CHAPTER 12

Managing Hardware Resource Utilization

This chapter contains Cisco NX-OS procedures recommended when managing hardware resources utilization such as the CPU, memory and I/O module TCAM table utilization.

This chapter includes the following sections:

CPU Processes

This section contains information for verifying the CPU utilization for the supervisor module.

Utilization

Introduced: Cisco NX-OS Release 4.0(1)

The **show system resources** command displays the high level CPU utilization for the supervisor module. The **show process cpu** command with the sort option lists all of the processes sorted by the highest CPU utilization per process. The **show process cpu history** command displays the CPU history in three increments: 60 seconds, 60 minutes, 72 hours. Viewing the CPU history is valuable when correlating a network event with the past CPU utilization. The sort and history options for the **show process cpu** command were introduced in Cisco NX-OS Release 4.2(1).

It should be noted that Cisco NX-OS takes advantage of preemptive CPU multitasking, so processes can take advantage of an Idle CPU to complete tasks faster. Therefore, the history option may report CPU spikes that do not necessarily mean there is an issue. Additional investigation should take place if the average CPU remains close to 100%.

```
n7000# show system resources
Load average:   1 minute: 0.06   5 minutes: 0.04   15 minutes: 0.00
Processes   :   310 total, 1 running
```

```
CPU states  :   0.0% user,   0.5% kernel,   99.5% idle
Memory usage:   4135780K total,   1180900K used,   2954880K free
                      0K buffers,  759580K cache

n7000# show process cpu sort

PID    Runtime(ms)  Invoked   uSecs  1Sec    Process
-----  -----------  --------  -----  ------  -----------
 3102         1692    371648      4    2.0%  platform
    1          162     49364      3    0.0%  init

<Text Omitted>


n7000# show process cpu history

                  1    1                1                      1
    151 2    1  176 6112 2212    1   21  511 1  2    31 151 1 10
100
 90
 80
 70
 60
 50
 40
 30
 20               #                    #
 10  #           ## #  #                #               #     #
    0....5....1....1....2....2....3....3....4....4....5....5....
              0    5    0    5    0    5    0    5    0    5
```

Restarting a Process

Introduced: Cisco NX-OS Release 4.0(1)

This section is included for reference and may not be required.

Some Cisco NX-OS processes can be restarted with the **restart** command. A process should not require a manual restart, but in the event it does a process can be restarted without re-configuring the protocol, or reloading the chassis. Restarting a process may be disruptive, so this feature should be used with caution.

```
n7000# restart ospf 10
```

Memory

This section contains information for verifying the supervisor module DRAM and Flash memory utilization.

DRAM Utilization

Introduced: Cisco NX-OS Release 4.0(1)

The supervisor module memory utilization for a chassis can be monitored with the following commands. The **show system resources** command displays the overall memory utilization for the supervisor module and the **show process memory** command displays memory utilization per process per VDC.

```
n7000# show system resources
Load average:   1 minute: 0.06   5 minutes: 0.04   15 minutes: 0.00
Processes   :   310 total, 1 running
CPU states  :   0.0% user,   0.5% kernel,   99.5% idle
Memory usage:   4135780K total,   1180900K used,   2954880K free
                      0K buffers,  759580K cache

n7000# show process memory

PID    MemAlloc  MemLimit    MemUsed     StackBase/Ptr      Process
-----  --------  ----------  ----------  -----------------  ----------------

<Text Omitted>

11849   2994176  329981836   127692800   bffff5e0/bfffc820  nfm
12019  13029376  334518976   115449856   bfffe1c0/bfffde30  ospf
12266    155648  0           1712128     bfffe800/bfffe5cc  more
12267   1118208  0           48463872    bffff670/bfff9c08  vsh
12268         0  0           0           bfffe410/bfffdd28  ps

<Text Omitted>
```

Flash Utilization

Introduced: Cisco NX-OS Release 4.0(1)

The flash file system capacity can be verified for each supervisor module. The following example has one supervisor module in slot 5. The bootflash: refers to the 2 GB onboard flash, and the logflash, and slot0 refers to the external compact flash slots on the supervisor module. The **dir** command displays the contents for each type of flash memory (output not displayed).

```
n7000# show hardware capacity | begin flash
         5       bootflash     1767480     1055144     40
         5       logflash      7997912     7555672      5
         5       slot0         1996928     1652944     17

n7000# dir bootflash:
n7000# dir logflash:
n7000# dir slot0:
```

MAC Address TCAM Tables

This section contains information for verifying the MAC address TCAM table utilization and modifying the aging-time if necessary.

