

# VDCF - Virtual Datacenter Cloud Framework for the Solaris™ Operating System

## Monitoring

Version 2.6  
25. April 2017

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## 1 Introduction

This documentation describes the Monitoring features of the Virtual Datacenter Cloud Framework (VDCF) for the Solaris Operating System and explains how to use this features.

*See these documents for more information about the related VDCF products:*

*VDCF – Administration Guide* for information about VDCF usage

### 1.1 Overview

VDCF Monitoring is a VDCF Enterprise extension available to VDCF Standard/Enterprise/HA customers.

This extension consists of four separate components:

- Hardware Monitoring (hwmon) to detect hardware failures
- Resource Monitoring (rcmon) to collect and display resource usage of global and local Solaris zones
- High Availability (HA) Monitoring (hamon) to automatically failover, if a data center or server fails
- Operating System Monitoring (osmon) to enable alerts when filesystems, datasets, swap and SMF services reach critical resource usage or state

While VDCF Resource Monitoring collects and displays resource usage, VDCF Resource Management is used to configure resource limits.

### 1.2 Hardware Monitoring

The VDCF Hardware Monitoring connects periodically to the system controller of all Nodes defined in the VDCF repository and checks for hardware, OS state and power usage.

#### 1.2.1 Alarming

If the VDCF Hardware Monitoring detects hardware failures the user may be informed in two ways:

- sending e-Mails
- executing a script to integrate other software products

#### 1.2.2 Requirements

As the Hardware Monitor is based on information from the system controller it's required to configure a 'console' for each Node within VDCF.

## 1.3 High Availability (HA) Monitoring

The VDCF High Availability feature is used to monitor the health of Nodes. If a failed Node is discovered the Node may be stopped and/or the Node evacuation logic is called to failover all vServers to other Nodes. This evacuation is based on resource usage information to avoid overloading the remaining Nodes.

This solution is positioned between manual failover initiated by a System Administrator and a full-featured failover solution using Cluster software. This VDCF HA feature is able to handle the typical Node failures, like boot disk issues, network outages, platform errors like CPU, memory problems or power supply failures. The goal is to keep this solution as simple and usable as possible, therefore it doesn't require cluster interconnects between the Nodes and it doesn't check and handle issues with SAN connections like a Cluster software does.

### 1.3.1 Components

The HA monitor is built from several components:

Each Node participating has a daemon (SMF service `vdcf_keep_alive`) installed that calls periodically into the management server. These keep-alive messages are stored within the `/var/opt/jomasoft/vdcf/keepalive` directory.

The second component is the monitoring daemon (`hamon_watchd`) on the VDCF management server. This daemon consists of two processes. One (`hamon_monitord`) is used to monitor for keep-alive messages at the interval of `HAMON_KEEP_ALIVE_INTERVAL` seconds from all participating Nodes. The second process (`hamon_checkd`) is used to check and act upon a failed Node was detected.

### 1.3.2 Node failure detection

A Node is considered as failed if the following rules are met

- no keep-alive messages are received within the defined threshold (`HAMON_KEEP_ALIVE_ACTION_THRESHOLD`)
- a ssh connection from VDCF to the Node fails
- Node's system controller / console does not respond or Node is at the OK prompt or powered off

An optional network probing rule may be activated by setting `HAMON_CHECK_NETWORK_PROBES="true"`. If the Node system controller is not reachable, the reason may be network-related or the Node has no power at all. If this setting is true, VDCF tries to connect to configured intermediate network equipment. If the network equipment is reachable, VDCF considers its network connection as good and therefore the Nodes as failed.

For more details about this failure detection consult the Appendix 4.1 Node failure detection details.

Based on the description above, the VDCF HA monitor is able to detect the following failures:

- complete hardware failure of the Node
- accidentally shutdown of Node by a System Administrator
- failure of network interfaces of the Node

The following failures are detected if network probing is activated and properly configured:

- complete power-failure of the Node (system controller not reachable)
- complete data center failure, as long as the network is still reachable (depends on configuration)

The following failures are **NOT** detected:

- failure or config issues of SAN components
- complete data center failure, if the network is affected (depends on configuration)
- accidentally network interface miss configuration by a System Administrator

For setting up and to configure your HA environment consulting services from JomaSoft are available.

### 1.3.3 Node Evacuation sequence

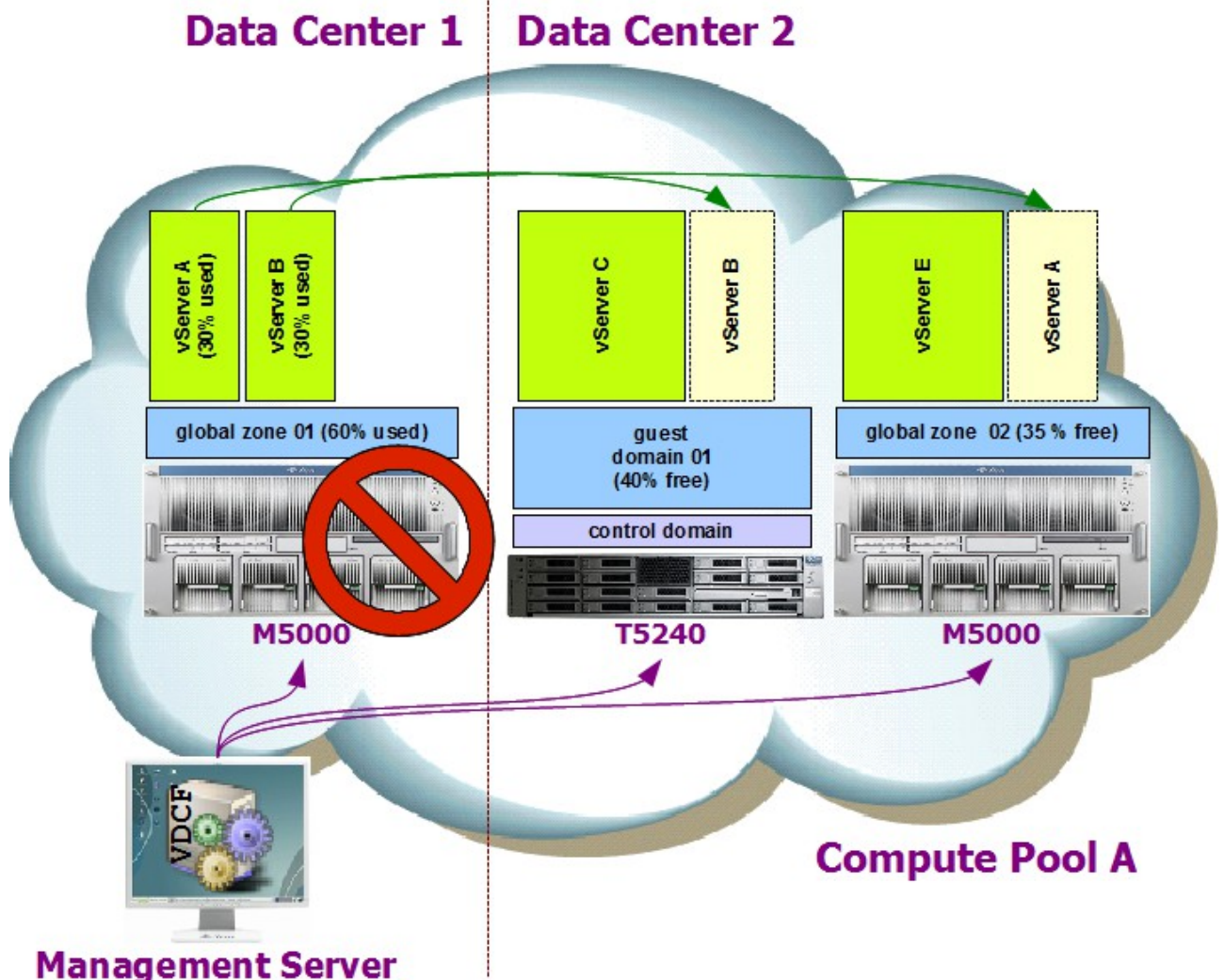
If Node Evacuation is configured, all vServers of a faulted Node are evacuated (failed over) to other active Nodes in the same compute pool. The procedure to detect the possible target Nodes looks as follows:

