

Managing Faults, Defects, and Alerts in Oracle® Solaris 11.3

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Using This Documentation

- **Overview** – Describes how to use the Oracle Solaris Fault Management Architecture (FMA) feature to manage hardware faults, some software defects, and other system events. FMA is one of the components of the wider Oracle Solaris Predictive Self Healing capability.
- **Audience** – System administrators who monitor and handle system faults and defects and other system events.
- **Required knowledge** – Experience administering Oracle Solaris systems.

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◆◆◆ CHAPTER 1

Introduction to the Fault Manager

The Oracle Solaris OS includes an architecture for building and deploying systems and services that are capable of predictive self healing. The service that is the core of the Fault Management Architecture (FMA) receives data related to hardware and software errors and system changes, and automatically diagnoses any underlying problem. For a hardware fault, FMA attempts to take faulty components offline. For other hardware problems, software problems, and some system changes, FMA provides information for the administrator to use to fix the problem. Other system changes produce only informational notification.

This chapter discusses the following topics:

- Description of the Oracle Solaris Fault Management feature
- Configuring when and how you will be notified of events
- Features of messages from the Fault Manager

When specific hardware faults occur, Oracle Auto Service Request (ASR) can automatically open an Oracle service request. See the [Oracle Auto Service Request \(ASR\)](#) support document for more information.

Fault Management Overview

The Oracle Solaris Fault Management feature includes the following components:

- An architecture for building resilient error handlers
- Structured telemetry
- Automated diagnostic software
- Response agents
- Structured messaging

Many parts of the software stack participate in fault management, including the CPU, memory and I/O subsystems, Oracle Solaris ZFS, and many device drivers.

FMA can diagnose and manage faults, defects, and alerts:

- **Faults** – A fault is a type of problem where something that used to work no longer does. A fault typically describes a failed hardware component.
- **Defects** – A defect is a type of problem where something never worked. A defect typically describes a software component.
- **Alerts** – An alert is neither a fault nor a defect. An alert can represent a problem or can be simply informational.

Most software problems are defects or are caused by configuration issues. Fault management and system services often interact. For example, a hardware problem might cause services to be stopped or restarted. An SMF service error might cause FMA to report a defect.

Fault Management Architecture

The fault management stack includes error and observation detectors, a diagnosis engine, and response agents.

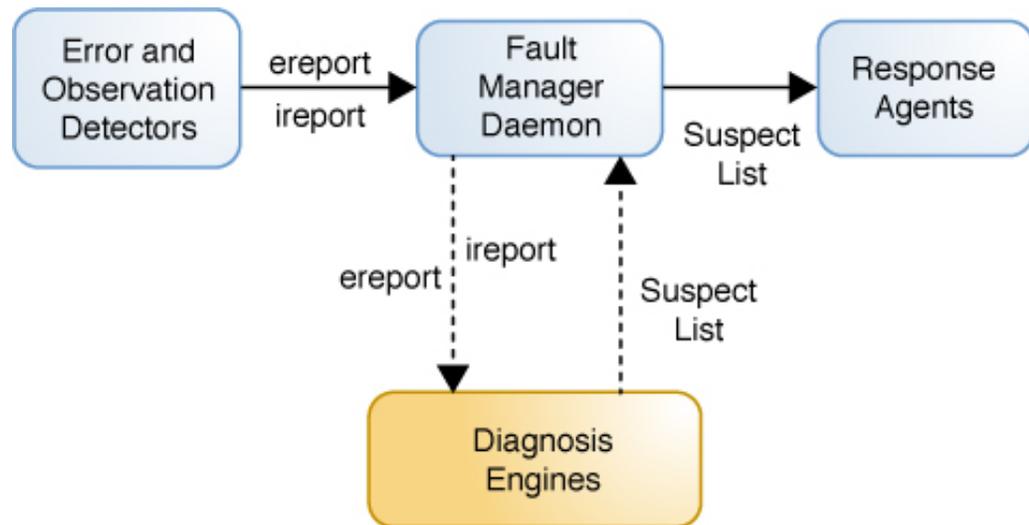
<i>Error detectors</i>	Error detectors detect errors in the system and perform any immediate, required handling. An error detector issues a well-defined error report (<i>ereport</i>) or informational report (<i>ireport</i>) to a diagnosis engine.
<i>Observation detectors</i>	Observation detectors report conditions in the system that are neither symptoms of faults nor defects. An observation detector issues a well-defined information report, or <i>ireport</i> , that might go to a diagnosis engine or might simply be logged.
<i>Diagnosis engine</i>	<p>The diagnosis engine interprets ereports and ireports and determines whether a fault, defect, or alert should be diagnosed. When such a determination is made, the diagnosis engine issues a <i>suspect list</i> that describes the resource or set of resources that might be the cause of the problem or condition. The resource might have an associated Field Replaceable Unit (FRU), a label, or an Automatic System Reconfiguration Unit (ASRU). An ASRU might be immediately removed from service to mitigate the problem until the FRU is replaced. See “Fault Management Glossary” on page 14 for definitions of resource, FRU, label, and ASRU.</p> <p>When the suspect list includes multiple suspects (for example, if the diagnosis engine cannot isolate a single suspect), each suspect is assigned a probability of being the key suspect. The probabilities in this list sum to 100 percent. Suspect lists are interpreted by response agents.</p>

