow Data, Real-time performance monitoring, IP SLA. What is outside normal bounds?
- Select the right tool to isolate the problem
  - E.g. Are you on a router or switch? What type of data do you need (flow visibility, pcap, forwarding data, etc)



Having these details helps us make progress towards a resolution.

Data Transfers Are Broken

A Problem with MTU?



Sometimes a cable is more than just a cable.

Acronyms / Definitions

➔ Reference Slide

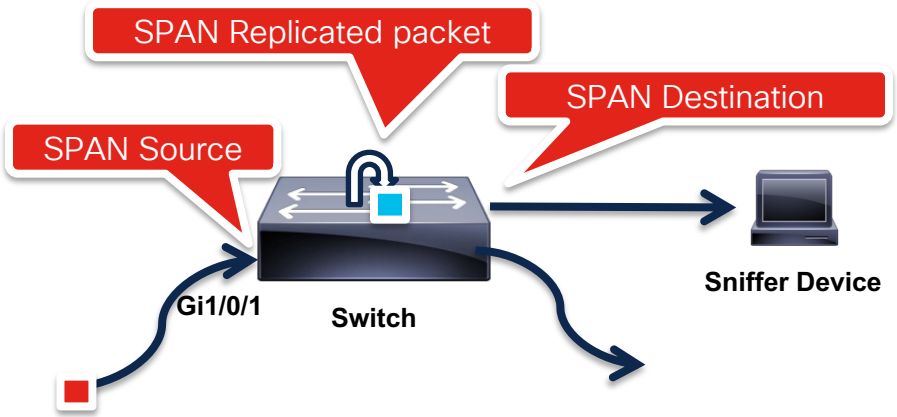
Acronyms	Definitions	Acronyms	Definitions
FNF	Flexible NetFlow	SP	Switch Processor
EPC	Embedded Packet Capture	RP	Route Processor
PSV	Packet State Vector	ASIC	Application Specific Integrated Circuit
SPF	Show Platform Forward	ELAM	Embedded Logic Analyzer Module
SPAN	Switch Port Analyzer	CoPP	Control Plane Policing
RSPAN	Remote SPAN	ACL	Access Control List
ERSPAN	Encapsulated RSPAN	FED	Forwarding Engine Driver
UADP	Unified Access Data Plane	RACL	Router-based ACL
		VACL	VLAN-based ACL

Port Mirroring Tools

Switch Port Analyzer (SPAN)

Overview

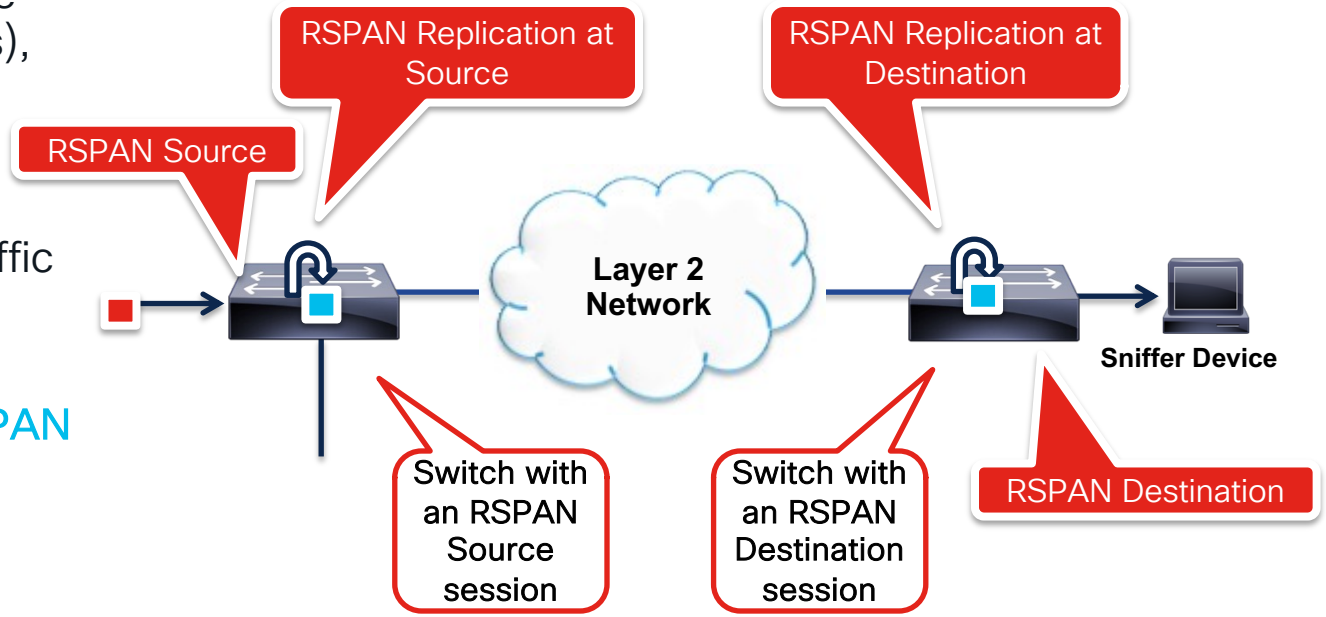
- A SPAN session (also known as port mirroring or monitoring) is an association of source ports/VLANs to one or more destination ports.
- Once the traffic is identified for replication, Cisco switch/router replicates the traffic to the destination port(s).



Remote Switch Port Analyzer (RSPAN)

Overview

- RSPAN supports source ports (or source VLANs), and destinations on different switches
- User-specified Layer 2 VLAN carries SPAN traffic between switches
- Consists of an RSPAN source session, an RSPAN VLAN, and an RSPAN destination session



SPAN/RSPAN

Configuration Example

Configuration syntax may differ depending on platform and version of code.

Local SPAN

```
monitor session 1 source <interface/vlan>
monitor session 1 destination interface <interface>
```

```
monitor session 1 type local
 source <interface/vlan>
 destination interface <interface>
 no shutdown
```

RSPAN Source

```
vlan 999
  remote-span
!
monitor session 1 source <interface/vlan>
monitor session 1 destination remote vlan 999
```

```
vlan 999
  remote-span
!
monitor session 1 type rspan-source
 source <interface/vlan>
 destination remote vlan 999
 no shutdown
```

RSPAN Destination

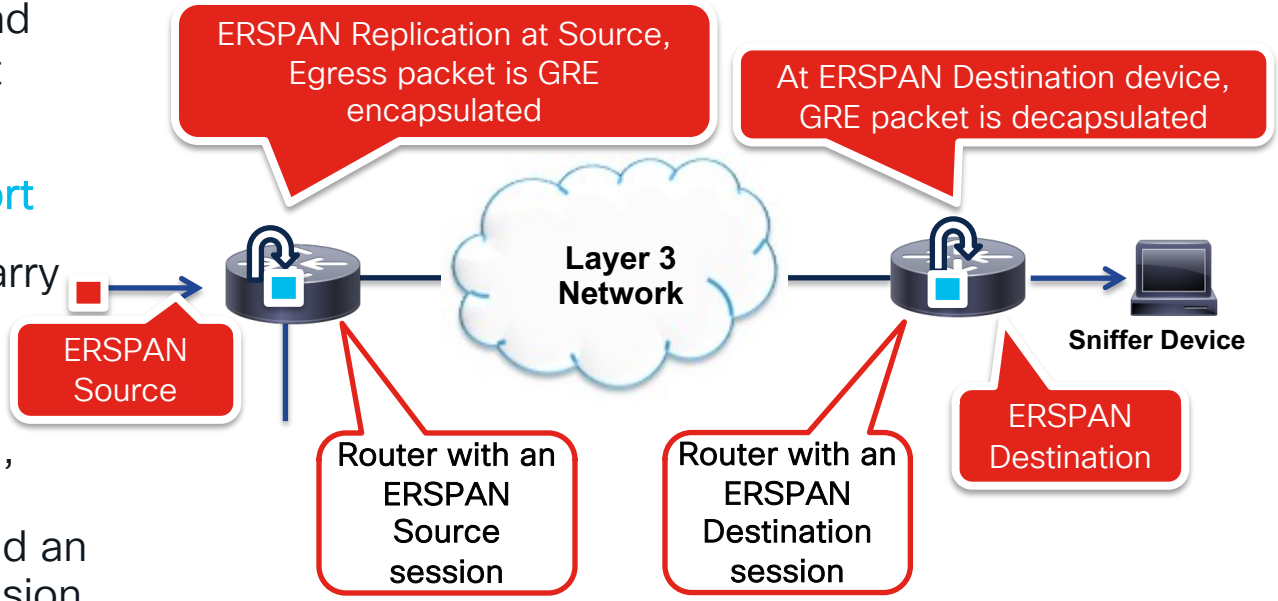
```
vlan 999
  remote-span
!
monitor session 1 source remote vlan 999
monitor session 1 destination interface <interface>
```

```
vlan 999
  remote-span
!
monitor session 1 type rspan-destination
 source remote vlan 999
 destination interface <interface>
 no shutdown
```

Encapsulated Remote SPAN (ERSPAN)

Overview

- ERSPAN supports source ports, source VLANs, and destinations on different devices
- Uses a Layer 3 Transport
- Uses a GRE tunnel to carry traffic
- ERSPAN consists of an ERSPAN source session, routable ERSPAN GRE-encapsulated traffic, and an ERSPAN destination session



ERSPAN

Configuration Example

ERSPAN Source

```
! Router-1
monitor session 1 type erspan-source
 source interface Gi0/0/1
 destination
  erspan-id 1
  ip address 2.2.2.2
  origin ip address 1.1.1.1
```

ERSPAN Destination

```
! Router-2
monitor session 1 type erspan-destination
 destination interface Gi0/0/0
 source
  erspan-id 1
  ip address 2.2.2.2
```

Embedded Packet Capture

Embedded Packet Capture Tools

What are they?

Built-in **control and data plane** capturing

Local buffer for storage

Restrictions

- Resource utilisation
- No logical ports
- Others...

What do they provide?

ACL filtering (**L3/L4 parameters**)

Export to a **PCAP**

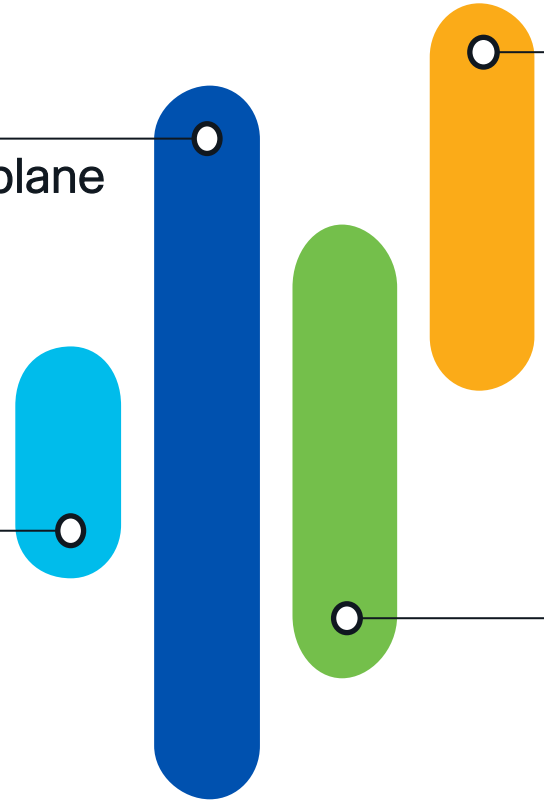
On-box analysis

Platforms

IOS-XE Routers and Switches

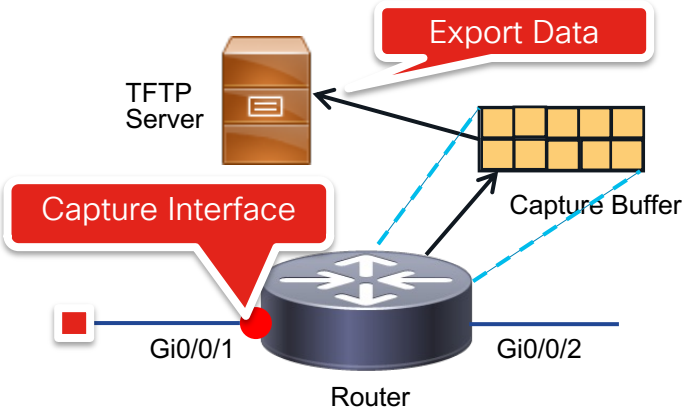
ISR1K, ISR4K, ASR1K, CSR1Kv, Cat8K, Cat8Kv

Cat3K, Cat9K



Embedded Packet Capture (EPC)

Workflow



Define Buffer Criteria → Determine interface and filter → Export/display captured data

```
Router# monitor capture MYCAP interface Gig0/0/1 in
Router# monitor capture MYCAP access-list MYACL
Router# monitor capture MYCAP start
```

Embedded Packet Capture (EPC)

Analyzing the Traffic on the Device

```
ASR# show monitor capture CAP parameter
   monitor capture CAP interface Gig0/0/2 both
   monitor capture CAP access-list MYACL
   monitor capture CAP buffer size 10
   monitor capture CAP limit pps 1000

ASR# show mon cap CAP buffer
 buffer size (KB) : 10240
 buffer used (KB) : 128
 packets in buf   : 5
 packets dropped  : 0
 packets per sec  : 1
```

Indicates total number of packets in the capture buffer

```
ASR# show monitor capture CAP buffer ?
  brief     brief display
  detailed  detailed display
  dump      for dump
  |         Output modifiers
  <cr>
ASR# show monitor capture CAP buffer brief
------------------------------------------------------------------------
 #   size   timestamp     source              destination   protocol
------------------------------------------------------------------------
   0  114    0.000000    10.254.0.2        ->  100.100.100.1    ICMP
   1  114    0.000992    10.254.0.2        ->  100.100.100.1    ICMP
   2  114    2.000992    10.254.0.2        ->  100.100.100.1    ICMP
```

"brief" option provides basic information of the traffic like source/destination IP address, protocol type, packet length

Embedded Packet Capture (EPC)

Analyzing the Traffic on the Device

"detail" option provides result of both "brief" and "dump" options

```
ASR# show monitor capture CAP buffer detail
 ------------------------------------------------------------
 #   size   timestamp     source      destination   protocol
 ------------------------------------------------------------
   0  114     0.000000    10.254.0.2       ->  100.100.100.1    ICMP
 0000:  0014A8FF A4020008 E3FFFC28 08004500   ...........(..E.
 0010:  00649314 0000FF01 551F0AFE 00026464   .d......U.....dd
 0020:  64010000 DF8F0071 00000000 000029E8   d.....).
 0030:  74C0ABCD ABCDABCD ABCDABCD            .............
```

Destination MAC

Source MAC

Source IP

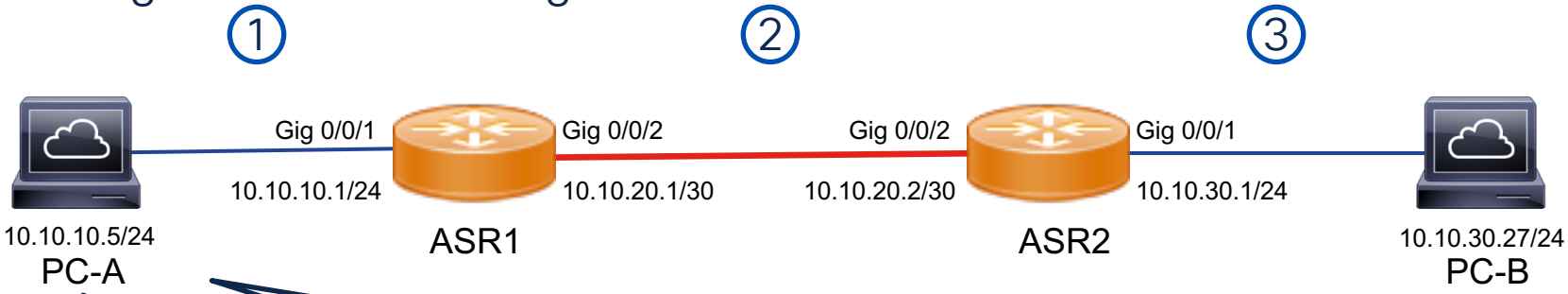
Destination IP

```
ASR# monitor capture CAP export bootflash:my_capture.pcap
Exported Successfully
```

Save capture in standard PCAP format

Real World Example

Isolating the Device Causing Packet Loss

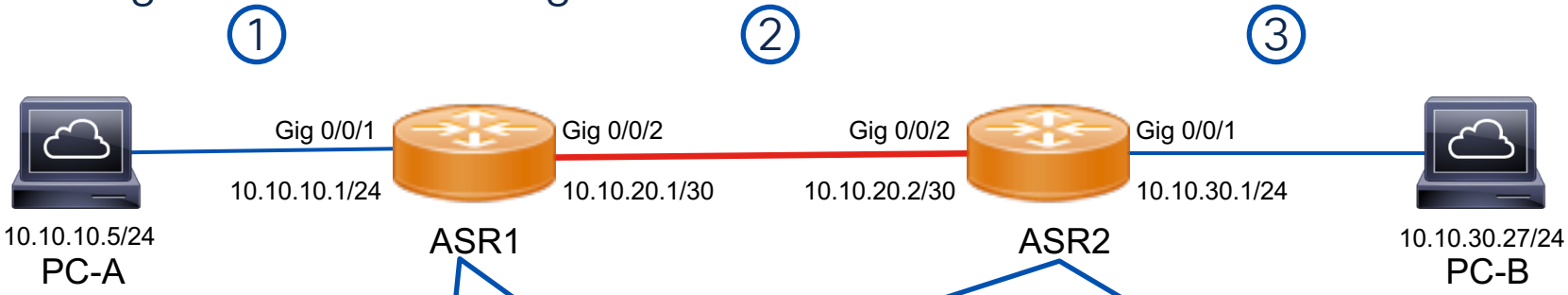



```
C:\>ping 10.10.30.27 -n 5 -l 100
Pinging 10.10.30.27 with 100 bytes of data:
Reply from 10.10.30.27: bytes=100 time<1ms TTL=126
Reply from 10.10.30.27: bytes=100 time<1ms TTL=126
Reply from 10.10.30.27: bytes=100 time<1ms TTL=126
Reply from 10.10.30.27: bytes=100 time<1ms TTL=126
Reply from 10.10.30.27: bytes=100 time<1ms TTL=126
Ping statistics for 10.10.30.27:
    Packets: Sent = 5, Received = 5, Lost = 0 (0% loss)
```

```
C:\>ping 10.10.30.27 -n 5 -l 1000
Pinging 10.10.30.27 with 1000 bytes of data:
Reply from 10.10.30.27: bytes=1000 time<1ms TTL=126
Reply from 10.10.30.27: bytes=1000 time<1ms TTL=126
Request timed out.
Request timed out.
Reply from 10.10.30.27: bytes=1000 time<1ms TTL=126
Ping statistics for 10.10.30.27:
    Packets: Sent = 5, Received = 3, Lost = 2 (40% loss)
```

