Everything you wanted to know about (HPE) OpenVMS Service Control – *but were afraid to ask !*

http://www.openservicecontrol.org/

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History

- The first production Release was V1.2 and was first used in March 2008 at the Austrian Lotteries.
- The first open Version was V2.4 and was released in December 2008
- The actual Version is V3.4 and was released In June 2015

Agenda

- Introduction
- Requirements
- Basic Concepts and Terminology
- OSC Components
  - Installation
  - Configuration
  - Management
- Examples
- OSC Resources

- Includes many of the slides that have been done in the past
- This time with configuration examples

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Introduction

- HP **O**penVMS **S**ervice**C**ontrol (**OSC**) is a management framework that makes non-cluster aware services (applications) highly available to their clients.

- ASE on OSF
- CAA on TruCluster
- Veritas

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What do we want to achieve ?

- MantisBT
  - an OpenSource BugTracking System
  - requires
    - WebServer
      - WASD
    - PHP
    - Database
      - MariaDB
  - Only runs on one Node/System at any one time

! We want to make this application highly available !

- This a reference to the previous presentation: Session Id 104 "Using OpenSource/Freeware Software on OpenVMS to help manage your small software business"
- Real life example

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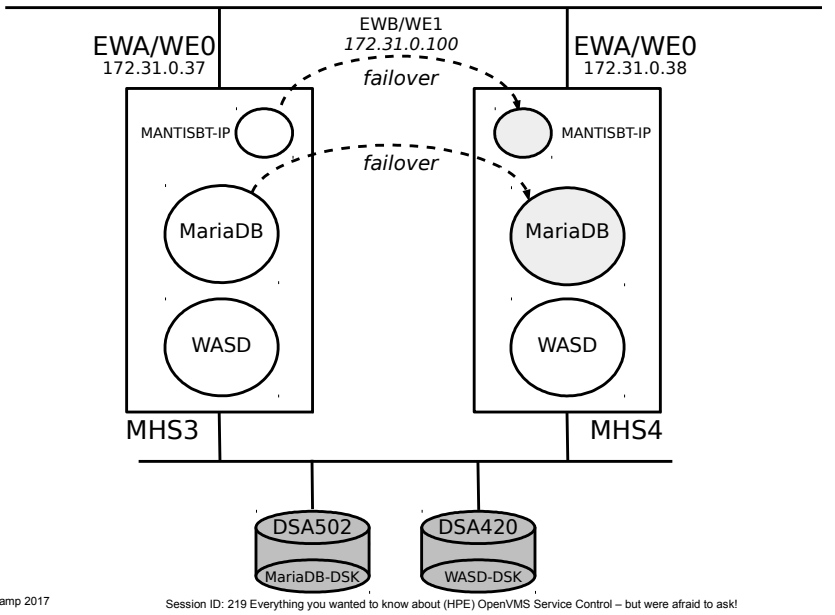
MantisBT Configuration



- Keep this picture in mind when studying the next few slides.
  - We want to ensure that a PHP application MantisBT becomes highly available,
  - This application runs on the WASD Web Server and uses MariaDB as its database.
  - It can only run on one cluster member at any one time.
    - Hence we define a failSafeIP Address that wanders to whichever system has the active MariaDB for MantisBT.
    - WASD is available for other applications on both systems concurrently.

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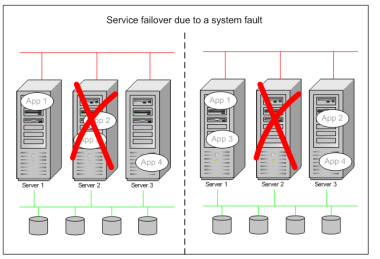
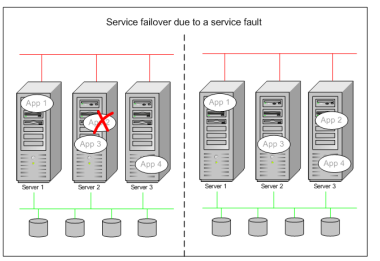
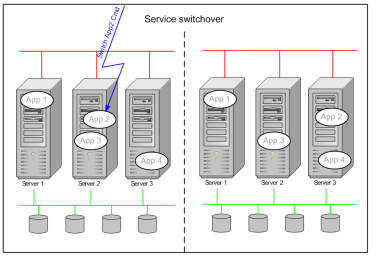
Basic Functionality

- Failover





- Switchover



- Failover
  - Due to a resource/service failover
  - System failover

- Switchover
  - Procatively because of a management decision

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Requirements

- Monitor the health of a service
  - Application plus all its required hardware and software resources (disks, shadow sets, network interfaces ...)
- Relocate services due to service or system failures
- Service switchover on user request
- Able to handle any kind of application
  - Easily extendable
  - Reuseability of exiting Management scripts (Startup, Shutdown, Monitor Scripts)
- Easy to configure and control
- Event notification
  - Ordered by occurrence
  - Freely definable event notification method

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Requirements (contd.)

- Common management interface
- Common configuration interface
- Terminology and management interfaces similar to VERITAS™ cluster server (VCS)
- Wide range of control attributes to adjust OSC behavior to customer needs

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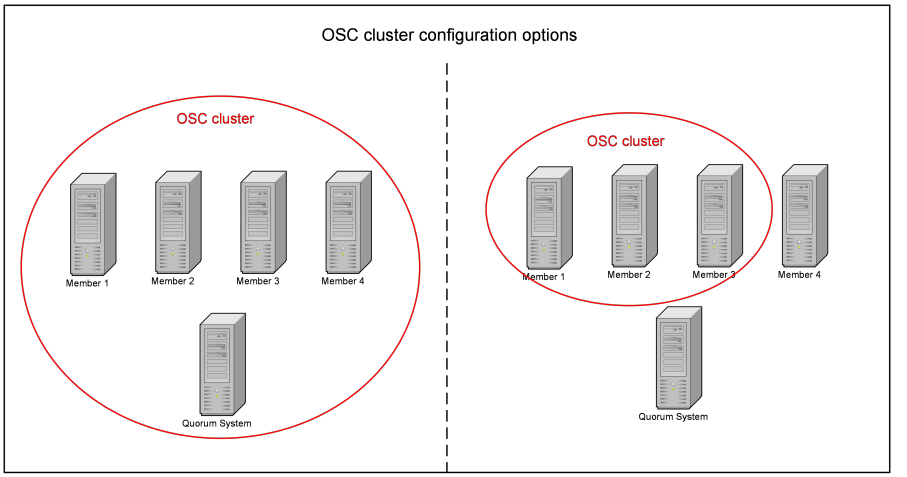
Basic Concepts and Terminology

- OSC cluster
- OSC management entities (building blocks)
  - Resource
  - Service
  - Service Group

What is an OSC cluster?

- Consists of all or a subset of OpenVMS cluster members



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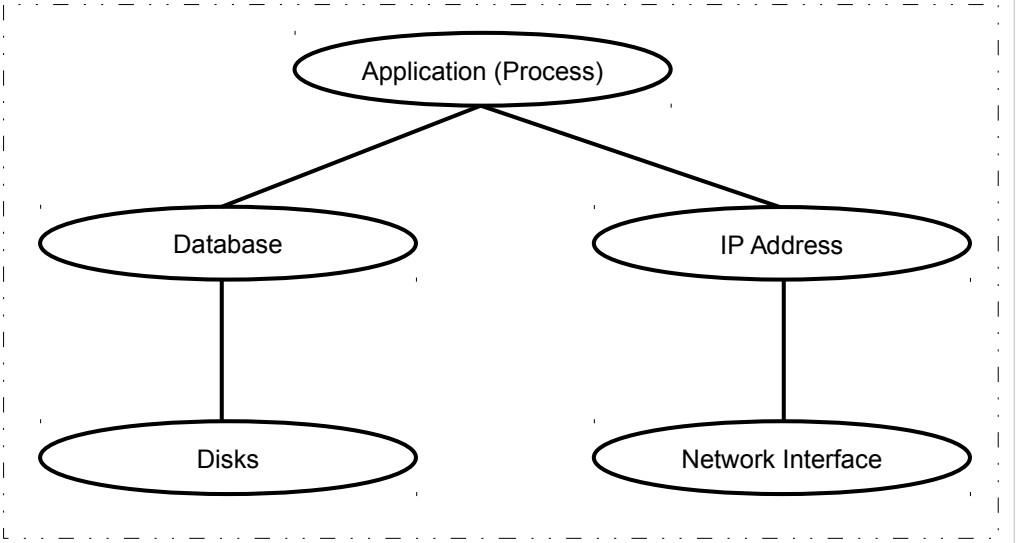
OSC Cluster

- OSC cluster members have to be defined when OSC is configured
  - Votes have to be assigned to each OSC cluster member
  - Quorum calculation (done the same way as on an OpenVMS cluster)
  - OSC quorum is different from an OpenVMS quorum
    - As long as the OSC cluster has quorum the system resources of all remaining OSC cluster members are sufficient to run all managed applications
    - When OSC quorum is lost due to a node failure:
      - Applications that have been online on the failing node are not automatically started on the remaining OSC cluster member, since an OSC quorum lost state signals that overall system resources are not sufficient to run all managed applications
      - OSC blocks interactive management commands except:
        - SHOW and ADJUST QUORUM commands

OSC Resources (RES)

- Resources are hardware and software entities such as:
  - Disks
  - Shadow Sets
  - Network Interface Cards
  - IP Addresses
  - Databases
  - Applications
  - ...
- Resource dependencies define the order in which resources are brought online or taken offline
  - Child resources must be online before a parent resource can be started
  - Parent resources have to be offline before a child resource can be shutdown

OSC Resource Dependency Example



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OSC Resource Criteria

- An OSC resource is whatever you define as a resource
- Nevertheless, an OSC resource has to fulfill certain criteria in oder to be managed by OSC
  - An OSC resource must be capable of being explicitly started by a set of commands
    - Startup of one OSC resource must not implicitly start other OSC resources. If so, these resources cannot be defined as independent OSC resources.
  - Each instance of a resource type (eg. database) must be capable of being stopped without affecting other instances of that resource type.

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OSC Resource Criteria (contd.)

