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VDCF - Virtual Datacenter Cloud Framework

for the Solaris™ Operating System

Monitoring

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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 five 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, SMF services and disk paths reach critical resource usage or state
- VDCF Dashboard web application

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 meet
- no keep-alive messages are received within the defined threshold `(HAMON_KEEP_ALIVE_ACTION_THOLD)`
- 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 therefor 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 proper 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.

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1.3.3 Node Evacuation sequence

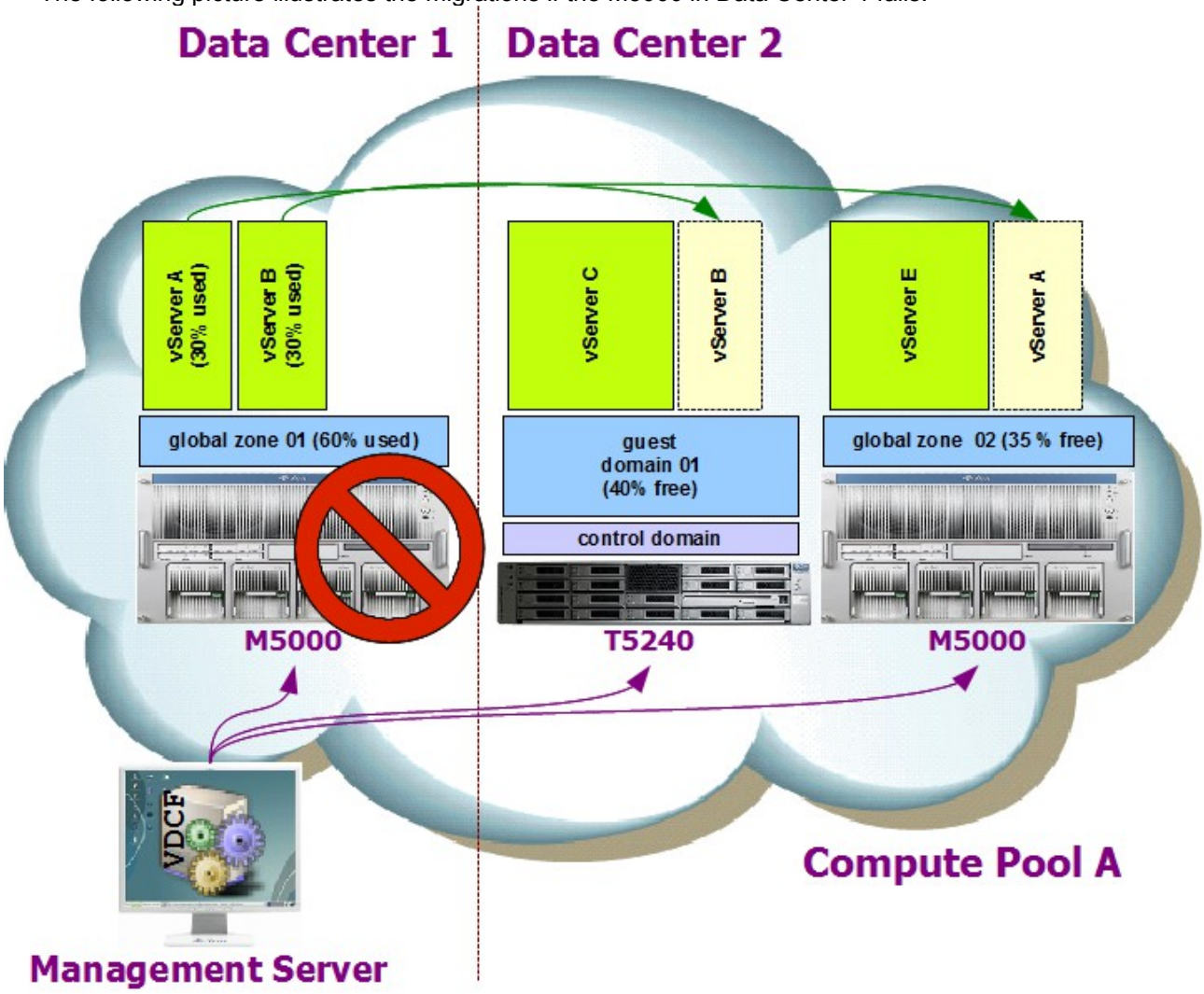
If Node Evacuation is configured, all vServers of a faulted Node are evacuated (failed over) to other active Nodes in the same computepool. The procedure to detect the possible target Nodes looks as follows:

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.

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1.5 Operating System (OS) Monitoring

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.

New since VDCF Monitoring 3.0

OS Monitoring has been extended with disk path count monitoring for MPxIO SAN storage LUNs.
If the 'Current Path Count' doesn't match the 'Target Path Count' an alert eMail is sent.
When the path count gets normal again a recovered eMail is sent.