1. For each vServer we get a list of candidate Nodes (using `vserver -c show candidates`).
2. Based on the resource usage data reported from resource monitoring we select a possible target Node for each vServer.
3. Because the source Node isn't reachable anymore we do a vserver detach force.
4. Then we try to attach and boot the vServer on the new Node.
5. If attach has failed we try the same procedure on the next possible target Node until all vServers are evacuated or no more target Nodes are left.

Upgrade on attach is supported by setting the value `HAMON_EVACUATE_UPGRADE` to true in the `customize.cfg` file.

The sequence of the vServer migration is ordered by the vServer category and/or priority. See configuration items for more details.

The following picture illustrates the migrations if the M5000 in Data Center 1 fails.



The Node Evacuation can be started manually using the command `node -c evacuate`.

### **1.3.4 Requirements**

As the HA monitor is monitoring the console and is trying to shutdown a failed Node through the system controller, it's required to configure a 'console' for each Node within VDCF.

The Node evacuation logic is based on resource information from Resource Monitoring. Activated VDCF Resource Monitoring on all participating Nodes is therefore required.

## 1.4 Resource Monitoring

Resource Monitoring may be enabled (and disabled) individually for each Node. A usage collector service is then started on the Node. This service is recording the resource usage (CPU and memory) of the Node and all installed vServers. Periodically each Node is pushing the recorded data onto the VDCF Management Server.

A cron job called 'Usage Data Collector' on the Management Server is importing the collected data periodically into the VDCF database.

A second cron job 'Usage Data Aggregator' is used to generate aggregated resource information. The aggregated data can be displayed on a daily, weekly, monthly or yearly base.

A third cron job is started / stopped together with the 'Usage Data Collector' cron job. This cron job is evaluating the current average resource usage of Nodes and vServers in the last 24 hours. This information may be used later by the HA monitor Node evacuation feature.

### 1.4.1 Requirements

The VDCF Resource Monitoring implementation is based on Solaris 10 8/07 (Update 4) features. To use this feature the target Nodes must run Solaris 10 8/07 or later. It is supported to use an older Solaris 10 Release (Update1,2,3) with Kernel Patch 120011-14 (sparc) or 120012-14 (i386) or later.

## 1.5 Operating System (OS) Monitoring

### New since VDCF Monitoring 2.2

Using the OS Monitoring you can monitor the filesystem usage of vServers. This Monitoring can be enabled/disabled globally on the VDCF management server. By enabling the OS Monitor a cron job for User root is added.

If the filesystem usage exceeds the defined WARNING threshold an alert eMail is sent or a RECOVERED eMail if the filesystem goes below the threshold.

### New since VDCF Monitoring 2.4

OS Monitoring has been extended with dataset (zpool) and SMF monitoring.

If the dataset usage exceeds the defined WARNING threshold or a SMF service has a critical state (maintenance/degraded) an alert eMail is sent. A RECOVERED eMail is sent if the dataset usage goes below the threshold or the SMF service is back online. OS Monitoring does also send an alarm, if the zpool has a critical state (degraded or failed).

### New since VDCF Monitoring 2.5

Individual warn thresholds may be defined for filesystems and datasets.

### New since VDCF Monitoring 2.6

OS Monitoring has been extended with SWAP monitoring.

If the SWAP usage exceeds the defined WARNING threshold an alert eMail is sent or a RECOVERED eMail if the SWAP usage goes below the threshold.

## 2 Installation and Configuration

### 2.1 Prerequisites

The JSvdcf-monitor package requires the following VDCF packages to be installed on the VDCF Management Server:

- JSvdcf-base 6.0.0 or later

### 2.2 Installation

#### a) sparc platform

```
cd <download-dir>  
pkgadd -d ./JSvdcf-monitor_<version>_sparc.pkg
```

#### b) i386 platform

```
cd <download-dir>  
pkgadd -d ./JSvdcf-monitor_<version>_i386.pkg
```



## 2.3 Configuration

### 2.3.1 Granting User Access

The VDCF Monitoring package introduces three new RBAC Profiles:

- "VDCF hwmonitor Module" for the Hardware and Resource Monitoring,
- "VDCF hamonitor Module" for the HA Monitoring and
- "VDCF osmonitor Module" for the OS Monitoring feature.

Assign these RBAC profiles to your admin users.

### 2.3.2 Customizing Monitoring eMail

#### Alarming

The Hardware Monitoring and OS Monitoring are able to send e-Mails, if a Hardware fault is detected or a OS Monitor threshold is reached.

To enable this feature you have to set the following variables in VDCF's customize.cfg:

```
export HWMON_EVENT=true
export OSMON_EVENT=true
export MONITOR_EVENT_EMAIL_LIST="user1@company.ch user2@company.ch"
export MONITOR_EVENT_EMAIL_FROM="root@system.domain.ch"
```

## 2.3.3 Customizing Hardware Monitoring

### Check Interval

By default the Hardware Monitoring cronjob is executed once an hour to check the state of all Nodes.