- An OSC resource must be capable of being explicitly stopped, by forcible means if necessary.
  - Shutdown of one OSC resource must not implicitly stop other OSC resources. If so, these resources cannot be defined as independent OSC resources.
- OSC resources must be capable of being monitored.
- OSC resources must be crash tolerant.
  - An OSC resource runs on a node that crashes -> OSC resource will start on a failover node in a none state (i.e. no memory content required to start the resource)
- OSC resources must be host independent within an OpenVMS cluster.
- No license restrictions or host name dependencies that prevents successful failover.

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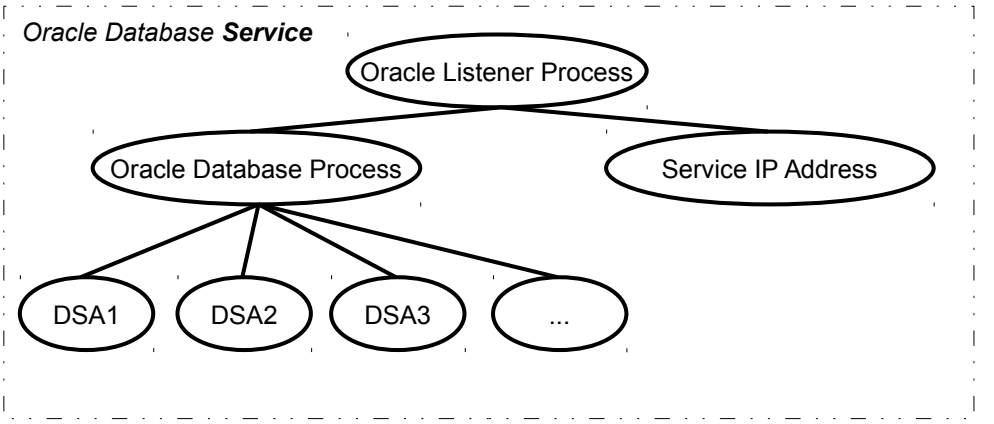
OSC Resource Categories

- ***On-Off***
  - Monitored
  - Started if required
  - Stopped if required
  - *Eg.*
    - *Process*
- ***On-Only***
  - Monitored
  - Started if required
  - *Eg.*
    - *Shadow Set*
- ***Persistent***
  - Monitored only
  - *Eg.*
    - *Network Interface Card*

OSC Service (SER)

- A service is a logical grouping of resources and resource dependencies that are required to run a dedicated service (application). It is the management unit that controls resource sets .



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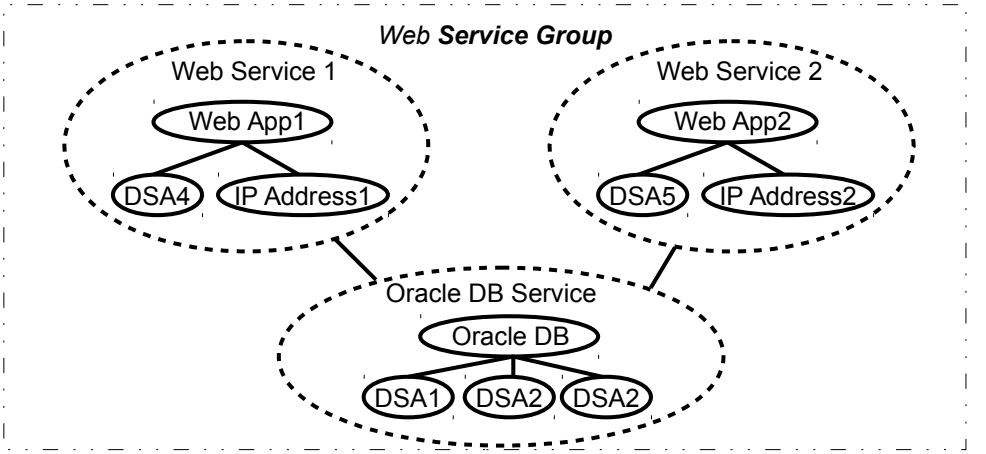
OSC Service Dependency

- Service dependencies define the order in which services are brought online or taken offline
  - Child Services must be online before a Parent Service can be started.
  - Parent Services have to be offline before a Child Service can be shutdown.

OSC Service Group (SRVGRP)

- A *service group* is a logical grouping of *services* and service dependencies.
- It is the OSC management and failover entity.



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OSC Service Group Categories

- Service Group Categories
  - *Failover*
    - A failover service group runs on one system in the OSC cluster at any time. Failover groups are used for non OpenVMS cluster aware applications (ie. applications that are not designed to maintain data consistency when multiple copies are started).
  - *Multi-Instance*
    - A Multi-Instance service group is active concurrently on more than one, but not on all systems within the OSC cluster. All services within the service group must be cluster aware.
  - *Parallel*
    - A parallel service group runs concurrently on all OSC cluster members. All services within the service group must be cluster aware.

An Execution *node list* and *priority* has to be defined for each service group

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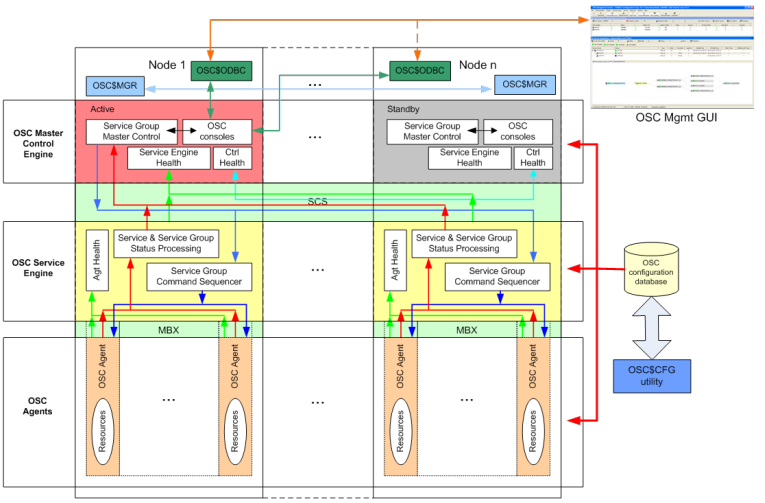
OSC components

1. OSC Agents
2. OSC Service Engine
3. OSC Master Engine
4. OSC Management Utility
5. OSC Configuration Utility
6. OSC Configuration Database
7. OSC Event Notification Service

OSC software architecture



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OSC Agents (1-1)

- Resources of a particular type are managed by one OSC Agent (i.e. Shadow sets, disks)
- Resource management means
  - Monitoring the status of a resource
    - an OSC agent decides whether a resource has failed
  - Starting a resource
  - Stopping a resource
  - Cleaning up a resource
- OSC Agent consists of the OSC Agent framework and action routines that provide the resource type specific logic
- OSC Agent framework provides processing logic
  - Understand common resource attributes
  - Workflow logic
  - Communication with the OSC Service Engine

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OSC Agent action routines (1-2)

- Monitor
  - The monitor action routine is periodically called to determine the resource state and to verify whether the resource state has changed.
  - The online and offline monitoring interval can be configured resource specific.
  - The monitor action routine is called for all managed resources whenever the OSC agent is re-started and after every attempt to put a resource online or offline in order to verify that the operation was successful.
- Online
  - The online action routine brings a specific resource online from an offline state.

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OSC Agent action routines (1-3)

- Offline
  - The offline action routine shuts down online resources
- Cleanup
  - The cleanup action routine is called (forced shutdown) for a resource after a resource has failed to come online, failed to go offline, or failed while in an online state.

    The cleanup action routine has to be designed to forcibly shutdown a resource when it has failed in order to ensure that the resource does not remain in an undefined state.

    The cleanup action routine will be executed only for *On-Off* resources, since these resources are typically not cluster aware. *On-Off* resources have to be offline before they can be brought online on another OSC cluster member.

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OSC Agent action routines (1-4)

- Actions routines can be implemented either using DCL scripts or as C functions
- OSC Agent action routines can be defined resource specific
  - Thus, an OSC Agent may call different action routines for resources of the same type
- Due to this design it is easy to develop new OSC Agents

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OSC Service Engine (2-1)

- Active on all OSC cluster members
- It monitors and controls the OSC agents on a node:
  - Starts all the required OSC Agents on a node whenever the OSC environment is started on a particular node.
  - Stops all required OSC Agent processes when the OSC environment is shutdown on a node.
  - Guarantees that all pending service group, service and resource transactions complete before the shutdown request is executed.
  - Monitors the status of the OSC Agents running on the node. The OSC Service Engine periodically checks the receipt of heartbeat signals from the OSC Agents. If this check fails (it has received no heartbeat message from an agent within a predefined time interval) for an OSC Agent, the OSC Service Engine automatically restarts the appropriate OSC Agent if it is allowed to. The agent fault processing behavior by the OSC Service Engine can be defined agent specific.

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OSC Service Engine (2-2)

- Maintains/updates the status of services and service groups locally configured according to the status information received from the OSC Agents.
- Forwards the resource, service and service group status information to the OSC Master Control Process.
- Guarantees that all resource, service and service group administrative commands received from the OSC Master Control Process are executed according to the configured dependencies.
  - Eg. if the OSC Service Engine receives the online command for a service group from the OSC Master Control Process, the OSC Service Engine ensures that all services of the service group and all resources defined within each of these services are brought online bottom-up according to the configured dependencies.