Additionally this Release introduces Security Compliance Assessments, where Nodes and vServer are checked against predefined Security Benchmarks. Solaris 11.3 is required for this feature.

Compliance reports are generated as html files and can be viewed with the VDCF Dashboard web application.

Additionally the node and vserver commands got a new function for hardening the OS to fix non-compliant systems. See Chapter 4.6.3 for details.

New since VDCF Monitoring 3.1

Node and OS filesystems Monitoring has been added. Using osmon -c show you have a complete Monitoring Report where you see all critical objects. When enabling the report cronjob you can produce a daily eMail report (osmon -c enable report).

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1.6 VDCF Dashboard web application

New since VDCF Monitoring 3.0

Using the new 'VDCF dashboard' web application you can access the Compliance reports by some clicks in your browser. Furthermore VDCF dashboard gives access to your VDCF Repository objects: Node, CDom, GDom and vServers lists are available.

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2 Installation

2.1 Prerequisites

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

- JSvdcf-base 7.2.0 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
```

3 Configuration

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.

3.2 Customizing Monitoring eMail

3.2.1 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"
```

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3.3 Customizing Hardware Monitoring

3.3.1 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
```

3.3.2 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

3.4 Customizing High Availability (HA) Monitoring

3.4.1 Keep Alive Interval

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

3.4.2 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"
```

3.4.3 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
```

3.4.4 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.

3.4.5 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 a higher patch-levels aren't potential targets for the evacuated vServers. Set HAMON_EVACUATE_UPGRADE to 'true' to enable the upgrade on attach feature.

3.4.6 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.

3.4.7 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 defined 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

3.4.8 Network reachability 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"`

3.4.9 Other recommended settings

The following are recommended settings. Please set these in the customize.cfg file:

```
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
```

3.5 Customizing Resource Monitoring

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

3.5.1 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
```

3.5.2 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
```

3.5.3 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
```

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3.6 Customizing OS Monitoring

3.6.1 Check Interval

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

You may display the current setting with this command:

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

                              Central Monitor Component Timespec
                    Crontab timespec for OS Monitor: '30 * * * *'
               Crontab timespec for OS Monitor Report: '0 8 * * 1-5'

                     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
                    OSMON_REPORT_FLAGS -R -s -H -e
```

To change this setting configure the cron timespecs in customize.cfg using this variables:

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

export OSMON_REPORT_INTERVAL="0 8 * * 1-5"
```

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

$ osmon -c disable report
OS Monitor Report: disabled

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

3.6.2 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 4.5.3 for details

3.6.3 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)

- MPxIO disks fail to reach the defined Target Path Count

3.6.4 OS Security Compliance benchmarks

Solaris 11.3 includes 3 predefined standard benchmarks 'baseline', 'recommended' and 'pci-dss'.
VDCF delivers additional tailorings named 'default' and 'cdom' both based on the 'baseline' benchmark.
These tailorings are stored in this configuration directory:

```
 $ ls -l /var/opt/jomasoft/vdcf/conf/compliance/*.tailor
-rw-r--r--   1 root     root        1314 Sep 11 15:31 cdom.tailor
-rw-r--r--   1 root     root        1321 Sep 11 15:31 default.tailor
```

Customers can define additional benchmarks by copying and modifying the tailor files.
For system individual benchmarks the files can be named <`vserver`>`.tailor` or <`node`>`.tailor`.

3.6.5 OS Security hardening profiles

Use the 'node -c harden help' command to get a list of available hardening rules and the available hardening profiles. You can create your own hardening profiles matching your security guidelines.

The hardening profiles must be stored in:

```
$ ls -l /var/opt/jomasoft/vdcf/conf/compliance/*.hardening
-rw-r--r--   1 root     other        578 Oct 23 14:22 baseline.hardening
```

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3.7 Customizing VDCF Dashboard web application

3.7.1 Initial setup

VDCF dashboard is a python based web application. Integrated into your Apache http server.
To setup the Apache Server config you have to run this command once:

```
# /opt/jomasoft/vdcf/mods/setup/setup_gui [ -p <apache https port> ]
Creating self-signed Test Certificate …
Configuring apache web server …
Apache restarted successfully. VDCF dashboard is ready on this URL:
https://yourserver:443
```

The web application requires user authentication. Users are authenticated against their local Solaris User Account. For security reasons the web application is running SSL-enabled.

