Process health monitoring

This chapter describes how to manage and monitor the health of various components of your device. It contains these sections:

- Monitor control plane resources, on page 1
- Monitoring hardware using alarms, on page 5

Monitor control plane resources

The following sections explain the of memory and CPU monitoring from the perspective of the Cisco IOS process and the overall control plane:

- Avoid problems through regular monitoring, on page 1
- Cisco IOS process resources, on page 2
- Overall Control Plane Resources, on page 3

Avoid problems through regular monitoring

Processes should provide monitoring and notification of their status/health to ensure correct operation. When a process fails, a syslog error message is displayed and either the process is restarted or the device is rebooted. A syslog error message is displayed when a monitor detects that a process is stuck or has crashed. If the process can be restarted, it is restarted; else, the device is restarted.

Monitoring system resources enables you to detect potential problems before they occur, thus avoiding outages. The advantages of regular monitoring:

- Lack of memory on line cards that are in operation for a few years can lead to major outages. Monitoring memory usage helps to identify memory issues in the line cards and enables you to prevent an outage.
- Regular monitoring establishes a baseline for a normal system load. You can use this information as a basis for comparison when you upgrade hardware or software—to see if the upgrade has affected resource usage.

Cisco IOS process resources

You can view CPU utilization statistics on active processes and see the amount of memory being used in these processes using the **show memory** command and the **show process cpu** command. These commands provide a representation of memory and CPU utilization from the perspective of only the Cisco IOS process; they do not include information for resources on the entire platform. For example, when the **show memory** command is used in a system with 8 GB RAM running a single Cisco IOS process, the memory usage is example shows:

```
Router# show memory
Tracekey : 1#cb0b8989b15e46da15c7630297789582

                                                                    Head    Total(b)
     Used(b)     Free(b)   Lowest(b)  Largest(b)
Processor  FFFF59A6B048   20578847040   289787696   20289059344   655646464   19922943908
reserve P  FFFF59A6B0A0      102404          92      102312      102312      102312
lsmpi_io  FFFF434FA1A8     6295128     6294304         824         824         412
Dynamic heap limit(MB) 19000     Use(MB) 0
```

