Report Problems with High CPU/QFP on Routers to TAC

Contents

Introduction

Prerequisites

- Requirements
- Components Used

Background Information

Symptoms for High QFP/CPU Utilization

- Control Plane (CPU) - IOSd
- Control Plane - Kernel (CPU)
- Data Plane (QFP)

Potential Logs Seen

Information TAC Needs for Initial Triage

Understanding High CPU/QFP Usage

General Troubleshooting Steps

Understanding High CPU on Cisco IOS XE Routers

Understanding High QFP on Cisco IOS XE Routers

High CPU/QFP on Cisco IOS XE Routers (ISR4300/4200/4400/4600 Series, Cat8200/8300/8500, CSR1000v, CAT8000v)

High CPU on Modular Cisco IOS XE Routers (ASR1k Series)

Introduction

This document describes general troubleshooting for properly reporting high CPU/QFP issues to TAC for faster case resolution.

Prerequisites

Requirements

Cisco recommends that you have basic knowledge of these topics:

- Basic knowledge of Cisco IOS® XE packet forwarding architecture.
- Basic experience with Packet Trace Feature.

Components Used

This document is not restricted to specific software and hardware versions. It applies for any routing Cisco IOS XE® platform with physical/virtualized QFP like ASR1000, ISR4000, ISR1000, Cat8000 or Cat8000v.

The information in this document was created from the devices in a specific lab environment. All of the devices used in this document started with a cleared (default) configuration. If your network is live, ensure that you understand the potential impact of any command.

Background Information

This document outlines the commands TAC needs for the initial triage of a high CPU/QFP problem for a great TAC experience from the very first contact.

Also, this document contains troubleshooting tips in order to identify a high Central Processing Unit (CPU) or a high Quantum Flow Processor(QFP) utilization problem so you can find a solution prior opening a TAC case.

The purpose of this document is not to explain any troubleshooting procedures extensively. If available, references to more in deep troubleshooting guides are provided.

At the end of this document, there are block diagrams that serve for educational purposes as a visual representation of the components.

High components - memory, TCAM, CPU, QFP - utilization typically is an indicator of either:

- Something going wrong on the device (that is process not working as expected, potential Sw problem) or in the network environment (that is punt traffic, loops).
- Reaching the hardware limitation of the device (that is too many traffic/features running on the device).

Identifying the underlying cause of the high component utilization is vital in order to determine proper course of action for solving the problem.

Symptoms for High QFP/CPU Utilization

You can validate if there is a high CPU or QFP condition via monitoring tools, or via these commands:

Control Plane (CPU) - IOSd

```
show process cpu sorted
iosxe_router#show process cpu sorted
CPU utilization for five seconds: 90%/0%; one minute: 0%; five minutes: 0%
 PID Runtime(ms)     Invoked      uSecs   5Sec   1Min   5Min TTY Process
 395       78769     1242162         63  89.07%  88.04%  89.02%   0 CDP Protocol
   1           8           88         90  0.00%  0.00%  0.00%   0 Chunk Manager
--- snip ---
```

From the line CPU utilization for five seconds: 90%/0%; one minute: 0%; five minutes: 0%, you need to focus on the first value after the five seconds string. In this case, the 90% indicates the overall CPU utilization, while the number to the right of the slash-0 in this case-represents the CPU usage due to interrupts. The difference between these two numbers represents the total CPU utilization due to processes. In this scenario, the CDP Protocol is consuming most of the CPU (control plane) resources.

Control Plane - Kernel (CPU)

Since Cisco IOS XE has a Linux-based kernel, sometimes you find issues along any of the processes running on top of it, you can use the show processes CPU platform sorted for validating if any process is causing problems (focus on the 5sec column) to show processes from the underlying operating system.

```
iosxe_router#show process cpu platform sorted
-- depending on the architecture, there can be multiple cores, deleting for brevity --
   Pid    PPid    5Sec    1Min    5Min  Status        Size  Name
-------------------------------------------------------------------------------
 18009   18001    323%    325%    328%  R           266740  ucode_pkt_PPE0
 11168   11160      1%      1%      1%  S           914556  linux_iosd-imag
    96       2      1%      0%      0%  S                0  ksmd
--- snip ---
```



Note: Routers with virtual QFP have the ucode_pkt_PPE0 process, which is the software process which emulates the data plane. Therefore that process can be ignored from the list of processes that contribute to CPU utilization.