The setup script configures Apache with a self-signed test server certificate! Please replace it by a valid server certificate. The certificate is configured in this apache file:

```
# grep SSLCertificate /etc/apache2/2.*/conf.d/vdcf_django_httpd_2*.conf
SSLCertificateFile      /var/opt/jomasoft/vdcf/conf/apache-cert/dashboard.crt
SSLCertificateKeyFile   /var/opt/jomasoft/vdcf/conf/apache-cert/dashboard.key
```

3.7.2 VDCF user for the web application

The web application is using the read-only vdcf user `vdcfgui` to access the VDCF repository.

Using the VDCF vpool command you can define what data you want to show to vdcfgui user and i.e. display in the VDCF dashboard.

3.7.3 Firewall Rules

If your system environment contains firewalls you may have to add a firewall rule to access the webserver on the VDCF management Server:

VDCF Management Server	Direction	Browser Client	Comment
WebServer (port 443)	←		Web server port depends on your apache configuration, default is 443 (see chapter 3.7)

4 Usage

4.1 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
```

4.1.1 Check Node manually

If the hwmon is enabled a cron job is checking periodically the state of all Nodes. To check a Node manually you may issue this command:

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

4.1.2 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>
```

4.1.3 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
```

4.1.4 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>
```

4.2 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:

4.2.1 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:

```
$ 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>
```

4.2.2 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
```

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4.3 High Availability (HA) Monitoring

4.3.1 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
```

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4.3.2 Display Node State

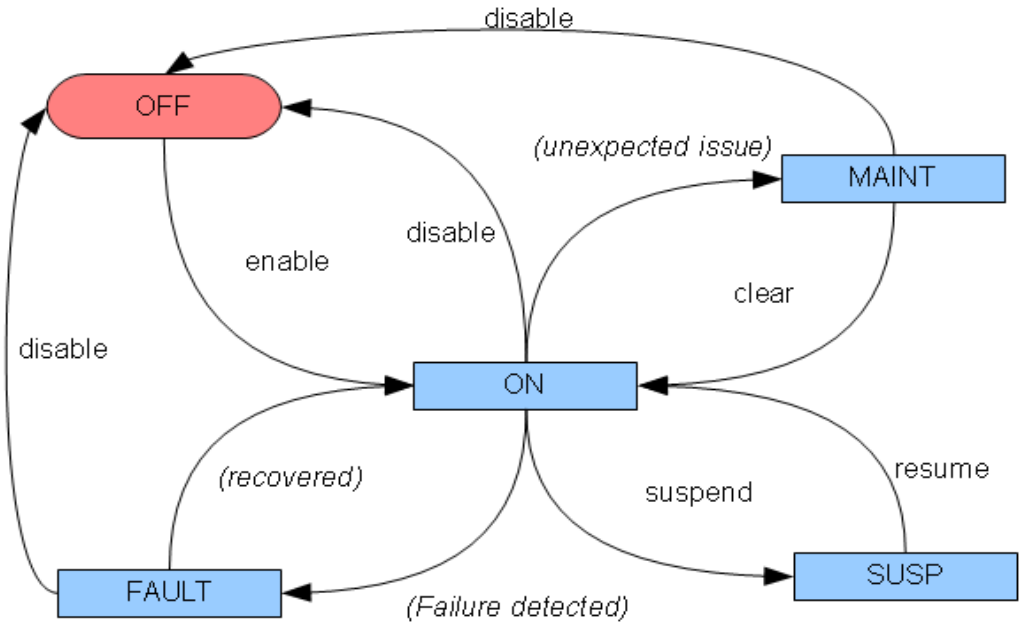
Using the show operation an overview about all Nodes is displayed.

```
$ 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:



4.3.3 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
```

4.3.4 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
```

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4.4 Resource Monitoring

4.4.1 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
```

4.4.2 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.

4.4.3 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.

4.4.4 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
```

4.4.5 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
```

4.4.6 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    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
...
```

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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

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

4.5 OS Monitoring

The OS Monitor is used to monitor

- vServer and Node filesystems
- SMF Services
- Dataset for Node and vServer (including local zfs rpools)
- Node SWAP Usage
- MPxIO SAN Disk Path Count

- Security Compliance (manually triggered only)

4.5.1 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 the OS monitoring:

```
$ osmon -c status
```

4.5.2 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>
```

4.5.3 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 server=<server name> 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 server=<server name> mountpoint=<mountpoint> remove_warn

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

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

4.5.4 Individual 'Target Path Count' for a node

By default, the 'Target Path Count' is based on the total configured path (listed by mpathadm) or from the variable DISK_DEFAULT_PATH_COUNT.
You can set an individual 'Target Path Count' for a specific or all LUNs assigned to a node.