Real World Example

Isolating the Device Causing Packet Loss




```
! Filter ICMP traffic between hosts
ip access-list extended ICMP1
 permit icmp host 10.10.10.5 host 10.10.30.27
 permit icmp host 10.10.30.27 host 10.10.10.5

! EPC on ASR1
monitor capture CAP1 int Gig0/0/2 both access-list ICMP1
monitor capture CAP1 start
monitor capture CAP1 stop
```

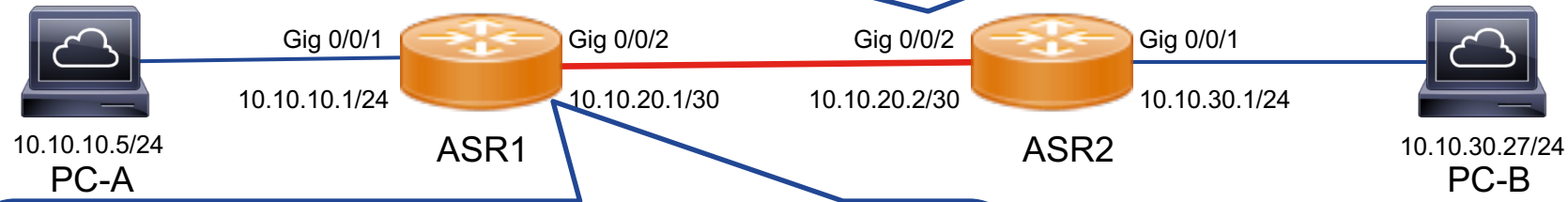
```
! Filter ICMP traffic between hosts
ip access-list extended ICMP1
 permit icmp host 10.10.10.5 host 10.10.30.27
 permit icmp host 10.10.30.27 host 10.10.10.5

! EPC on ASR2
monitor capture CAP2 int Gig0/0/2 both access-list ICMP1
monitor capture CAP2 start
monitor capture CAP2 stop
```

Real World Example

Isolating the Device Causing Packet Loss

5 Echo Requests from PC-A to PC-B.
Only 3 Echo Replies from PC-B to PC-A

```
ASR2# show monitor capture CAP2 buffer brief | inc ICMP|#
#    size    timestamp     source              destination     protocol
  0 1014     0.000000     10.10.10.5       ->  10.10.30.27      ICMP
  1 1014     0.003997     10.10.30.27      ->  10.10.10.5       ICMP
  2 1014     0.004013     10.10.10.5       ->  10.10.30.27      ICMP
  3 1014     0.004976     10.10.30.27      ->  10.10.10.5       ICMP
  4 1014     0.005033     10.10.10.5       ->  10.10.30.27      ICMP
  5 1014     2.006834     10.10.10.5       ->  10.10.30.27      ICMP
  6 1014     4.007125     10.10.10.5       ->  10.10.30.27      ICMP
  7 1014     4.008003     10.10.30.27      ->  10.10.10.5       ICMP
```



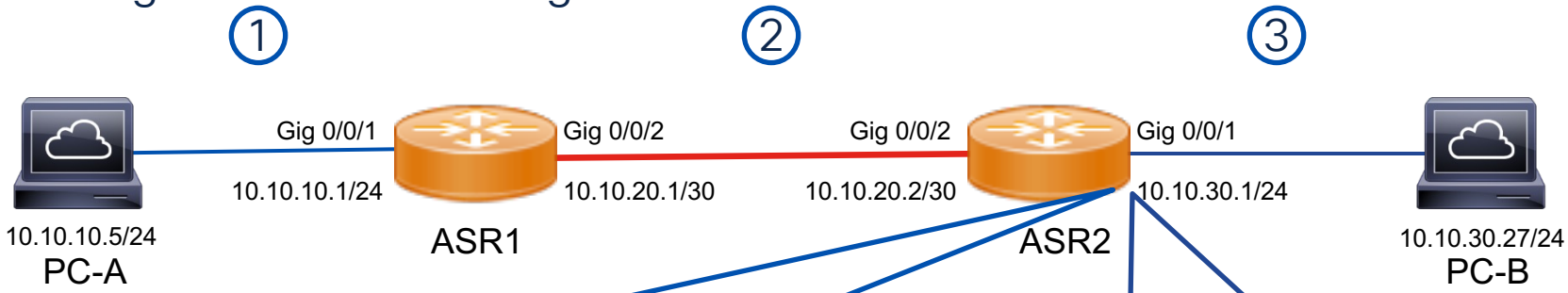

```
ASR1# show monitor capture CAP1 buffer brief | inc ICMP|#
#    size    timestamp     source              destination     protocol
  0 1014     0.000000     10.10.10.5       ->  10.10.30.27      ICMP
  1 1014     0.003998     10.10.30.27      ->  10.10.10.5       ICMP
  2 1014     0.004012     10.10.10.5       ->  10.10.30.27      ICMP
  3 1014     0.004978     10.10.30.27      ->  10.10.10.5       ICMP
  4 1014     0.005031     10.10.10.5       ->  10.10.30.27      ICMP
  5 1014     2.006832     10.10.10.5       ->  10.10.30.27      ICMP
  6 1014     4.007124     10.10.10.5       ->  10.10.30.27      ICMP
  7 1014     4.008006     10.10.30.27      ->  10.10.10.5       ICMP
```

ASR1 sent out 5 ICMP Echo Requests on Gig0/0/2 and they were received by ASR2 on Gig0/0/2.

Were all of the ICMP Echo Requests sent out on Gig0/0/1 by ASR2? Let's find out.

Real World Example

Isolating the Device Causing Packet Loss



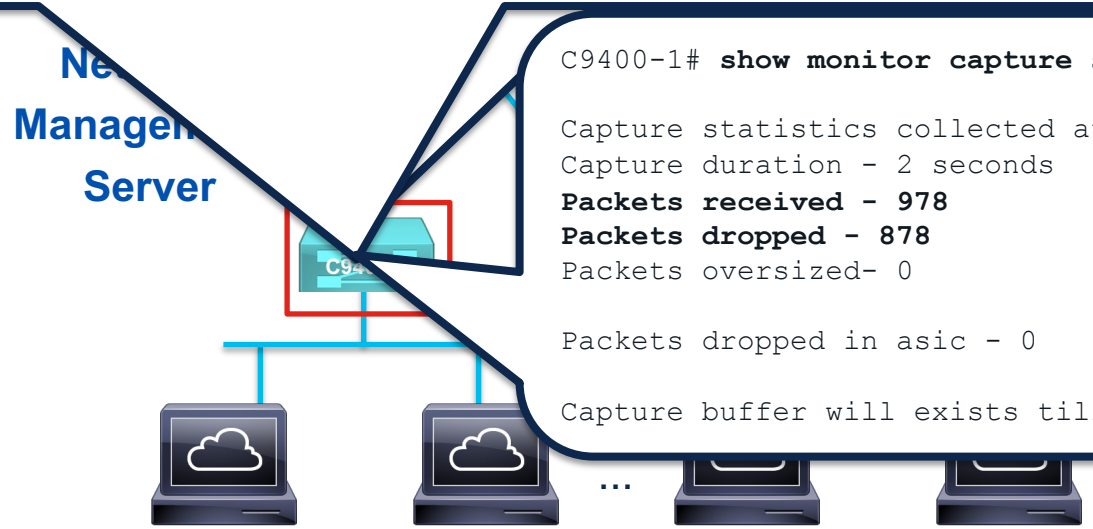

```
! EPC on ASR2
monitor capture CAP2 int Gig0/0/1 both access-list ICMP1
monitor capture CAP2 start
monitor capture CAP2 stop
```

EPC capture on Gig0/0/1 confirms that only 3 Echo Request from PC-A to PC-B are sent out by ASR2.

The device dropping the packets is ASR2!

```
ASR2# show monitor capture CAP2 buffer brief | inc ICMP|#
 #   size   timestamp     source           destination     protocol
   0 1014     0.000000    10.10.10.5       ->  10.10.30.27      ICMP
   1 1014     0.003814    10.10.30.27      ->  10.10.10.5       ICMP
   2 1014     0.003838    10.10.10.5       ->  10.10.30.27      ICMP
   3 1014     0.004612    10.10.30.27      ->  10.10.10.5       ICMP
   4 1014     4.008062    10.10.10.5       ->  10.10.30.27      ICMP
   5 1014     4.008822    10.10.30.27      ->  10.10.10.5       ICMP
```

```
C9400-1# monitor capture snmp_cap control-plane in limit packets 100
C9400-1# monitor capture snmp_cap match ipv4 protocol udp any any eq 161

C9400-1# monitor capture snmp_cap start

Enabling Control plane capture may seriously impact system performance. Do you want to continue?
[yes/no]: yes
Started capture point : snmp_cap

%BUFCAP-6-ENABLE: Capture Point snmp_cap enabled.

%BUFCAP-6-ENABLE: Capture Point snmp_cap disabled.
```




```
C9400-1# show monitor capture snmp_cap capture-statistics

Capture statistics collected at software:
Capture duration - 2 seconds
Packets received - 978
Packets dropped - 878
Packets oversized- 0

Packets dropped in asic - 0

Capture buffer will exists till exported or cleared
```

Real World Example

Access Switch with High CPU utilization in SNMP Engine

```
C9400-1# show monitor capture snmp_cap buffer brief
Starting the packet display ........ Press Ctrl + Shift + 6 to exit

  1    0.000000    172.16.1.25 -> 172.16.1.11    SNMP 90 get-next-request 1.3.6.1.4.1.9.2.1.1.0
  2    0.000003    172.16.1.25 -> 172.16.1.11    SNMP 90 get-next-request 1.3.6.1.4.1.9.2.1.1.0
  3    0.000005    172.16.1.25 -> 172.16.1.11    SNMP 90 get-next-request 1.3.6.1.4.1.9.2.1.1.0
  4    0.000007    172.16.1.25 -> 172.16.1.11    SNMP 90 get-next-request 1.3.6.1.4.1.9.2.1.1.0
  5    0.000009    172.16.1.25 -> 172.16.1.11    SNMP 90 get-next-request 1.3.6.1.4.1.9.2.1.1.0
  6    0.000010    172.16.1.25 -> 172.16.1.11    SNMP 90 get-next-request 1.3.6.1.4.1.9.2.1.1.0
  7    0.000012    172.16.1.25 -> 172.16.1.11    SNMP 90 get-next-request 1.3.6.1.4.1.9.2.1.1.0
  8    0.000019    172.16.1.25 -> 172.16.1.11    SNMP 90 get-next-request 1.3.6.1.4.1.9.2.1.1.0
  9    0.000021    172.16.1.25 -> 172.16.1.11    SNMP 90 get-next-request 1.3.6.1.4.1.9.2.1.1.0
 10    0.000023    172.16.1.25 -> 172.16.1.11    SNMP 90 get-next-request 1.3.6.1.4.1.9.2.1.1.0

C9400-1# show monitor capture snmp_cap buffer brief | count 1.3.6.1.4.1.9.2.1.1.0
Number of lines which match regexp = 97

C9400-1# monitor capture snmp_cap clear
```

FED Capture

FED Packet Capture

Catalyst 9000

Forwarding Engine Driver (FED) is the heart of Cisco switching and is responsible for hardware programming and forwarding.

- Supported with UADP and Silicon One*
- Non-Intrusive Debug
- Linear buffer [circular], 4096 frames [256-16384]

Direction

From CPU's Perspective

- Punt (Rx)
- Inject (Tx)

Wireshark Based Filters

- Display Filters:
  http://wiki.wireshark.org/DisplayFilters
  `"eth.addr==00:00:0c:07:ac:01"`
  `"ip.src==10.1.1.1 && ip.dst==10.1.1.2"`
- Capture Filters:
  http://wiki.wireshark.org/CaptureFilters
  `"ether host 00:00:0c:07:ac:01"`
  `"src host 10.1.1.1 and dst host 10.1.1.2"`

FED Packet Capture - Example

```
CAT9300-1# debug platform software fed switch active [punt|inject] packet-capture [start|stop]
Punt packet capturing started.

CAT9300-1# show platform software fed switch active punt packet-capture status
Punt packet capturing: disabled. Buffer wrapping: disabled
Total captured so far: 4096 packets. Capture capacity : 4096 packets

CAT9300-1# show platform software fed switch active punt packet-capture brief
Punt packet capturing: disabled. Buffer wrapping: disabled
Total captured so far: 4096 packets. Capture capacity : 4096 packets

------ Punt Packet Number: 1, Timestamp: 2023/01/02 18:22:51.757 ------
 interface : physical: GigabitEthernet1/0/2[if-id: 0x0000000a], pal: Vlan101 [i
0x00000042]
 metadata  : cause: 11 [For-us data], sub-cause: 0, q-no: 2, linktyp  LINK_TYPE_IP [1]
 ether hdr : dest mac: 3c51.0e7c.01c1, src mac: 0016.c81c.2f81
 ether hdr : ethertype: 0x0800 (IPv4)
 ipv4  hdr : dest ip: 10.1.1.2, src ip: 10.1.1.1
 ipv4  hdr : packet len: 100, ttl: 255, protocol: 1 (ICMP)
 icmp  hdr : icmp type: 8, code: 0
```

Capture Complete! If the capture is still running use the 'stop' command.

Ingress on port Gi1/0/2 on VLAN 101

Source and Destination MAC Address

Ethertype is 0x0800 for IPv4

Source and Destination IPv4 Address

FED Packet Capture - Example

```
CAT9300-1# show platform software fed switch active punt packet-capture detailed
<snip>
------ Punt Packet Number: 2, Timestamp: 2023/01/02 18:22:51.757 ------
 interface : physical: GigabitEthernet1/0/2[if-id: 0x0000000a], pal: Vlan101 [if-id:
0x00000042]
 metadata  : cause: 11 [For-us data], sub-cause: 0, q-no: 2, linktype:
MCP_LINK_TYPE_IP [1]
 ether hdr : dest mac: 3c51.0e7c.01c1, src mac: 0016.c81c.2f81
 ether hdr : ethertype: 0x0800 (IPv4)
 ipv4  hdr : dest ip: 10.1.1.2, src ip: 10.1.1.1
 ipv4  hdr : packet len: 100, ttl: 255, protocol: 1 (ICMP)
 icmp  hdr : icmp type: 8, code: 0

 Packet Data Hex-Dump (length: 118 bytes) :
   3C510E7C01C10016  C81C2F8108004500  0064A2BF0000FF01  02D50A0101010A01
   0102[illegible]   17A80000000000FD  96A8ABCDABCDABCD  ABCDABCDABCDABCD
   ABCD[illegible]   ABCDABCDABCDABCD  ABCDABCDABCDABCD  ABCDABCDABCDABCD
   AB[illegible]     ABCDABCDABCDABCD  ABCD1FECA2[illegible]
```

Punt Cause

ICMP Packet

Dest MAC

Source MAC

Ethertype 0x0800

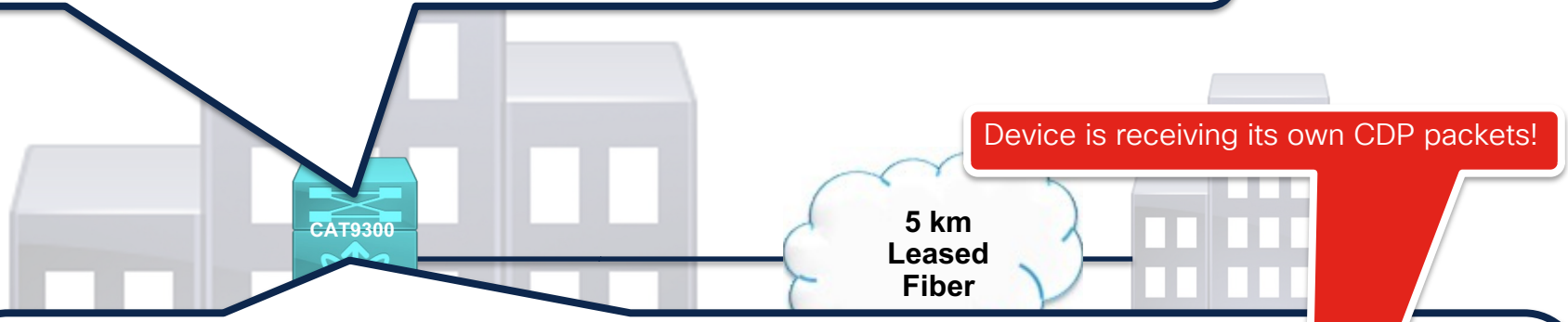
Source IP 10.1.1.1

Dest IP 10.1.1.2

Real World Example

High CPU due to CDP Protocol

```
CAT9300-1# show proc cpu sort
CPU utilization for five seconds: 27%/7%; one minute: 28%; five minutes: 20%
 PID Runtime(ms)     Invoked      uSecs   5Sec   1Min   5Min TTY Process
 227     1196642     9627692        124 16.87% 17.20% 12.43%   0 CDP Protocol
```




```
CAT9300-1# show cdp neighbors
Capability Codes: R - Router, T - Trans Bridge, B - Source Route Bridge
                  S - Switch, H - Host, I - IGMP, r - Repeater, P - Phone,
                  D - Remote, C - CVTA, M - Two-port Mac Relay
Device ID        Local Intrfce     Holdtme    Capability  Platform  Port ID
ASR1000.cisco.com   Gig 1/0/3        158              R I   ASR1006   Gig 0
ISR4K-1.cisco.com   Gig 1/0/1        155            R S I  ISR4451-X Gig 0/0/3
ISR4K-2.cisco.com   Gig 1/0/4        136            R S I  ISR4351/K Gig 0/0/0
CAT9300-1.cisco.com Gig 1/0/2        179             S I   C9300L-48 Gig 1/0/2
Total cdp entries displayed : 4
```