Data Plane (QFP)

QFP is the System on a Chip responsible of all the packet forwarding. Additional information can be found in the section: Understanding High QFP on IOS XE routers.

```
iosxe_router #show platform hardware qfp active datapath utilization
  CPP 0: Subdev 0            5 secs        1 min        5 min       60 min
--- snip ---
                  (bps)        21992        13648        13736        13720
Processing: Load (pct)             0            0            0            0

Crypto/IO
        RX: Load (pct)             0            0            0            0
        TX: Load (pct)             1            1            1            0
            Idle (pct)            99           99           99           99
```

From the **show platform hardware qfp active data path utilization** command, focus on the processing: Load for the 5 seconds column, as this provides the most recent overall QFP usage. Some devices display the usage of the Crypto/IO module as well, focus on Idle, the closer to 100%, the better.

Potential Logs Seen

By default, there are no logs generated by the system that shows a high CPU utilization on IOSd which uses CPU number 0, the first CPU on Cisco IOS XE systems.

This command must be configured first for syslog to be generated on the first core.

This command must be written according to the format described in CPU Thresholding Notification: **process cpu threshold type {total | process | interrupt} rising percentage interval seconds [falling percentage interval *seconds*]**

In that way, you would be able to see this type of notification:

```
%SYS-1-CPURISINGTHRESHOLD: Threshold: Total CPU Utilization(Total/Intr): 91%/2%, Top 3 processes(Pid/Ut
```

Another way to catch high usage on it is via SNMP or Telemetry measurements.

In some cases, you would see a resource LIMIT alert like this one when other cores have a high usage hit:

```
PLATFORM_INFRA-5-IOS_INTR_OVER_LIMIT:
```

For data plane, you would see this type of QFP alert in log generally indicating that the threshold load as exceeded:

```
MCPRP-QFP-ALERT: Slot: 0, QFP:0, Load 93% exceeds the setting threshold(80%).
```

Information TAC Needs for Initial Triage

- Output of these commands when the high CPU behavior is observed:
  - **show clock**
  - **show version**
  - **show running**
  - **show process cpu sorted**
  - **show process cpu history**
  - **show platform resources**
  - **show platform hardware qfp active datapath utilization summary**
  - **show logging**
- Network topology.
- CPU/QFP utilization history graphs.
- Provide additional information in detail such as recent network or configuration changes, expected traffic rate/flow.

If CPU is not stuck at a constant 100%, include a show tech output. This is of great help to the TAC, and you can benefit from the automations TAC has developed to help you find issues faster.



Note: High-CPU condition must be troubleshooted while the problem is present, as the device does not store any historical data about processes running time.



Note: Make sure you are running a supported version. Look for the End-of-Sale and End-of-Life document for the release. If needed, move to a version that is currently under Software Maintenance Releases. Otherwise, TAC is limited on the troubleshooting and resolution options.

Understanding High CPU/QFP Usage

As a rule, a CPU/QFP is considered to be running high if it is running greater than 80%.

Cisco IOS XE routers can be associated with high utilization on the control plane (CPU) or in the data plane (QFP).



Note: Ideally, a high CPU/QFP utilization must be evaluated relative to the typical usage patterns of the device over time. For example, if a device normally operates at 10% CPU usage but suddenly jumps to 40%, this could indicate high CPU usage for that device. On the other hand, a device consistently running at 80% CPU usage is not necessarily a problem if that is its usual operating level. Monitoring systems with CPU graphs can help collect and analyze this data to establish a baseline for each device.