You may display the current setting with this command:

```
$ hwmon -c status

                                Central Monitor Component Status
                                HW Monitor: enabled

                                Central Monitor Component Timespec
                                Crontab timespec for HW Monitor: '15 * * * *'

                                VDCF Configuration Variables
                                HWMON_EVENT true
                                MONITOR_EVENT_EMAIL_FROM support@jomasoft.ch
                                MONITOR_EVENT_EMAIL_LIST support@jomasoft.ch
                                MONITOR_EVENT_SCRIPT /opt/jomasoft/vdcf/testing/monitor
```

To change this setting configure the cron timespec in customize.cfg using this variable:

```
export MONITOR_HW_INTERVAL="15 * * * *"
```

If the Hardware Monitor was already enabled before, you have to re-enable the cron job using these commands:

```
$ hwmon -c disable
HW Monitor: disabled
```

```
$ hwmon -c enable
HW Monitor: enabled
```

### Alarming

Additionally to send eMails it is supported to configure a script, which is called at every event. This feature allows you to forward events to your event management or ticketing system.

```
export MONITOR_EVENT_SCRIPT=/opt/company/bin/my_vdcf_hwmon_script
```

The 'MONITOR\_EVENT\_SCRIPT' will be executed if a monitor event occurs. The script may use the following 5 input arguments:

```
<node> <new_state> <date> <time> <logfile name>
```

<node>	Node name where the event occurred
<new_state>	Hardware and OS state after the event occurred e.g. OK:OS-RUN FAULTED:ON-OBP N/A:N/A
<date/time>	Date and time when the event was recorded
<logfile name>	Logfile on the management server where detailed information is stored

## 2.3.4 Customizing High Availability (HA) Monitoring

### Keep Alive Interval

At each `HAMON_KEEP_ALIVE_INTERVAL` (default: 60 seconds) the Node is posting a keep-alive message to the Management Server.

### Warning Threshold

After a number of missing keep-alive messages (`HAMON_KEEP_ALIVE_WARN_THOLD` (default 10) an e-Mail is sent if requested.

Define your e-Mail addresses as follows:

```
export HAMON_EVENT_EMAIL_LIST="user1@company.ch user2@company.ch"
```

### Action Threshold

A Node is considered as suspect if during `HAMON_KEEP_ALIVE_ACTION_THOLD` (default 20) intervals no keep-alive message has been posted.

You may display the current setting with the status command:

```
$ hamon -c status
      HA Monitor Information
          Interval: 60s
Warning Threshold: 10
Action Threshold: 20
      Watch Daemon: disabled

      VDCF Configuration Variables
MONITOR_EVENT_EMAIL_FROM support@jomasoft.ch
HAMON_EVENT_EMAIL_LIST support@jomasoft.ch
HAMON_EVACUATE_ON_FAILURE false
VIRTUAL_EVACUATION_CATEGORY_ORDER
VIRTUAL_EVACUATION_IGNORE_CATEGORIES
VIRTUAL_EVACUATION_SHUTDOWN_CATEGORIES
```

### Actions on failure

Set `HAMON_POWEROFF_ON_FAILURE` to 'true' for a Node poweroff after failure detection. This setting is highly recommended. If this setting is false, you risk to corrupt your data if the filesystems are mounted twice ...

Set also `HAMON_EVACUATE_ON_FAILURE` if all vServers of failed Nodes must be migrated to other running Nodes. If the failed Node is a Control Domain, all vServers running on dependent Guest domains are migrated to other Nodes.

### Node evacuation

A Node is set to `INACTIVE` after an evacuate by default. Set `HAMON_EVACUATE_INACTIVATE` to 'false' to leave the Node in `ACTIVE` state.

vServer do not upgrade on attach by default. Therefore Nodes with an higher patch-levels aren't potential targets for the evacuated vServers. Set `HAMON_EVACUATE_UPGRADE` to 'true' to enable the upgrade on attach feature.

## vServer target detection

First of all you have to categorize/prioritize your vServer using the `vserver -c modify` command. You may use categories to identify important or less important vServers and the priority to order within a category. vServers with Priority 1 are evacuated first, then Priority 2, ...

Then customize the evacuation variables in your `customize.cfg`. Use `VIRTUAL_EVACUATION_CATEGORY_ORDER` to identify the most important categories to be migrated first. Identify categories which you don't want to evacuate at all in `VIRTUAL_EVACUATION_IGNORE_CATEGORIES`.

By default CPU\_Share resource definitions aren't used for target Node detection. Set the `NODE_EVACUATION_USE_CPUSHARES` to 'true' to enable a check if the target Node has enough free CPU\_Shares available.

## vServer shutdown on target Nodes

### New since VDCF Monitoring 2.6

Your target Nodes may not have enough free resources for the evacuated vServers. In such environments you can define the Categories for less important vServers, which VDCF can shutdown to free resources. The vServers are shutdown only when required and ordered by the vServer Priority.

Define the Categories in `VIRTUAL_EVACUATION_SHUTDOWN_CATEGORIES`

## Network reach ability check

To enable the network reach ability check you have to configure the `HAMON_CHECK_NETWORK_PROBES` to true and the `HAMON_KEEP_ALIVE_NET_PROBE` variable. The monitor selects the target probe address based on the Nodes MNGT interface and derives the network number from it. With this network number a search is done in `HAMON_KEEP_ALIVE_NET_PROBE` to find an associated probe address. If no match is found the default address is used if it is not set to 0.0.0.0. The variable `HAMON_KEEP_ALIVE_NET_PROBE` has the following format: "`net_number:probe_ip default:probe_ip net_number:probe_ip`"

The following are recommended settings for your customize.cfg:

```
export HAMON_EVENT_EMAIL_LIST="user1@company.ch user2@company.ch"
export HAMON_POWEROFF_ON_FAILURE="true"
export HAMON_EVACUATE_ON_FAILURE="true"
export HAMON_EVACUATE_UPGRADE="true"

# migration category order (comma separated categories)
export VIRTUAL_EVACUATION_CATEGORY_ORDER="PROD,ACC,BANK1"

# migration ignore categories (comma separated categories)
export VIRTUAL_EVACUATION_IGNORE_CATEGORIES="TEST,MAINT"
```

#### Optional settings

1. To lower the reaction times (Warn after 5 Mins, instead of 10 / Action 20 → 10)

```
export HAMON_KEEP_ALIVE_WARN_THOLD="5"
export HAMON_KEEP_ALIVE_ACTION_THOLD="10"
```

2. To take CPU\_Shares into account for the check of free resources on target Nodes.

```
export HAMON_EVACUATE_USE_CPUSHARES="true"
```

3. To enable Network Probing (depends on your network infrastructure)

```
export HAMON_CHECK_NETWORK_PROBES="true"
export HAMON_KEEP_ALIVE_NET_PROBE="192.168.0.0:192.168.0.1 10.1.1.0:10.1.1.1"
```

4. Define Shutdown Categories

```
# shutdown categories (comma separated categories)
export VIRTUAL_EVACUATION_SHUTDOWN_CATEGORIES="DEV,TEST,MAINT"
```

If High Availability monitoring was already enabled before, you have to re-enable the daemon to activate the new settings:

```
$ hamon -c disable daemon
$ hamon -c enable daemon
```

### 2.3.5 Customizing Resource Monitoring

You may customize some aspects of the resource monitoring by overwriting this VDCF variables using the customize.cfg.