Real World Example

High CPU due to CDP Protocol

```
CAT9300-1# debug platform software fed switch active punt packet-capture start
Punt packet capturing started.

CAT9300-1# show platform software fed switch active punt packet-capture status
Punt packet capturing: disabled. Buffer wrapping: disabled
Total captured so far: 4096 packets. Capture capacity : 4096 packets

CAT9300-1# show platform software fed switch active punt packet-capture brief
Punt packet capturing: disabled. Buffer wrapping: disabled
Total captured so far: 4096 packets. Capture capacity : 4096 packets
------ Punt Packet Number: 1, Timestamp: 2023/01/02 19:22:1[illegible]
 interface : physical: GigabitEthernet1/0/2[if-id: 0x0000000a],
   0x0000000a]
 metadata  : cause: 96 [Layer2 control protocols], sub-cause: 0, [illegible]
   MCP_LINK_TYPE_LAYER2 [10]
 ether hdr : dest mac: 0100.0ccc.cccc, [illegible] mac: 3c51.0e7c.0182
 ether hdr : length: 449

CAT9300-1# debug plat soft fed switch act punt packet-capture set-filter "eth.addr == 0100.0ccc.cccc"
CAT9300-1# debug platform software fed switch active punt packet-capture start
```

After identifying the flow a short-term solution would be to disable CDP on G1/0/2 until the link issue is resolved:

```
CAT9300-1(config)# int G1/0/2
CAT9300-1(config-if)# no cdp enable
```

Leased Fiber link for the ingress interface

CDP Destination MAC for filter to narrow results

Packet Trace
Routing Platforms

Packet Trace Details

- Gain a deep understanding of the actions taken on a packet during packet processing
- Integrates with **`debug platform condition`** for filtering
- For **control** and **data plane** traffic in the datapath

Packet Trace is supported on the CAT8000, ASR1000, ISR1000, ISR4000, and CSR1000V

Packet Trace: Forwarding Data

Three levels of forwarding data:

- Common forwarding data (e.g. IP tuple)
- Feature specific data (e.g. NAT)
- Feature Invocation Array (FIA) trace – optionally enabled (e.g. fia-trace)

- Copy all or part of the incoming and/or outgoing packet – optionally enabled
- Safe to use with **appropriate filters** in place
- Potential delay for traced packets only (with **fia-trace** and **packet copy**)

Packet Trace

Workflow


```
debug platform packet-trace packet <16-8192> [circular] fia-trace
debug platform packet-trace copy packet <input|output|both> [L2|L3|L4] [size <16-2048>]
```

```
show platform conditions
show platform packet-trace configuration
clear platform condition all
```

8000

```
ASR1000# show platform packet-trace packet 8
Packet: 8            CBUG ID: 142
Summary
  Input     : GigabitEthernet0/0/3
  Output    : GigabitEthernet0/0/0
  State     : DROP 187 (FirewallPolicy)
  Timestamp
    Start   : 2417018445350231 ns (04/19/2023 19:02
    Stop    : 2417018445407738 ns (04/19/2023 19:02
Path Trace
  Feature: IPV4(Input)
    Input       : GigabitEthernet0/0/3
    Output      : <unknown>
    Source      : 10.1.250.50
    Destination : 10.122.144.137
    Protocol    : 17 (UDP)
      SrcPort   : 63478
      DstPort   : 514
  Feature: DEBUG_COND_INPUT_PKT
    Entry       : Input - 0x11460100
    Input       : GigabitEthernet0/0/3
    Output      : <unknown>
    Lapsed time : 5140 ns
  Feature: IPV4_INPUT_DST_LOOKUP_CONSUME
    Entry       : Input - 0x1145fe74
    Input       : GigabitEthernet0/0/3
    Output      : <unknown>
    Lapsed time : 9380 ns
```

```
Feature: ZBFW
    Action  : Drop
    Reason  : ICMP policy drop:classify result
    Zone-pair name          : IN-TO-OUT
    Class-map name          : class-default
    Input interface         : GigabitEthernet0/0/3
    Egress interface        : GigabitEthernet0/0/0
    AVC Classification ID   : 0
    AVC Classification name: N/A
  Feature: OUTPUT_DROP
    Entry       : Output - 0x1145f484
    Input       : GigabitEthernet0/0/3
    Output      : GigabitEthernet0/0/0
    Lapsed time : 1500 ns
  Feature: IPV4_OUTPUT_INSPECT
    Entry       : Output - 0x1145fb8c
    Input       : GigabitEthernet0/0/3
    Output      : GigabitEthernet0/0/0
    Lapsed time : 1134760 ns
Packet Copy In
  0022bdf9 a993848a 8d48cd51 08004500 00820005 0000ff11
  1c2f0a01 fa320a7a 9089f7f6 0202006e 8b403c31 38373e39
  39373a20 41707220 31392030 313a3333
```

Packet Trace
Catalyst 9000 Series

cisco Live!

Switch Capturing Tool Availability

RSPAN

FED Capture

Embedded Packet Capture (EPC)

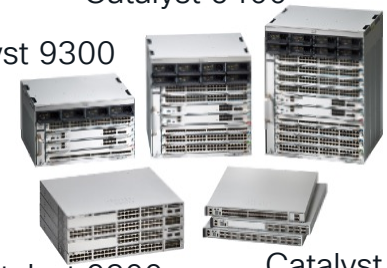
Show Platform Forward (SPF)

Packet Trace

UADP 2.0/UADP 2.0 mini

Catalyst 9400

Catalyst 9300



Catalyst 9200

Catalyst 9500

Packet State Vector (PSV)

UADP 3.0

Catalyst 9600

Catalyst 9500H

Show Platform Forward

Catalyst 9000 Series UADP 2.0, 2.0 mini, 3.0

- Available starting in 16.3.1
- User defined L2/L3/L4 packet data for a specific packet
- Import a specific packet from a PCAP
- Switch generates 150-200 packets to determine ingress and egress forwarding decisions
  NOTE: generated packets do not leave the switch
- Determine handling of the packet:
  - Ingress & Egress decisions
  - Forwarding Interfaces
  - Rewrite Type

Show Platform Forward

"Debug Platform Packet-Trace Feature Simulate" Syntax in 17.3.1 onwards

- Provides the L2 Packet Data for the generated traffic
- Specify the L3/L4 Protocol, Addressing, Ports, and Flags for the traffic
- Define the ingress port, vlan, etc.

```
mac access-list extended DNS-PACKET-L2
 permit host 0cd0.f852.8042 host c014.f384.cc40

CAT9300-1# debug platform condition feature simulate mac DNS-PACKET-L2

ip access-list extended DNS-PACKET
 10 permit udp host 192.168.1.37 eq 5193 host 8.8.8.8 eq domain

CAT9300-1# debug platform condition feature simulate ipv4 DNS-PACKET

CAT9300-1# debug platform condition feature simulate interface Ten1/0/1

CAT9300-1# debug platform condition start
CAT9300-1# debug platform packet-trace simulation start
```

Show Platform Forward

Verify the Results in 17.3.1 onward

After 2-5 min

```
show platform packet-trace simulation status
========================
Switch 1:
========================
Available Flows in Switch: 1
65537    Progress
```

```
show platform packet-trace simulation summary
```

Input Packet

```
Input Packet Details:
###[ Ethernet ]###
  dst       = c0:14:fe:84:cc:40
  src       = 0c:d0:f8:52:80:42
  type      = 0x800
###[ IP ]###
     version   = 4
     ihl       = 5
     tos       = 0x0
     len       = 28
     id        = 1
     flags     =
     frag      = 0
     ttl       = 64
     proto     = udp
     chksum    = 0xa8f3
     src       = 192.168.1.37
     dst       = 8.8.8.8
     options   = ''
###[ UDP ]###
        sport     = 5193
        dport     = domain
        len       = 8
        chksum    = 0x1983
```

Ingress Details

```
Ingress:
   Port               : Ten1/0/1
   Global Port Number : 1
   Local Port Number  : 1
   Asic Port Number   : 0
   Asic Instance      : 3
   Vlan               : 1
   Mapped Vlan ID     : 4
   STP Instance       : 2
   L3 Interface       : 37
    IPv4 Routing   : enabled
    IPv6 Routing   : enabled
    Vrf Id         : 0
   Adjacency:
    Station Index      : 180
    Destination Index  : 16402
    Rewrite Index      : 2
 Decision:
   Forwarding Mode    : 0 [Bridging]
   Replication Bit Map: ['localData']
   Winner : L2DESTMACVLAN LOOKUP
 No exceptions occured.
 CMI-2 Catch-all. Do not punt to CPU
```

Egress Details

```
Egress:
 Possible Replication   :
       Port             : Ten1/0/1
       Port             : Ten1/0/2
       Port             : Ten1/0/3
       Port             : Ten1/0/4
 Output Port Data       :
       Port             : Ten1/0/2
    Global Port Number  : 1536
    Local Port Number   : 2
    Asic Port Number    : 1
    Asic Instance       : 3
    Unique RI           : 0
    Rewrite Type        : 1
                [L2_BRIDGE]
    Mapped Rewrite Type : 4
                [L2_BRIDGE_INNER_IPv4]
    Vlan                : 1
    Mapped Vlan ID      : 4
```

Output Packet

```
Output Packet Details:
    Port         : Ten1/0/2
###[ Ethernet ]###
  dst       = c0:14:fe:84:cc:40
  src       = 0c:d0:f8:52:80:42
  type      = 0x800
###[ IP ]###
     version   = 4
     ihl       = 5
     tos       = 0x0
     len       = 28
     id        = 1
     flags     =
     frag      = 0
     ttl       = 64
     proto     = udp
     chksum    = 0xa8f3
     src       = 192.168.1.37
     dst       = 8.8.8.8
     options   = ''
###[ UDP ]###
        sport     = 5193
        dport     = domain
        len       = 8
        chksum    = 0x1983
```

Real World Example
HSRP Forwarding Concerns

```
CAT9300-1# debug platform condition feature simulate mac HSRP-L2
CAT9300-1# debug platform condition feature simulate ipv4 HSRP-L3
```

```
CAT9300-1# debug platform packet-trace simulation start
```

```
CAT9300-1# debug p
CAT9300-1# debug plati
```

```
CAT9300-1# show platform pacl
<SNIP>
Egress:
   Possible Replication
       Port
Output Port Data          :
     Port                 :
```

```
CAT9300-1# show platform packet-trace simulation status
=========================
Switch 1:
=========================
Available Flows in Switch: 1
100728840    Complete
100728841    Complete
=========================
```

```
CAT9300-1# show platform packet-trace simulation status
=========================
Switch 1:
=========================
Available Flows in Switch: 1
100728840    Complete
=========================
```

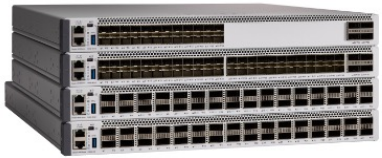
Packet Trace

Catalyst 9500H & 9600
Packet State Vector

Packet Trace
Catalyst 9500H & 9600- UADP 3.0

- UADP 3.0 feature that is only available on 9600 & 9500H
- “Packet State Vector” first introduced in 16.8.1
- New “Packet Trace” syntax starting in 17.3.1
- Live capture of a single packet
- Visibility into the ASIC level forwarding details for the captured packet

Catalyst 9600

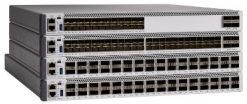


Catalyst 9500H

Packet Trace

UADP 3.0

Catalyst 9600



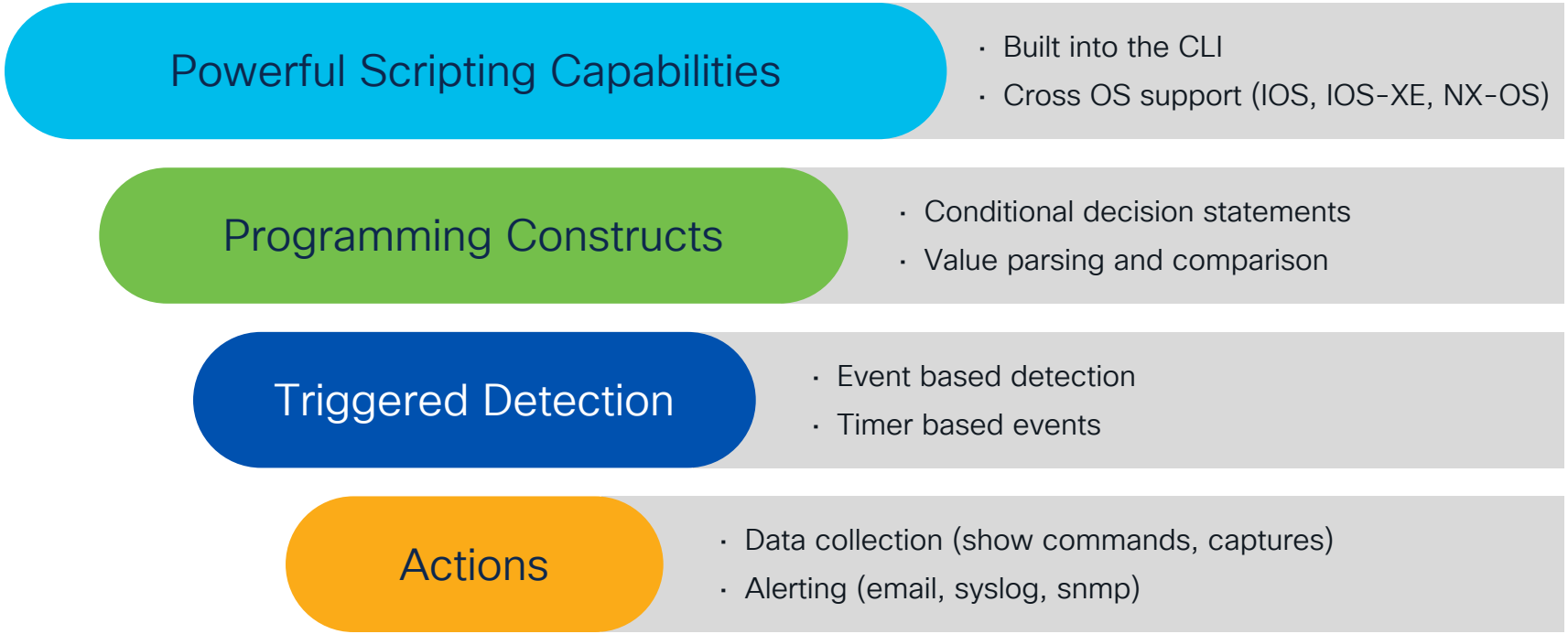
Catalyst 9500H

Define Trigger & Start Capture → Review Configuration/Status & Clear → View Packet Forwarding Decision

```
show platform packet-trace summary                  <--- PSV Summary results
show platform packet-trace packet all               <--- Packet details
show platform packet-trace detailed ingress         <--- PSV FIR (Forwarding Ingress Resolution)
show platform packet-trace detailed egress          <--- PSV FER (Forwarding Egress Resolution)
```

Event Triggered Captures

Embedded Event Manager (EEM)



Event Triggered Captures

Workflow

Match the event → Set the actions → Review Data

Syslog, timer, counter, OID

CLI, email, SNMP trap

PCAP, Appended outputs

```
*Jan 10 19:13:31.512: %DUAL-5-NBRCHANGE: EIGRP-IPv4 10: Neighbor 10.10.20.3 (GigabitEthernet0/0/2) is
down: holding time expired
```

Router A

Router B

EIGRP dropped! Trigger EEM script to run!

Stop capture and append commands to file!

Scripting Captures Example

- Before the script can run, careful preparation and consideration should be made to ensure the script triggers correctly and runs the appropriate commands to capture relevant information.

```
monitor capture EIGRP-CAP match ipv4 any any control-plane in buffer size 10 circular
monitor capture EIGRP-CAP start
```

Setup and start the capture for all IPv4 traffic ingressing the control plane. Circular buffer used for continuous capture.

```
event manager applet EIGRP-FLAP
 event syslog pattern "holding time expired"
 action 1.0 cli command "enable"
 action 1.1 syslog msg "EIGRP Flap Detected! Running EEM Script!"
 action 1.2 cli command "monitor capture EIGRP-CAP stop"
 action 2.1 cli command "show ip eigrp neighbor | append bootflash:EIGRP_flap.txt"
 action 2.2 cli command "show proc cpu sorted | append bootflash:EIGRP_flap.
 action 2.3 cli command "show proc cpu history | append bootflash:EIGRP_flap.tx
 ...
 action 3.1 cli command "monitor capture EIGRP-CAP export bootflash:EIGRP-CAP.pcap
```

Logging message pattern that will be matched to trigger the script.