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OSC Master Control Engine (3-1)

- Started on all OSC cluster members
- Active only on one OSC cluster member
- All standby OSC Master Control Engine instances check the health of the active OSC Master Control Engine
- Knows the status of all service groups on all OSC cluster members. Thus, the active OSC Master Control Engine is the one that decides whether to put a service group online, offline or to failover the service group .
- The OSC Master Control Engine checks the health of the OSC Service Engines running on the OSC cluster members
  - Checks the heartbeat signals sent by the OSC Service Engines.
  - If the OSC Master Control Process does not receive a heartbeat within a predefined time period from a particular OSC Service Engine it automatically tries to restart that OSC Service Engine according to the OSC Service Engine control parameters

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OSC Master Control Engine (3-2)

- The active OSC Master Control process provides the console interface for interactive OSC management.
  - Up to 64 console links are supported
- SCS layer utilized for reliable communication between the OSC Service Engines

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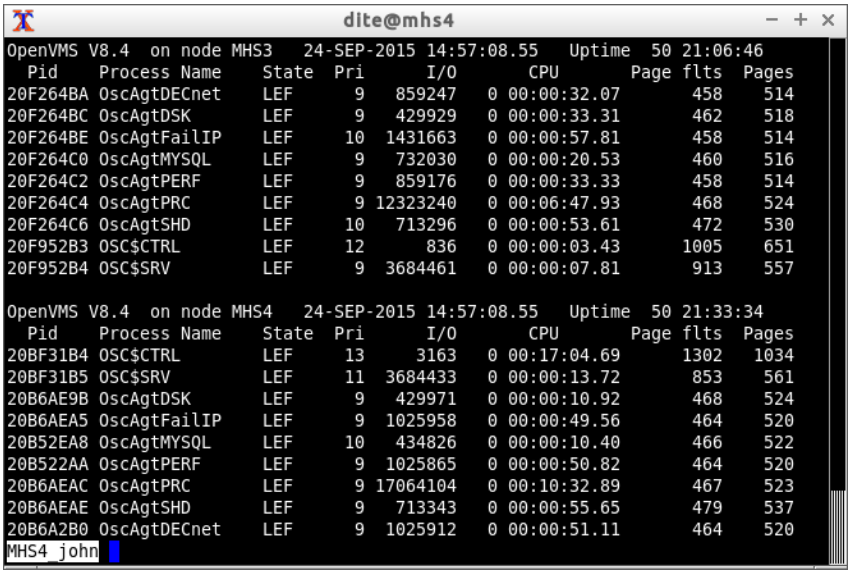
OSC OpenVMS Processes



- The master control engine process: OSC$CTRL
- The service engine process: OSC$SRV
- One Agent process is started for each resource category that has been defined in the active OSC configuration.

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OSC Installation

- VMSINSTAL
  - `@SYS$UPDATE:VMSINSTAL OSC034 disk:[kit-directory]`
  - Common Cluster Disk
    - otherwise the CFG Database has to be distributed manually
  - a license valid for a 32 node OpenVMS cluster is applied automatically

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OSC Directories

- OSC$COMMON:[000000]
  - OSC$COMMON:[BIN]
    - EXEs for IA64 and AXP
    - Startup Scripts
  - OSC$COMMON:[CFG]
    - CFG Databases
    - OSC$TEMPLATES.CFG
    - Template Agent Monitor, Offline, Online scripts
    - This is where I put my scripts
  - OSC$COMMON:[EXAMPLES]
  - OSC$COMMON:[HELP]
  - OSC$COMMON:[INCLUDE]
    - .H and OLB library files
  - OSC$COMMON:[LOG]
    - OSC$CTRL_<node>.LOG
    - OSC$SRV_<node>.LOG
    - OSC$EVENT.LOG_<YYYY-MM-DD>
    - OSCAGT<agent>_<node>.LOG
  - OSC$COMMON:[STARTUP]
    - Copies of what is in SYS$STARTUP

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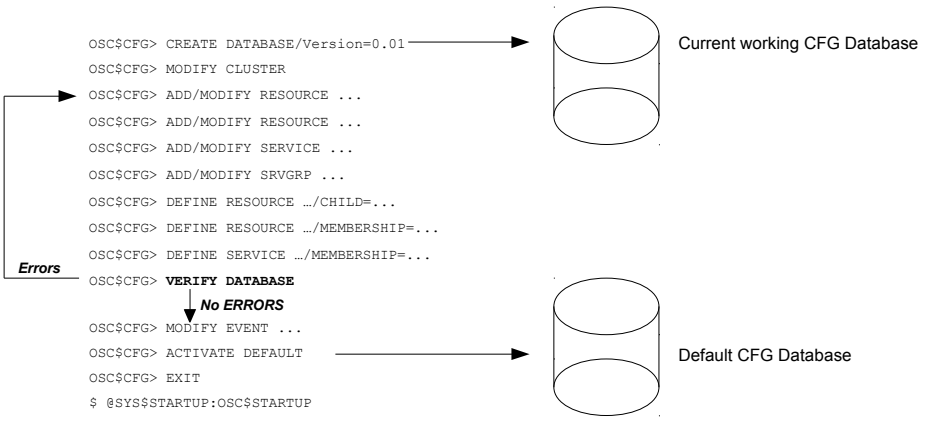
OSC Configuration Utility

- `$ MC OSC$BIN:OSC$CFG.EXE`
- Common OSC Configuration Utility to
  - Manage OSC configuration projects (databases)
  - Configure within an OSC configuration project
    - OSC cluster
    - OSC Master Engine control parameters
    - OSC Service Engine control parameters
    - OSC agent definition and control parmameters
    - Resources and resource dependencies
    - Services and service dependencies
    - Service groups
    - OSC events and notification method

- Hopefully there is no confusion here. OSC cannot run without a configuration that contains definitions for the OSC cluster, resources, services and service groups.

OSC Databases and Configuration

- Assuming that no Default CFG database exists and OSC has not yet been started



- Only one CFG Database can be used by OSC at anyone time, this is called the *"Default CFG DB"*.
- The *"Default CFG DB"* cannot be modified. Only *"working CFG Databases"* can be modified.
- There can be many *"working CFG Databases"*, differentiated by version numbers.
- The working database that has been opened is called the *"current working CFG DB"* .

- This is to give you an overview of how the database versions are handled.
- All the resource, service and service-group definitions are held in a database.
- You have to provision the database with these definitions.
- Before activating the database you have to "verify" the database.
- If errors are reported during the "verification", then these need to be corrected, before re-verifying the database again.
- Only once there are no verification errors can a database be "activated".
- The "activated" database becomes the "default" (read-only) database.
- The other databases are called "working" databases.
- If you want to extend the current "activated" database, the only way to do this is to copy it first, creating a new database with a higher version number, and modifying this. Once the modifications are completed and the database is "verified", then this new database can be "activated".
- Remember, you have to shutdown OSC in the cluster, in order to activate this new database.

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OSC$CFG Database Commands

- CREATE
  - `OSC$CFG> CREATE DATABASE/VERSION=V8.3`
- CLOSE
  - `OSC$CFG> CLOSE DATABASE`
- COPY
  - `OSC$CFG> COPY DATABASE OSC$COMMON:[CFG]OSC$CONFIG_190.DAT;1 -`
    `_OSC$CFG> /VERSION=V10.0`
- SHOW
  - `OSC$CFG> SHOW DATABASE`
- OPEN
  - `OSC$CFG> OPEN DATABASE/VERSION=V10.0`
- VERIFY
  - `OSC$CFG> VERIFY DATABASE`
- ACTIVATE
  - `OSC$CFG> ACTIVATE DEFAULT`
- EXPORT (into a text file)
  - `OSC$CFG> EXPORT SYS$LOGIN:OSC_V10-0.CFG`
- LOAD (from a text file)
  - `OSC$CFG> LOAD SYS$LOGIN:OSC_V10-0.CFG`

- An overview of the possible commands

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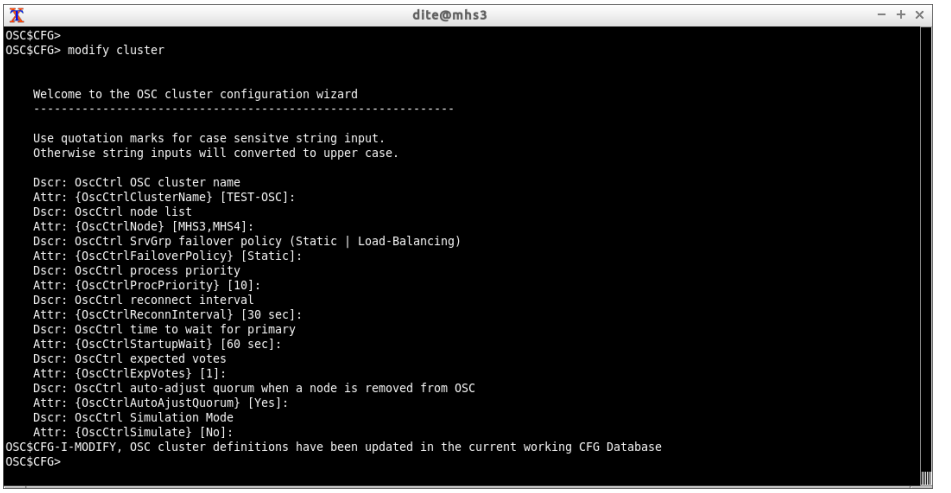
OSC$CFG Configuration Commands

RESOURCE (RES) / SERVICE (SER) / SERVICE GROUPS (SRV)

- ADD (calls the appropriate wizard)
  - `OSC$CFG> ADD PRC::WASD`
- AUTOCONFIGURE (only for Shadow Set Resources)
  - `OSC$CFG> AUTOCONFIG SHD/EXCLUDE=(DSA10,DSA20)`
- COPY
  - `OSC$CFG> COPY RESOURCE PRC::WASD PRC::WASD-NEW`
- MODIFY (calls the appropriate wizard)
  - `OSC$CFG> MODIFY CLUSTER ! Starts it off !`
- SHOW
  - `OSC$CFG> SHOW RESOURCE /BRIEF`
- RENAME
  - `OSC$CFG> RENAME RESOURCE PRC::WASD PRC::WASD-NEW`

- The best way is to just experiment
- You cannot break anything.