Response agents Response agents attempt to take action based on the suspect list. Responses include logging messages, taking CPU strands offline, retiring memory pages, and retiring I/O devices.

When specific hardware faults occur, Oracle Auto Service Request (ASR) can automatically open an Oracle service request. See the [Oracle Auto Service Request \(ASR\)](#) support document for more information.

Error detectors, observation detectors, diagnosis engines, and response agents are connected by the Fault Manager daemon, `fmd`, which acts as a multiplexor between the various components, as shown in the following figure.

FIGURE 1 Fault Management Architecture Components



Lifecycle of a Problem or Condition Managed by the Fault Manager

The lifecycle of a problem or condition managed by the Fault Manager can include the following stages. Each of these lifecycle state changes is associated with the publication of a unique list event.

Diagnose	A new diagnosis has been made by the Fault Manager. The diagnosis includes a list of one or more suspects. A <code>list.suspect</code> event is published. The diagnosis is identified by a UUID in the event payload, and further events describing the resolution lifecycle of this diagnosis quote a matching UUID.
Isolate	A suspect has been automatically isolated to prevent further errors from occurring. A <code>list.isolated</code> event is published. For example, a CPU or disk has been offlined.
Update	One or more of the suspect resources in a problem diagnosis has been repaired, replaced, or acquitted, or the resource has faulted again. A <code>list.updated</code> event is published. The suspect list still contains at least one faulted resource. A repair might have been made by executing an <code>fmadm</code> command, or the system might have detected a repair such as a changed serial number for a part. The <code>fmadm</code> command is described in Chapter 3, “Repairing Faults and Defects and Clearing Alerts” .
Repair	All of the suspect resources in a diagnosis have been repaired, resolved, or acquitted. A <code>list.repaired</code> event is published. Some or all of the resources might still be isolated.
Resolve	All of the suspect resources in a diagnosis have been repaired, resolved, or acquitted and are no longer isolated. A <code>list.resolved</code> event is published. For example, a CPU that was a suspect and was offlined is now back online again. Offlining and onlining resources is usually automatic.

The Fault Manager daemon is a Service Management Facility (SMF) service. The `svc:/system/fmd` service is enabled by default. See [Managing System Services in Oracle Solaris 11.3](#) for more information about SMF services. See the [fmd\(1M\)](#) man page for more information about the Fault Manager daemon.

The `fmadm config` command shows the name, description, and status of each module in the Fault Manager. These modules diagnose, isolate resources, generate notifications, and auto-repair problems in the system. The `fmstat` command displays additional information about these modules, as shown in [“Fault Manager and Module Statistics” on page 40](#).