#### Usage interval

With this variable you may set the interval used to get zone usage information on the Compute Node in seconds. Using the default value of 60 produces a usage record every minute.

```
export MONITOR_ZONE_USAGE_INTERVAL=60
```

#### Usage delivery

The number of samples accumulated before delivery to the VDCF Management Server happens. The actual time between delivery of zone usage information is computed by `MONITOR_ZONE_USAGE_INTERVAL * MONITOR_ZONE_USAGE_DELIVERY`.

```
export MONITOR_ZONE_USAGE_DELIVERY=60
```

#### Collector and aggregator interval

You may display the current cron timespec setting with this command:

```
$ rcmon -c status verbose

                                Central Monitor Component Status
                                Usage Data Collector: enabled
                                Usage Data Aggregation: enabled

                                Central Monitor Component Timespec
                                Crontab timespec for Usage Data Collector: '5,25,45 * * * *'
                                Crontab timespec for Usage Data Aggregation: '0 6 * * *'
                                Crontab timespec for Usage Data 24h average: '0 23 * * *'
```

To change this settings configure the cron timespec in customize.cfg using these variables:

```
export MONITOR_USAGE_TX_INTERVAL="5,25,45 * * * *"
export MONITOR_AGGR_INTERVAL="0 6 * * *"
export CURRENT_RES_USAGE_UPDATE_INTERVAL="0 23 * * *"
```

If resource monitoring was already enabled before, you have to re-enable the cron jobs using these commands. (The 24h average cron job is controlled together with the collector cron job):

```
$ rcmon -c disable aggregator
$ rcmon -c enable aggregator

$ rcmon -c disable collector
$ rcmon -c enable collector
```

## 2.3.6 Customizing OS Monitoring

### Check Interval

By default the OS Monitoring cronjob is executed once an hour to check the usage and states of filesystems, datasets, swap usage and SMF services.

You may display the current setting with this command:

```
$ osmon -c status
                                Central Monitor Component Status
                                OS Monitor: enabled

                                Central Monitor Component Timespec
                                Crontab timespec for OS Monitor: '30 * * * *'

                                VDCF Configuration Variables
                                OSMON_EVENT true
                                MONITOR_EVENT_EMAIL_FROM support@jomasoft.ch
                                MONITOR_EVENT_EMAIL_LIST support@jomasoft.ch
                                OSMON_FS_WARNING 80
                                OSMON_DATASET_WARNING 80
                                OSMON_SWAP_WARNING 60
```

To change this setting configure the cron timespec in `customize.cfg` using this variable:

```
export OSMON_FS_INTERVAL="30 * * * *"
```

If the OS Monitor was already enabled before, you have to re-enable the cron job using these commands:

```
$ osmon -c disable
OS Monitor: disabled

$ osmon -c enable
OS Monitor: enabled
```

### Warning Threshold

The default warning threshold for filesystems and datasets is set to 80 (%).

To change this value add or modify the “`OSMON_FS_WARNING`” or “`OSMON_DATASET_WARNING`” variable in `customize.cfg`

```
export OSMON_FS_WARNING=70
export OSMON_DATASET_WARNING=70
```

The default warning threshold for swap usage is set to 60 (%).

To change this value add or modify the “`OSMON_SWAP_WARNING`” variable in `customize.cfg`

```
export OSMON_SWAP_WARNING=70
```

Individual warning threshold may be set for filesystems, datasets and swap. See Chapter 3.5.3 for details

## Alarming

The OS Monitor will send WARNING e-Mails if

- filesystems reach the defined threshold  
(default from OSMON\_FS\_WARNING or individual filesystem configuration)
- datasets reach the defined threshold  
(default from OSMON\_DATASET\_WARNING or individual dataset configuration)
- swap usage reach the defined threshold  
(default from OSMON\_SWAP\_WARNING or individual node configuration)
- zpool datasets reach a critical state (faulted, degraded or suspended)  
(default from OSMON\_ZPOOL\_STATE\_OF\_INTEREST)

To receive eMails when a mirror operation starts and ends you can optionally add "RESILVERING" to the OSMON\_ZPOOL\_STATE\_OF\_INTEREST

- SMF Services reach a critical state (degraded or maintenance)



## 3 Usage

### 3.1 Hardware Monitoring

Enabling / Disabling

The hardware monitoring feature can be enabled/disabled globally.

```
$ hwmon -c enable  
$ hwmon -c disable
```

Use the status command to display the current state of hardware monitoring:

```
$ hwmon -c status  
  
Central Monitor Component Status  
HW Monitor: enabled  
  
Central Monitor Component Timespec  
Crontab timespec for HW Monitor: '15 * * * *'  
  
VDCF Configuration Variables  
HWMON_EVENT true  
MONITOR_EVENT_EMAIL_FROM support@jomasoft.ch  
MONITOR_EVENT_EMAIL_LIST support@jomasoft.ch  
MONITOR_EVENT_SCRIPT /opt/jomasoft/vdcf/testing/monitor
```

It's also possible to disable or enable specific Nodes from being monitored:

```
$ hwmon -c disable node=s0003  
HW Monitor disabled for Node s0003
```

#### 3.1.1 Check Node manually

If the hwmon is enabled a cron job is checking periodical the state of all Nodes.

To check a Node manually you may issue this command:

```
$ hwmon -c update all | node=<node name>
```

#### 3.1.2 System Locator LED

The hardware monitoring feature let you also control the system locator LED.

Displays the current state of the Locator LED as either on or off:

```
$ hwmon -c show_locator node=<node name>  
Locator led is OFF
```

Turns the locator LED on:

```
$ hwmon -c set_locator node=<node name>
```

Turns the locator LED off:

```
$ hwmon -c clear_locator node=<node name>
```



### 3.1.3 Display Hardware state

Using the show operation an overview about all Nodes is displayed.

```
$ hwmon -c show
```

```
Current Hardware State
Node Model Console Soft State HW State Last Change Last Update Mon..
s0003 SUNW,Sun-Fire-T1000 ALOMCMT PWR-OFF OK 2013-04-22 2013-04-22 ON
s0024 ORCL,SPARC-T4-1 ILOM OS-RUN OK 2012-06-04 2013-04-23 ON
```