OSC$CFG>MODIFY CLUSTER



- This is the starting point.
- Unlike Resources, Services or Service-Groups, one cannot ADD a Cluster, as it deemed to always be there.
- Use the command MODIFY to initate the configuration

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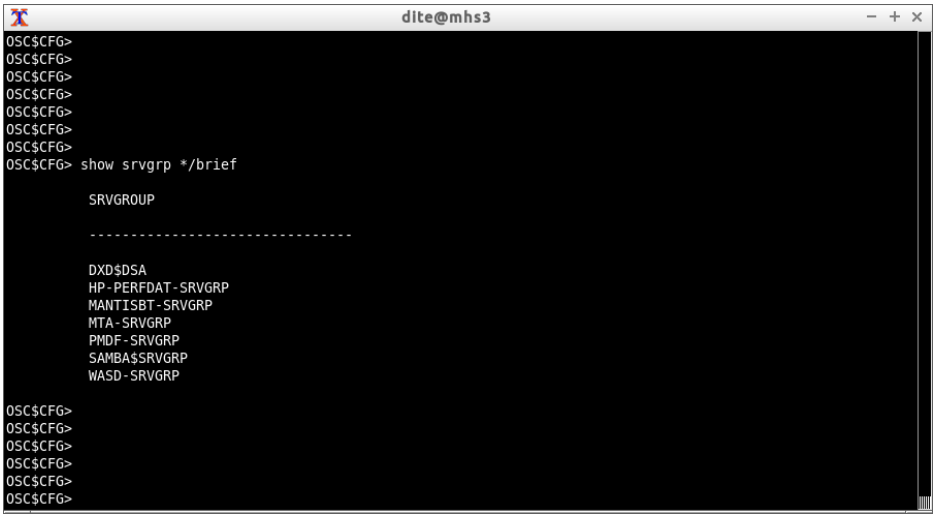
OSC$CFG> SHOW SRVGRP



- An example of the SHOW SRVGRP command

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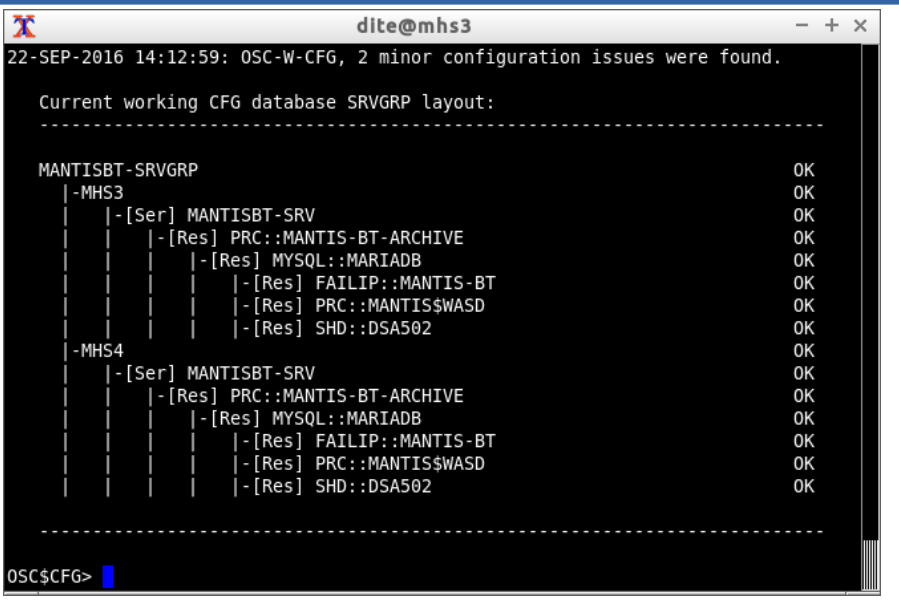
OSC$CFG> SHOW SRVGRP /LAYOUT



- This illustrates how one can display the hierarchy of a Service Group, displaying the relationships between resources, services and service groups.
- The next slides will show the attributes of the individual resources involved.
- This shows the hierarchy of our resources, service and Service-Group from our MantisBT example:
  - At the lowest level we have defined the following resource:
    - Shadow Disk Resource = SHD::DSA502
    - A process Resource = PRC:MATIS$WASD this represents the WASD WebServer that has to be available for MantisBT
    - A FailIP Resource) FAILIP::MANTIS-BT this represents the service specific IP address (that is active only ever on one system at any one time).
  - At the next level is
    - the MYSQL Resource = MYSQL::MARIADB
  - At the next level is
    - The process Resource = PRC::MANTIS-BT-ARCHIVE this represents the archiving process.

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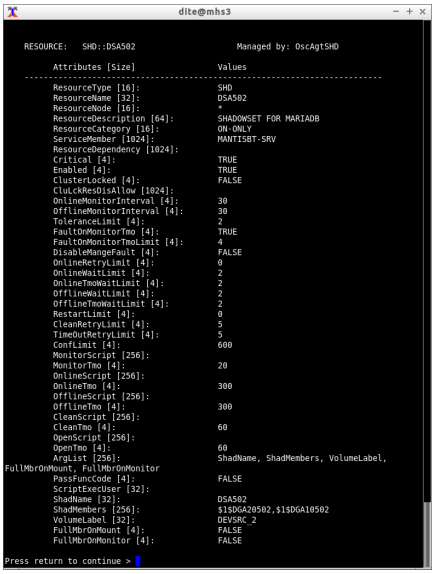
OSC$CFG> SHOW RES SHD::DSA502



- This illustrates ShadowSet Resource.
- This shows how can display the individual attributes of a resource, many of these contain default values.

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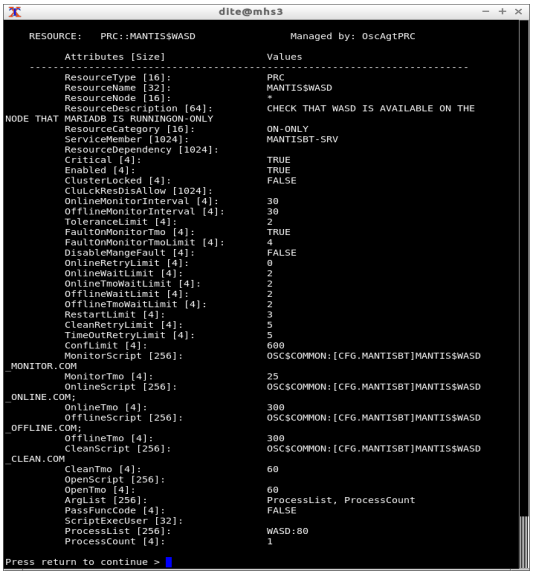
OSC$CFG>SHOW RES MANTIS$WASD



- This illustrate the attributes associated with the process Resource PRC::MANTIS$WASD
- Please note the MONITOR, ONLINE, OFFLINE and CLEAN scripts that have been defined.
- These scripts contain the logic of how this resource is monitored and/or controlled,
- In this case, all that this resource is trying to do is to check the availability of the WASD WebServer and whether it is active. It it had some kind of problem then this Resource would signal a 'failure' condition.

OSC$CFG – PRC::MANTIS$WASD Monitor Script

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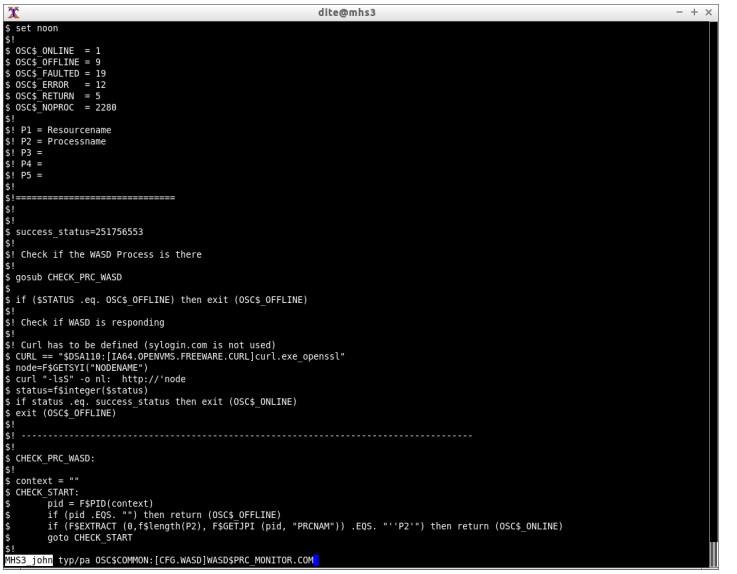

- This is an example of a MONITOR Script.
- The existence of the WASD process is checked and whether the WebServer reacts to a http request using the CURL utility

OSC$CFG – PRC::MANTIS$WASD Online Script

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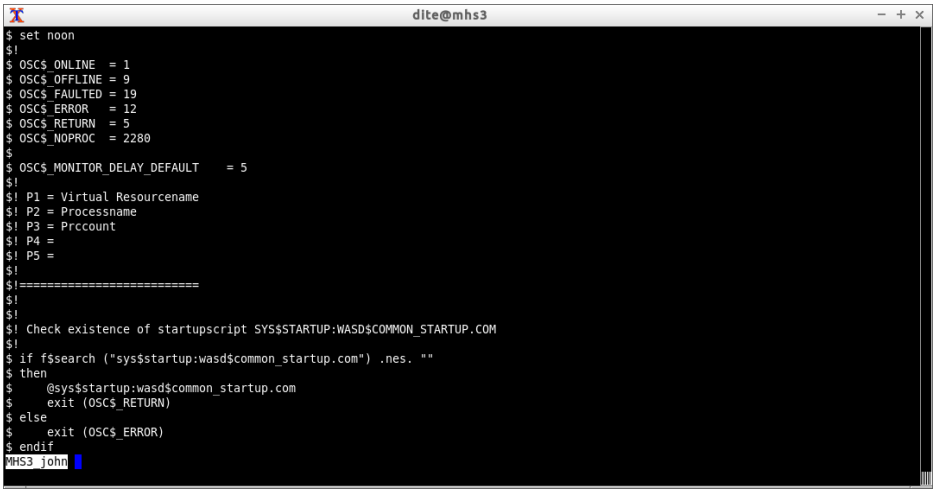

- This is an example of a ONLINE Script.
- The ONLINE script just executes the startup script for he WASD WebServer.

OSC$CFG – PRC::MANTIS$WASD Offline Script

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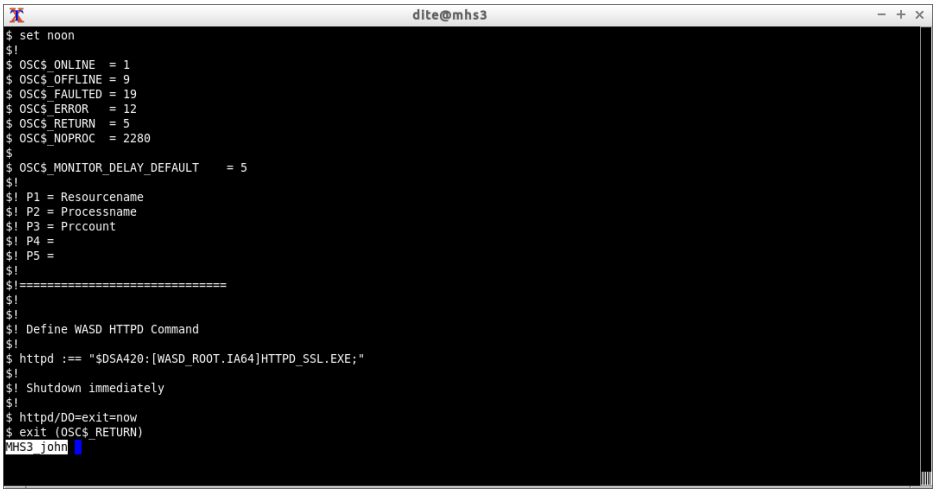


- This is an example of an OFFLINE Script.
- A CLI command is executed to OFFLINE the WASD WebServer process.