General Troubleshooting Steps

1. Identify if the problem is control plane (CPU) or data plane (QFP).
2. Identify the offended process via specific commands.
3. Based on process name, do a web search for that process:
    - Focus on matching that process with a known feature/configuration.
    - Check if there is any software defect matching the process name and behavior. If any, implement workaround or Sw upgrade to a fixed release.
4. With the help of CPU/QFP graphs, identify the exact time when the CPU/QFP starts increasing its usage. If it matches with a recent change, revert to the initial configuration/software version and check the results.
5. If the web search does not provide useful results, or you believe a feature is acting wrong, open a TAC case with this information:
    - **show tech**
    - Commands collected (look the Information TAC needs for initial triage section).
    - Try to match the time when the issue started with a specific configuration change and include this information when opening the TAC case.
    - If the data plane is identified as the problem: provide the network topology, expected number of users, and typical traffic rate flowing through the device.
    - If available, provide the CPU/QFP utilization history graph.

Understanding High CPU on Cisco IOS XE Routers

Referring to CPU on an Cisco IOS XE router is referring to the CPU responsible for the administrative/control plane operations of the device. There are many processes running on the device, all of them running on top of a Linux based kernel. Each one of these processes are running in a general-purpose CPU.

When a high CPU condition is present, it is typically an indicator of:

- One or more processes having to complete a high-intensity task.
- One or more processes not working as expected.
- Control plane receiving and processing packets being sent by the Data Plane.

Some platforms have multiple general purpose CPUs, which abide by these rules:

- If the Cisco IOS XE router is modular (that is accepts multiple cards, such as Route Processor, Embedded Service Processor, SPA Interface processor), there are multiple CPUs available for control plane operations, and one general purpose CPU for each one of the cards.
- If the Cisco IOS XE router is an embedded one, and only accepts service modules or interface cards, the router has a single general-purpose CPU (either virtual or physical) which is considered to be in the route processor (as seen in the **show platform resources** output).

On Cisco IOS XE devices, generally you have data plane and control plane CPU-dedicated cores.

Generally, if CPU 0 (the first CPU) is tied to IOSd (IOS daemon), the CPU-dedicated core is control plane-related. Other CPUs can be a mix of control plane and data plane CPUs.

In the case of ASR 1000, which is generally modular, command outputs like **show platform resources** and **show platform software status control-processor brief** show the usage for control plane (RP) and data plane (ESP) CPUs.

- In the case of ISR4000 Series, refer to Implement Performance License for Integrated Service Router 4000 which depicts the diagrams for the different CPUs distributions among the existing models.
- In the case if virtual platforms like Cisco CSR1000v and Cisco CSR8000v they are template based where by default, most of the vCPUs are dedicated to the data plane. Refer to Configuring the vCPU Distribution across the Data, Control and Service Planes and Cisco Catalyst 8000V Edge Software Installation And Configuration Guide.

Control plane CPUs are dedicated to controlling protocol processing like processing BGP protocol, STP protocol, CDP, SSH and so on. Control plane CPUs process packets destined to the router itself for its processing.

Data plane generally refers to transit packets that the router does not consume itself in Routing Processor (RP), instead, data plane process packets that are processed only in Quantum Flow Processor (QFP) component which is the packet processor. These packets have its processing in QFP where lookups happen to send the transit packet to its intended destination.

Understanding High QFP on Cisco IOS XE Routers

The Quantum Flow Processor (QFP) is the System on a Chip (SoC) in charge of all the packet forwarding operations in the device. The QFP runs a specialized piece of software called microcode. This microcode is

responsible for executing and applying features to all the packets passing through the device based on the input/output interface configuration. It also interacts with the rest of the system through the different processes.

When a high QFP condition is present, it is typically an indicator of:

- QFP processing too much network traffic (packets per second).
- QFP having to process high-intensity features.
- A combination of packets per second + high-intensive features have greater impact on QFP utilization.
- Microcode processing something in the wrong way.