Using the Node attribute and/or verbose flag the state history and details from the system controller is shown.

```
$ hwmon -c show node=s0003
```

```
Current Hardware State
Node Model Console Soft State HW State Last Change Last Update Mon..
s0003 SUNW,Sun-Fire-T1000 ALOMCMT PWR-OFF OK 2013-04-22 2013-04-22 ON
```

```
State Change History
Node Soft State HW State Event Date
s0003 OS-RUN OK 2010-08-18 09:15:01
s0003 PWR-OFF OK 2010-05-25 17:15:02
```

```
$ hwmon -c show node=s0003 verbose
```

```
Current Hardware State
Node Model Console Soft State HW State Last Change Last Update Mon..
s0003 SUNW,Sun-Fire-T1000 ALOMCMT PWR-OFF OK 2013-04-22 2013-04-22 ON
```

```
State Change History
Node Soft State HW State Event Date
s0003 OS-RUN OK 2010-08-18 09:15:01
s0003 PWR-OFF OK 2010-05-25 17:15:02
```

```
System Locator Status
Locator led is OFF
```

```
System Specific Status Informations
```

```
==== Environmental Status =====
```

```
-----
System Temperatures (Temperatures in Celsius):
-----
```

Sensor	Status	Temp	LowHard	LowSoft	LowWarn	HighWarn	HighSoft	HighHard
MB/T_AMB	OK	24	-10	-5	0	45	50	55
MB/CMP0/T_TCORE	OK	40	-10	-5	0	85	90	95
MB/CMP0/T_BCORE	OK	39	-10	-5	0	85	90	95
MB/IOB/T_CORE	OK	37	-10	-5	0	95	100	105

```
-----
System Indicator Status:
-----
```

```
SYS/LOCATE SYS/SERVICE SYS/ACT
OFF OFF ON
```



-----  
 -----  
 Fans (Speeds Revolution Per Minute):  
 -----

Sensor	Status	Speed	Warn	Low
FT0/F0	OK	9166	2240	1920
FT0/F1	OK	8776	2240	1920
FT0/F2	OK	8967	2240	1920
FT0/F3	OK	8967	2240	1920

-----  
 Voltage sensors (in Volts):  
 -----

Sensor	Status	Voltage	LowSoft	LowWarn	HighWarn	HighSoft
MB/V_VCORE	OK	1.32	1.20	1.24	1.36	1.39
MB/V_VMEM	OK	1.78	1.69	1.72	1.87	1.90
MB/V_VTT	OK	0.87	0.84	0.86	0.93	0.95
MB/V_+1V2	OK	1.18	1.09	1.11	1.28	1.30
MB/V_+1V5	OK	1.48	1.36	1.39	1.60	1.63
MB/V_+2V5	OK	2.50	2.27	2.32	2.67	2.72
MB/V_+3V3	OK	3.29	3.06	3.10	3.49	3.53
MB/V_+5V	OK	4.99	4.55	4.65	5.35	5.45
MB/V_+12V	OK	12.18	10.92	11.16	12.84	13.08
MB/V_+3V3STBY	OK	3.31	3.13	3.16	3.53	3.59

-----  
 System Load (in amps):  
 -----

Sensor	Status	Load	Warn	Shutdown
MB/I_VCORE	OK	23.360	80.000	88.000
MB/I_VMEM	OK	6.420	60.000	66.000

-----  
 Current sensors:  
 -----

Sensor	Status
MB/BAT/V_BAT	OK

-----  
 Power Supplies:  
 -----

Supply	Status	Underspeed	Overtemp	Overvolt	Undervolt	Overcurrent
PS0	OK	OFF	OFF	OFF	OFF	OFF

Last POST run: WED AUG 18 05:52:20 2010  
 POST status: Passed all devices

No failures found in System

### 3.1.4 Clear hardware state history

A history record is generated for every hardware state change discovered by the periodical (or manually initiated) system check.

To clear all history records of a Node:

```
$ hwmon -c clear_history node=<node name>
```

## 3.2 Server Power Usage

### New since VDCF Monitoring 2.6

The actual Usage (Watts) is collected during the health check of the hardware (by default once an hour).

Use this command to show the current power usage of all nodes and a summary for each datacenter location:

```
$ hwmon -c show_power
```

By default there is no datacenter location configured for a server. If you need the power usage summarized by the datacenter location, you must enable the datacenter location feature first:

### 3.2.1 Configuration of different datacenter locations

The 'DataCenter' is optional and can be enabled by creating the file `/var/opt/jomasoft/vdcf/conf/datacenter.cfg`

In this file you list all your physical datacenter locations. For example:

```
-bash-3.2$ cat /var/opt/jomasoft/vdcf/conf/datacenter.cfg
#NODE DataCenters
#DCName,default -> Default Datacenter
#DCName -> additional DataCenter
#DCName allowed characters and number, no special characters
ZUERICH,default
NEWYORK
SINGAPORE
```

The datacenter attribute is displayed using `nodecfg -c show`, but only if you add 'DATACENTER' to the `NODECFG_SHOW_ATTR` variable in `customize.cfg`.

To modify the datacenter attribute, use the following command:

```
-bash-3.2$ nodecfg -c modify name=<node name> datacenter=<datacenter>
```

### 3.2.2 Power Usage 'History'

The power changes are logged to a separate VDCF logfile `/var/opt/jomasoft/vdcf/log/hwmon_power.log` where you can see the history of each node.

This log can be disabled by setting the variable 'HWMON\_POWER\_LOG' to 'FALSE'.

Sample Output of Logfile:

```
$ tail -f /var/opt/jomasoft/vdcf/log/hwmon_power.log
16:09:2016 17:41:24 LOG PowerUsage change discovered for node: s0024 old usage: 317 Watts new usage: 314 Watts
16:09:2016 17:41:25 LOG PowerUsage change discovered for node: s0009 old usage: 213 Watts new usage: 0 Watts
16:09:2016 17:41:27 LOG PowerUsage change discovered for node: s0013 old usage: 62 Watts new usage: 65 Watts
```

## 3.3 High Availability (HA) Monitoring

### 3.3.1 Enabling / Disabling

The HA monitoring feature can be enabled/disabled globally.

```
$ hamon -c enable daemon  
$ hamon -c disable daemon
```

Then each participating Node has to be enabled too:

```
$ hamon -c enable node=<node name>  
$ hamon -c disable node=<node name>
```

Please notice that only non-cluster Nodes may be enabled for HA monitoring.