Make sure **enable** is defined before any other CLI command action!

Stop the capture once the flap occurs.

Router A

Router B

Note: If using AAA command authorization

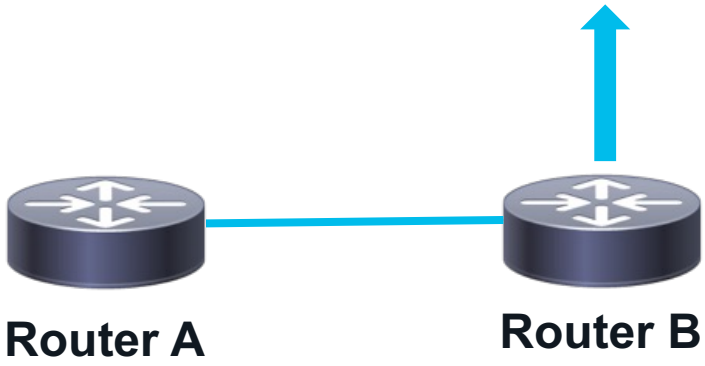
`event manager session cli username <NAME>` OR

`event manager applet EIGRP-FLAP authorization bypass`

Scripting Captures Example (Continued)

- Once the event is detected, EEM will log a message stating that it has been triggered and will run the commands defined.

```
Router_B#
*Jan 16 19:27:59.672: %DUAL-5-NBRCHANGE: EIGRP-IPv4 10: Neighbor 10.10.20.3 (GigabitEthernet0/0/2) is down:
holding time expired
*Jan 16 19:27:59.686: %HA_EM-6-LOG: EIGRP-FLAP: EIGRP Flap Detected! Running EEM Script!
```




```
SCRIPT IS RUNNING...
```

The user-defined message in the EEM script is generated alerting that the script is running.

Files have been created and can be copied off for external review.

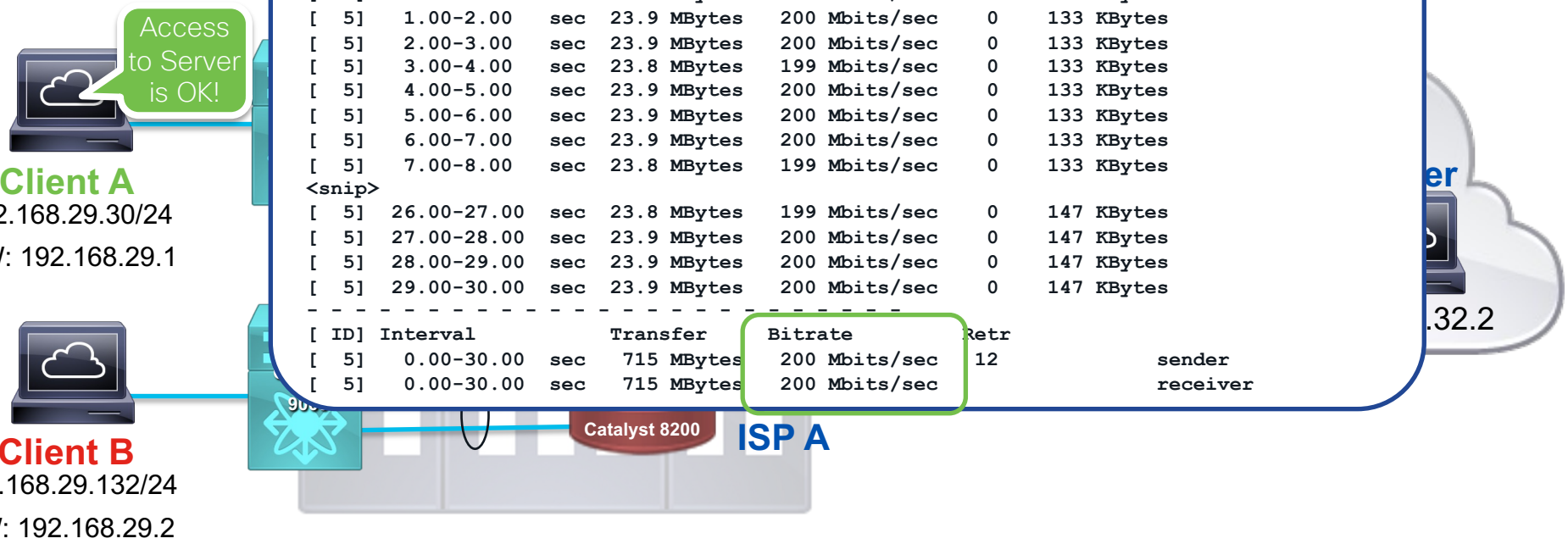
```
Router_B# show bootflash: | in EIGRP
! PCAP FILE FROM THE CAPTURE
135          24 Jan 16 2023 19:27:59 +00:00 /bootflash/EIGRP-CAP.pcap
! FILE WITH CAPTURED COMMANDS
136       56257 Jan 16 2023 19:28:00 +00:00 /bootflash/EIGRP_flap.txt
```

Putting it All Together

Real World Example

Degraded Perf

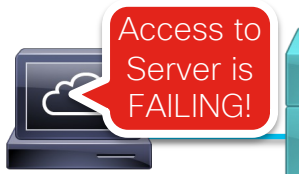
```
cisco@linux1:~$ iperf3 -b 200M -c 192.168.32.2 -t 30
Connecting to host 192.168.32.2, port 5201
[  5] local 192.168.29.30 port 58538 connected to 192.168.32.2 port 5201
[ ID] Interval           Transfer     Bitrate         Retr  Cwnd
[  5]   0.00-1.00   sec  23.9 MBytes   200 Mbits/sec   12    133 KBytes
[  5]   1.00-2.00   sec  23.9 MBytes   200 Mbits/sec    0    133 KBytes
[  5]   2.00-3.00   sec  23.9 MBytes   200 Mbits/sec    0    133 KBytes
[  5]   3.00-4.00   sec  23.8 MBytes   199 Mbits/sec    0    133 KBytes
[  5]   4.00-5.00   sec  23.9 MBytes   200 Mbits/sec    0    133 KBytes
[  5]   5.00-6.00   sec  23.9 MBytes   200 Mbits/sec    0    133 KBytes
[  5]   6.00-7.00   sec  23.9 MBytes   200 Mbits/sec    0    133 KBytes
[  5]   7.00-8.00   sec  23.8 MBytes   199 Mbits/sec    0    133 KBytes
<snip>
[  5]  26.00-27.00  sec  23.8 MBytes   199 Mbits/sec    0    147 KBytes
[  5]  27.00-28.00  sec  23.9 MBytes   200 Mbits/sec    0    147 KBytes
[  5]  28.00-29.00  sec  23.9 MBytes   200 Mbits/sec    0    147 KBytes
[  5]  29.00-30.00  sec  23.9 MBytes   200 Mbits/sec    0    147 KBytes
- - - - - - - - - - - - - - - - - - - - - - - - -
[ ID] Interval           Transfer     Bitrate         Retr
[  5]   0.00-30.00  sec   715 MBytes   200 Mbits/sec   12             sender
[  5]   0.00-30.00  sec   715 MBytes   200 Mbits/sec                  receiver
```



Real World Example

Degraded Perfor

Client A
192.168.29.30/24
GW: 192.168.29.1

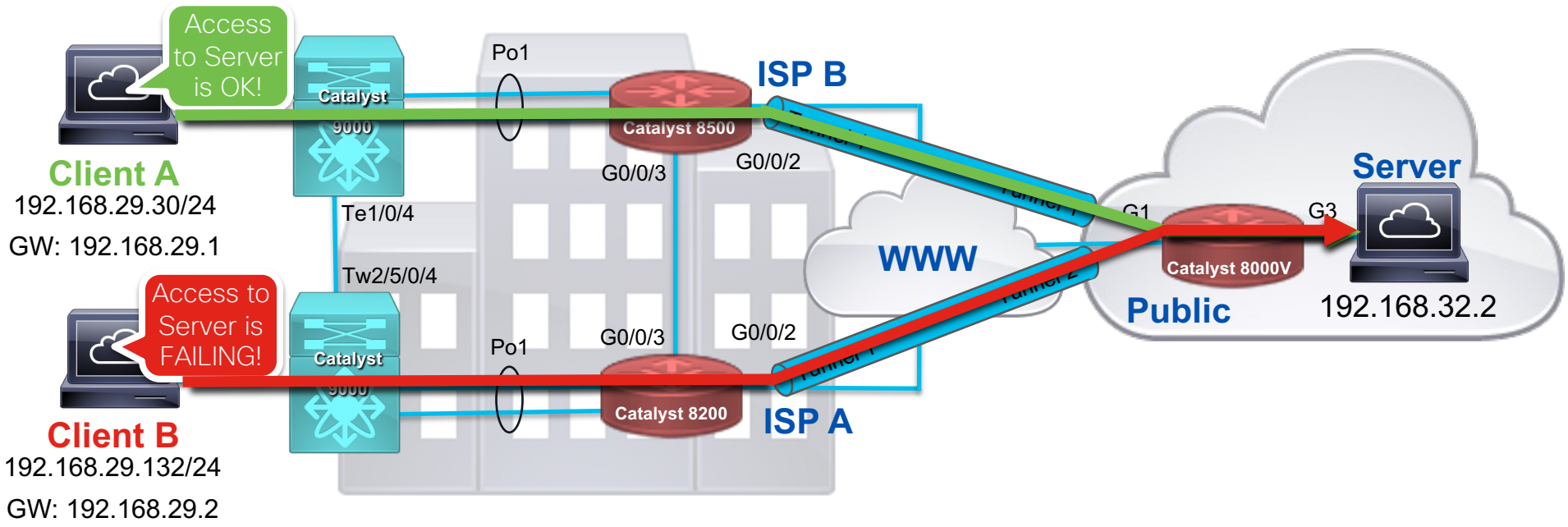


Client B
192.168.29.132/24
GW: 192.168.29.2

```
cisco@linux2:~$ iperf3 -b 200M -c 192.168.32.2 -t 30
Connecting to host 192.168.32.2, port 5201
[  5] local 192.168.29.132 port 39190 connected to 192.168.32.2 port 5201
[ ID] Interval           Transfer     Bitrate         Retr  Cwnd
[  5]   0.00-1.00   sec  5.57 MBytes  46.7 Mbits/sec    7   2.19 MBytes
[  5]   1.00-2.00   sec  12.8 MBytes   107 Mbits/sec  385   1.50 MBytes
[  5]   2.00-3.00   sec  15.2 MBytes   128 Mbits/sec    0   1.59 MBytes
[  5]   3.00-4.00   sec  16.1 MBytes   135 Mbits/sec    0   1.66 MBytes
[  5]   4.00-5.00   sec  16.8 MBytes   141 Mbits/sec    0   1.70 MBytes
[  5]   5.00-6.00   sec  16.4 MBytes   137 Mbits/sec    0   1.73 MBytes
[  5]   6.00-7.00   sec  16.8 MBytes   141 Mbits/sec    0   1.75 MBytes
[  5]   7.00-8.00   sec  17.1 MBytes   144 Mbits/sec    0   1.76 MBytes
[  5]   8.00-9.00   sec  17.2 MBytes   145 Mbits/sec   19   1.61 MBytes
[  5]   9.00-10.00  sec  6.00 MBytes  50.3 Mbits/sec  1843    622 KBytes
[  5]  10.00-11.00  sec  6.25 MBytes  52.4 Mbits/sec    0    675 KBytes
[  5]  11.00-12.00  sec  6.75 MBytes  56.6 Mbits/sec    0    712 KBytes
[  5]  12.00-13.00  sec  6.88 MBytes  57.7 Mbits/sec    0    734 KBytes
[  5]  13.00-14.00  sec  7.12 MBytes  59.8 Mbits/sec    0    746 KBytes
[  5]  14.00-15.00  sec  7.25 MBytes  60.8 Mbits/sec    0    750 KBytes
<snip>
[  5]  26.00-27.00  sec  12.6 MBytes   106 Mbits/sec    0   1.40 MBytes
[  5]  27.00-28.00  sec  14.9 MBytes   125 Mbits/sec    0   1.61 MBytes
[  5]  28.00-29.00  sec  6.12 MBytes  51.4 Mbits/sec  1123    585 KBytes
[  5]  29.00-30.00  sec  6.00 MBytes  50.3 Mbits/sec    0    632 KBytes
- - - - - - - - - - - - - - - - - - - - - - - - -
[ ID] Interval           Transfer     Bitrate         Retr
[  5]   0.00-30.00  sec   305 MBytes  85.2 Mbits/sec  3377             sender
[  5]   0.00-30.10  sec   303 MBytes  84.4 Mbits/sec                   receiver
```

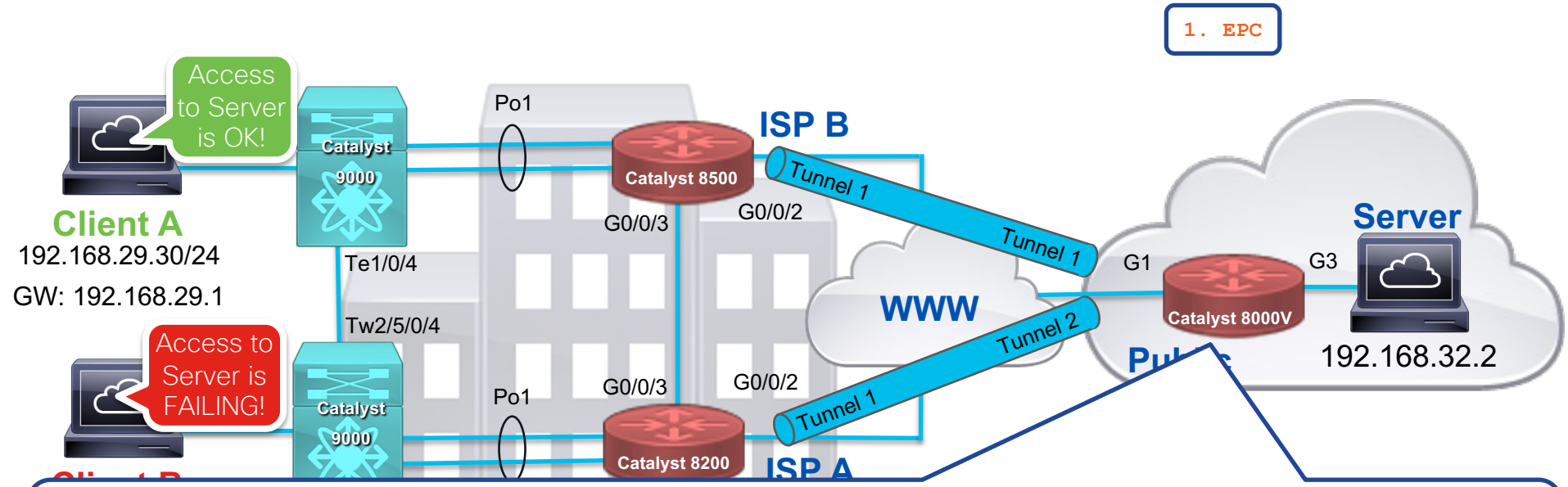
Real World Example

Degraded Performance



Real World Example

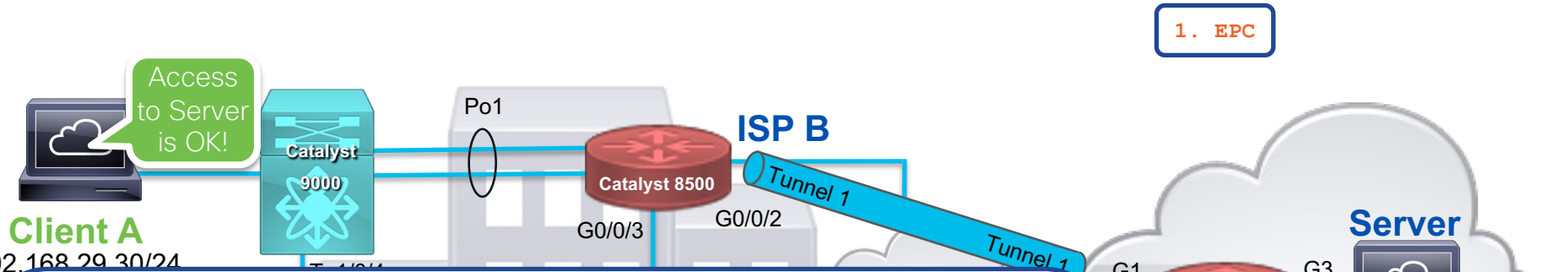
Degraded Performance




```
c8000v# monitor capture clienta buffer size 100 match ipv4 host 192.168.29.30 host 192.168.32.2 interface gi3 both
c8000v# monitor capture clienta start
c8000v# monitor capture clientb buffer size 100 match ipv4 host 192.168.29.132 host 192.168.32.2 interface gi3 both
c8000v# monitor capture clienta start
```