The **show process cpu** command displays Cisco IOS CPU utilization average:

```
Router# show process cpu
CPU utilization for five seconds: 1%/0%; one minute: 1%; five minutes: 1%
 PID Runtime(ms)     Invoked      uSecs   5Sec   1Min   5Min TTY Process
   1           1          14         71  0.00%  0.00%  0.00%   0 Chunk Manager
   2         127         872        145  0.00%  0.00%  0.00%   0 Load Meter
   3           0           1          0  0.00%  0.00%  0.00%   0 Policy bind Proc
   4           0           1          0  0.00%  0.00%  0.00%   0 Retransmission o
   5           0           1          0  0.00%  0.00%  0.00%   0 IPC ISSU Dispatc
   6          11          13        846  0.00%  0.00%  0.00%   0 RF Slave Main Th
   7           0           1          0  0.00%  0.00%  0.00%   0 EDDRI_MAIN
   8           0           1          0  0.00%  0.00%  0.00%   0 RO Notify Timers
   9        1092         597       1829  0.00%  0.01%  0.00%   0 Check heaps
  10           8          73        109  0.00%  0.00%  0.00%   0 Pool Manager
  11           0           1          0  0.00%  0.00%  0.00%   0 DiscardQ Backgro
  12           0           2          0  0.00%  0.00%  0.00%   0 Timers
  13           0          32          0  0.00%  0.00%  0.00%   0 WATCH_AFS
  14           0           1          0  0.00%  0.00%  0.00%   0 MEMLEAK PROCESS
  15        1227       40758         30  0.00%  0.02%  0.00%   0 ARP Input
  16          41        4568          8  0.00%  0.00%  0.00%   0 ARP Background
  17           0           2          0  0.00%  0.00%  0.00%   0 ATM Idle Timer
  18           0           1          0  0.00%  0.00%  0.00%   0 ATM ASYNC PROC
  19           0           1          0  0.00%  0.00%  0.00%   0 CEF MIB API
  20           0           1          0  0.00%  0.00%  0.00%   0 AAA_SERVER_DEADT
  21           0           1          0  0.00%  0.00%  0.00%   0 Policy Manager
  22           0           2          0  0.00%  0.00%  0.00%   0 DDR Timers
  23          60          23       2608  0.00%  0.00%  0.00%   0 Entity MIB API
  24          43          45        955  0.00%  0.00%  0.00%   0 PrstVbl
  25           0           2          0  0.00%  0.00%  0.00%   0 Serial Backgroun
  26           0           1          0  0.00%  0.00%  0.00%   0 RMI RM Notify Wa
  27           0           2          0  0.00%  0.00%  0.00%   0 ATM AutoVC Perio
  28           0           2          0  0.00%  0.00%  0.00%   0 ATM VC Auto Crea
  29          30        2181         13  0.00%  0.00%  0.00%   0 IOSXE heartbeat
  30           1           9        111  0.00%  0.00%  0.00%   0 Btrace time base
  31           5         182         27  0.00%  0.00%  0.00%   0 DB Lock Manager
  32          16        4356          3  0.00%  0.00%  0.00%   0 GraphIt
  33           0           1          0  0.00%  0.00%  0.00%   0 DB Notification
  34           0           1          0  0.00%  0.00%  0.00%   0 IPC Apps Task
  35           0           1          0  0.00%  0.00%  0.00%   0 ifIndex Receive
  36           4         873          4  0.00%  0.00%  0.00%   0 IPC Event Notifi
  37          49        4259         11  0.00%  0.00%  0.00%   0 IPC Mcast Pendin
  38           0           1          0  0.00%  0.00%  0.00%   0 Platform appsess
  39           2          73         27  0.00%  0.00%  0.00%   0 IPC Dynamic Cach
```

```
 40           5         873           5  0.00%  0.00%  0.00%   0 IPC Service NonC
 41           0           1           0  0.00%  0.00%  0.00%   0 IPC Zone Manager
 42          38        4259           8  0.00%  0.00%  0.00%   0 IPC Periodic Tim
 43          18        4259           4  0.00%  0.00%  0.00%   0 IPC Deferred Por
 44           0           1           0  0.00%  0.00%  0.00%   0 IPC Process leve
 45           0           1           0  0.00%  0.00%  0.00%   0 IPC Seat Manager
 46           3         250          12  0.00%  0.00%  0.00%   0 IPC Check Queue
 47           0           1           0  0.00%  0.00%  0.00%   0 IPC Seat RX Cont
 48           0           1           0  0.00%  0.00%  0.00%   0 IPC Seat TX Cont
 49          22         437          50  0.00%  0.00%  0.00%   0 IPC Keep Alive M
 50          25         873          28  0.00%  0.00%  0.00%   0 IPC Loadometer
 51           0           1           0  0.00%  0.00%  0.00%   0 IPC Session Deta
 52           0           1           0  0.00%  0.00%  0.00%   0 SENSOR-MGR event
 53           2         437           4  0.00%  0.00%  0.00%   0 Compute SRP rate
```

Overall Control Plane Resources

Control plane memory and CPU utilization on each control processor allows you to keep a tab on the overall control plane resources. You can use the **show platform resources** command to monitor the overall system health and resource usage for the IOS XE platforms. Also, you can use the **show platform software status control-processor brief** command (summary view) or the **show platform software status control-processor** command (detailed view) to view control plane memory and CPU utilization information.

All control processors should show status, Healthy. Other possible status values are Warning and Critical. Warning indicates that the device is operational, but that the operating level should be reviewed. Critical implies that the device is nearing failure.

If you see a Warning or Critical status, take the following actions:

- Reduce the static and dynamic loads on the system by reducing the number of elements in the configuration or by limiting the capacity for dynamic services.
- Reduce the number of routes and adjacencies, limit the number of ACLs and other rules, reduce the number of VLANs, and so on.

The following sections describe the fields in the **show platform software status control-processor** command output.

Load Average

Load average represents the process queue or process contention for CPU resources. For example, on a single-core processor, an instantaneous load of 7 would mean that seven processes are ready to run, one of which is currently running. On a dual-core processor, a load of 7 would mean that seven processes are ready to run, two of which are currently running.

