



# Process Health Monitoring

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

- [Monitoring Control Plane Resources, on page 1](#)
- [Monitoring Hardware Using Alarms, on page 5](#)

## Monitoring Control Plane Resources

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

- [Avoiding Problems Through Regular Monitoring, on page 1](#)
- [Cisco IOS Process Resources, on page 1](#)
- [Overall Control Plane Resources, on page 3](#)

## Avoiding 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 router 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 router is restarted.

Monitoring system resources enables you to detect potential problems before they occur, thus avoiding outages. It also 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. When the **show memory** command is used in a system with 4 GB RAM running a single Cisco IOS process, the following memory usage is displayed:

```

Router# show memory
Tracekey : 1#24c450a57e03d03a6788866ae1d462e4
Address      Bytes      Prev      Next      Ref      PrevF      NextF      what      Alloc
PC
Head      Total(b)      Used(b)      Free(b)      Lowest(b)      Largest(b)
Processor  7F51210010    1499843648    303330248    1196513400    786722360    713031588
lsmpi_io   7F506281A8    6295128      6294304      824          824          412
Dynamic heap limit(MB) 680          Use(MB) 0

```

## Processor memory

```

Address      Bytes      Prev      Next      Ref      PrevF      NextF      what
Alloc PC
7F51210010  0000000568  00000000  7F512102A0  001  -----  -----  *Init*
:400000+896EB88
7F512102A0  0000032776  7F51210010  7F51218300  001  -----  -----  Managed Chunk Q
:400000+295B3C8
7F51218300  0000000056  7F512102A0  7F51218390  001  -----  -----  *Init*
:400000+896EB88
7F51218390  0000012808  7F51218300  7F5121B5F0  001  -----  -----  *Init*
:400000+896EB88
Address      Bytes      Prev      Next      Ref      PrevF      NextF      what
Alloc PC
7F5121B5F0  0000032776  7F51218390  7F51223650  001  -----  -----  List Elements
:400000+2948680
7F51223650  0000010008  7F5121B5F0  7F51225DC0  001  -----  -----  List Headers
:400000+2948680
7F51225DC0  0000032776  7F51223650  7F5122DE20  001  -----  -----  IOSXE Process S
:400000+295B3C8
7F5122DE20  0000032776  7F51225DC0  7F51235E80  001  -----  -----  IOSXE Queue Pro
:400000+295B3C8
7F51235E80  0000065544  7F5122DE20  7F51245EE0  001  -----  -----  IOSXE Queue Bal
:400000+295B3C8
7F51245EE0  0000000112  7F51235E80  7F51245FA8  001  -----  -----  *Init*
:400000+2951DE0
7F51245FA8  0000036872  7F51245EE0  7F5124F008  001  -----  -----  *Init*
:400000+2950FB4
7F5124F008  0000010008  7F51245FA8  7F51251778  001  -----  -----  Platform VM Pag
:400000+295B3C8
7F51251778  0000000328  7F5124F008  7F51251918  001  -----  -----  *Init*
:400000+896EB88
7F51251918  0000000328  7F51251778  7F51251AB8  001  -----  -----  *Init*
:400000+896EB88
7F51251AB8  0000000896  7F51251918  7F51251E90  001  -----  -----  Watched Message
:400000+295B3C8
...

```

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

```

Router# show process cpu
CPU utilization for five seconds: 1%/1%; one minute: 1%; five minutes: 1%
PID Runtime(ms)      Invoked      uSecs      5Sec      1Min      5Min  TTY Process
  1           0           21           0      0.00%    0.00%  0.00%  0 Chunk Manager
  2        5692        12584         452      0.00%    0.00%  0.00%  0 Load Meter
  3           0           1           0      0.00%    0.00%  0.00%  0 PKI Trustpool
  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          16          12         1333      0.00%    0.00%  0.00%  0 RF Slave Main Th
  7           4           1         4000      0.00%    0.00%  0.00%  0 EDDRI_MAIN