Real World Example

Degraded Performance

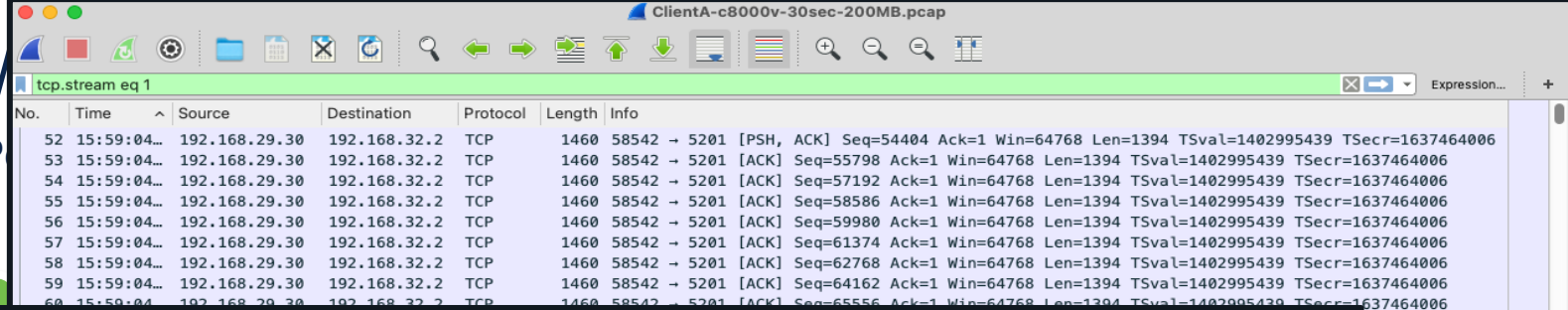


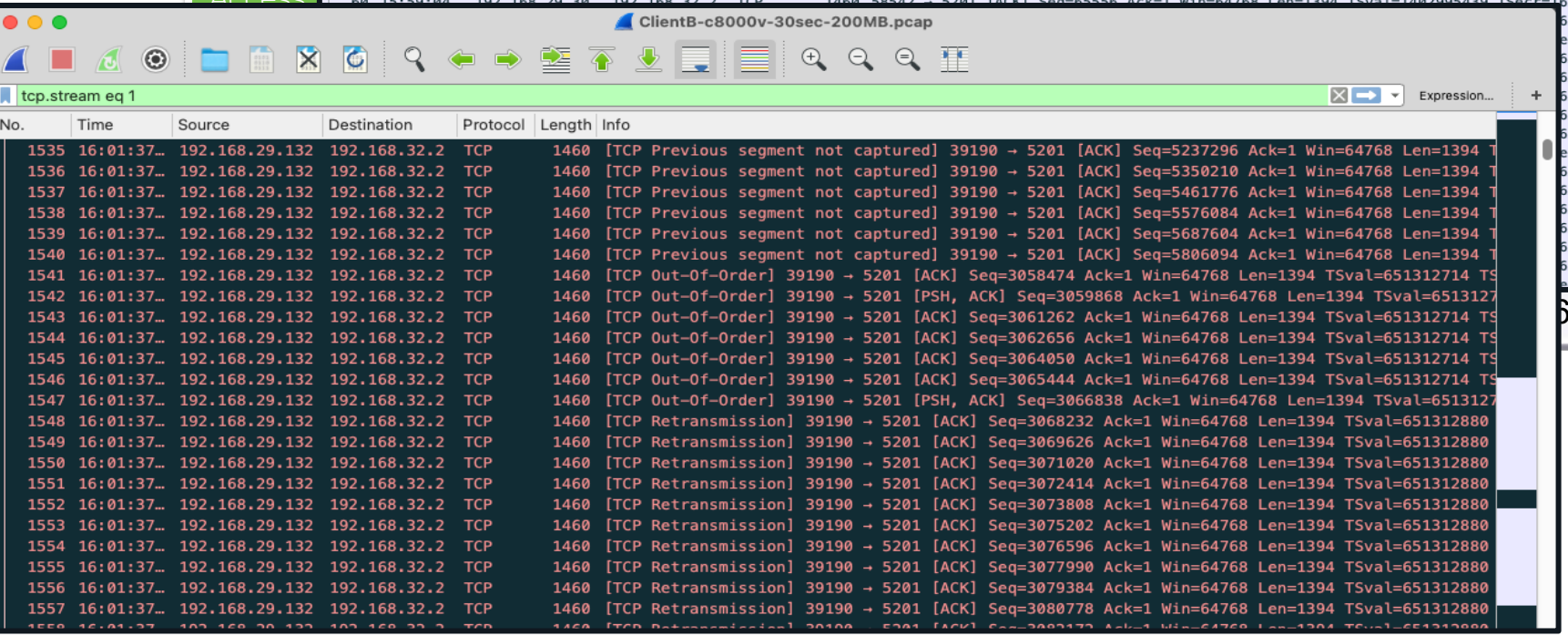

```
c8000v# monitor capture clienta stop
Stopped capture point : clienta
c8000v# show monitor capture clienta buffer brief
 ------------------------------------------------------------------------------
 #    size    timestamp     source              destination       dscp    protocol
 ------------------------------------------------------------------------------
   0    74     0.000000    192.168.29.30     ->  192.168.32.2      0   BE    TCP
   1    66     0.001007    192.168.29.30     ->  192.168.32.2      0   BE    TCP
   2   103     0.001007    192.168.29.30     ->  192.168.32.2      0   BE    TCP
<snip>
c8000v# monitor capture clienta export bootflash:ClientA-c8000v-30sec-200MB.pcap
Exported Successfully
```

Real W

Degraded P

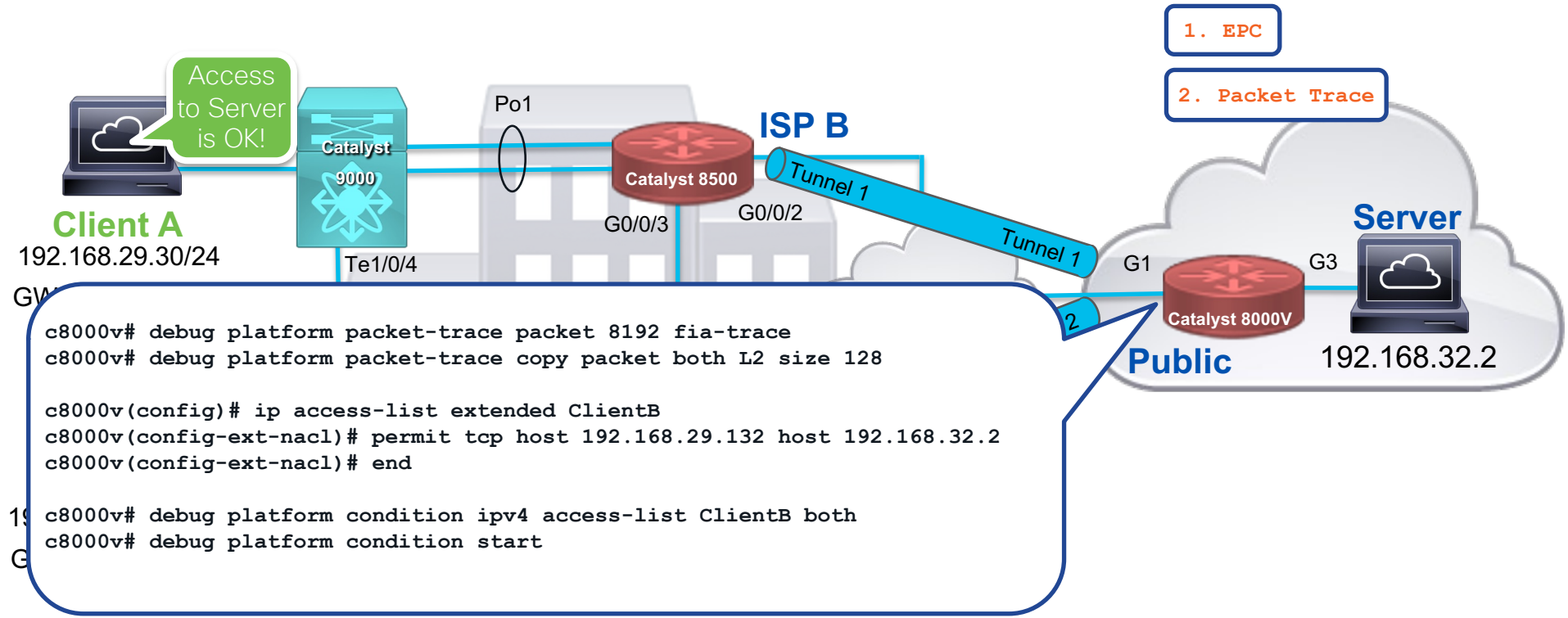
Access





Real World Example

Degraded Performance



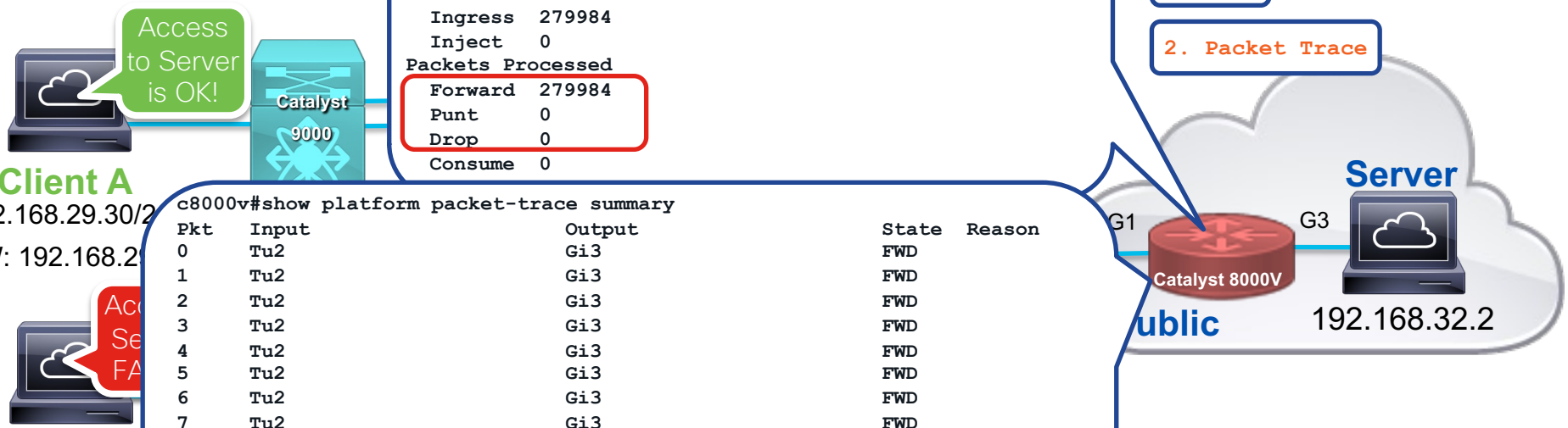

```
c8000v# debug platform packet-trace packet 8192 fia-trace
c8000v# debug platform packet-trace copy packet both L2 size 128

c8000v(config)# ip access-list extended ClientB
c8000v(config-ext-nacl)# permit tcp host 192.168.29.132 host 192.168.32.2
c8000v(config-ext-nacl)# end

c8000v# debug platform condition ipv4 access-list ClientB both
c8000v# debug platform condition start
```

Real World Example

Degraded Performan

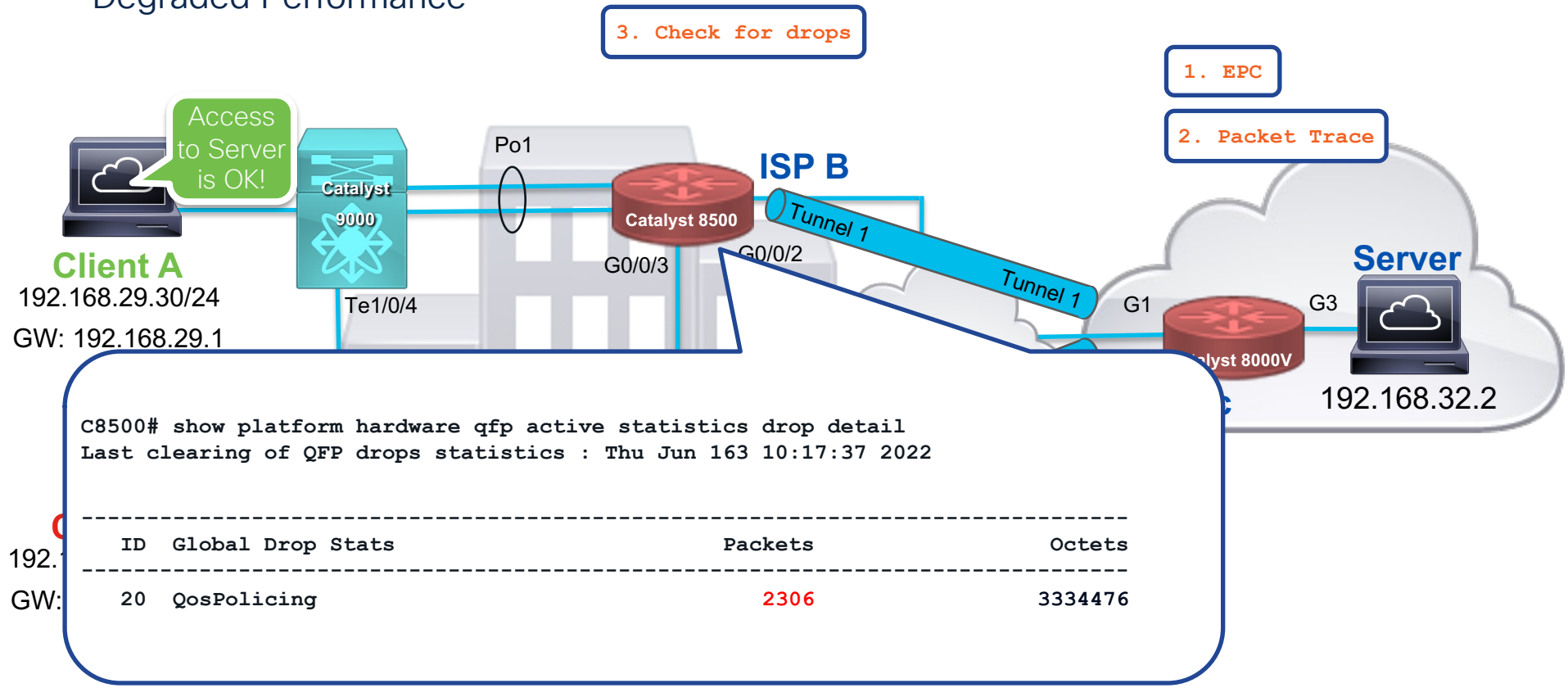
```
c8000v#show platform packet-trace statistics
Packets Summary
  Matched   279984
  Traced    8192
Packets Received
  Ingress   279984
  Inject    0
Packets Processed
  Forward   279984
  Punt      0
  Drop      0
  Consume   0
```

```
c8000v#show platform packet-trace summary
Pkt    Input                Output               State  Reason
0      Tu2                  Gi3                  FWD
1      Tu2                  Gi3                  FWD
2      Tu2                  Gi3                  FWD
3      Tu2                  Gi3                  FWD
4      Tu2                  Gi3                  FWD
5      Tu2                  Gi3                  FWD
6      Tu2                  Gi3                  FWD
7      Tu2                  Gi3                  FWD
8      Tu1                  Gi3                  FWD
9      Tu1                  Gi3                  FWD
10     Tu1                  Gi3                  FWD
11     Tu1                  Gi3                  FWD
12     Tu1                  Gi3                  FWD
13     Tu1                  Gi3                  FWD
14     Tu1                  Gi3                  FWD
```



Real World Example

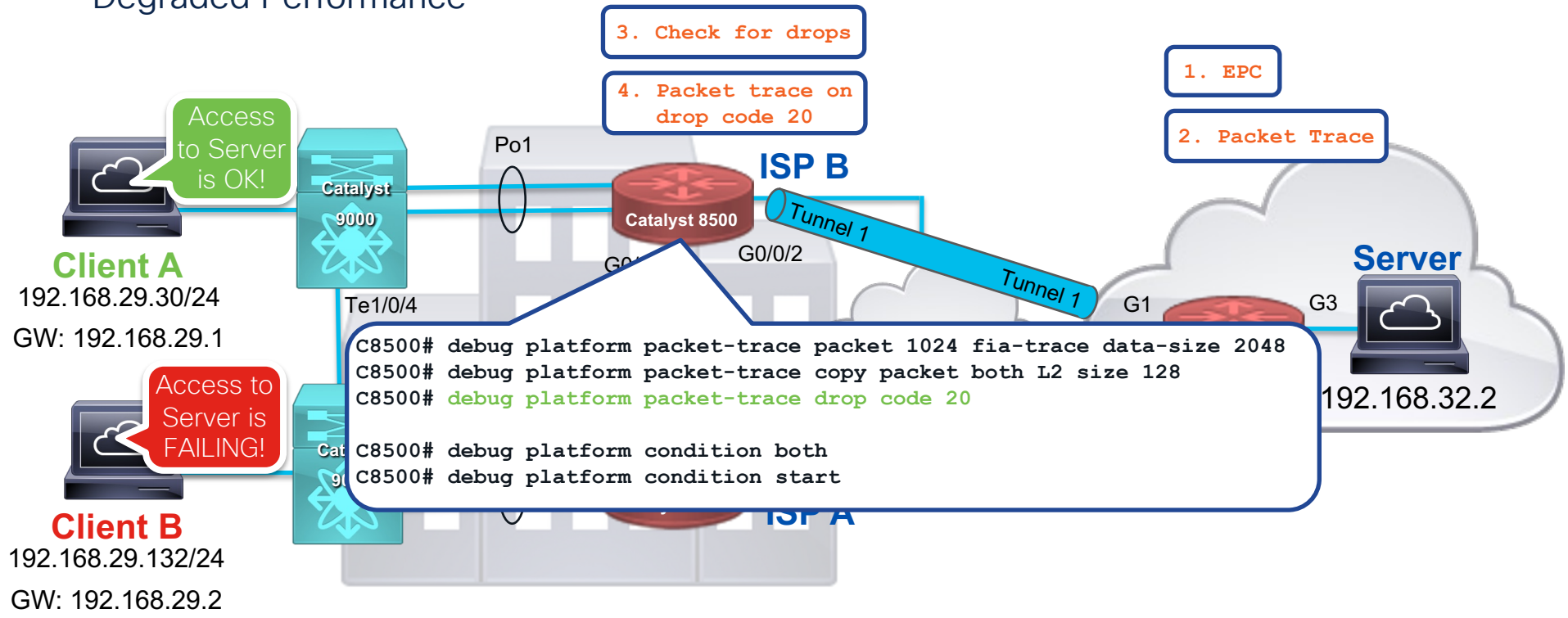
Degraded Performance




```
C8500# show platform hardware qfp active statistics drop detail
Last clearing of QFP drops statistics : Thu Jun 163 10:17:37 2022

-------------------------------------------------------------------------------
   ID  Global Drop Stats                          Packets                Octets
-------------------------------------------------------------------------------
   20  QosPolicing                                2306                   3334476
```