Memory Utilization

Memory utilization is represented by the following fields:

- Total—Total line card memory
- Used—Consumed memory
- Free—Available memory
- Committed—Virtual memory committed to processes

CPU Utilization

CPU utilization is an indication of the percentage of time the CPU is busy, and is represented by the following fields:

- CPU—Allocated processor
- User—Non-Linux kernel processes
- System—Linux kernel process
- Nice—Low-priority processes
- Idle—Percentage of time the CPU was inactive
- IRQ—Interrupts
- SIRQ—System Interrupts
- IOwait—Percentage of time CPU was waiting for I/O

Example: show platform software status control-processor Command

The following are some examples of using the **show platform software status control-processor** command:

```
Router# show platform software status control-processor
RP0: online, statistics updated 3 seconds ago
RP0: online, statistics updated 5 seconds ago
Load Average: healthy
  1-Min: 1.35, status: healthy, under 9.30
  5-Min: 1.06, status: healthy, under 9.30
  15-Min: 1.02, status: healthy, under 9.30
Memory (kb): healthy
  Total: 7768456
  Used: 2572568 (33%), status: healthy
  Free: 5195888 (67%)
  Committed: 3112968 (40%), under 90%
Per-core Statistics
CPU0: CPU Utilization (percentage of time spent)
  User:  3.00, System:  2.40, Nice:  0.00, Idle: 94.60
  IRQ:  0.00, SIRQ:  0.00, IOwait:  0.00
CPU1: CPU Utilization (percentage of time spent)
  User:  0.00, System:  0.00, Nice:  0.00, Idle:100.00
  IRQ:  0.00, SIRQ:  0.00, IOwait:  0.00
CPU2: CPU Utilization (percentage of time spent)
  User:  0.00, System:  0.00, Nice:  0.00, Idle:100.00
  IRQ:  0.00, SIRQ:  0.00, IOwait:  0.00
CPU3: CPU Utilization (percentage of time spent)
  User:  0.00, System:  0.00, Nice:  0.00, Idle:100.00
  IRQ:  0.00, SIRQ:  0.00, IOwait:  0.00
CPU4: CPU Utilization (percentage of time spent)
  User:  7.30, System:  1.70, Nice:  0.00, Idle: 91.00
  IRQ:  0.00, SIRQ:  0.00, IOwait:  0.00
CPU5: CPU Utilization (percentage of time spent)
  User:  3.30, System:  1.50, Nice:  0.00, Idle: 95.20
  IRQ:  0.00, SIRQ:  0.00, IOwait:  0.00
CPU6: CPU Utilization (percentage of time spent)
  User: 17.91, System: 11.81, Nice:  0.00, Idle: 70.27
  IRQ:  0.00, SIRQ:  0.00, IOwait:  0.00
CPU7: CPU Utilization (percentage of time spent)
  User: 11.91, System: 13.31, Nice:  0.00, Idle: 74.77
```

```
  IRQ:  0.00, SIRQ:  0.00, IOwait:  0.00
CPU8: CPU Utilization (percentage of time spent)
  User:  2.70, System:  2.00, Nice:  0.00, Idle: 95.30
  IRQ:  0.00, SIRQ:  0.00, IOwait:  0.00
CPU9: CPU Utilization (percentage of time spent)
  User:  0.00, System:  0.00, Nice:  0.00, Idle:100.00
  IRQ:  0.00, SIRQ:  0.00, IOwait:  0.00
CPU10: CPU Utilization (percentage of time spent)
  User:  0.00, System:  0.00, Nice:  0.00, Idle:100.00
  IRQ:  0.00, SIRQ:  0.00, IOwait:  0.00
CPU11: CPU Utilization (percentage of time spent)
  User:  0.00, System:  0.00, Nice:  0.00, Idle:100.00
  IRQ:  0.00, SIRQ:  0.00, IOwait:  0.00
```

```
Router# show platform software status control-processor brief
Load Average
 Slot  Status  1-Min  5-Min 15-Min
  RP0 Healthy   1.14   1.07   1.02

Memory (kB)
 Slot  Status    Total     Used (Pct)     Free (Pct) Committed (Pct)
  RP0 Healthy  7768456  2573416 (33%)  5195040 (67%)   3115096 (40%)

CPU Utilization
 Slot  CPU   User System   Nice   Idle    IRQ   SIRQ IOwait
  RP0    0   2.80   1.80   0.00  95.39   0.00   0.00   0.00
         1   0.00   0.00   0.00 100.00   0.00   0.00   0.00
         2   0.00   0.00   0.00 100.00   0.00   0.00   0.00
         3   0.00   0.00   0.00 100.00   0.00   0.00   0.00
         4   6.80   1.80   0.00  91.39   0.00   0.00   0.00
         5   3.20   1.60   0.00  95.19   0.00   0.00   0.00
         6  16.30  12.60   0.00  71.10   0.00   0.00   0.00
         7  12.40  13.70   0.00  73.90   0.00   0.00   0.00
         8   2.40   2.40   0.00  95.19   0.00   0.00   0.00
         9   0.00   0.00   0.00 100.00   0.00   0.00   0.00
        10   0.00   0.00   0.00 100.00   0.00   0.00   0.00
        11   0.00   0.00   0.00 100.00   0.00   0.00   0.00
```