To display the status of HA monitoring use this command:

```
$ hamon -c status  
  
      HA Monitor Information  
          Interval: 60s  
Warning Threshold: 10  
Action Threshold: 20  
      Watch Daemon: disabled  
  
      VDCF Configuration Variables  
MONITOR_EVENT_EMAIL_FROM support@jomasoft.ch  
  HAMON_EVENT_EMAIL_LIST support@jomasoft.ch  
HAMON_EVACUATE_ON_FAILURE false  
VIRTUAL_EVACUATION_CATEGORY_ORDER  
VIRTUAL_EVACUATION_IGNORE_CATEGORIES  
VIRTUAL_EVACUATION_SHUTDOWN_CATEGORIES
```

### 3.3.2 Display Node State

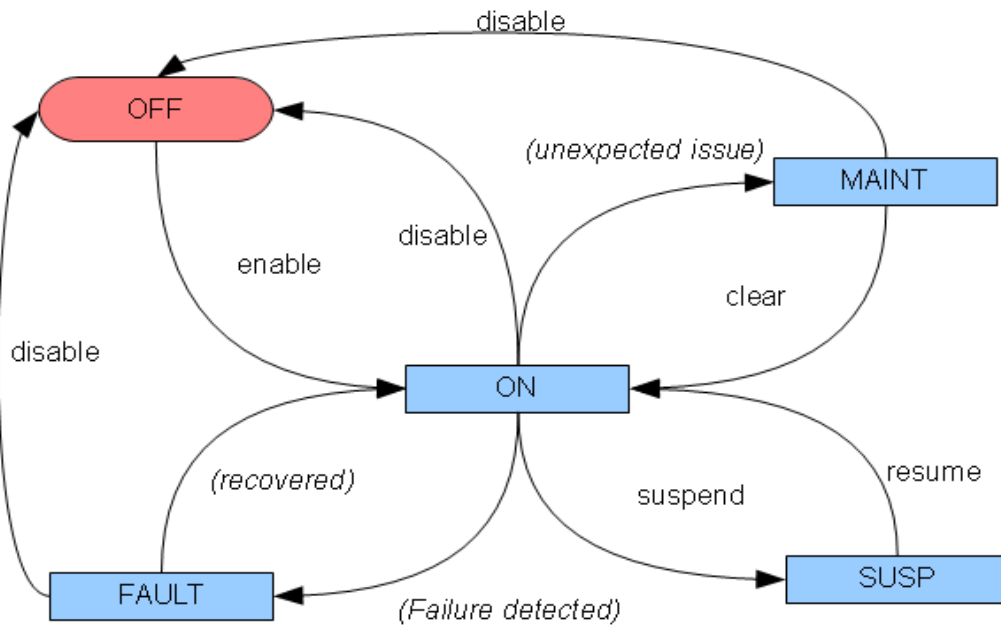
Using the show operation an overview about all Nodes is displayed.

```
$ hamon -c show
```

Node	Mon State	Ops State	Date	Details
s0003	ON	PROBING	2011-02-16 16:37:48	normal operation
s0009	ON	PROBING	2011-02-16 16:32:43	normal operation
s0010	ON	PROBING	2011-02-16 16:38:19	normal operation
s0004	FAULT	-	2011-02-16 16:45:22	console did not respond / not powered off

Each Node has a Mon(itoring) State, which is influenced by the System Administrator using hamon operations and by the VDCF HA monitor.

The following diagram explains the possible states and actions:



### 3.3.3 Suspending Nodes

To avoid unnecessary failovers, it is required to suspend the Node from Monitoring if Maintenance is done on the Node. Suspend the Node before you shutdown the Node, for example to add more Memory.

```
$ hamon -c suspend node=s0003  
HA monitor suspended on Node s0003
```

```
$ hamon -c show node=s0003  
Node  Mon State      Ops State      Date                Details  
s0003  SUSP              -              2011-02-16 16:57:19 -
```

```
$ hamon -c resume node=s0003  
HA monitor resumed for Node s0003
```

```
$ hamon -c show node=s0003  
Node  Mon State      Ops State      Date                Details  
s0003  ON              PROBING        2011-02-16 16:57:33 normal operation
```

### 3.3.4 Fallback after Evacuation

Using the VDCF recommended settings, if a Node fails, the vServers are evacuated and the Node is set to state INACTIVE. This is done to avoid usage of that Node for new vServers.

You boot the Node when the issues, that caused the Node to fail, are solved, The HA Monitoring is then re-activated automatically. To use the Node for vServers again, you need to activate the Node again:

```
$ node -c activate name=mynode
```

The vServers are NOT automatically migrated back to the Node. You need to migrate the vServers manually back to your Node using the migrate operation.

```
$ vserver -c migrate name=myvserver node=mynode shutdown
```



## 3.4 Resource Monitoring

### 3.4.1 Enable resource monitoring

The recording of resource usage information may be activated individually for each Node. By enabling a Node a `usage_collect` service is started on the Node. After the defined interval (`MONITOR_ZONE_USAGE_INTERVAL`) a usage record is saved locally on the Node. After a defined number of records (`MONITOR_ZONE_USAGE_DELIVERY`) are saved the `usage_collect` service transfers the data to the VDCF management server.

To enable usage collection on Nodes use this command:

```
$ rcmon -c enable      node=<node name> | node all
```

To display the status of resource monitoring for all Nodes use this command:

```
$ rcmon -c status node

                          Central Monitor Component Status
                          Usage Data Collector: enabled
                          Usage Data 24h average: enabled
                          Usage Data Aggregation: enabled

                          Node Monitor Component Status
                          Usage Data Collection on s0002: enabled
                          Usage Data Collection on s0003: enabled
```

### 3.4.2 Usage Collector

The usage data transferred from the Nodes is imported periodically into the VDCF repository using the 'Usage Data Collector' cron job.

You enable this collector using:

```
$ rcmon -c enable collector
```

When enabling the collector a further cron job is enabled: The 'Usage Data 24h average' cron job is a summary function to calculate the average resource usage of all Nodes and vServers in the last 24 hours. To display that average data use the `rcmon -c summary` command.

### 3.4.3 Usage Aggregator

To avoid using up too much space on the VDCF management server VDCF offers a 'Usage Data Aggregation'. This cron job aggregates old data.

```
$ rcmon -c enable aggregator
```

Usage records older than a week are aggregated to a record per hour.

Usage records older than a month are aggregated to a record per day.

### 3.4.4 Disable resource monitoring

Same procedure as for enabling the resource monitoring components

Disable collection on Nodes:

```
$ rcmon -c disable node=<node name> | node all
```

Disable Usage Data Collector:

```
$ rcmon -c disable collector
```

Disable Usage Data Aggregation:

```
$ rcmon -c disable aggregator
```

### 3.4.5 Update Node data manually

You may request an update of the database with the newest usage data available.