Real World Example

Degraded Performance

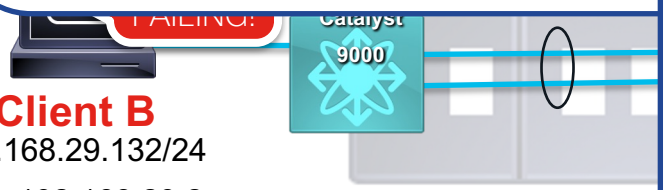


Real World Example

```
C8500# show platform packet-trace packet 0
Packet: 0            CBUG ID: 20486
Summary
  Input      : GigabitEthernet0/0/3
  Output     : Tunnel1
  State      : DROP 20  (QosPolicing)
  Timestamp
    Start    : 876257676515945 ns (04/13/2023 1
    Stop     : 876257676522704 ns (04/13/2023 1
Path Trace
  Feature: IPV4(Input)
    Input        : GigabitEthernet0/0/3
    Output       : <unknown>
    Source       : 192.168.29.132
    Destination  : 192.168.32.2
    Protocol     : 6 (TCP)
      SrcPort    : 39226
      DstPort    : 5201
<snip>
```

```
<snip>
  Feature: QOS
    Direction
    Action
    Drop Cause
    Policy name
    Class name
  Feature: OUTPUT_FNF_DROP_SDWAN
    Entry        : Output - 0x814f4700
    Input        : GigabitEthernet0/0/3
    Output       : Tunnel1
    Lapsed time  : 2406 ns
  Feature: OUTPUT_DROP
    Entry        : Output - 0x814e1798
    Input        : GigabitEthernet0/0/3
    Output       : Tunnel1
    Lapsed time  : 738 ns
  Feature: IPV4_OUTPUT_QOS
    Entry        : Output - 0x8151e720
    Input        : GigabitEthernet0/0/3
    Output       : Tunnel1
    Lapsed time  : 24400 ns
```

```
interface Tunnel1
 ip address 192.168.30.1 255.255.255.0
 tunnel source GigabitEthernet0/0/2
 tunnel mode ipsec ipv4
 tunnel destination 14.2.56.124
 tunnel protection ipsec profile PROFILE_IPSEC
 service-policy output POLICELOWER
end
!
policy-map POLICELOWER
 class LOWER
  police cir 50000000
   conform-action transmit
   exceed-action drop
```



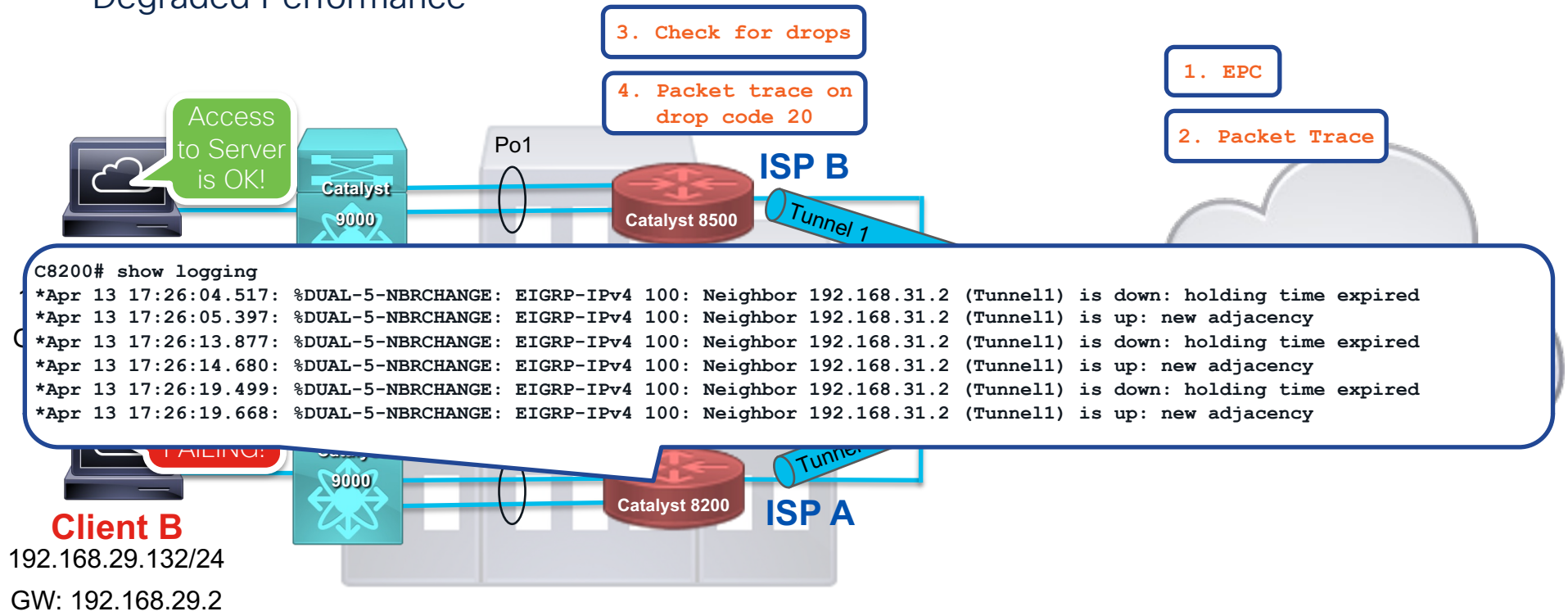
Client B

192.168.29.132/24

GW: 192.168.29.2

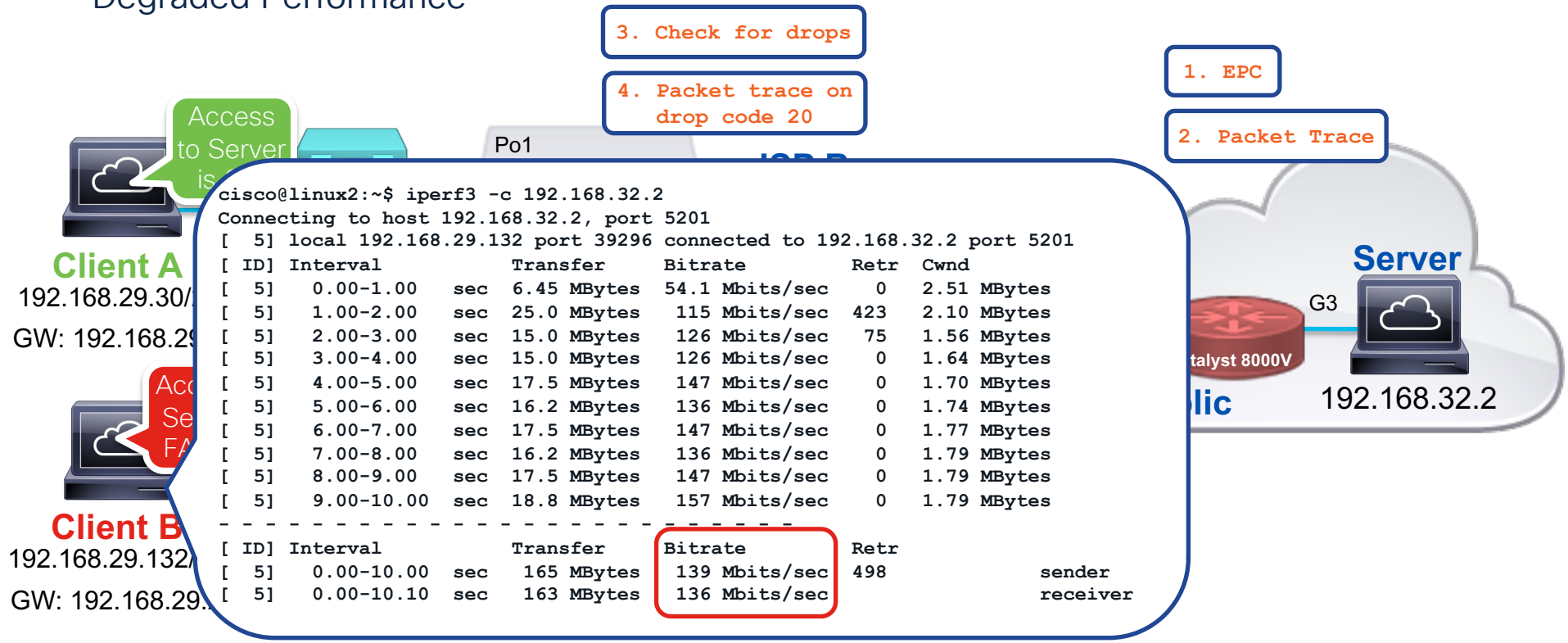
Real World Example

Degraded Performance



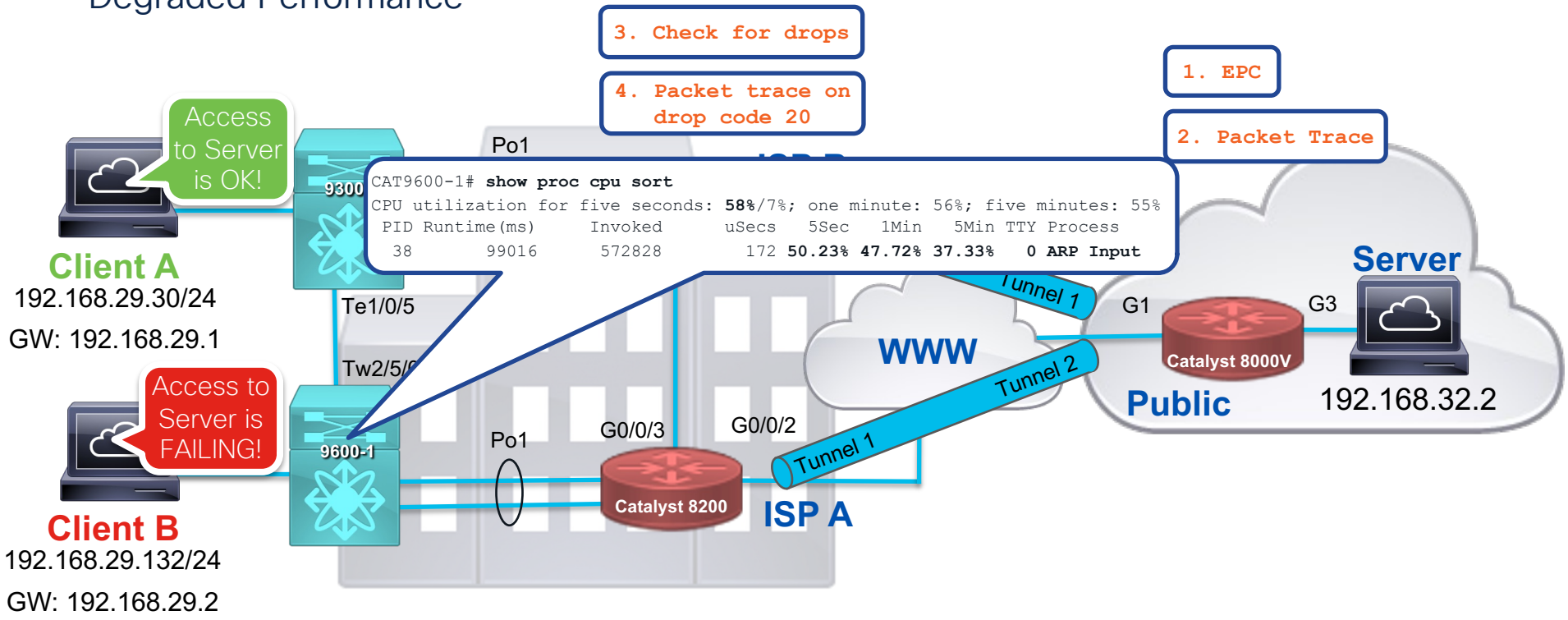
Real World Example

Degraded Performance



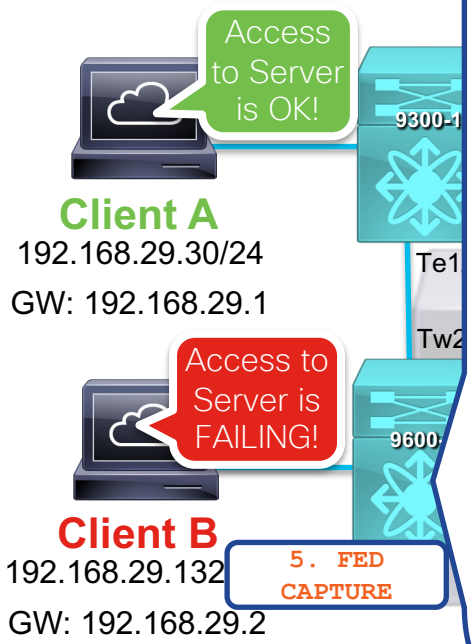
Real World Example

Degraded Performance



Real World Example

Degraded Performa

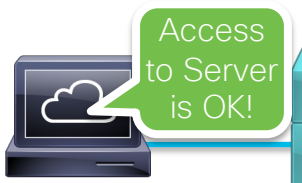



```
CAT9600-1# debug platform software fed switch active punt packet-capture start
Punt packet capturing started.

CAT9600-1# show platform software fed switch active punt packet-capture status
Punt packet capturing: disabled. Buffer wrapping: disabled
Total captured so far: 4096 packets. Capture capacity : 4096 packets

CAT9600-1# show platform software fed switch active punt packet-capture brief
Punt packet capturing: disabled. Buffer wrapping: disabled
Total captured so far: 4096 packets. Capture capacity : 4096 packets

------ Punt Packet Number: 1, Timestamp: 2023/01/02 22:02:32.660 ------
 interface : physical: GigabitEthernet1/0/2[if-id: 0x0000000a], pal: Vlan500 [if-id: 0x00000042]
 metadata  : cause: 7 [ARP request or response], sub-cause: 1, q-no: 5, linktype: MCP_LINK_TYPE_IP [1]
 ether hdr : dest mac: ffff.ffff.ffff, src mac: 0016.c81c.2f81
 ether hdr : ethertype: 0x0806 (ARP)

CAT9600-1# show platform software fed switch active punt packet-capture cpu-top-talker summary
Punt packet capturing: disabled. Buffer wrapping: disabled
Total captured so far: 4096 packets. Capture capacity : 4096 packets

L2 Top Talkers:
3937    Source mac      00:16:c8:1c:2f:81
3946    Dest mac        ff:ff:ff:ff:ff:ff
3937    Vlan    500

L3 Top Talkers:
3937    Source IPv4     10.1.1.178
15      Dest IPv4       10.1.1.4
131     TTL     255

L4 Top Talkers:
104     Protocol Num    (TCP)
104     L4 Source Port  5427
104     L4 Dest Port    23

Internal Top Talkers:
3937    Interface       Vlan500
3946     CPU Queue        ARP request or response
```