OSC$CFG – Defining Dependencies

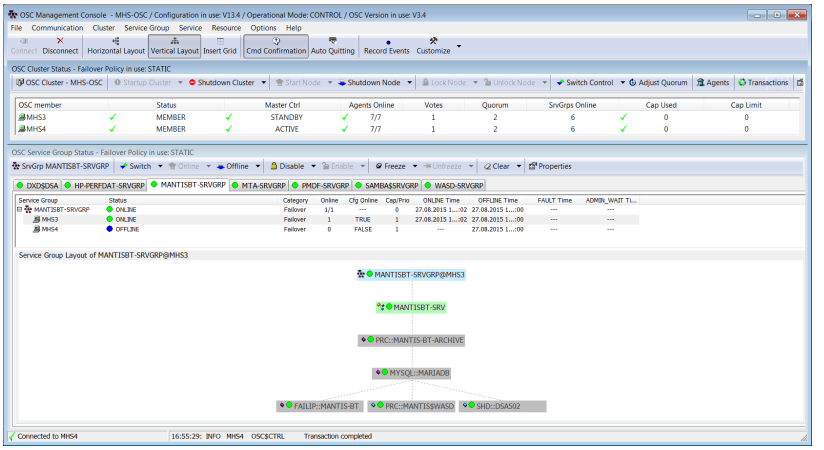
```
------------------------------------------------------------------------------

WASD-SRVGRP                                                            OK
  |-MHS3                                                               OK
  |   |-[Ser] WASD-SRV                                                 OK
  |   |   |-[Res] PRC::WASD                                            OK
  |   |   |   |-[Res] SHD::DSA420                                      OK
  |-MHS4                                                               OK
  |   |-[Ser] WASD-SRV                                                 OK
  |   |   |-[Res] PRC::WASD                                            OK
  |   |   |   |-[Res] SHD::DSA420                                      OK

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

- Defining Resource Dependency
  - `OSC$CFG> DEFINE RES PRC::WASD/CHILD=SHD::DSA420`
- Defining Service (Membership) Dependency
  - `OSC$CFG> DEFINE RES PRC::WASD/MEMBERSHIP=WASD-SRV`
- Defining Service Group (Membership) Dependency
  - `OSC$CFG> DEFINE SER WASD-SRV/MEMBERSHIP=WASD-SRVGRP`
- Defining Service Group Interdependencies
  - `OSC$CFG> DEFINE SRVGRP <...> /DISALLOW=<srvgrpX,srvgrpY,...>`

- This is just to illustrate how to define resource dependencies

OSC Management

- Command Line OSC$MGR>
- GUI – (only Windows based)



- This illustartes the GUI that is available to monitor an manage OSC.

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OSC Management Utility

- `$MC OSC$BIN:OSC$MGR.EXE`
- Automatically connects to the active OSC Master Control Engine
- Management actions:
  - Status display of the OSC cluster environment
  - Status display of all service groups, services and resources
  - Management of all service groups, services and resources
    - Setting a service group online, taking it offline
    - Service group switchover
    - Freeze / Disable a service group or a resource
    - Clear faults and change ADMIN_WAIT state
    - ...
  - Management of the OSC cluster environment

- A CLI utility is available to manage OSC as well.

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OSC$MGR Command Overview

- STARTUP
  - `OSC$MGR> STARTUP/CLUSTER [/MODE=SIMULATION]`
  - `OSC$MGR> STARTUP/NODE=MHS4`
    - If previously shutdown with `OSC$MGR> SHUTDOWN/NODE=MHS4`
- SHUTDOWN
  - `OSC$MGR> SHUTDOWN/CLUSTER`
  - `OSC$MGR> SHUTDOWN/NODE=MHS4`
- LOCK / UNLOCK OSC Node
  - `OSC$MGR> LOCK/NODE=MHS4`
  - `OSC$MGR> UNLOCK/NODE=MHS4`
- Cluster Commands
  - `OSC$MGR> ADJUST QUORUM`
- Agent Commands
  - `OSC$MGR> RESTART AGENT <Agent> [/NODE=<node>]`

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OSC$MGR Command Overview

- Console Commands
  - `OSC$MGR> SHOW CONSOLE`
  - `OSC$MGR> DISCONNECT CONSOLE/ID=#`
  - `OSC$MGR> CONNECT`
- Command Execution
  - `OSC$MGR> DEFINE MODE [/SYNC | /ASYNC]`
  - `OSC$MGR> FLUSH COMMAND_QUEUE`
- Logging
  - `OSC$MGR> MONITOR EVENTS`
  - `OSC$MGR> EXTRACT EVENTS [/BEFORE /SINCE /OUTPUT]`
- Fault Commands (RESOURCE | SERVICE | SRVGRP)
  - `OSC$MGR> CLEAR RESOURCE [/ADMIN_WAIT|/FAULT][/NODE=<node>]`
- Master Control Proces Commands
  - `OSC$MGR> SWITCH CONTROL [/TARGET_NODE=<node>]`
  - `OSC$MGR> MOVE CONTROL [/TARGET_NODE=<node>]`

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OSC$MGR Command Overview

- Transaction
  - `OSC$MGR> SHOW TRANSACTION [/ALL|/SRVGRP|/SERVICE|/RESOURCE]`
  - `OSC$MGR> CANCEL TRANSACTION [/ID=#|/ALL|/NODE]`
- Manual Failover
  - `OSC$MGR> SWITCH SRVGRP <srvgrp-name>[/TARGET_NODE/SOURCE_NODE]`
  - `OSC$MGR> MOVE SRVGRP <srvgrp-name>[/TARGET_NODE/SOURCE_NODE]`
- Manual OFFLINE | ONLINE (RESOURCE | SERVICE | SRVGRP)
  - `OSC$MGR> ONLINE RESOURCE <res-name> [/NODE=<node>]`
  - `OSC$MGR> OFFLINE RESOURCE <res-name> [/NODE=<node>]`
- Status Monitoring handling (RESOURCE | SERVICE | SRVGRP)
  - `OSC$MGR> DISABLE SERVICE <serv-name> [/NODE=<node>]`
  - `OSC$MGR> ENABLE SERVICE <serv-name> [/NODE=<node>]`
- Failover handling (RESOURCE | SERVICE | SRVGRP)
  - `OSC$MGR> FREEZE SRVGRP <srvgrp-name> [/NODE=<node>]`
  - `OSC$MGR> UNFREEZE SRVGRP <srvgrp-name> [/NODE=<node>]`

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OSC$MGR Command Overview

- SHOW
  - AGENT
  - CONSOLE
  - CLUSTER
  - RESOURCE
  - SERVICE
  - SRVGRP
  - TRANSACTION

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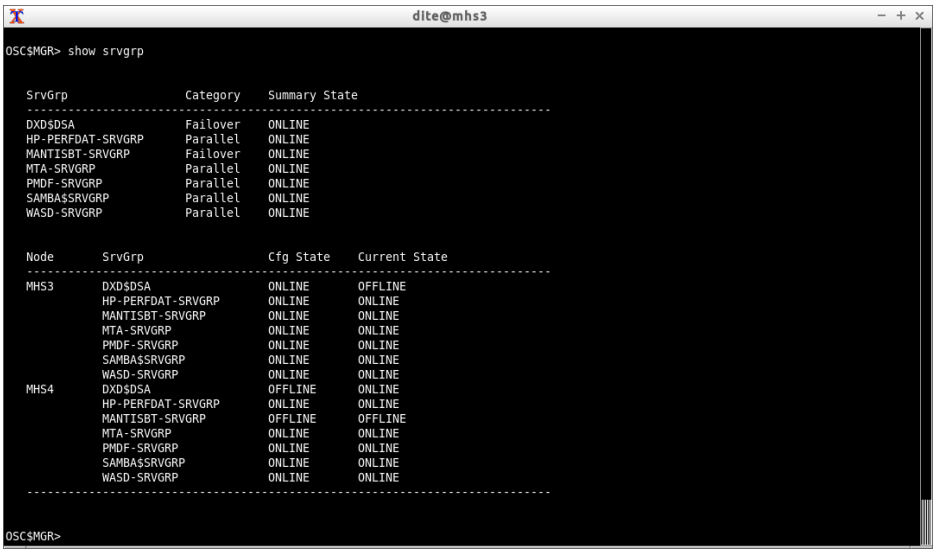
OSC$MGR>SHOW SRVGRP [*]



- An example display of defined SRVGRPs and their statuses.

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OSC behavior on resource faults 1

- OSC considers a resource as faulted when
  - the resource state changes unexpectedly
    - Eg. an online resource goes offline.
  - a required state change does not occur
    - Eg. a resource failed to go online or offline.
- Typically OSC agents take predefined actions to correct an issue before reporting a resource fault condition to the OSC Service Engine.
  - Eg. the agent may try set a resource online several times before reporting a fault.
- Managing resource faults
- Cleaning up Resources
- Critical and Non-Critical Resources
- Fault Propagation
- Service Priority
- Service Group Failover

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OSC behavior on resource faults 2

- OSC considers a resource as faulted when:
  - the resource state changes unexpectedly.
    - Eg. an online resource goes offline.
  - a required state change does not occur.
    - Eg. a resource fails to go online or offline.

- Typically OSC Agents take predefined actions to correct an issue before reporting a resource fault condition to the OSC Service Engine.
  - Eg. the agent may try to bring a resource online several times before reporting a fault.

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OSC behavior on resource faults 3