To update the 'Target Path Count' for one LUN assigned to a node, issue the following command:

```
$ osmon -c modify_disk node=<node name> targetcount=<target path count> guids=<guid
list>
```

To update the 'Target Path Count' for all LUNs assigned to a node, issue the following command:

```
$ osmon -c modify_disk node=<node name> targetcount=<target path count> all
```

4.5.5 Display Filesystem usage

The filesystem usage is displayed on the vserver and node 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/GB        Used     warn-over
 g0051  v0151    v0151_root   /zones/v0151    yes    zfs    <undefined>    100%     (80%)
 g0080  v0160    v0160_root   /zones/v0160    yes    zfs    4.0            92%      (80%)
 g0086           g0086_root   /var            no     zfs    <undefined>    85%      (80%)
 g0059  v0134    v0134_root   /tmp            no     tmpfs  1.0            81%      (80%)
```

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'.

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4.5.6 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'.

4.5.7 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'.

4.5.8 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
```

4.5.9 Display Disk Path Count

A list of all disks without enough paths online can be displayed using the 'osmon -c show_disk' command.

```
 $ osmon -c show_disk

Disk Path Count with critical state
    Node  GUID                                  Current Path Count  Target Path Count
   s0024  6001438012599B620001100010C70000      1                   2
   s0024  6001438012599B6200011000291E0000      1                   2
   s0024  6001438012599B620001100029220000      1                   2
   s0024  6001438012599B62000110001F4E0000      1                   2
```

Use the summary flag to additionally display a summary of the current path count:

```
 $ osmon -c show_disk summary

   CurrentPathCount  Count
                  1      4

Disk Path Count with critical state
    Node  GUID                                  Current Path Count  Target Path Count
   s0024  6001438012599B620001100010C70000      1                   2
   s0024  6001438012599B6200011000291E0000      1                   2
   s0024  6001438012599B620001100029220000      1                   2
   s0024  6001438012599B62000110001F4E0000      1                   2
```

You can list the current path count for each node the disk is assigned by using the following command:

```
$ diskadm -c show name=6001438012599B620001100029220000

Dataset-Name  Use-Type   Dev-Type  GUID             Size/GB   Tier    Location
           -  FREE       MPXIO     600143..29220000 15.0      n/a     HPEVA

     Nodes connected to this disk:

      Node  Model                  cPool       Location    Path Count  Comment

     s0003  ORCL,SPARC-S7-2        sol11       RZ          4           S7-2 Server
     s0024  ORCL,SPARC-T4-1        sol11       RZ          1           T4-1 Server
```

4.5.10 VDCF Monitoring Report

New since VDCF Monitoring 3.1

The osmon -c show provides a full report about all critical objects.

```
-bash-4.4$ osmon -c show hwmon

-------------------------------------------------------------------------------------------
VDCF Monitoring Report from g0069
Date: 25.03.2019 07:57:28
-------------------------------------------------------------------------------------------
OS-Monitor

Filesystems with usage over warn threshold

  Node  vServer   Dataset     Mountpoint           zRoot  Type  Size/GB Used  warn-over
  g0056 v0124     v0124_root  /export/home/admin   no     zfs   0.1     85%   (80%)
  g0056 v0145     v0145_root  /export/home/admin   no     zfs   0.1     81%   (80%)

SMF with state: degraded,maintenance
  Server  Type        SMF-Name (FMRI)                          State
  v0121   vServer     svc:/system/webconsole:console           maintenance
  v0170   vServer     svc:/application/puppet:master           maintenance

-------------------------------------------------------------------------------------------
HW-Monitor (with State FAULTED or N/A)

Current Hardware State
  Node  Model             Console Soft State  HW State  Last Change
  s0009 SUNW,SPARC-T5220  ILOM    PWR-OFF     FAULTED   2019-01-05 14:00:56

-------------------------------------------------------------------------------------------
```

The OS Monitoring daily report cronjob can be enabled/disabled.

```
$ osmon -c enable report
```

```
$ osmon -c disable report
```

Use the status command to display the current state of the OS monitoring components:

```
$ osmon -c status
```

4.6 OS Security

4.6.1 Run Security Compliance Assessments

Security Compliance Assessments can be run against Nodes and vServer running on Solaris 11.3.

The benchmark to be used can be defined individually per system. For systems without a defined benchmark the VDCF 'default' benchmark is used. You can configure your default Benchmark by adding the COMPLIANCE_DEFAULT_BENCHMARK variable to customize.cfg.

```
$ vserver -c modify name=myserver benchmark=baseline

$ nodecfg -c modify name=server1 benchmark=cdom
```

See Chapter 3.6.4 to see where to define your own benchmarks.