NOTE:
packet-capture cpu-top-talker summary is available in 17.6.1 onwards

Real World Example

Degraded Per



Client A
192.168.29.30/24
GW: 192.168.29.1

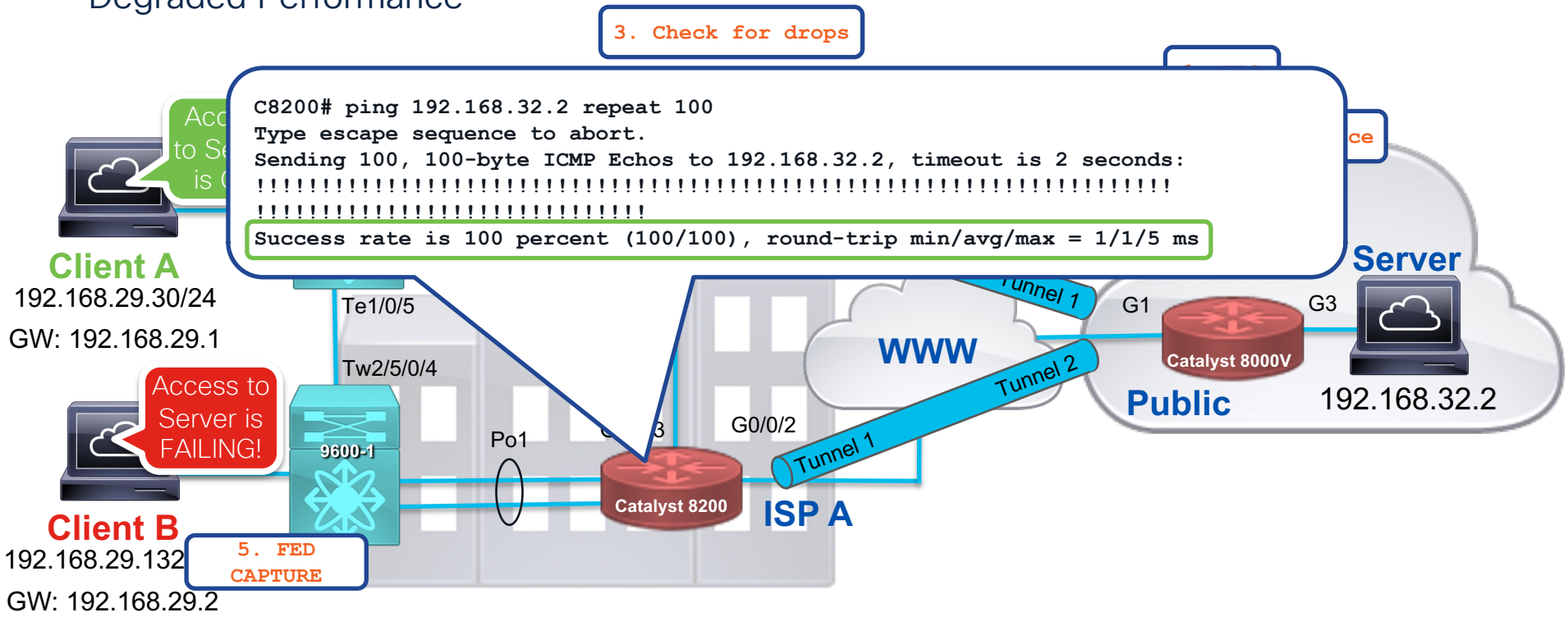
```
cisco@linux2:~$ ping -c 100 192.168.29.2
PING 192.168.29.2 (192.168.29.2): 56 data bytes
64 bytes from 192.168.29.2: icmp_seq=0 ttl=239 time=33.818 ms
64 bytes from 192.168.29.2: icmp_seq=1 ttl=239 time=27.150 ms
64 bytes from 192.168.29.2: icmp_seq=2 ttl=239 time=26.890 ms
<snip>
64 bytes from 192.168.29.2: icmp_seq=97 ttl=239 time=26.538 ms
64 bytes from 192.168.29.2: icmp_seq=98 ttl=239 time=27.251 ms
64 bytes from 192.168.29.2: icmp_seq=99 ttl=239 time=26.676 ms

--- 192.168.29.2 ping statistics ---
100 packets transmitted, 100 packets received, 0.0% packet loss
round-trip min/avg/max/stddev = 25.932/26.959/33.818/0.864 ms
cisco@linux2:~$
```

Client B
192.168.29.132
GW: 192.168.29.2

```
cisco@linux2:~$ ping -c 100 192.168.32.2
PING 192.168.32.2 (192.168.32.2): 56 data bytes
64 bytes from 192.168.32.2: icmp_seq=0 ttl=239 time=33.354 ms
64 bytes from 192.168.32.2: icmp_seq=1 ttl=239 time=26.603 ms
Request timeout for icmp_seq 2
Request timeout for icmp_seq 3
64 bytes from 192.168.32.2: icmp_seq=4 ttl=239 time=26.551 ms
<snip>
64 bytes from 192.168.32.2: icmp_seq=96 ttl=239 time=26.710 ms
Request timeout for icmp_seq 97
Request timeout for icmp_seq 98
64 bytes from 192.168.32.2: icmp_seq=99 ttl=239 time=26.520 ms

--- 192.168.32.2 ping statistics ---
100 packets transmitted, 80 packets received, 20.0% packet loss
round-trip min/avg/max/stddev = 25.621/26.990/33.354/0.883 ms
cisco@linux2:~$
```

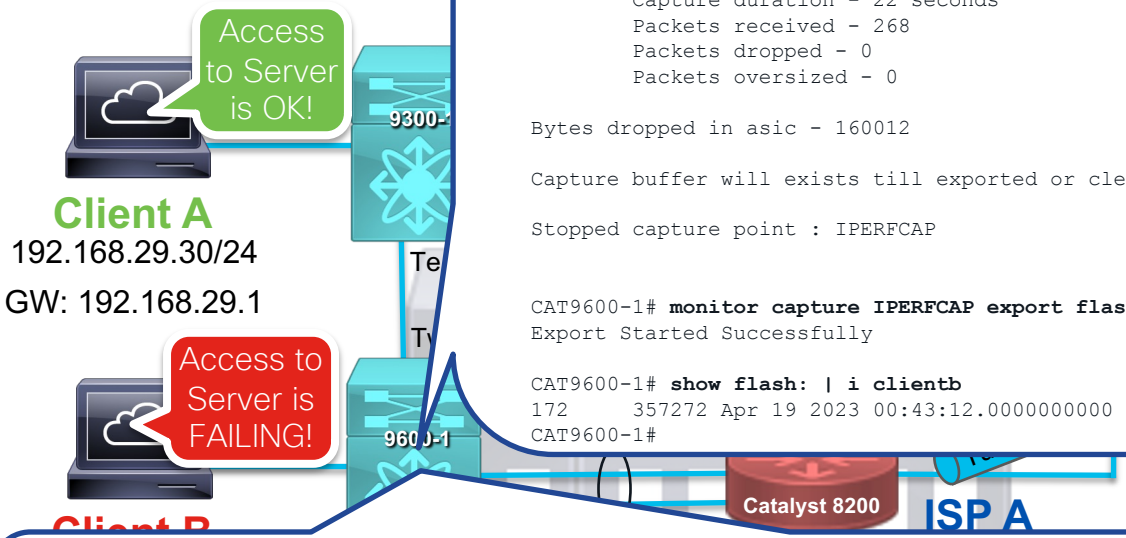
Real World Example

Degraded Performance



Real World Example

Degraded Performa




```
CAT9600-1# monitor capture IPERFCAP vlan 119 both match ipv4 host 192.168.29.132 host 192.168.32.2
CAT9600-1# monitor capture IPERFCAP start

CAT9600-1# monitor capture IPERFCAP stop
Capture statistics collected at software:
        Capture duration - 22 seconds
        Packets received - 268
        Packets dropped - 0
        Packets oversized - 0

Bytes dropped in asic - 160012

Capture buffer will exists till exported or cleared

Stopped capture point : IPERFCAP


CAT9600-1# monitor capture IPERFCAP export flash:clientb_iperf_capture.pcap
Export Started Successfully

CAT9600-1# show flash: | i clientb
172     357272 Apr 19 2023 00:43:12.0000000000 +00:00 clientb_iperf_capture.pcap
CAT9600-1#
```

```
CAT9600-1# show monitor capture file flash:clientb_iperf_capture.pcap brief
Starting the packet display ........ Press Ctrl + Shift + 6 to exit

    1   0.000000 192.168.29.132 -> 192.168.32.2 TCP 78 39488 -> 5201 [SYN] Seq=0 Win=64676 Len=0 MSS=1406 SACK_PERM=1 TSval=1112716044 TSecr=0 WS=128
    2   0.001182 192.168.29.132 -> 192.168.32.2 TCP 70 39488 -> 5201 [ACK] Seq=1 Ack=1 Win=64768 Len=0 TSval=1112716045 TSecr=2858875194
    3   0.001217 192.168.29.132 -> 192.168.32.2 TCP 107 39488 -> 5201 [PSH, ACK] Seq=1 Ack=1 Win=64768 Len=37 TSval=1112716045 TSecr=2858875194
    4   0.002761 192.168.29.132 -> 192.168.32.2 TCP 70 39488 -> 5201 [ACK] Seq=38 Ack=2 Win=64768 Len=0 TSval=1112716047 TSecr=2858875196
```

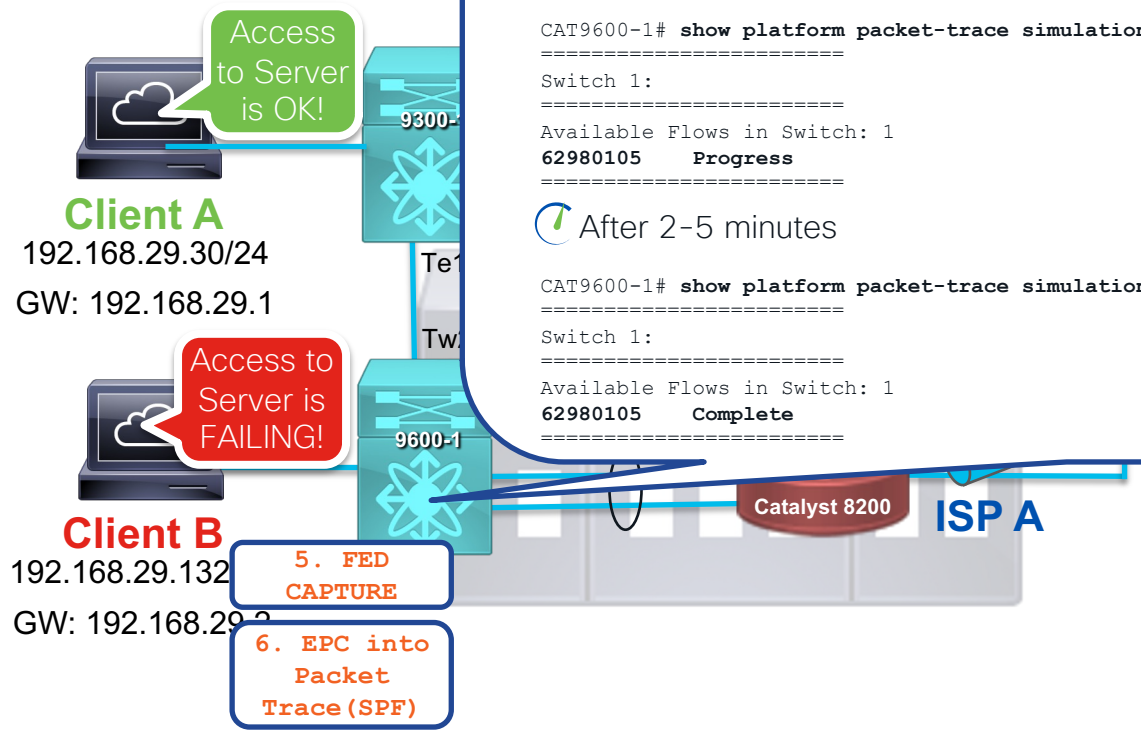
Real World Example

Degraded Performa

```
CAT9600-1# debug platform condition feature simulate pcap flash:clientb_iperf_capture.pcap number 1
CAT9600-1# debug platform condition feature simulate interface tw2/5/0/1

CAT9600-1# debug platform condition start
CAT9600-1# debug platform packet-trace simulation start

CAT9600-1# show platform packet-trace simulation status
==========================
Switch 1:
==========================
Available Flows in Switch: 1
62980105     Progress
==========================
```

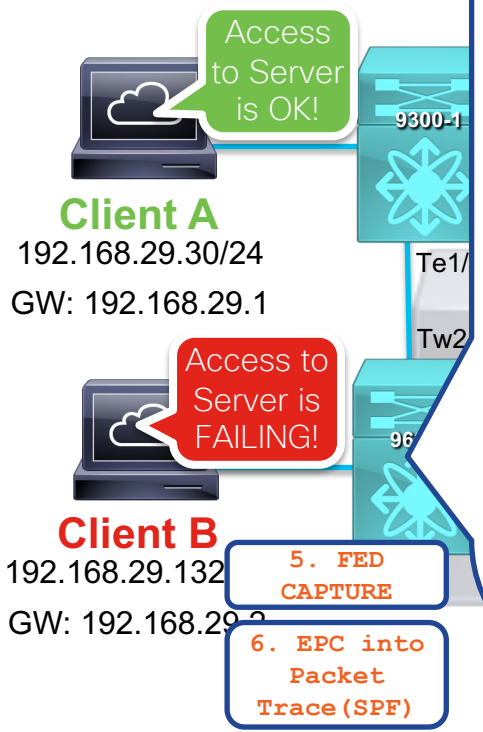
After 2-5 minutes

```
CAT9600-1# show platform packet-trace simulation status
==========================
Switch 1:
==========================
Available Flows in Switch: 1
62980105     Complete
==========================
```



Real World Example

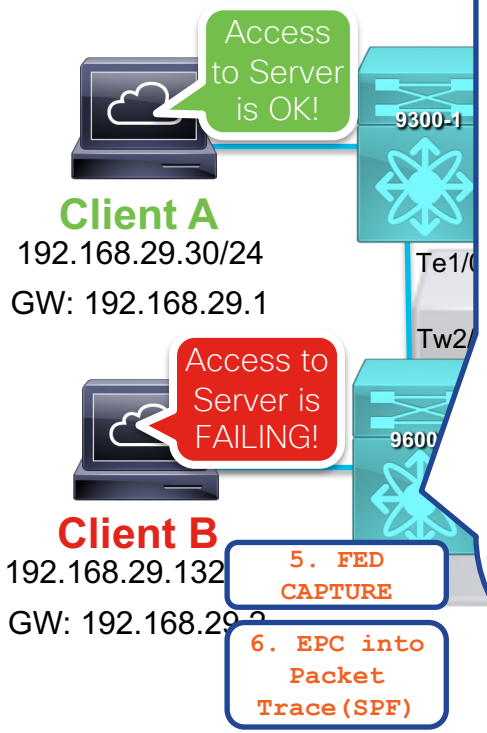
Degraded Performance




```
CAT9600-1# show platform packet-trace simulation flowid 62980105 summary
=======================
Switch Active:
=======================
Input Packet Details:
###[ Ethernet ]###
  dst       = 00:00:0c:07:ac:02
  src       = 00:50:56:b4:23:4f
  type      = 0x8100
###[ 802.1Q ]###
     prio      = 0
     id        = 0
     vlan      = 119
     type      = 0x800
###[ IP ]###
     version   = 4
     ihl       = 5
     tos       = 0x0
     len       = 60
     id        = 37744
     flags     = DF
     frag      = 0
     ttl       = 64
     proto     = tcp
     chksum    = 0xe874
     src       = 192.168.29.132
     dst       = 192.168.32.2
     options   = ''
###[ Raw ]###
        load      = '9A 40 14 51 8F CB 40 06 00 00 00 00 A0 02 FC A4 18 F8 00 00 02 04 05 7E 04 02 08
0A 42 52 B3 0C 00 00 00 00 01 03 03 07'
```

Real World Example

Degraded Performance




```
Ingress:
    Port                          : TwentyFiveGigE2/5/0/1
    Global Port Number            : 961
    Local Port Number             : 1
    Asic Port Number              : 1
    Asic Instance                 : 0
    Vlan                          : 119
    Mapped Vlan ID                : 5
    STP Instance                  : 4
    BlockForward                  : 0
    BlockLearn                    : 0
    L3 Interface                  : 73
        IPv4 Routing              : enabled
        IPv6 Routing              : enabled
        Vrf Id                    : 0
    Adjacency:
        Station Index             : 179
        Destination Index         : 965
        Rewrite Index             : 2
        Replication Bit Map       : 0x15    ['localData', 'remoteData', 'coreData']
    Decision:
        Destination Index         : 16402   [DI_ETHER_CHANNEL]
        Rewrite Index             : 2       [RI_L2]
        Dest Mod Index            : 0       [IGR_FIXED_DMI_NULL_VALUE]
        CPU Map Index             : 0       [CMI_NULL]
        Forwarding Mode           : 0       [Bridging]
        Replication Bit Map       :         ['localData', 'remoteData', 'coreData']
        Winner                    :         L2DESTMACVLAN LOOKUP
        Qos Label                 : 1
        SGT                       : 0
        DGTID                     : 0
```

Real World Example

```
Egress:
 Possible Replication      :
     Port                  : TwentyFiveGigE2/5/0/2
     Port                  : TwentyFiveGigE2/5/0/3
 Output Port Data          :
   Port                    : TwentyFiveGigE2/5/0/3
     Global Port Number    : 1285
     Local Port Number     : 25
     Asic Port Number      : 11
     Asic Instance         : 3
     Unique RI             : 0
     Rewrite Type          : 0       [Unknown]
     Mapped Rewrite Type   : 4       [L2_BRIDGE_INNER_IPv4]
     Vlan                  : 119
     Mapped Vlan ID        : 5

Output Packet Details:
   Port                    : TwentyFiveGigE2/5/0/3
###[ Ethernet ]###
  dst       = dc:77:4c:6f:a7:1f
  src       = 00:50:56:b4:23:4f
  type      = 0x8100
###[ 802.1Q ]###
     prio      = 0
     id        = 0
     vlan      = 119
     type      = 0x800
###[ IP ]###
        version   = 4
        ihl       = 5
        tos       = 0x0
        len       = 84
        id        = 4258
        flags     =
        frag      = 0
        ttl       = 255
        proto     = icmp
        chksum    = 0x9502
        src       = 192.168.29.132
        dst       = 192.168.29.2
        options   = ''
```