- Managing resource faults
  - OSC takes automatic actions on a resource fault only if the service group of the failed resource is configured to manage faults
- Cleaning up Resources
  - When a resource fails and fault management is enabled, OSC calls a cleanup action routine to forcibly shutdown the resource. If the cleanup action routine fails to shutdown a failed resource the resource state is undefined and so service group failover processing will not be initiated. Failover of a service group that contains undefined resources may cause concurrency violations.
  - The cleanup routine is only called for *On-Off* resources since these resources are - in OSC terminology - not cluster aware. All other resource types (*On-Only*, *Persistent*) are cluster aware resources that can be online concurrently on multiple nodes. Thus, a service group failover due to a fault of an *On-Only* or *Persistent* resource never causes concurrency violations.

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OSC behavior on resource faults 4

- Critical and Non-Critical Resources
  - The Critical attribute of a resource defines whether or not a resource fault initiates fault propagation to the service group level.

    If a resource is configured as non-critical (by setting the Critical attribute to FALSE), services and service groups that contain this resource will not be marked as faulted. Failover processing will be initiated only if the service group is declared as faulted. Thus, faults on non-critical resources will not cause service group failover.
- Fault Propagation
  - Fault propagation is the name given to the process of marking a service and a service group as faulted when a resource fails.
  - If fault propagation is disabled the services and service groups of the resource will not be marked as faulted and thus, the service groups will not failover.

Basic OSC behavior on resource faults (contd.)

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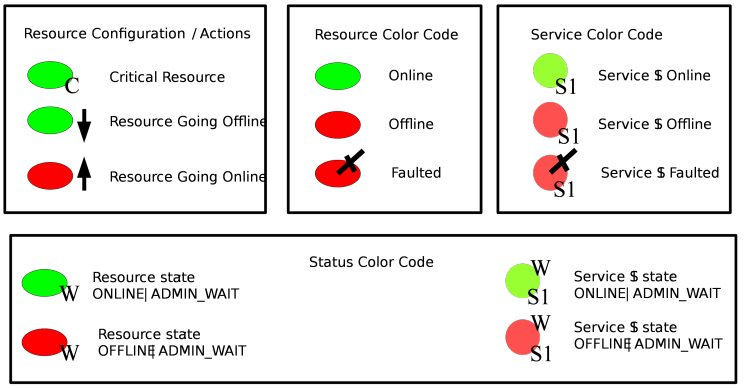
- Service Priority
  - Once a service is marked faulted, OSC checks the service priority of all independent service trees configured within the service group. If the service priority of an online service tree is greater than the value of the failed service tree, no service group failover is initiated.
- Service Group Failover
  - If the service group is marked as faulted it takes the whole service group offline
  - If service group failover is enabled *On-Off* and *Multi-Instance*, service groups are started on another node within the OSC cluster providing a valid node to start the service group exists

OSC behavior diagrams

- Symbols used to illustrate OSC functionality when a resource fails



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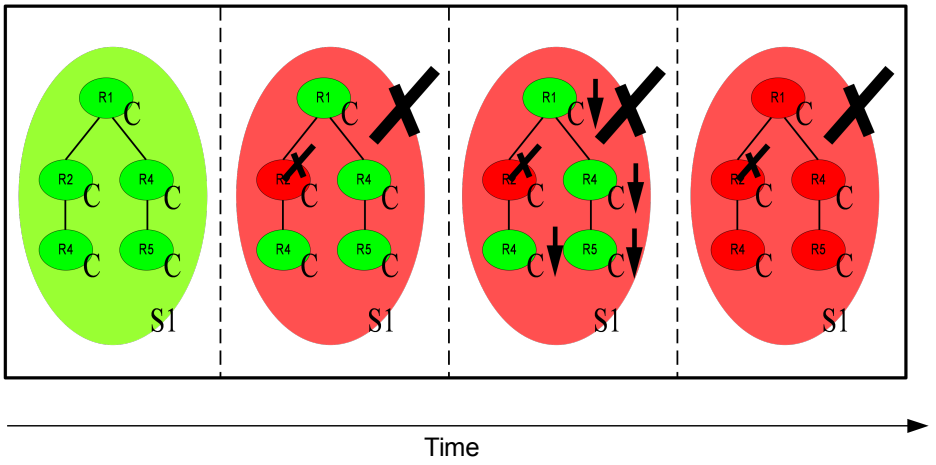
Critical Resource fails



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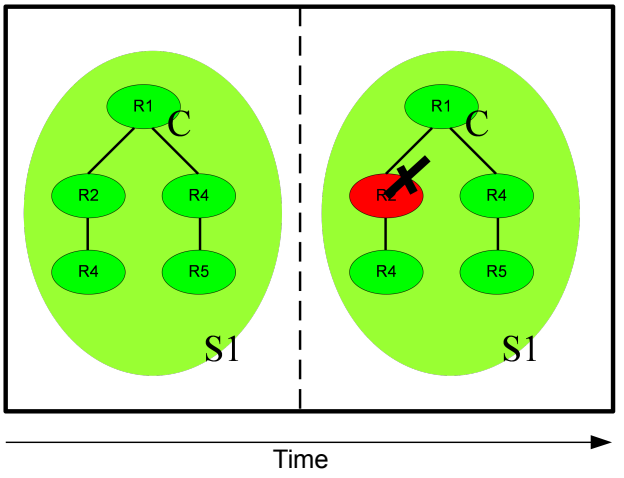
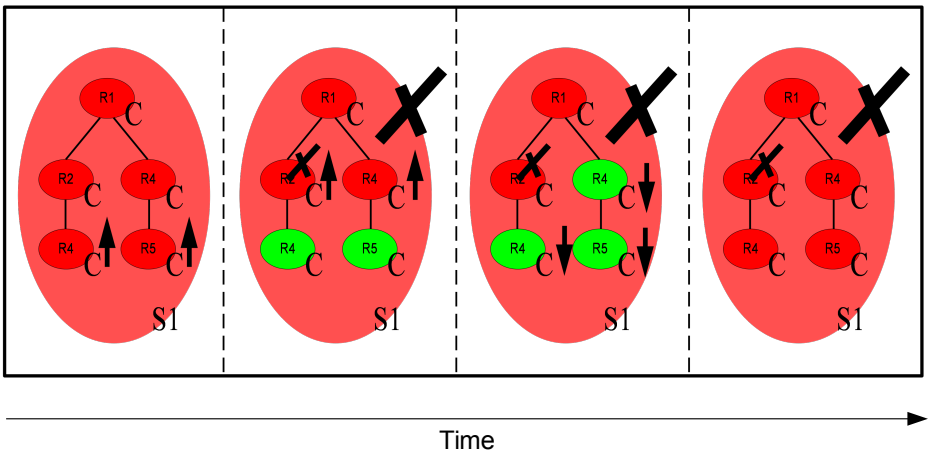
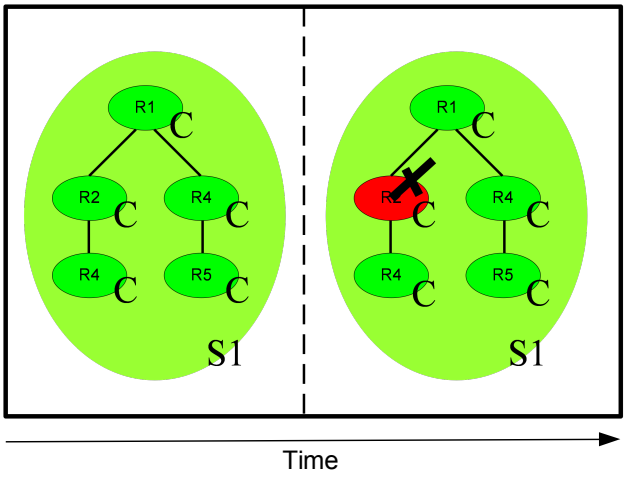
Non-Critical Resource fails



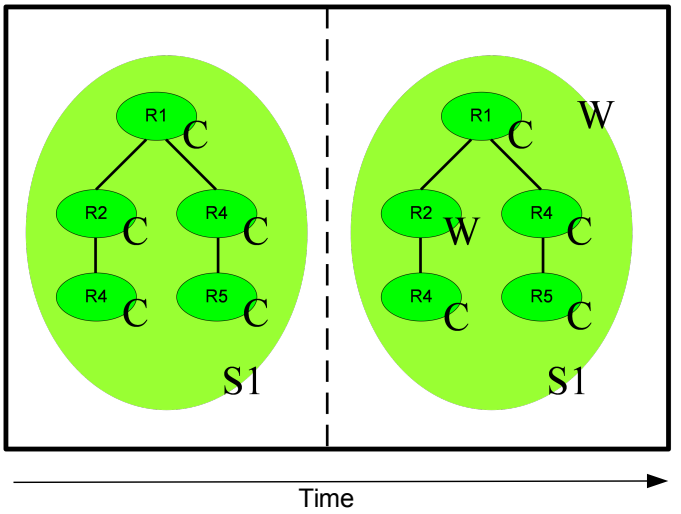
Critical Resource fails to come online



Critical Resource fails
– fault propagation is disabled



Critical Resource fails
– fault management is disabled



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OSC Event Notification

- OSC provides event notification messages when:
  - A resource, service or service group state changes
  - The OSC cluster state changes
    - The operational state of any component of OSC changes
      (OSC Agents, OSC Service Engine, OSC Master Control Process)
    - Any of the OSC cluster members change state
      (OSC cluster member leaves or joins the OSC cluster)
- OSC executes automatic or user initiated administrative operations to:
  - Recover resource fault conditions
  - Set service groups Online/offline/failover/switchover
  - Reestablish OSC cluster integrity
    (restart of operational OSC components, removing a member from the OSC cluster if a node fails …)

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OSC Event Classes

- Nine OSC Event Classes exist:
  - HEARTBEAT
    - Heartbeat events are triggered whenever an OSC component receives a heartbeat message from one of its managed OSC components (see section 4.3 OSC software architecture).
  - OSCAGT_CONTROL_EVT
    - This OSC Event Class contains resource control messages. Resource control messages are triggered by OSC agents when they execute administrative operations (like online, offline commands) either on request by the OSC Service Engine or triggered automatically to recover a resource fault condition.
  - OSCAGT_STATE_EVT
    - This OSC Event Class contains resource state change messages. Resource state change messages are sent by an OSC Agent when it detects a resource state change.

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OSC Event Classes

- OSCSRV_CNXMAN_EVT
  - This OSC Event Class contains all OSC connection management messages from the OSC Service Engine. The OSC Service Engine triggers connection management messages when:
    - The OSC Service Engine detects that the state of an OSC Agent has changed from operational to in-operational
    - The OSC Service Engine starts (restarts) OSC agents
    - The OSC Service Engine lost/established connection to the OSC Master Control Process
- OSCSRV_CONTROL_EVT
  - This OSC Event Class contains all control messages from the OSC Service Engine. A control message is triggered when the OSC Service Engine executes administrative operations on service groups and services at the request of the OSC Master Control Process.
- OSCSRV_STATE_EVT
  - This OSC Event Class contains all state change messages from the OSC Service Engine. A state change event is triggered if the state of one of the services and service groups managed by the OSC Service Engine has changed.