Utilization

Introduced: Cisco NX-OS Release 4.0(1)

The Cisco Nexus 7000 Series uses a distributed forwarding architecture in which each Ethernet M series module has a forwarding engine responsible for forwarding packets. A forwarding engine on an M series module is capable of storing 128,000 MAC Address entries. MAC address tables are synchronized between Ethernet M series modules that have ports configured in the same Virtual Device Context (VDC). The following command is useful for verifying the MAC address table capacity for all modules in a chassis.

```
n7000# show hardware capacity forwarding | begin L2

L2 Forwarding Resources
-----------------------
  L2 entries: Module   total    used   mcast   ucast   lines   lines_full
              1       131072       6       1       5    8192            0
              2       131072       6       1       5    8192            0

<Text Omitted>
```

Aging Time

Introduced: Cisco NX-OS Release 4.0(1)

This section was included for reference and may not be required.

The default MAC-Address table aging time is 1,800 seconds (30 minutes). The aging time can be modified to a more or less aggressive timeout value. The MAC Address aging time should be consistent for all of the devices within a switched domain.

```
n7000(config)# mac address-table aging-time ?
  <0-0>         0 disables aging
  <120-918000>  Aging time in seconds.
```

Unicast or Multicast TCAM Tables

This section contains information for verifying the unicast/multicast TCAM table utilization.

Utilization

Introduced: Cisco NX-OS Release 4.0(1)

The Cisco Nexus 7000 Series uses a distributed forwarding architecture in which each Ethernet M series module has a forwarding engine responsible for forwarding packets. A forwarding engine on an M series module is capable of storing 128,000 IPv4/IPv6 routing entries or 1,000,000 entries if it is an XL module with a Scalable-Feature license installed. IPv4/IPv6 unicast/multicast tables are synchronized between Ethernet M series modules that have ports configured in the same Virtual Device Context (VDC). The following example displays the default TCAM allocation for a non-XL module. Beginning in Cisco NX-OS Release 4.2(1), Cisco NX-OS supports dynamic TCAM allocation. This allows for better resource utilization in the event and address family (i.e. IPv6 unicast) requires additional entries.

```
n7000# show hardware capacity forwarding | begin TCAM

Key: Log/Phys = Logical entries / Physical entries
Note: IPv4 Multicast/IPv6 Unicast entries share one FIB TCAM entry pool

Module 1 usage:
Route Type            Used      %Used      Free      %Free      Total
                   (Log/Phys)            (Log/Phys)           (Log/Phys)
------------------------------------------------------------------------------
IPv4 Unicast:        19/19         0    57325/57325     99    57344/57344
IPv4 Multicast:       4/8          0    16380/32760     99    16384/32768
IPv6 Unicast:         9/18         0    16375/32750     99    16384/32768
IPv6 Multicast:       5/20         0     2043/8172      99     2048/8192
```

NetFow TCAM Tables

This section contains information for verifying the NetFlow TCAM table utilization.

Utilization

Introduced: Cisco NX-OS Release 4.0(1)

The Cisco Nexus 7000 Series uses a distributed forwarding architecture in which each Ethernet M series module has a forwarding engine responsible for forwarding packets. A forwarding engine on an M series module is capable of storing 512,000 NetFlow entries. This value is the same for both non-XL and XL M series modules.

```
n7000# show hardware capacity forwarding | begin Netflow

n7000# show hardware capacity forwarding | begin Netflow
Netflow Resources
-----------------
Flow Table Usage:  Module  Util    Used    Free    Fail
                   1       0.00%   0       515090  0
                   2       0.00%   0       515090  0
ICAM Usage:        Module  Util    Used    Free
                   1       0.00%   0       16
                   2       0.00%   0       16
IPv4 Mask Usage:   Module  Util    Used    Free
                   1       0.00%   0       32
                   2       0.00%   0       32
IPv6 Mask Usage:   Module  Util    Used    Free
                   1       0.00%   0       32
                   2       0.00%   0       32
```

ACL or QoS TCAM Tables

This section contains information for verifying the ACL or QoS TCAM table utilization and enabling ACL TCAM chaining if required.

Utilization

Introduced: Cisco NX-OS Release 4.0(1)

The Cisco Nexus 7000 Series uses a distributed forwarding architecture in which each Ethernet M series module has a forwarding engine responsible for forwarding packets. A forwarding engine on an M series module is capable of storing 64,000 (non-XL) or 128,000 ACL QoS entries if it is an XL module with the Scalable Feature license installed.

```
n7000# show hardware capacity | begin ACL
         ACL Hardware Resource Utilization (Module 1)
         ---------------------------------------------
                           Used    Free    Percent
                                           Utilization
-----------------------------------------------------
Tcam 0, Bank 0             1       16383   0.00
Tcam 0, Bank 1             2       16382   0.01
Tcam 1, Bank 0             1       16383   0.00
Tcam 1, Bank 1             2       16382   0.01
```

```
LOU                       0       104     0.00
Both LOU Operands         0
Single LOU Operands       0
LOU L4 src port:          0
LOU L4 dst port:          0
LOU L3 packet len:        0
LOU IP tos:               0
LOU IP dscp:              0
LOU ip precedence:        0
TCP Flags                 0       16      0.00

Protocol CAM              0       7       0.00
Mac Etype/Proto CAM       0       14      0.00

Non L4op labels, Tcam 0   0       6143    0.00
Non L4op labels, Tcam 1   0       6143    0.00
L4 op labels, Tcam 0      0       2047    0.00
L4 op labels, Tcam 1      0       2047    0.00
```

ACL Resource Polling

Introduced: Cisco NX-OS Release 4.2(1)

This section is included for reference and may not be required.