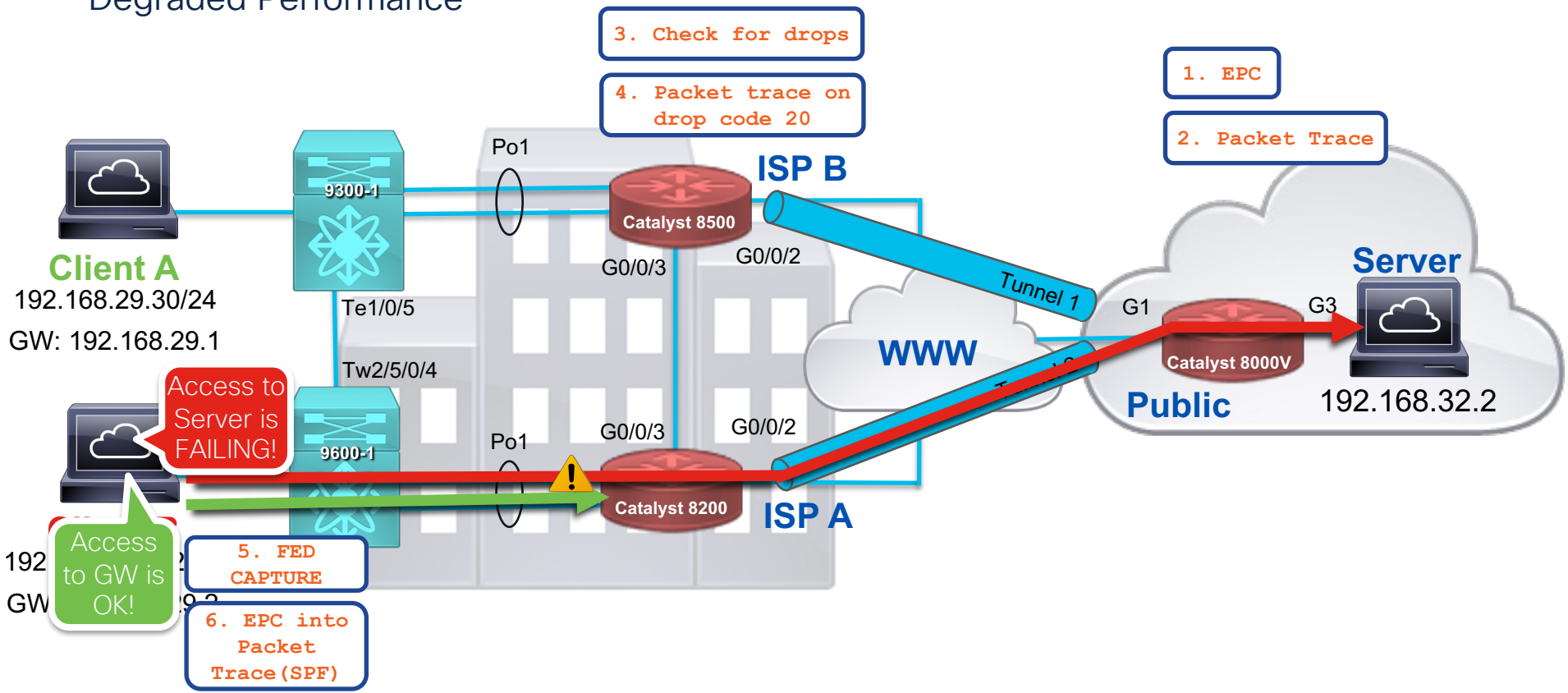
ICMP TO GATEWAY

```
Egress:
 Possible Replication      :
     Port                  : TwentyFiveGigE2/5/0/2
     Port                  : TwentyFiveGigE2/5/0/3
 Output Port Data          :
   Port                    : TwentyFiveGigE2/5/0/2
     Global Port Number    : 1346
     Local Port Number     : 25
     Asic Port Number      : 11
     Asic Instance         : 3
     Unique RI             : 0
     Rewrite Type          : 0       [Unknown]
     Mapped Rewrite Type   : 4       [L2_BRIDGE_INNER_IPv4]
     Vlan                  : 119
     Mapped Vlan ID        : 5

Output Packet Details:
   Port                    : TwentyFiveGigE2/5/0/2
###[ Ethernet ]###
  dst       = 00:00:0c:07:ac:02
  src       = 00:50:56:b4:23:4f
  type      = 0x8100
###[ 802.1Q ]###
     prio      = 0
     id        = 0
     vlan      = 119
     type      = 0x800
###[ IP ]###
        version   = 4
        ihl       = 5
        tos       = 0x0
        len       = 60
        id        = 37744
        flags     = DF
        frag      = 0
        ttl       = 64
        proto     = tcp
        chksum    = 0xe874
        src       = 192.168.29.132
        dst       = 192.168.32.2
        options   = ''
```

TCP TO SERVER

Real World Example

Degraded Performance



Real World Example

Degr

```
cisco@linux2:~$ iperf3 -b 200M -c 192.168.32.2
Connecting to host 192.168.32.2, port 5201
[  5] local 192.168.29.132 port 37510 connected to 192.168.32.2 port 5201
[ ID] Interval           Transfer     Bitrate         Retr  Cwnd
[  5]   0.00-1.00   sec  23.8 MBytes   199 Mbits/sec   12    133 KBytes
[  5]   1.00-2.00   sec  23.9 MBytes   200 Mbits/sec    0    133 KBytes
[  5]   2.00-3.00   sec  23.9 MBytes   200 Mbits/sec    0    133 KBytes
[  5]   3.00-4.00   sec  23.9 MBytes   200 Mbits/sec    0    133 KBytes
[  5]   4.00-5.00   sec  23.8 MBytes   199 Mbits/sec    0    133 KBytes
[  5]   5.00-6.00   sec  23.9 MBytes   200 Mbits/sec    0    133 KBytes
[  5]   6.00-7.00   sec  23.9 MBytes   200 Mbits/sec    0    133 KBytes
[  5]   7.00-8.00   sec  23.9 MBytes   200 Mbits/sec    0    133 KBytes
[  5]   8.00-9.00   sec  23.8 MBytes   199 Mbits/sec    0    147 KBytes
[  5]   9.00-10.00  sec  23.9 MBytes   200 Mbits/sec    0    147 KBytes
- - - - - - - - - - - - - - - - - - - - - - - - -
[ ID] Interval           Transfer     Bitrate         Retr
[  5]   0.00-10.00  sec   312 MBytes   200 Mbits/sec   12             sender
[  5]   0.00-10.00  sec   311 MBytes   200 Mbits/sec                  receiver
iperf Done.
cisco@linux2:~$
```

1. EPC

2. Packet Trace

Client

192.168.2

GW: 192.

Access to Server is OK!

Access to GW is OK!

9600-1

Po1

G0/0/3

G0/0/2

Catalyst 8200

ISP A

G3

Catalyst 8000V

Server

Public

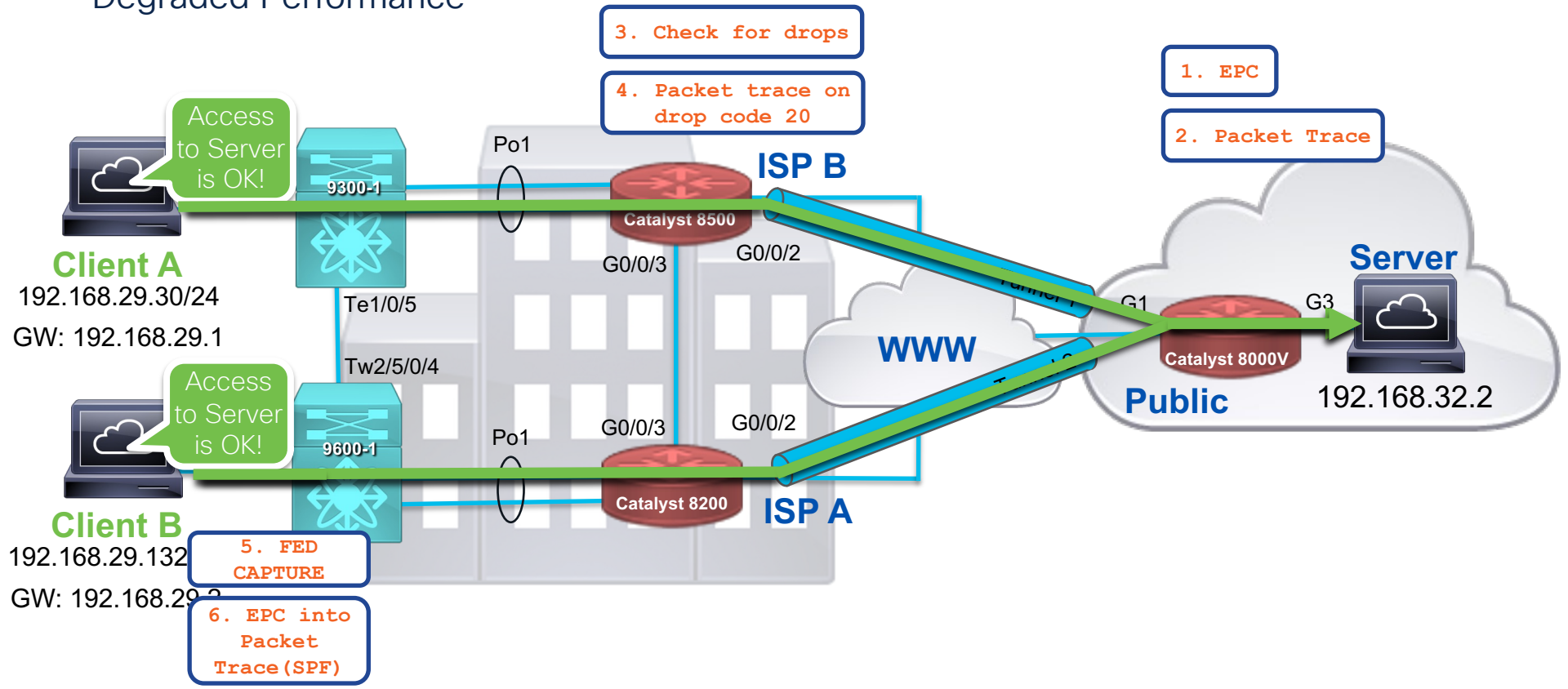
192.168.32.2

5. FED CAPTURE

6. EPC into Packet Trace (SPF)

Real World Example

Degraded Performance



Summary & Take Away

Packet Capturing Tools

Usage Considerations

Tool	Impact	Comments
Show commands		This command shows detail of the packets in the system buffer
Catalyst 3650/3850/9000 FED Tracing/Packet Capture		Uses limited CPU/memory resources and can be run during high CPU utilization
Flexible NetFlow		For software-based forwarding platforms, this feature utilizes memory/buffer and CPU cycles. For hardware-based forwarding platforms, number of flows is limited by the hardware capacity.
SPAN / RPSAN / ERSPAN		Packet replication is performed by a specific ASIC. With oversubscription, this could cause adverse effects. With RSPAN, the replicated traffic may get flooded throughout the network. ERSPAN may require CPU cycles for decapsulation.
Embedded Packet Capture		The traffic captured by these tools is saved in the system memory/buffer. It is recommended to fine-tune the capture filters/ACLs to reduce the number of packets captured, size of the packets, etc.
Packet Trace (Switches)		Captures a single packet (PSV) or mimics packet forwarding decision (SPF). Perfectly safe to run with any packet type or conditions.
Packet Trace (Routers)		Similar concerns to Embedded Packet Capture (above)
Debug Commands		Use caution, can increases CPU utilization, filters reduce impact

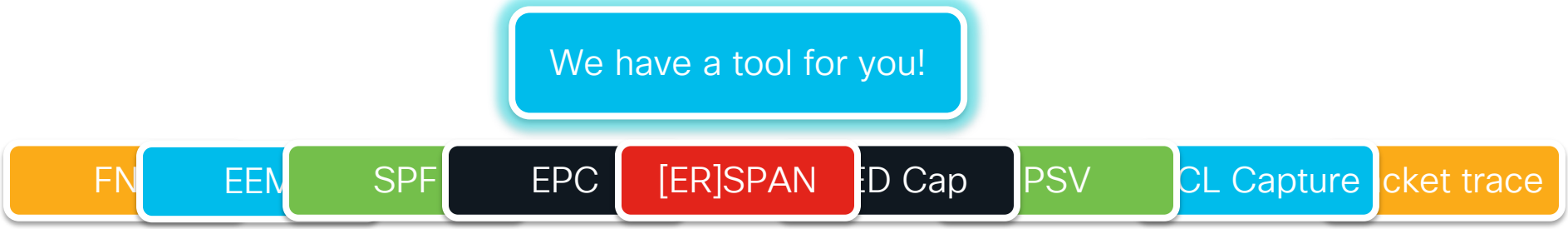
*Cannot capture on the management port

Packet Capturing Tool	Control Plane	Data Plane	PCAP	Header Info	Full Packet	Local Viewing	Remote Viewing	Filtering	Single Packet	Forwarding Information	CLI Analyzer Support	Platform
Flexible NetFlow	●	●		●		●	●			●		All
FED Tracing/Packet Capture	●			●	●	●		●				3650/3850 & 9000
SPAN/RSPAN/ERSPAN		●	●	●	●		●					Switches & IOS-XE Routers
* Embedded Packet Capture	●	●	●	●	●	●	●	●			●	All Routers /IOS-XE Switches
Packet Trace (Routers)	●	●		●	●	●		●		●		IOS-XE Routers
Packet Trace (Switches-SPF)	●	●		●		●			●	●		Catalyst 9000 Series UADP2.0, 2.0 mini, & 3.0
Packet Trace (Switches-PSV)		●		●		●		●	●	●		Catalyst 9600 & 9500H UADP 3.0

Overview of Troubleshooting Tools

Summary and Take Away ....

- Cisco Routers and Switches are advanced and feature-rich, built with keeping end-users and network engineers in mind.
- Cisco provides a rich set of packet capturing tools embedded and supported across the spectrum of our products. These tools give visibility into the products, helping to validate the path-of-the-packet and isolate problems.
- Knowing the tools and capabilities available on each platform will reduce the time to resolution of network issues.



Additional Breakout Sessions and Labs

For more info...

LABTRS-2456 Packet Capturing Tools in Routing Environments
LABTRS-2048 Packet Trace and Conditional Debugger on IOS-XE Routers

LABCRT-2452 CCNP ENCOR – Core Enterprise Network Technologies Practice Lab
LABCRT-2460 CCNP ENARSI – Implementing Cisco Enterprise Advanced Routing and Services Practice Lab
LABCRT-2464 Troubleshoot like a CCNP – Basic
LABCRT-2465 Troubleshoot like a CCNP - Intermediate
LABCRT-2466 Troubleshoot like a CCNP - Advanced

BRKTRS-3475 Automation and In-Depth Troubleshooting of Cisco Catalyst 8000, ASR 1000, ISR and SD-WAN Edge

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Friday	**10:30am – 1:30pm**

Session Surveys

We would love to know your feedback on this session!

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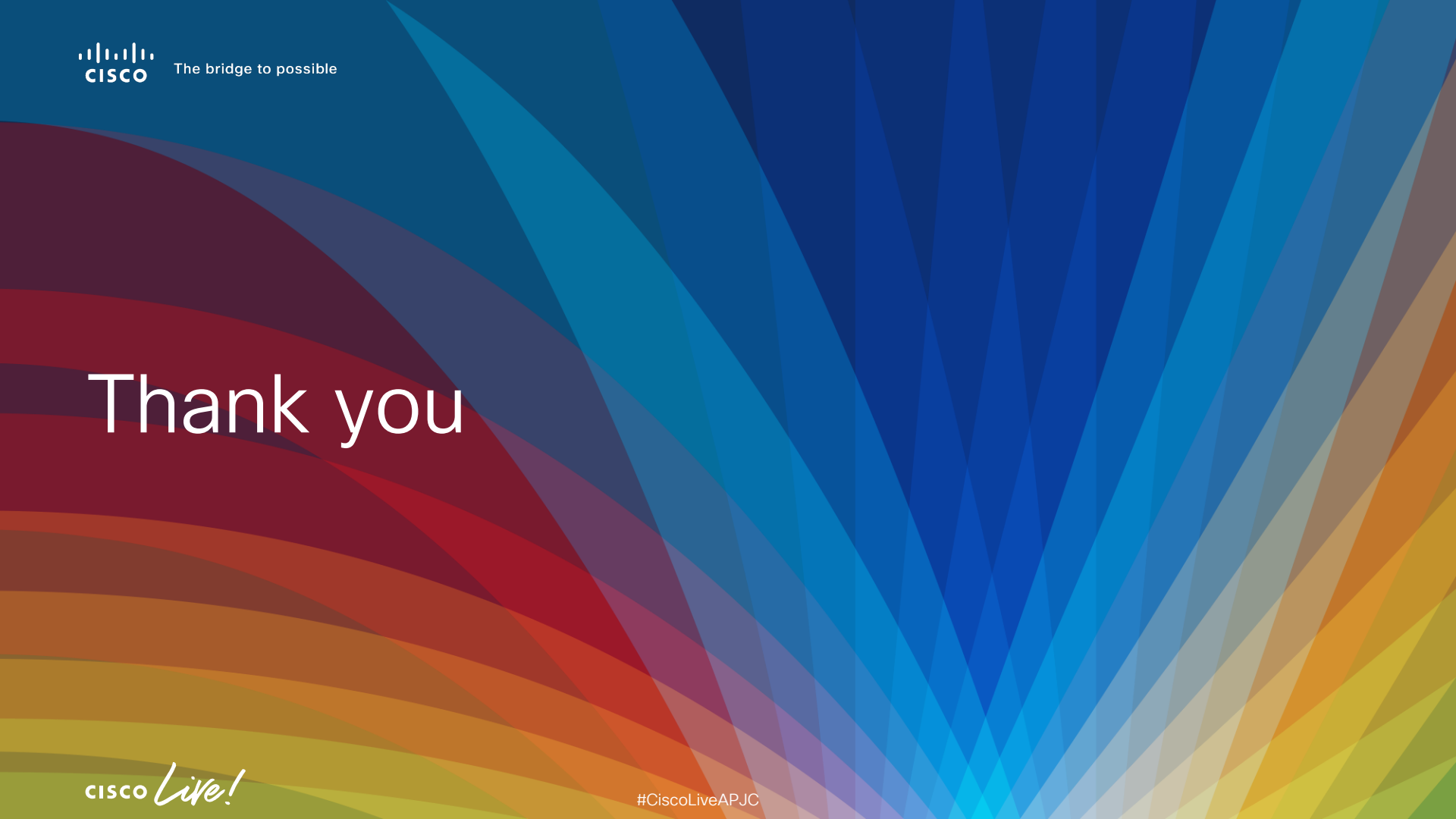
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