This command restarts the usage collector service on the Node and transfers back the current usage data file to the VDCF management server. Followed by an import into the VDCF repository.

```
$ rcmon -c update node=<node name> | node all
```



### 3.4.6 Show resource consumption data

To show the collected usage information for a vServer or a Node use the show operation.

```
rcmon -c show          cpu | memory | memory_extended
                      hourly | daily | monthly | yearly
                      server=<server name>
                      [ verbose ]

                      [ gz_total | gzt ]

rcmon -c show          cpu | memory | memory_extended
                      from=<'time-spec'>
                      server=<server name>
                      [ to=<'time-spec'> ]
                      [ aggr=<aggr-spec> ]
                      [ verbose ]
                      [ gz_total | gzt ]
```

For explanation of the command flags and output, please see manpage 'rcmon -H show' for detailed information. Some examples:

The following command lists the available CPU usage information of the last hour with no further aggregation:

```
$ rcmon -c show server=s0180 cpu hourly

----- Pool -----   --- CpuShr ---   --- CpuSys ---   --- CpuUsr ---
--- CpuAll --   -- CpuSAll --
DateTime          ID/Type  Max   Cur   All   Min /Avg /Max   Min /Avg /Max   Min /Avg /Max
Min /Avg /Max   Min /Avg /Max   Name
2010-08-26 18:48:18 30/priv 15   2     8.3% - 100% -   -   0.0% -   -   0.0% -
-   0.0% -   -   0.0% -   s0180
2010-08-26 18:49:19 30/priv 15   2     8.3% - 100% -   -   0.0% -   -   0.0% -
-   0.0% -   -   0.0% -   s0180
...
```

This command lists a Nodes memory consumption during the last month. It includes summed up resource values of the global and the non global zones:

```
$ rcmon -c show server=s0003 memory monthly gzt

----- RamTot -----   ---- RamKern ----   ---- RamFree ----   ---- RamUse ----
---- RamUtil ----   ---- VmUse ----   ---- VmUtil ----
DateTime          Min / Avg / Max   Min / Avg / Max   Min / Avg / Max   Min / Avg / Max
Min / Avg / Max   Min / Avg / Max   Name
2010-07-26 23:59:07 -   1920M -   -   1625M -   -   427M -   -   455M -
-   24% -   -   367M -   -   18% -   s0003
2010-07-27 23:59:36 -   1920M -   -   1628M -   -   423M -   -   456M -
-   24% -   -   367M -   -   18% -   s0003
...
```



The following command lists the used memory resources of a vServer of the last 5 hours:

```
$ rcmon -c show server=s0180 memory from="-5 hours" aggr=hour
```

----- VmUtil -----		----- RamKern -----			----- RamUse -----			----- RamUtil -----			----- VmUse -----		
DateTime	Min / Avg / Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max
2010-08-26 14:59:51	2.0% 2.0% 2.0%	1614M	1614M	1615M	-	48M	-	-	12%	-	-	42M	-
Name													
	s0180												
2010-08-26 15:59:37	2.0% 2.0% 2.0%	1614M	1615M	1615M	-	48M	-	-	12%	-	-	42M	-
	s0180												
2010-08-26 16:59:23	2.0% 2.0% 2.0%	1615M	1615M	1616M	48M	48M	48M	12%	12%	12%	-	42M	-
	s0180												
2010-08-26 17:59:39	2.0% 2.0% 2.3%	1615M	1616M	1618M	48M	49M	55M	12%	12%	14%	42M	43M	49M
	s0180												
2010-08-26 18:59:25	- 2.0% -	1617M	1617M	1618M	49M	49M	49M	12%	12%	12%	-	42M	-
	s0180												
2010-08-26 19:47:04	- 2.0% -	1617M	1618M	1618M	-	49M	-	-	12%	-	-	42M	-
	s0180												

Use this summary operation to display the average resource usage data of the last 24 hours. Results may be ordered by ram, cpu or server name in ascending or descending order. Default ordering is ram descending:

```
$ rcmon -c summary sortkey=cpu
```

24h resource usage average ordered by cpu/desc:

Node	Total RAM	Free RAM	Total CPU	Free CPU	LastUpdate	Comment
s0003	768	40 (5.2%)	800	795 (99.4%)	2011-10-11 23:00:28	Sol 11
s0006	2048	135 (6.6%)	658	612 (93.0%)	2011-12-06 23:00:20	Sol 10
s0009	1024	615 (60.1%)	193	188 (97.4%)	2011-12-06 23:00:17	Bank01

vServer	Used RAM	Used CPU	CPU Pool	LastUpdate	Comment
v0104	25	1	0	2011-11-30 23:00:33	Exkl IP im AccessNet
v0100	50	1	0	2011-12-04 23:00:19	ZFS vServer
v0101	50	1	0	2011-12-06 23:00:20	on Diskset
v0103	50	1	0	2011-12-06 23:00:21	Virtual Server v0103
v0105	50	1	0	2011-12-06 23:00:23	ufs to zfs
v0106	50	1	0	2011-12-06 23:00:26	VDCF Zone

The data shown for free ram and free cpu are reduced by a percentage reserved for the global zone (Node). This reserved percentage of the total ram/cpu can be configured using these framework variables:

```
# - Minimum RAM required/reserved for NODE in %
export RESOURCE_NODE_RAM_MIN=10
# - Minimum CPU required/reserved for NODE in %
export RESOURCE_NODE_CPU_MIN=0
```

The data of the summary operation is also used by the Node evacuation feature. The configured percentage is used to prevent overloading a Node with too many vServers.

## 3.5 OS Monitoring

Starting with Version 2.6 the OS Monitor can be used to monitor

- vServer Filesystems
- SMF Services
- Dataset for Node and vServer (including local zfs rpool)
- Node SWAP Usage

### 3.5.1 Enabling / Disabling

The OS Monitoring feature can be enabled/disabled globally.

```
$ osmon -c enable  
$ osmon -c disable
```

Use the status command to display the current state of hardware monitoring:

```
$ osmon -c status  
  
Central Monitor Component Status  
OS Monitor: enabled  
  
Central Monitor Component Timespec  
Crontab timespec for OS Monitor: '25 8-18 * * 1-5'  
  
VDCF Configuration Variables  
OSMON_EVENT true  
MONITOR_EVENT_EMAIL_FROM lab@jomasoft.ch  
MONITOR_EVENT_EMAIL_LIST support@jomasoft.ch  
OSMON_FS_WARNING 80  
OSMON_DATASET_WARNING 80  
OSMON_SWAP_WARNING 60
```

### 3.5.2 Check Node manually

If the osmon is enabled a cron job is checking periodically the state and usage of all OS Monitor objects.

To update monitoring values in the database manually you may issue this command:

```
$ osmon -c update all | node=<node name>
```

### 3.5.3 Individual warning threshold for filesystems, datasets and swap usage

You can set an individual threshold for a specific filesystem, dataset or node swap.