The assessments may be running for several minutes, therefore they are not executed by 'osmon -c update' operation. Use the assess operation to initiate a Security Compliance Assessment:

```
$ osmon -c assess node=g0062 all_vserver

Assessing Node and all vServers on Node g0062
Executing compliance assess with Benchmark Solaris Baseline on g0062 ...
Executing compliance assess with Benchmark default on v0123 ...
Executing compliance assess with Benchmark default on v0143 ...

Compliance Report for Node g0062 from 2017-09-11T16:33:55
Score:       89.855064
Total Rules: 140   Passed: 134
                   Failed: 6   (Error: 0 / High: 1 / Med: 5 / Low: 0 / Info: 0)

Compliance Report for vServer v0123 from 2017-09-11T16:35:39
Score:       77.938248
Total Rules: 144   Passed: 140
                   Failed: 4   (Error: 0 / High: 0 / Med: 4 / Low: 0 / Info: 0)

Compliance Report for vServer v0143 from 2017-09-11T16:37:19
Score:       77.938248
Total Rules: 144   Passed: 140
                   Failed: 4   (Error: 0 / High: 0 / Med: 4 / Low: 0 / Info: 0)

Detailed Text Report can be found in /var/opt/jomasoft/vdcf/compliance_reports
WARN:  Assess of Node and all vServers on Node g0062 was not successful
```

For convenience the assess operation is also available in the node and vserver commands:

```
$ node -c assess name=g0062 vserver

$ vserver -c assess name=v0123 benchmark=recommended
```

4.6.2 Display Compliance Reports

A Compliance Report overview can be displayed by 'osmon -c show_compliance':

```
 $ osmon -c show_compliance

Server  Type     Benchmark  Score      Time        Passed  Failed  Error ...
v0123   vServer  default    77.938248  2017-09-11  140     4       0
v0143   vServer  default    77.938248  2017-09-11  140     4       0
s0024   Node     cdom       87.619041  2017-09-11  140     3       0
g0062   Node     baseline   89.855064  2017-09-11  134     6       0
s0003   Node     cdom       95.238091  2017-09-11  142     1       0
```

A detailed report in HTML can be found in the compliance html report directory:
`/var/opt/jomasoft/vdcf/compliance_reports/html`

These reports can be displayed with your preferred browser using the VDCF Dashboard.
See Chapter 4.7 for details.

4.6.3 OS Hardening

This feature is only available on Solaris 11.

To resolve the security findings discovered by the assess operation you may use the hardening operations on the node and vserver commands. These commands do apply OS hardening using a dedicated hardening profile:

```
 $ node -c harden profile=<hardening profile>

 $ vserver -c harden profile=<hardening profile>
```

Use the 'node -c harden help' or 'vserver -c harden help' to get a list of all available hardening profiles.
You may define your own hardening profiles (see Chapter 3.6.5)

```
-bash-4.4$ node -c harden name=g0098 profile=baseline

Hardening started ...
OSC-12510: Service svc:/network/nfs/fedfs-client:default is in disabled state - DONE
OSC-15510: Service svc:/network/finger is disabled or not installed - DONE
OSC-17510: Service svc:/network/ftp:default is in disabled state - DONE
OSC-55010: The r-protocols services are disabled in PAM - DONE
OSC-63005: Service svc:/network/rpc/gss is enabled if and only if Kerberos is
configured - DONE
Hardening of 5 items on Node g0098 was successful
```

4.7 VDCF Dashboard web application

Starting with Version 3.0 the VDCF Monitoring comes with a web application to display some information stored in the VDCF Repository. And to access compliance reports generated by the 'osmon -c assess' command.

4.7.1 Enabling / Disabling

The web application is running as a apache daemon process and therefore it can be controlled by the normal apache restart commands. The web application is deployed in a separate virtual host.

It's enabled by default (after running the setup_gui tool, see Chapter 3.7).

To disable the web application just remove this file from the apache conf.d directory:
`/etc/apache2/2.*/conf.d/vdcf_django_httpd_2*.conf`
and restart Apache.