The ACL TCAM is divided into four banks (16K per bank for non-XL and 32K per bank for XL modules) on the current M series forwarding engines. Prior to Cisco NX-OS Release 4.2(1) an ACL could only contain 1 bank of entries (16K or 32K entries depending on the module type). Starting in Cisco NX-OS Release 4.2(1) a single ACL can be programmed across multiple banks allowing up to 64, 000 entries in a single ACL per non-XL and 132,000 entries in an XL module. This feature should only be enabled on systems that require ACLs that contain more than 16,000 entries. This feature is configured in the default VDC(1) for all VDCs.

```
n7000(config)# hardware access-list resource pooling module 1

n7000# show hardware access-list resource pooling
  Module 1 enabled
```

Fabric Utilization

The fabric utilization can be monitored to verify the ingress and egress bandwidth utilization. The **show hardware fabric-utilization** commands are useful for verifying the high-level and detailed utilization. The **show hardware capacity fabric-utilization** is useful for verifying the peak utilization history.

```
n7000# show hardware fabric-utilization
------------------------------------------------
Slot        Total Fabric        Utilization
            Bandwidth      Ingress % Egress %
------------------------------------------------
1             138 Gbps          0.0       0.0
2             138 Gbps          0.0       0.0
4             138 Gbps          0.0       0.0
5              69 Gbps          0.0       0.0
7             138 Gbps          0.0       0.0
8             138 Gbps          0.0       0.0
9             138 Gbps          0.0       0.0
```

```
10            138 Gbps          0.0       0.0

n7000# show hardware fabric-utilization detail
--------------------------------------------------------------------------------
Fabric Planes:
A -- Unicast fabric interface
B -- Multicast/Multidestination fabric interface
--------------------------------------------------------------------------------
Unidirectional Fabric Bandwidth per Fab Link is 23 Ggps (A+B)
--------------------------------------------------------------------------------
I/O   Fab  Fab  Fab  Fab  Fab        Fabric Utilization
Slot  Mod  Ins  Chnl Link Plane    Ingress%     Egress%
--------------------------------------------------------------------------------
1     1    1    5    0    A          0            0
1     1    1    5    0    B          0            0
1     1    1    3    1    A          0            0
1     1    1    3    1    B          0            0
1     2    1    5    2    A          0            0
1     2    1    5    2    B          0            0
1     2    1    3    3    A          0            0
1     2    1    3    3    B          0            0
1     3    1    5    4    A          0            0
1     3    1    5    4    B          0            0
1     3    1    3    5    A          0            0
1     3    1    3    5    B          0            0

<Text omitted>

n7000# show hardware capacity fabric-utilization
--------------------------------------------------------------------------------
Fabric Planes:
A -- Unicast fabric interface
B -- Multicast/Multidestination fabric interface
-------------------------PEAK FABRIC UTILIZATION-------------------------
I/O  |-----FABRIC----|       Ingress           |       Egress
Slot |Mod Inst  Plane| Util           Time     | Util          Time
--------------------------------------------------------------------------------
1     1     1     A      0%     11-01@23:09:42    0%     11-01@23:09:42
1     1     1     B      0%     11-01@23:09:42    0%     11-01@23:09:42
1     1     1     A      0%     11-01@23:09:42    0%     11-01@23:09:42
1     1     1     B      0%     11-01@23:09:42    0%     11-01@23:09:42
1     2     1     A      0%     11-01@23:09:42    0%     11-01@23:09:42
1     2     1     B      0%     11-01@23:09:42    0%     11-01@23:09:42
1     2     1     A      0%     11-01@23:09:42    0%     11-01@23:09:42
1     2     1     B      0%     11-01@23:09:42    0%     11-01@23:09:42
1     3     1     A      0%     11-01@23:09:42    0%     11-01@23:09:42
```

VDC Resource Utilization

Introduced: Cisco NX-OS Release 4.0(1)

Global VDC resources can be verified with the **show vdc resource** command. This is useful to know, since VDCs can contend for common resources such as memory, SPAN sessions, etc.).

```
n7000# show vdc resource

  vlan                16 used    48 unused  16368 free  16320 avail  16384 total

  monitor-session      0 used     0 unused      2 free      2 avail      2 total
```

```
monitor-session-erspan-dst      0 used     0 unused     23 free     23 avail  23 total

vrf                             8 used     0 unused    992 free    992 avail   1000 total

port-channel                    0 used     0 unused    768 free    768 avail    768 total

u4route-mem                   120 used     0 unused    396 free    396 avail    516 total

u6route-mem                    36 used     0 unused    172 free    172 avail    208 total

m4route-mem                    82 used     0 unused    118 free    118 avail    200 total
```