To update the threshold for a filesystem, issue the following command:

```
$ osmon -c modify_fs vserver=<vserver> mountpoint=<mountpoint> warnover=<percent>
```

To update the threshold for a dataset, issue the following command:

```
$ osmon -c modify_dataset server=<server name> dataset=<dataset> warnover=<percent>
```

To update the threshold for the swap usage, issue the following command:

```
$ osmon -c modify_swap node=<node name> warnover=<percent>
```

To remove an individual threshold use the 'remove\_warn' flag:

```
$ osmon -c modify_fs vserver=<vserver> mountpoint=<mountpoint> remove_warn
```

```
$ osmon -c modify_dataset server=<server name> dataset=<dataset> remove_warn
```

```
$ osmon -c modify_swap node=<node name> remove_warn
```

### 3.5.4 Display Filesystem usage

The filesystem usage is displayed on the vserver show detail command and a list of all critical filesystems can be displayed using the 'osmon -c show\_fs' command.

```
$ osmon -c show_fs
```

Filesystems with usage over warn threshold

Node	vServer	Dataset	Mountpoint	zRoot	Type	Size/MB	Used	warn-over
g0051	v0151	v0151_root	/zones/v0151	yes	zfs	<undefined>	100%	80% (default)
g0080	v0160	v0160_root	/zones/v0160	yes	zfs	4096	92%	80% (default)

Use the summary flag to display additionally a usage summary of the most utilized filesystems or the root flag to only show root filesystems:

```
$ osmon -c show_fs summary
```

Used	Count
100%	1
90%-99%	1

Filesystems with usage over warn threshold

Node	vServer	Dataset	Mountpoint	zRoot	Type	Size/MB	Used	warn-over
g0051	v0151	v0151_root	/zones/v0151	yes	zfs	<undefined>	100%	80% (default)
g0080	v0160	v0160_root	/zones/v0160	yes	zfs	4096	92%	80% (default)

To view filesystems with another usage than defined in 'OSMON\_FS\_WARNING' you can give a value directly on the command line by the option 'over'.

### 3.5.5 Display Dataset usage

A list of all critical datasets can be displayed using the 'osmon -c show\_dataset' command.

```
$ osmon -c show_dataset
```

Datasets with critical state found

Server	Type	Dataset	Dataset-Type	State	Size/MB	Used	warn-over
g0081	Node	rpool	Node rpool	DEGRADED	n/a	50%	80% (default)

Datasets with usage over warn threshold

Server	Type	Dataset	Dataset-Type	State	Size/MB	Used	warn-over
v0145	vServer	v0145_root	ZPOOL	ONLINE	5120	91%	80% (default)
s0030	Node	s0030_vbox	ZPOOL	ONLINE	51200	88%	80% (default)

Use the summary flag to display additionally a usage summary of the most utilized datasets or the root flag to only show Node rootpools:

```
$ osmon -c show_dataset summary root
```

State	Count
DEGRADED	1

Used	Count
50%-59%	1

Datasets with critical state found

Server	Type	Dataset	Dataset-Type	State	Size/MB	Used	warn-over
g0081	Node	rpool	Node rpool	DEGRADED	n/a	50%	80% (default)

rpool Datasets with usage over warn threshold

Server	Type	Dataset	Dataset-Type	State	Size/MB	Used	warn-over
g0085	Node	rpool	Node rpool	ONLINE	n/a	58%	50%

To view datasets with another usage than defined in 'OSMON\_DATASET\_WARNING' you can give a value directly on the command line by the option 'over'.

### 3.5.6 Display SWAP usage

A list of critical swap usage can be displayed using the 'osmon -c show\_swap' command.

```
$ osmon -c show_swap

Node swap with usage over warn threshold
      Node  Size/GB      Used    warn-over
      g0081  1.0           60%     (60%)
```

Use the summary flag to display additionally a usage summary of the most utilized swap areas:

```
$ osmon -c show_swap summary

Node swap with usage over 60%

      Used  Count
70%-79%      1
60%-69%      2

      Node  Size/GB      Used    warn-over
      g0081  1.0           70%     (60%)
      g0069  1.0           62%     (60%)
      g0091  1.0           61%     (60%)
```

To view the swap usage with another usage than defined in 'OSMON\_SWAP\_WARNING' you can give a value directly on the command line by the option 'over'.



### 3.5.7 Display SMF Services

A list of all critical SMF services can be displayed using the 'osmon -c show\_smf' command.

```
$ osmon -c show_smf
```

```
SMF with state: degraded,maintenance
Server Type      SMF-Name (FMRI)                               State
s0013  Node      svc:/system/sysobj:default                   maintenance
v0149  vServer    svc:/site/vdcf_postinstall:default          maintenance
```

Use the summary flag to additionally display a summary of the critical SMF services:

```
$ osmon -c show_smf summary
```

```
SMF-State  Count
maintenance  2
```

```
SMF with state: degraded,maintenance
Server Type      SMF-Name (FMRI)                               State
s0013  Node      svc:/system/sysobj:default                   maintenance
v0149  vServer    svc:/site/vdcf_postinstall:default          maintenance
```

To view SMF services other than 'degraded,maintenance' you can define states on the command line by the option 'state'.

```
$ osmon -c show_smf state=uninitialized
```

```
SMF with state: uninitialized
Server Type      SMF-Name (FMRI)                               State
v0142  vServer    svc:/application/font/stfsloader:default    uninitialized
v0142  vServer    svc:/application/print/rfc1179:default      uninitialized
```

It is also possible to search services of interest by the option 'search'.

```
$ osmon -c show_smf search=sendmail
```

```
Server Type      SMF-Name (FMRI)                               State
s0013  Node      svc:/network/sendmail-client:default        disabled
s0013  Node      svc:/network/smtp:sendmail                  disabled
v0149  vServer    svc:/network/sendmail-client:default        online
v0149  vServer    svc:/network/smtp:sendmail                  online
```

## 4 Appendixes

### 4.1 Node failover detection details

A Node is considered as failed if for a defined number of intervals no probe message has been posted from a Node. The monitor will kick off an action after  $(\text{HAMON\_KEEP\_ALIVE\_ACTION\_THOLD}+1) * \text{HAMON\_KEEP\_ALIVE\_INTERVAL}$  seconds after a Node is no longer submitting its keep alive messages.

The action part of the hamon\_check goes through several steps until it considers a Node as failed:

1. First of all network connectivity is verified by trying to check the status of the vdcf\_keep\_alive service on the suspect Node. If the Node can be reached and the check returns a service state other than enabled, the monitor tries to reestablish the vdcf\_keep\_alive service. If this succeeds, the monitor returns to normal operation and awaits the keep alive probe for this Node. If the service state already was enabled and the monitor was able to query its state, it also returns to normal operation, assuming the probe failure was of temporary nature.
2. If network reachability of the suspect Node is not given, the monitor tries to access the Nodes system controller. If we successfully reach the system controller the monitor checks the Node's console for a running operating system. In this case the monitor resumes normal operation, assuming a healthy Node with keep-alive failures due to temporary network problems. If the console check returns no signs of live the Node will be powered off, if configured so and its workload will be evacuated.
3. If the monitor is not able to reach the system controller and HAMON\_CHECK\_NETWORK\_PROBES is true, the network will be checked. This is done by trying to reach intermediate network equipment as defined in HAMON\_KEEP\_ALIVE\_NET\_PROBE. If, based on this check, the network is considered as healthy, the suspect Node will be assumed as failed and the workload is evacuated. If the network is considered as failed, the monitor resumes normal operation without acting on the suspect Node.