```

8	0	1	0	0.00%	0.00%	0.00%	0	RO Notify Timers
9	38188	8525	4479	0.00%	0.04%	0.05%	0	Check heaps
10	12	1069	11	0.00%	0.00%	0.00%	0	Pool Manager
11	0	1	0	0.00%	0.00%	0.00%	0	DiscardQ Backgro
PID	Runtime (ms)	Invoked	uSecs	5Sec	1Min	5Min	TTY	Process
12	0	2	0	0.00%	0.00%	0.00%	0	Timers
13	0	29	0	0.00%	0.00%	0.00%	0	WATCH_AFS
14	0	1	0	0.00%	0.00%	0.00%	0	MEMLEAK PROCESS
15	3840	23732	161	0.00%	0.00%	0.00%	0	ARP Input
16	1156	65637	17	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
PID	Runtime (ms)	Invoked	uSecs	5Sec	1Min	5Min	TTY	Process
23	76	19	4000	0.00%	0.00%	0.00%	0	Entity MIB API
24	124	38	3263	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	768	31455	24	0.00%	0.00%	0.00%	0	IOSXE heartbeat
30	180	1866	96	0.00%	0.00%	0.00%	0	DB Lock Manager
31	0	1	0	0.00%	0.00%	0.00%	0	DB Notification
32	0	1	0	0.00%	0.00%	0.00%	0	IPC Apps Task
33	0	1	0	0.00%	0.00%	0.00%	0	ifIndex Receive

...

## 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 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 router is operational, but that the operating level should be reviewed. Critical implies that the router 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 system 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 5 seconds ago
Load Average: healthy
  1-Min: 0.90, status: healthy, under 5.00
  5-Min: 0.87, status: healthy, under 5.00
 15-Min: 0.95, status: healthy, under 5.00
Memory (kb): healthy
  Total: 3448368
  Used: 1979068 (57%), status: healthy
  Free: 1469300 (43%)
  Committed: 2002904 (58%), under 90%
Per-core Statistics
CPU0: CPU Utilization (percentage of time spent)
  User: 1.54, System: 1.33, Nice: 0.00, Idle: 97.11
  IRQ: 0.00, SIRQ: 0.00, IOWait: 0.00
CPU1: CPU Utilization (percentage of time spent)
  User: 1.53, System: 0.82, Nice: 0.00, Idle: 97.64
  IRQ: 0.00, SIRQ: 0.00, IOWait: 0.00
CPU2: CPU Utilization (percentage of time spent)
```

```

User: 2.77, System: 9.38, Nice: 0.00, Idle: 87.84
IRQ: 0.00, SIRQ: 0.00, IOWait: 0.00
CPU3: CPU Utilization (percentage of time spent)
User: 12.62, System: 64.63, Nice: 0.00, Idle: 22.74
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 0.87 0.87 0.94
```

```
Memory (kB)
```

```
Slot Status Total Used (Pct) Free (Pct) Committed (Pct)
RP0 Healthy 3448368 1996720 (58%) 1451648 (42%) 2003380 (58%)
```

```
CPU Utilization
```

```
Slot CPU User System Nice Idle IRQ SIRQ IOWait
RP0 0 1.54 0.92 0.00 97.53 0.00 0.00 0.00
    1 1.64 1.12 0.00 97.22 0.00 0.00 0.00
    2 3.32 8.36 0.00 88.30 0.00 0.00 0.00
    3 12.58 64.44 0.00 22.97 0.00 0.00 0.00
```

# Monitoring Hardware Using Alarms

## Router 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.

## BootFlash Disk Monitoring

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 following example:

```
Oct 6 14:10:56.292: %FLASH_CHECK-3-DISK_QUOTA: R0/0: flash_check: Flash disk quota exceeded
[free space is 1429020 kB] - Please clean up files on bootflash.
```

## Approaches for Monitoring Hardware Alarms

### Viewing 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

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.

### Alarms

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