4.7.2 Logfiles

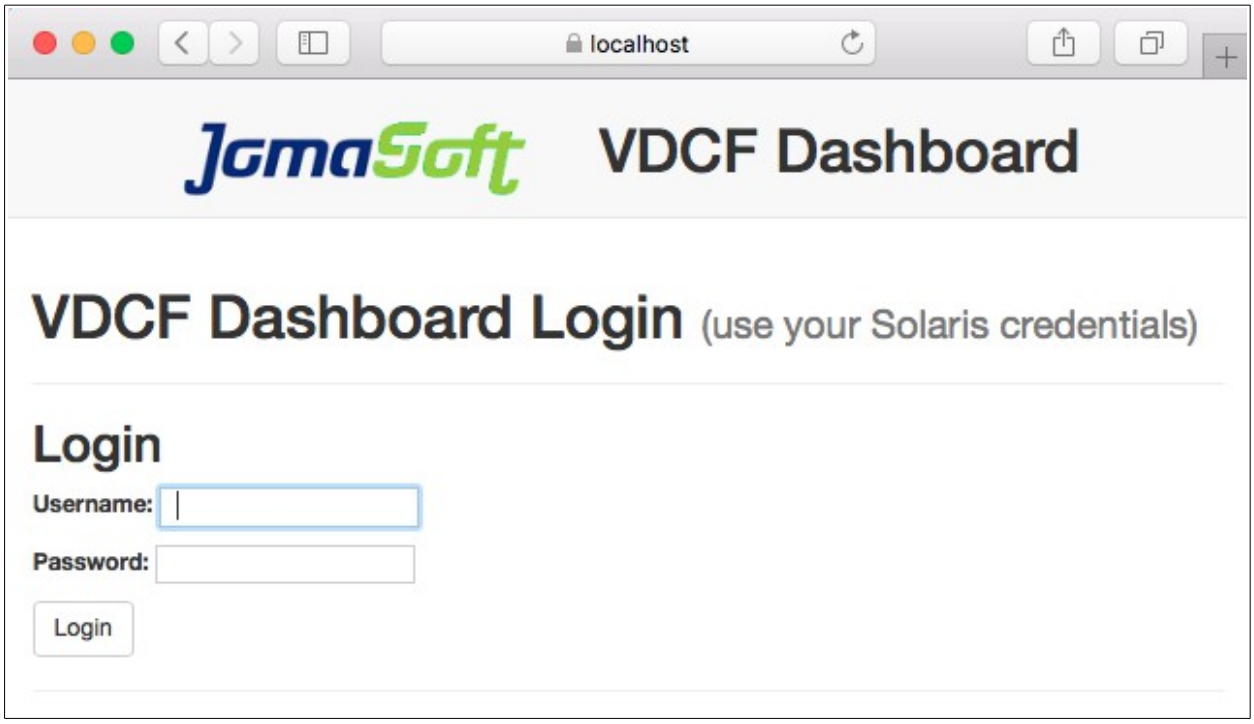
Web application logfiles are located in the normal VDCF log directory:

```
$ ls -l /var/opt/jomasoft/vdcf/log/vdcfgui_*
-rw-r--r--  1 root    root     304 Sep 19 15:44 vdcfgui_access.log
-rw-r--r--  1 vdcfgui webservd  92 Sep 19 15:43 vdcfgui_django.log
-rw-r--r--  1 root    root     465 Sep 19 15:17 vdcfgui_error.log
```

4.7.3 Web application screenshots

Start your preferred browser and navigate to the dashboard url: https://<yourserver>:<your port> (depends on your apache configuration).

To authenticate you have to use your local unix account credentials.
Users without a Solaris account can't use the VDCF Dashboard.