OSC Event Classes

- OSCCTRL_CNXMAN_EVT
  - This OSC Event Class contains all OSC connection management messages from the OSC Master Control Process.

The OSC Master Control Process triggers connection management messages when:

- The OSC cluster state changes. These are:
  - OSC cluster member leaves/joins the OSC cluster
  - The OSC Master Control Process detects that the state of a managed OSC Service Engine has changed from operational to in-operational
- The OSC Master Control Process starts (restarts) an OSC Service Engine
- The OSC Master Control Process initiates an OSC cluster state transition
- The OSC Master Control Process modifies OSC quorum due to OSC cluster reformation

OSC Event Classes

- OSCCTRL_CONTROL_EVT
  - This OSC Event Class contains all control messages from the OSC Master Control Process. The OSC Master Control Process triggers control messages when it executes administrative operations on service group (online, offline, switchover, failover, freezing a service group, disabling a service group …) either due to a service group fault condition or on user request.
- OSCCTRL_STATE_EVT
  - This OSC Event Class contains all state change messages from the OSC Master Control Process. A state change message is triggered when the state of a service group on any OSC cluster member changes.

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OSC Event Severity

- Informational
  - Informational messages indicate that a managed item has changed state as expected or no state change related events have occurred. Eg.:
    - An informational event message is sent when a user connects to the console of the OSC Master Control Process via the OSC$MGR utility.
    - An informational event message is sent if a user requests to set a service group offline and the service group changes state to offline as expected.
- Warning
  - Warning messages are triggered when OSC detects a fault condition that does not cause OSC intervention. Typically warning messages are sent if a non-critical resource fails or OSC rejects a user command due to state or authorization conflicts.
    - Eg. the user issues a command to set a service group online and the service group is already online, or the user is not authorized to manage a particular service group.

OSC Event Severity

- Error
  - Error messages are triggered when OSC detects any fault condition that causes OSC to intervene automatically. OSC is able to recover from the fault condition. Error messages are typically triggered when a resource, service and service group is declared faulted, a node is removed from the OSC cluster or OSC detects that one of its component (OSC Agent, OSC Service Engine, OSC Master Control Process) is in-operative and this component has had to be restarted.
- Fatal
  - Fatal messages are sent when OSC detects a fault condition that cannot be managed by OSC and requires immediate system management intervention.

    Eg. if a resource, service or service group state is set to ADMIN_WAIT a fatal event message is sent. A managed item is set to ADMIN_WAIT when OSC cannot recover the fault condition.

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OSC Event Notification Methods

- Log events into the common OSC event message file
- Provide OPCOM messages for OSC events
- Forward events to all connected OSC consoles
- Execute a user script for each OSC event for site specific event handling

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Bundled OSC Agents

- OscAgtDSK – OSC disk agent
- OscAgtFSYS – OSC single disk volume agent
- OscAgtSHD – OSC shadow set agent
- OscAgtPRC – OSC process agent
- OscAgtETH – OSC ethernet adapter agent
- OscAgtFailIP – OSC failSAFE IP agent
- OscAgtIP – OSC service IP agent
- OscAgtORA – OSC Oracle 10 agent
- OscAgtORALS – OSC Oracle 10 Listener agent
- OscAgtRDB – OSC Oracle RDB agent
- OscAgtPERF – OSC HP PERFDAT agent

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Supported Versions

- OpenVMS V7.3-2 AXP *
- OpenVMS V8.2 AXP
- OpenVMS V8.3 AXP
- OpenVMS V8.4 AXP
- OpenVMS V8.2 IA64
- OpenVMS V8.2-1 IA64
- OpenVMS V8.3 IA64
- OpenVMS V8.3-1H1 IA64
- OpenVMS V8.4 IA64
- OpenVMS V8.4-2L1 IA64

* with TCP/IP V5.4 ECO5 and scalable kernel enabled

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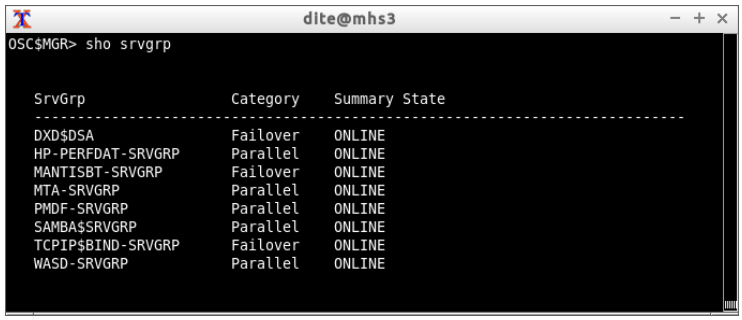
OSC – MantisBT Example 1



- An overview of various SRVGRPs

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OSC – MantisBT Example Overview

- MantisBT – see www.mantisbt.org
  - PHP Bug Tracker Tool
    - requires
      - WebServer
        - WASD
        - PHP (Mark Berryman)
      - Database
        - MariaDB (not cluster-aware)
    - want automatic archiving

- Define an OSC MantisBT Service Group

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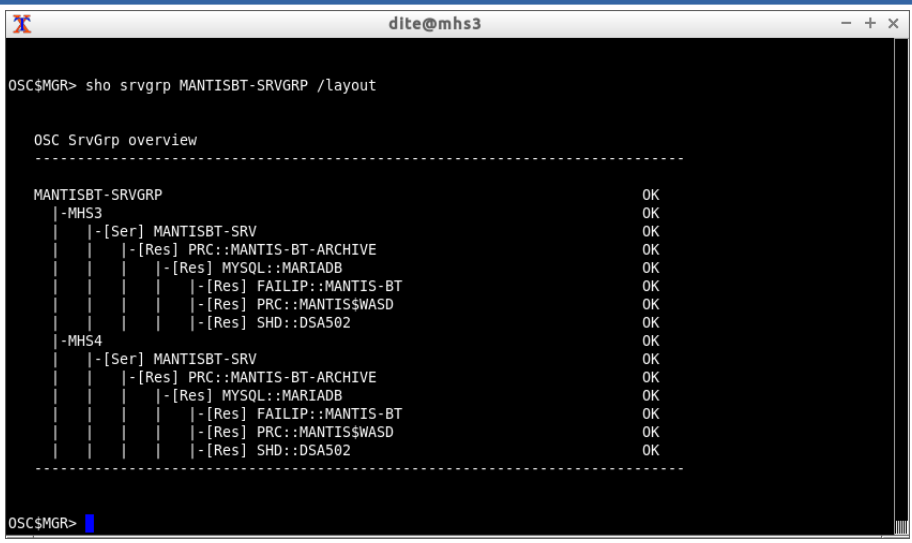
OSC – MantisBT Example 2



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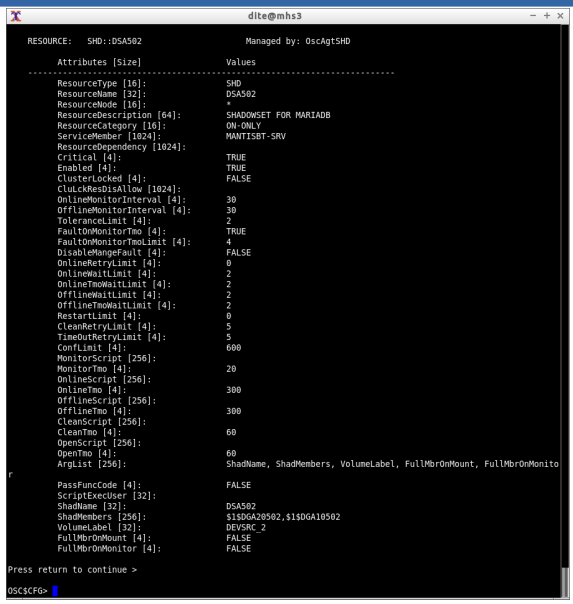
OSC - MantisBT Example 3

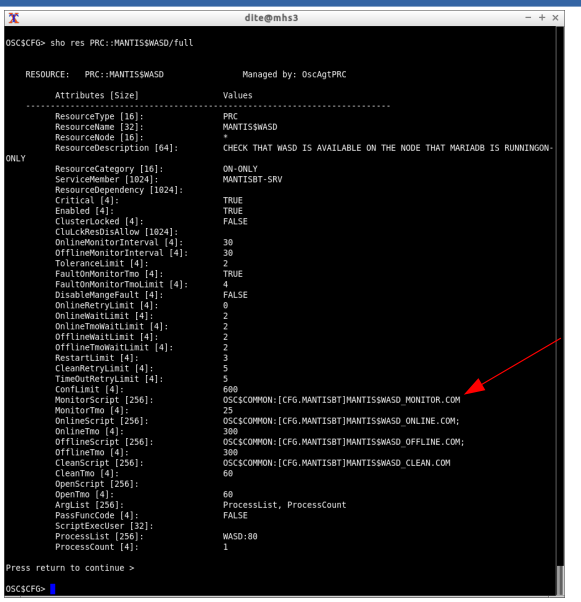
- 5 Resources
  - SHD::DSA502
    - DSA502 ShadowSet where the Database is located
  - PRC::MANTIS$WASD
    - the state of the underlying Web-Server Process
  - FAILIP::MANTIS-BT
    - IPv4 Alias adress associated with the MantisBT Service
  - MYSQL::MARIADB
    - the state of the underlying MariaDB Database
  - PRC::MANTIS-BT-ARCHIVE
    - the state of the archiving process for Mantis-BT
- 1 Service
  - MANTISBT-SRV
- 1 Service Group
  - MANTISBT-SRVGRP

OSC – MantisBT Example 4



Resource SHD::DSA502
Critical: True
Resource Category: On-Only
ServiceMember: MANTISBT-SRV

OSC – MantisBT Example 5



Resource: PRC::MANTIS$WASD
Critical: True
Resource Category: On-Only
ServiceMember: MANTISBT-SRV
ProcessList: WASD:80

OSC – MantisBT Example 6

MANTIS$WASD_MONITOR.COM