For better understanding of the situation, TAC must collect the Feature Invocation Array (FIA) trace for additional analysis. This is documented at Troubleshoot with the IOS-XE Datapath Packet Trace Feature

High CPU/QFP on Cisco IOS XE Routers (ISR4300/4200/4400/4600 Series, Cat8200/8300/8500, CSR1000v, CAT8000v)

These are starting basic commands that must be gathered at issue time (EEM logic can be implemented to match log notification and get the output):

```
router_non_modular#show platform resources
**State Acronym: H - Healthy, W - Warning, C - Critical
Resource                Usage                Max            Warning         Critical        State
-------------------------------------------------------------------------------------------------
RP0 (ok, active)                                                                            H
 Control Processor      10.64%               100%           80%             90%             H
  DRAM                  2143MB(54%)          3913MB         88%             93%             H
  bootflash             2993MB(97%)          3099MB         70%             90%             C
ESP0(ok, active)                                                                            H
 QFP                                                                                        H
  DRAM                  52844KB(20%)         262144KB       85%             95%             H
  IRAM                  207KB(10%)           2048KB         85%             95%             H
  CPU Utilization       0.00%                100%           90%             95%             H
```

```
Router#show platform software status control-processor brief
Load Average
 Slot  Status  1-Min  5-Min 15-Min
  RP0 Healthy   1.75   1.25   1.14

Memory (kB)
 Slot  Status    Total     Used (Pct)     Free (Pct) Committed (Pct)
  RP0 Healthy  4003008  2302524 (58%)  1700484 (42%)   3043872 (76%)

CPU Utilization
 Slot  CPU   User System   Nice   Idle    IRQ   SIRQ IOwait
  RP0    0   5.60  10.80   0.00  75.00   0.00   0.10   8.50
         1   8.10  11.81   0.00  66.66   0.00   0.20  13.21
```

```
          2   4.69   9.49   0.00  80.81   0.00   0.19   4.79
          3   4.80  10.20   0.00  79.30   0.00   0.10   5.60
          4   3.70   3.20   0.00  92.90   0.00   0.00   0.20
          5   1.09   2.99   0.00  95.00   0.00   0.09   0.79
          6  20.00  33.10   0.00  46.90   0.00   0.00   0.00
          7   0.00   0.00   0.00 100.00   0.00   0.00   0.00

Router#
```

High CPU on Modular Cisco IOS XE Routers (ASR1k Series)

High CPU usage in a modular Cisco IOS XE router can have a high CPU condition in the Route Processor (RP) card, the Embedded Service Processor (ESP) or the SPA Interface Processor (SIP) card. These commands help in understanding if the high CPU condition is related with a different card within the device:

```
ios_xe_modular_router#show platform resources
**State Acronym: H - Healthy, W - Warning, C - Critical
Resource                Usage                Max             Warning         Critical        State
-------------------------------------------------------------------------------------------------
RP0 (ok, active)                                                                             H
 Control Processor      11.62%               100%            90%             95%             H
  DRAM                  1730MB(45%)          3783MB          90%             95%             H
ESP0(ok, active)                                                                             H
 Control Processor      19.59%               100%            90%             95%             H
  DRAM                  616MB(65%)           946MB           90%             95%             H
 QFP                                                                                         H
  TCAM                  8cells(0%)           65536cells      45%             55%             H
  DRAM                  79212KB(30%)         262144KB        80%             90%             H
  IRAM                  9329KB(7%)           131072KB        80%             90%             H
SIP0                                                                                         H
 Control Processor      2.30%                100%            90%             95%             H
  DRAM                  280MB(60%)           460MB           90%             95%             H
```

* Depending on the Cisco IOS version, QFP can contain the processor usage, otherwise you need to collect the **show platform hardware qfp datapath utilization**

A good reference guide for ASR1k can be found at Troubleshoot High CPU on ASR1000 Series Router

---



Note: Commands vary sometimes depending on the platform and version. Look for the specific platform documentation in some cases.