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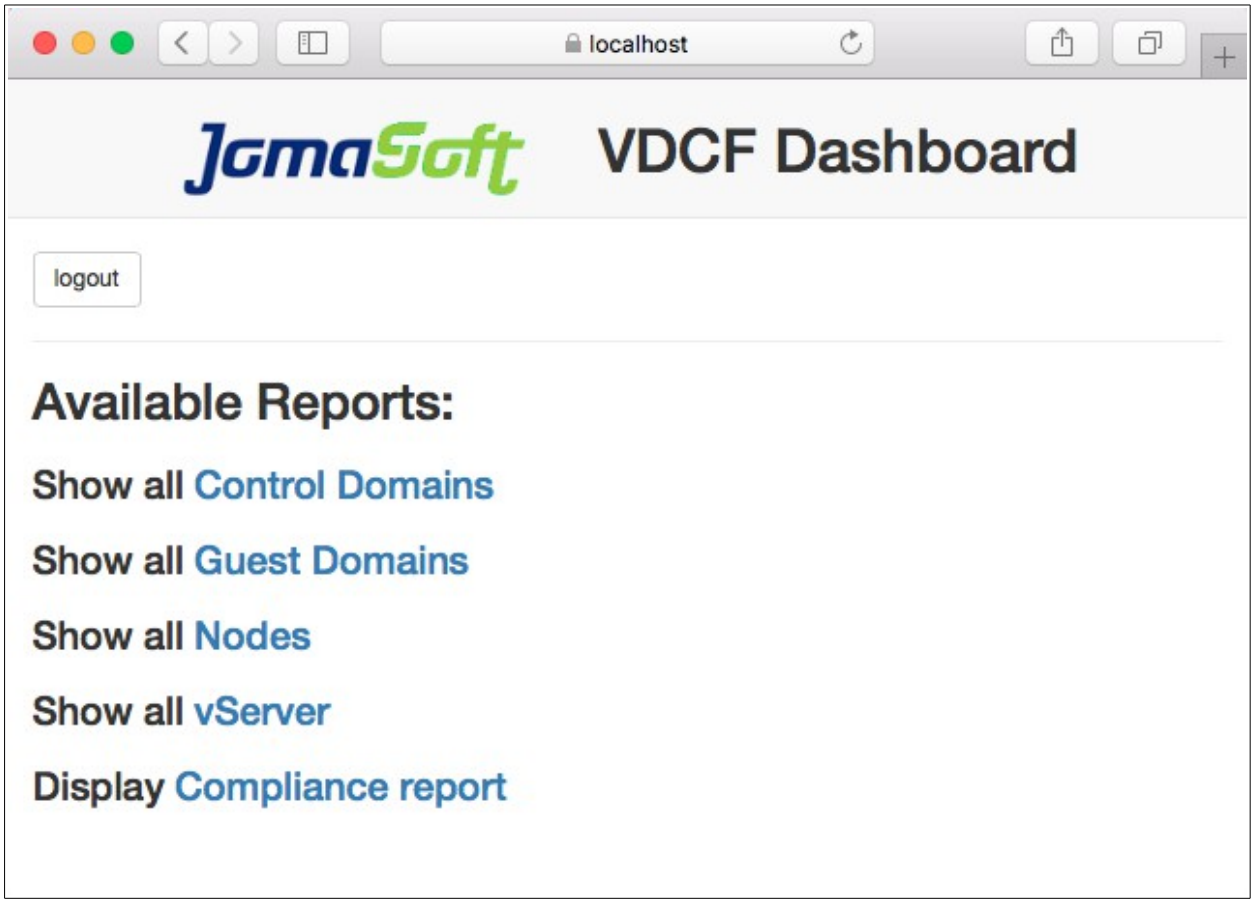
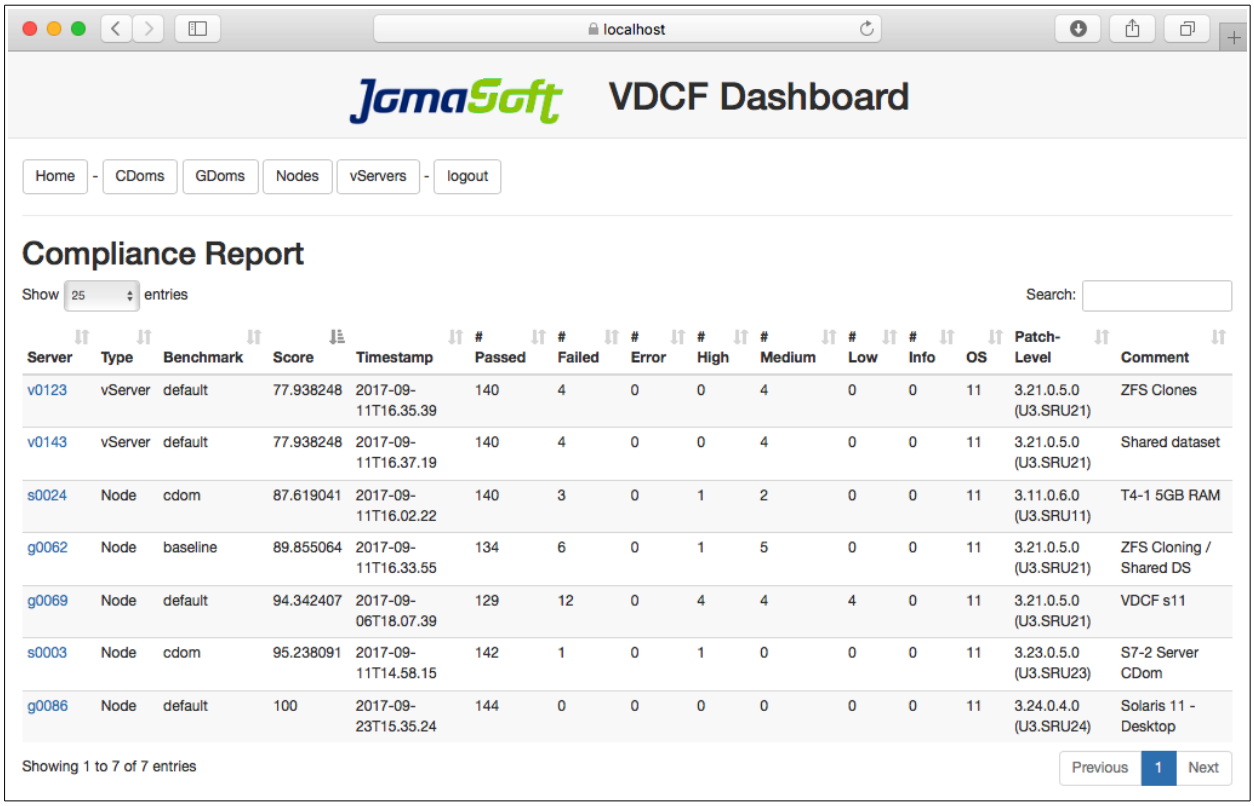
After authentication you get redirected to the front page of the application:



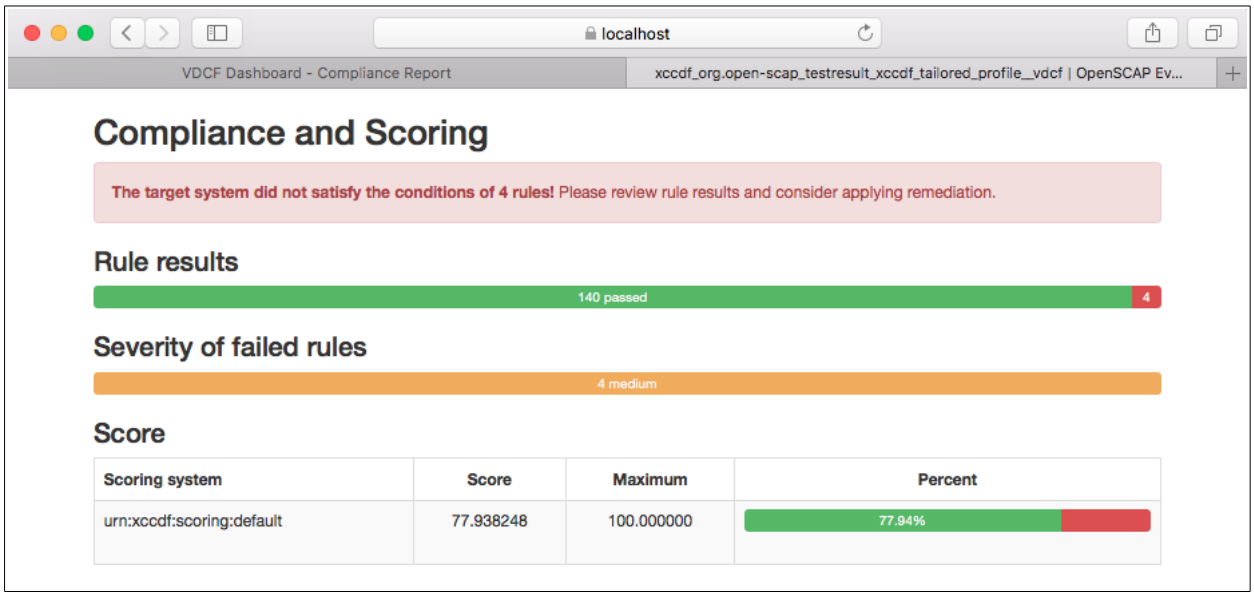
From here you can select the different reports. For example the compliance overview:



Server	Type	Benchmark	Score	Timestamp	# Passed	# Failed	# Error	# High	# Medium	# Low	# Info	OS	Patch-Level	Comment
v0123	vServer	default	77.938248	2017-09-11T16.35.39	140	4	0	0	4	0	0	11	3.21.0.5.0 (U3.SRU21)	ZFS Clones
v0143	vServer	default	77.938248	2017-09-11T16.37.19	140	4	0	0	4	0	0	11	3.21.0.5.0 (U3.SRU21)	Shared dataset
s0024	Node	cdom	87.619041	2017-09-11T16.02.22	140	3	0	1	2	0	0	11	3.11.0.6.0 (U3.SRU11)	T4-1 5GB RAM
g0062	Node	baseline	89.855064	2017-09-11T16.33.55	134	6	0	1	5	0	0	11	3.21.0.5.0 (U3.SRU21)	ZFS Cloning / Shared DS
g0069	Node	default	94.342407	2017-09-06T18.07.39	129	12	0	4	4	4	0	11	3.21.0.5.0 (U3.SRU21)	VDCF s11
s0003	Node	cdom	95.238091	2017-09-11T14.58.15	142	1	0	1	0	0	0	11	3.23.0.5.0 (U3.SRU23)	S7-2 Server CDom
g0086	Node	default	100	2017-09-23T15.35.24	144	0	0	0	0	0	0	11	3.24.0.4.0 (U3.SRU24)	Solaris 11 - Desktop

Showing 1 to 7 of 7 entries
Previous 1 Next

And finally display a compliance report for a specific system:



Scoring system	Score	Maximum	Percent
urn:xccdf:scoring:default	77.938248	100.000000	77.94%

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5 Appendixes

5.1 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 (HAMON_KEEP_ALIVE_ACTION_THOLD+1) * 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 then 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.