```
Device# show facility-alarm status
Source          Severity          Description [Index]
-----
Cellular0/2/0   INFO              Physical Port Administrative State Down [2]
Cellular0/2/1   INFO              Physical Port Administrative State Down [2]
```

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

```
Device# show facility-alarm status critical
system Totals Critical: 4 Major: 0 Minor: 0
Source          Time              Severity Description          [Index]
-----
GigabitEthernet0/1/0 Jul 12 2017 22:27:25 CRITICAL Physical Port Link Down [1]
GigabitEthernet0/1/1 Jul 12 2017 22:27:25 CRITICAL Physical Port Link Down [1]
GigabitEthernet0/1/2 Jul 12 2017 22:27:25 CRITICAL Physical Port Link Down [1]
GigabitEthernet0/1/3 Jul 12 2017 22:27:25 CRITICAL Physical Port Link Down [1]
```

To view the operational state of the major hardware components on the Device, use the **show platform diag** command. This example shows that power supply P0 has failed:

```
Device# show platform diag

Chassis type: C1117-4PLTEEA

Slot: 0, C1117-4PLTEEA
  Running state           : ok
  Internal state          : online
  Internal operational state : ok
  Physical insert detect time : 00:01:52 (09:02:14 ago)
  Software declared up time  : 00:03:12 (09:00:54 ago)
  CPLD version            : 17100501
  Firmware version        : 16.6(1r)RC3

Sub-slot: 0/0, C1117-1x1GE
  Operational status      : ok
  Internal state          : inserted
  Physical insert detect time : 00:04:34 (08:59:32 ago)
  Logical insert detect time  : 00:04:34 (08:59:32 ago)
```

```

Sub-slot: 0/1, C1117-ES-4
  Operational status      : ok
  Internal state         : inserted
  Physical insert detect time : 00:04:34 (08:59:32 ago)
  Logical insert detect time  : 00:04:34 (08:59:32 ago)

Sub-slot: 0/2, C1117-LTE
  Operational status      : ok
  Internal state         : inserted
  Physical insert detect time : 00:04:34 (08:59:32 ago)
  Logical insert detect time  : 00:04:34 (08:59:32 ago)

Sub-slot: 0/3, C1117-VADSL-A
  Operational status      : ok
  Internal state         : inserted
  Physical insert detect time : 00:04:34 (08:59:32 ago)
  Logical insert detect time  : 00:04:34 (08:59:32 ago)

Slot: R0, C1117-4PLTEEA
  Running state          : ok, active
  Internal state         : online
  Internal operational state : ok
  Physical insert detect time : 00:01:52 (09:02:14 ago)
  Software declared up time  : 00:01:52 (09:02:14 ago)
  CPLD version           : 17100501
  Firmware version       : 16.6(1r)RC3

Slot: F0, C1117-4PLTEEA
  Running state          : ok, active
  Internal state         : online
  Internal operational state : ok
  Physical insert detect time : 00:01:52 (09:02:14 ago)
  Software declared up time  : 00:04:06 (09:00:00 ago)
  Hardware ready signal time : 00:02:44 (09:01:22 ago)
  Packet ready signal time  : 00:04:31 (08:59:35 ago)
  CPLD version           : 17100501
  Firmware version       : 16.6(1r)RC3

Slot: P0, PWR-12V
  State                  : ok
  Physical insert detect time : 00:02:24 (09:01:43 ago)

Slot: GE-POE, Unknown
  State                  : NA
  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.

## Network Management System Alerts a Network Administrator when an Alarm is 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.

SNMP provides notification of faults, alarms, and conditions that might affect services. It allows a network administrator to access router 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, RFC4133(required for the CISCO-ENTITY-ALARM-MIB, ENTITY-STATE-MIB and CISCO-ENTITY-SENSOR-MIB to work)
- CISCO-ENTITY-ALARM-MIB
- ENTITY-STATE-MIB
- CISCO-ENTITY-SENSOR-MIB(for transceiver environmental alarm information, which is not provided through the CISCO-ENTITY-ALARM-MIB)