Monitoring hardware using alarms

- Device design and monitoring hardware, on page 5
- Monitor bootFlash disk, on page 6
- Approaches for monitoring hardware alarms, on page 6

Device design and monitoring hardware

The router sends alarm notifications when problems are detected, allowing you to monitor the network remotely. You do not need to use **show** commands to poll devices on a routine basis; however, you can perform onsite monitoring if you choose.

Monitor bootFlash disk

The bootflash disk must have enough free space to store two core dumps. This condition is monitored, and if the bootflash disk is too small to store two core dumps, a syslog alarm is generated, as shown in the example:

```
Aug 22 13:40:41.038 R0/0: %FLASH_CHECK-3-DISK_QUOTA: Flash disk quota exceeded
[free space is 7084440 kB] - Please clean up files on bootflash.
```

The size of the bootflash disk must be at least of the same size as that of the physical memory installed on the device. If this condition is not met, a syslog alarm is generated as shown in the example:

```
%IOSXEBOOT-2-FLASH_SIZE_CHECK: (rp/0): Flash capacity (8 GB) is insufficient for fault
analysis based on
installed memory of RP (16 GB)
%IOSXEBOOT-2-FLASH_SIZE_CHECK: (rp/0): Please increase the size of installed flash to at
least 16 GB (same as
physical memory size)
```

Approaches for monitoring hardware alarms

- Onsite network administrator responds to audible or visual Alarms, on page 6
- View the console or syslog for alarm messages, on page 7
- Alarm reported through SNMP, on page 10

Onsite network administrator responds to audible or visual Alarms

- About audible and visual alarms, on page 6
- Clear an audible alarm, on page 6
- Clearing a visual alarm, on page 6

About audible and visual alarms

An external element can be connected to a power supply using the DB-25 alarm connector on the power supply. The external element is a DC light bulb for a visual alarm and a bell for an audible alarm.

If an alarm illuminates the CRIT, MIN, or MAJ LED on the faceplate of the device, and a visual or audible alarm is wired, the alarm also activates an alarm relay in the power supply DB-25 connector, and either the bell rings or the light bulb flashes.

Clear an audible alarm

To clear an audible alarm, perform one of these tasks:

- Press the **Audible Cut Off** button on the faceplate.
- Enter the **clear facility-alarm** command.

Clearing a visual alarm

To clear a visual alarm, you must resolve the alarm condition. The **clear facility-alarm** command does not clear an alarm LED on the faceplate or turn off the DC light bulb. For example, if a critical alarm LED is

illuminated because an active module was removed without a graceful deactivation, the only way to resolve that alarm is to replace the module.

View the console or syslog for alarm messages

The network administrator can monitor alarm messages by reviewing alarm messages sent to the system console or to a system message log (syslog).