```
$ set noon
$!
$ OSC$_ONLINE  = 1
$ OSC$_OFFLINE = 9
$ OSC$_FAULTED = 19
$ OSC$_ERROR   = 12
$ OSC$_RETURN  = 5
$ OSC$_NOPROC  = 2280
$!
$! P1 = Resourcename
$! P2 = Processname
$! P3 =
$! P4 =
$! P5 =
$! write sys$output "Starting Execution MANTIS$WASD_MONITOR.COM Routine"
$ RESET_PRINT_BIT = %xEFFFFFFF
$ SS_NORMAL = 1
$
$ tempfile1 := MANTIS$WASD-'f$getjpi("","pid")'.tmp
$
$!
$     pipe show system/proc="''P2'" > 'tempfile1
$     sea 'tempfile1 "''P2'"
$     search_status = f$integer ($status) .and. RESET_PRINT_BIT
$     delete/nolog 'tempfile1;*
$     if search_status .EQ. SS_NORMAL
$     then
$         exit (OSC$_ONLINE)
$     else
$         exit (OSC$_OFFLINE)
$      endif
$!
$! ------------------------------------------------------------------------------
```

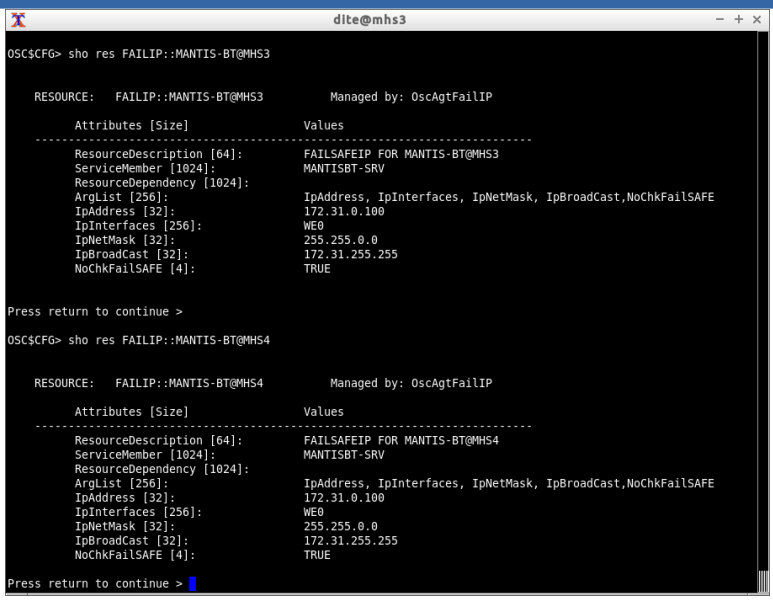
OSC – MantisBT Example 7

MANTIS$WASD_ONLINE.COM

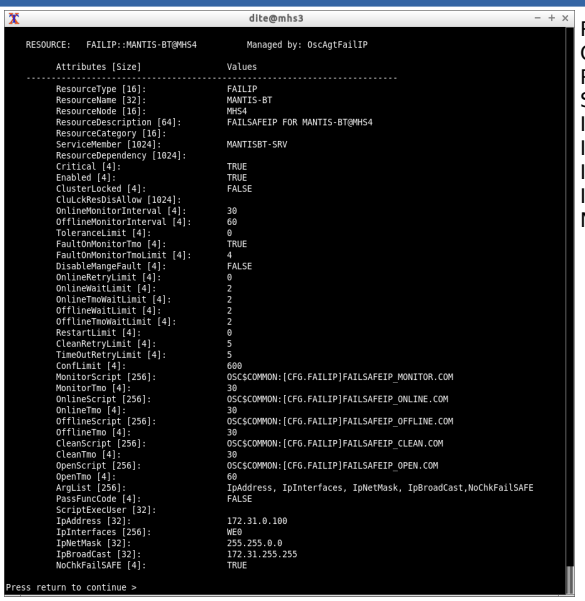
```
$ set noon
$!
$ OSC$_ONLINE  = 1
$ OSC$_OFFLINE = 9
$ OSC$_FAULTED = 19
$ OSC$_ERROR   = 12
$ OSC$_RETURN  = 5
$ OSC$_NOPROC  = 2280
$
$ OSC$_MONITOR_DELAY_DEFAULT    = 5
$!
$! P1 = Virtual Resourcename
$! P2 = Processname
$! P3 = Prccount
$! P4 =
$! P5 =
$!
$!==========================
$!
$!
$! Just signal Online !
$!
$     exit (OSC$_ONLINE)
```

OSC – MantisBT Example 8

OSC – MantisBT Example 9

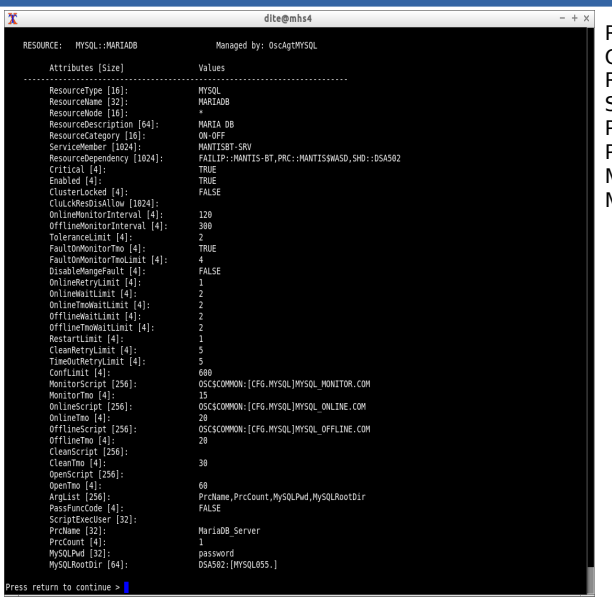


OSC – MantisBT Example 10



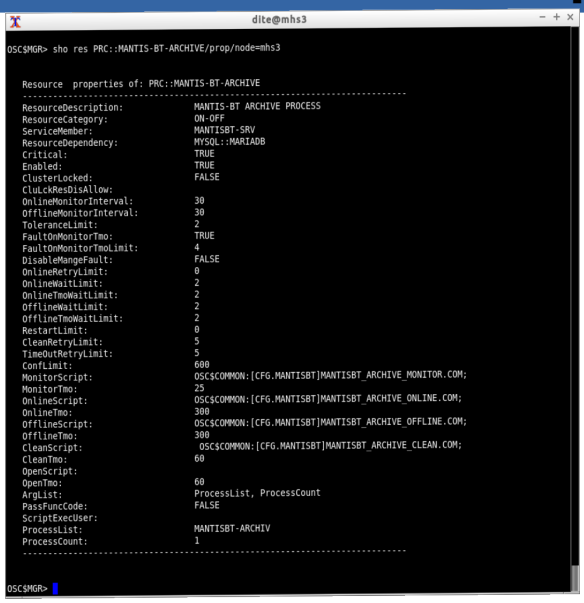
Resource: FAILIP::MANTIS-BT@MHS4
Critical: TRUE
Resource Category: ON-OFF
ServiceMember: MANTISBT-SRV
IpAddress: 172.31.0.100
IpInterface: WE0
IpNetMask: 255.255.0.0
IpBroadcast: 172.31.255.255
NoChkFailSafe: TRUE

OSC – MantisBT Example 11



Resource: MYSQL::MARIADB
Critical: True
Resource Category: On-Off
ServiceMember: MANTISBT-SRV
PrcName: MariaDB_Server
PrcCount: 1
MySQLPwd: password
MySQLRootDir: DSA502:[MYSQL055.]

OSC – MantisBT Example 12



Resource: PRC::MANTIS-BT-ARCHIVE
Critical: True
Resource Category: On-Off
ServiceMember: MANTISBT-SRV
ResourceDependency: MYSQL::MARIADB
ProcessList: MANTISBT-ARCHIV
PrcCount: 1

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Resources

- http://www.openservicecontrol.org/
  - Documenation
    - User Guide / Release Notes in OSC$COMMON:[HELP]
  - Kits
    - OpenVMS
    - Windows GUI
  - Support Forum (new)
    - http://feedback.openservicecontrol.org/index.php?p=/
  - Mail Contact
    - info@openservicecontrol.org
  - HP Engineering contact:
    - Wolfgang Burger
      mailto:Wolfgang.Burger@hpe.com

OSC Resource Control Attributes

- ResourceCategory
- MonitorScript
- MonitorTmo
- OnlineScript
- OnlineTmo
- OfflineScript
- OfflineTmo
- CleanScript
- CleanTmo

OSC Resource Control Attributes

- Critical
- Enabled
- RestartLimit
- ToleranceLimit
- FaultOnMonitorTmo
- FaultOnMonitorTmoLimit
- OnlineRetryLimit
- OnlineWaitLimit
- OnlineTmoWaitLimit

OSC Resource Control Attributes

- OfflineWaitLimit
- OfflineTmoWaitLimit
- ConfInterval
- CleanRetryLimit
- TimeOutRetryLimit
- DisableManageFault
- PassFuncCode

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OSC Service Control Attributes

- ServicePriority

OSC Service Group Control Attributes

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- SrvGrpType
- SrvGrpNodes
- SrvGrpMultiInstance
- SrvGrpAutoStart
- SrvGrpManageFaults
- SrvGrpDisable
- SrvGrpFaultProp
- SrvGrpFailover
- SrvGrpCleanOnUnexpOn

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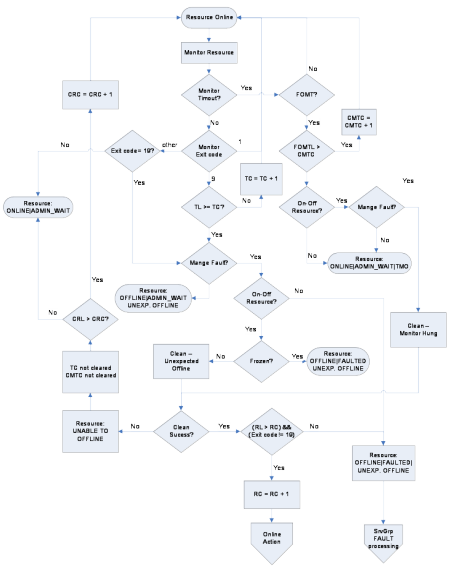
IT SERVICES

Monitor Flowchart (online resource)



Online flowchart