- Enabling the logging alarm Command, on page 7
- Examples of alarm messages, on page 7
- Reviewing and Analyzing Alarm Messages, on page 10

Enabling the logging alarm Command

The **logging alarm** command must be enabled for the system to send alarm messages to a logging device, such as the console or a syslog. This command is not enabled by default.

You can specify the severity level of the alarms to be logged. All the alarms at and above the specified threshold generate alarm messages. For example, the following command sends only critical alarm messages to logging devices:

```
Router(config)# logging alarm critical
```

If alarm severity is not specified, alarm messages for all severity levels are sent to logging devices.

Examples of alarm messages

The following are examples of alarm messages that are sent to the console when a module is removed before performing a graceful deactivation. The alarm is cleared when the module is reinserted.

Module removed

```
*Aug 22 13:27:33.774: %C-SM-X-16G4M2X: Module removed from subslot 1/1, interfaces disabled
*Aug 22 13:27:33.775: %SPA_OIR-6-OFFLINECARD: Module (SPA-4XT-SERIAL) offline in subslot
1/1
```

Module reinserted

```
*Aug 22 13:32:29.447: %CC-SM-X-16G4M2X: Module inserted in subslot 1/1
*Aug 22 13:32:34.916: %SPA_OIR-6-ONLINECARD: Module (SPA-4XT-SERIAL) online in subslot 1/1
*Aug 22 13:32:35.523: %LINK-3-UPDOWN: SIP1/1: Interface EOBC1/1, changed state to up
```

Alarms

To view alarms, use the **show facility-alarm status** command. This example shows a critical alarm for the power supply:

```
Router# show facility-alarm status
System Totals  Critical: 1  Major: 0  Minor: 0

Source                    Time                   Severity      Description [Index]
------                    ------                 --------      -------------------

Power Supply Bay 1        Jul 08 2020 11:51:34   CRITICAL      Power Supply/FAN Module
Missing [0]

POE Bay 0                 Jul 08 2020 11:51:34   INFO          Power Over Ethernet Module
```

```
 Missing [0]

POE Bay 1                  Jul 08 2020 11:51:34   INFO          Power Over Ethernet Module
 Missing [0]

xcvr container 0/0/4       Jul 08 2020 11:51:47   INFO          Transceiver Missing - Link
 Down [1]

TenGigabitEthernet0/1/0    Jul 08 2020 11:52:24   INFO         Physical Port Administrative
 State Down [2]

GigabitEthernet1/0/0       Jul 08 2020 11:56:35   INFO         Physical Port Administrative
 State Down [2]

GigabitEthernet1/0/1       Jul 08 2020 11:56:35   INFO         Physical Port Administrative
 State Down [2]

GigabitEthernet1/0/2       Jul 08 2020 11:56:35   INFO         Physical Port Administrative
 State Down [2]

GigabitEthernet1/0/3       Jul 08 2020 11:56:35   INFO         Physical Port Administrative
 State Down [2]

GigabitEthernet1/0/4       Jul 08 2020 11:56:35   INFO         Physical Port Administrative
 State Down [2]

GigabitEthernet1/0/5       Jul 08 2020 11:56:35   INFO         Physical Port Administrative
 State Down [2]

GigabitEthernet1/0/6       Jul 08 2020 11:56:35   INFO         Physical Port Administrative
 State Down [2]

GigabitEthernet1/0/7       Jul 08 2020 11:56:35   INFO         Physical Port Administrative
 State Down [2]

TwoGigabitEthernet1/0/17   Jul 08 2020 11:56:35   INFO         Physical Port Administrative
 State Down [2]

TwoGigabitEthernet1/0/18   Jul 08 2020 11:56:35   INFO         Physical Port Administrative
 State Down [2]

TwoGigabitEthernet1/0/19   Jul 08 2020 11:56:35   INFO         Physical Port Administrative
 State Down [2]
```

To view critical alarms, use the **show facility-alarm status critical** command, as shown in this example:

```
Router# show facility-alarm status critical
System Totals  Critical: 1  Major: 0  Minor: 0

Source                     Time                   Severity      Description [Index]
------                     ------                 --------      -------------------

Power Supply Bay 1         Jul 08 2020 11:51:34   CRITICAL      Power Supply/FAN Module
Missing [0]
```

To view the operational state of the major hardware components on the device, use the **show platform diag** command.

```
Router# show platform diag
Slot: 0, C8375-E-G2
Running state               : ok
Internal state              : online
Internal operational state  : ok
Physical insert detect time : 00:00:23 (2d01h ago)
Software declared up time   : 00:01:07 (2d01h ago)
```

```
CPLD version               : 25033132
Firmware version           : v17.15(3.1r).s2.cp
Sub-slot: 0/0, 4M-2xSFP+
Operational status         : ok
Internal state             : inserted
Physical insert detect time : 00:01:17 (2d01h ago)
Logical insert detect time  : 00:01:17 (2d01h ago)
Sub-slot: 0/1, C-NIM-8M
Operational status         : ok
Internal state             : inserted
Physical insert detect time : 00:01:17 (2d01h ago)
Logical insert detect time  : 00:01:17 (2d01h ago)
Slot: 1, C8375-E-G2
  Running state            : ok
  Internal state           : online
  Internal operational state  : ok
  Physical insert detect time : 00:00:23 (2d01h ago)
  Software declared up time   : 00:01:13 (2d01h ago)
  CPLD version             : 25033132

  Firmware version         : v17.15(3.1r).s2.cp

                                                        Slot: R0, C8375-E-G2


  Running state            : ok, active

  Internal state           : online

  Internal operational state  : ok

  Physical insert detect time : 00:00:23 (2d01h ago)

  Software declared up time   : 00:00:23 (2d01h ago)

  CPLD version             : 25033132

  Firmware version         : v17.15(3.1r).s2.cp

                                                        Slot: F0, C8375-E-G2
  Running state            : ok, active
  Internal state           : online

  Internal operational state  : ok
  Physical insert detect time : 00:00:23 (2d01h ago)
  Software declared up time   : 00:01:00 (2d01h ago)

  Hardware ready signal time  : 00:00:58 (2d01h ago)
  Packet ready signal time    : 00:01:13 (2d01h ago)

  CPLD version             : 25033132
  Firmware version         : v17.15(3.1r).s2.cp

Slot: P0, PWR-CC1-760WAC
  State                    : fail, badinput
  Physical insert detect time : 00:00:01 (2d01h ago)
Slot: P1, PWR-CC1-400WAC
  State                    : ok
  Physical insert detect time : 00:00:01 (2d01h ago)
  Slot: P2, C8300-FAN-1R
  State                    : ok
  Physical insert detect time : 00:00:02 (2d01h ago)
  Slot: POE0, PWR-CC1-760WAC
  State                    : fail, badinput
```

```
Physical insert detect time : 00:00:01 (2d01h ago)
Slot: POE1, Unknown
State                       : empty
Physical insert detect time : 00:00:00 (never ago)
```

Reviewing and Analyzing Alarm Messages

To facilitate the review of alarm messages, you can write scripts to analyze alarm messages sent to the console or syslog. Scripts can provide reports on events such as alarms, security alerts, and interface status.

Syslog messages can also be accessed through Simple Network Management Protocol (SNMP) using the history table defined in the CISCO-SYSLOG-MIB.

Alarm reported through SNMP

The SNMP is an application-layer protocol that provides a standardized framework and a common language used for monitoring and managing devices in a network. Of all the approaches to monitor alarms, SNMP is the best approach to monitor more than one device in an enterprise and service provider setup.

SNMP provides notification of faults, alarms, and conditions that might affect services. It allows a network administrator to access device information through a network management system (NMS) instead of reviewing logs, polling devices, or reviewing log reports.

To use SNMP to get alarm notification, use the following MIBs:

- ENTITY-MIB, RFC 4133 (required for the CISCO-ENTITY-ALARM-MIB and CISCO-ENTITY-SENSOR-MIB to work)
- CISCO-ENTITY-ALARM-MIB
- CISCO-ENTITY-SENSOR-MIB (for transceiver environmental alarm information, which is not provided through the CISCO-ENTITY-ALARM-MIB)