Fault Management Glossary

ASRU An Automatic System Reconfiguration Unit (ASRU) is associated with a resource and is the hardware or software component in the system that can be

disabled to mitigate the effects of problems in the resource. For example, a CPU thread is an ASRU that can be offlined in response to a CPU fault. An ASRU can also be a hardware or software component in the system whose service state is impacted by the fault. The ASRU is named in the `Affects` field in `fmadm list` or `fm dump -v` output.

chassis	A chassis is associated with an FRU and identifies where the FRU resides. To replace an FRU, you must know the chassis location and the FRU location within that chassis. The chassis location can be <code>/SYS</code> for the main system chassis, a <code>chassis_name.chassis_serial_number</code> for an external chassis, or it could be a user defined alias for the chassis. See also <i>label</i> below.
diagnosis class	The diagnosis class is a unique identifier of the form <code>sub-class1.sub-class2...sub-classN</code> that uniquely identifies the type of fault, defect, or alert event associated with a diagnosis. The diagnosis class is also called the problem class.
FMRI	A Fault Management Resource Identifier (FMRI) is used to identify resources, FRUs, and ASRUs. FMRI's have a scheme and a scheme-specific syntax. See the fmri(5) man page for more information. You can see FMRI's by using the <code>fm dump -v</code> command.
FRU	A Field Replaceable Unit (FRU) is associated with a resource and is the hardware or software component in the system that can be replaced or repaired to fix a problem. For example, a CPU module is an FRU that can be replaced in response to a CPU fault.
label	A label is associated with an FRU and identifies the physical marking on the hardware that can be used to locate a specific FRU within a chassis. See also <i>chassis</i> above. Location fields in <code>fm dump</code> and <code>fmadm list</code> command output give the <code>/dev/chassis</code> path, which is a combination of the chassis and a label, or possibly a hierarchical set of labels. See the Location fields in the examples in Chapter 2, "Displaying Fault, Defect, and Alert Information" . For more information about the <code>/dev/chassis</code> path, see the devchassis(7FS) man page.
resource	A resource is a physical or abstract entity in the system against which diagnoses can be made.

Receiving Notification of Faults, Defects, and Alerts

The Fault Manager daemon notifies you that a fault or defect has been detected and diagnosed and alerts you to other changes to your system.

Configuring When and How You Will Be Notified

Use the `svcs -n` and `svccfg listnotify` commands to show event notification parameters, as shown in [“Showing Event Notification Parameters” in *Managing System Services in Oracle Solaris 11.3*](#). Settings for notification parameters for FMA events are stored in properties in `svc:/system/fm/notify-params:default`. System-wide notification parameters for SMF state transition events are stored in `svc:/system/svc/global:default`.

Use the `svccfg setnotify` command to configure FMA event notification, as shown in [“Configuring Notification of State Transition and FMA Events” in *Managing System Services in Oracle Solaris 11.3*](#). For example, the following command creates a notification that sends an SMTP message when an FMA-managed problem is repaired:

```
$ svccfg setnotify problem-repaired smtp:
```

You can configure notification of fault management error events to use the Simple Mail Transfer Protocol (SMTP) or the Simple Network Management Protocol (SNMP).

FMA event tags include `problem-diagnosed`, `problem-updated`, `problem-repaired`, and `problem-resolved`. These tags correspond to the problem lifecycle stages described in [“Fault Management Overview” on page 11](#).

Event notification and FMA event tags are also described in the Notification Parameters section in the `smf(5)` man page. For more information about the notification daemons, see the `snmp-notify(1M)`, `smtp-notify(1M)`, and `asr-notify(1M)` man pages.

Events generated by SMF state transitions are stored in the service or in the transitioning service instance.

Understanding Messages From the Fault Manager Daemon

The Fault Manager daemon sends messages to both the console and the `/var/adm/messages` file. Messages from the Fault Manager daemon use the format shown in the following example

except that lines in the following example that do not begin with a date actually belong with the preceding line that begins with a date:

```
Apr 17 15:57:35 bur-7430 fmd: [ID 377184 daemon.error] SUNW-MSG-ID: FMD-8000-CV,  
TYPE: Alert, VER: 1, SEVERITY: Minor  
Apr 17 15:57:35 bur-7430 EVENT-TIME: Fri Apr 17 15:56:28 EDT 2015  
Apr 17 15:57:35 bur-7430 PLATFORM: SUN SERVER X4-4, CSN: 1421NM900G, HOSTNAME: bur-7430  
Apr 17 15:57:35 bur-7430 SOURCE: software-diagnosis, REV: 0.1  
Apr 17 15:57:35 bur-7430 EVENT-ID: b22c3c73-77d7-4f4e-8030-c589bf057bb9  
Apr 17 15:57:35 bur-7430 DESC: FRU '/SYS/HDD0' has been removed from the system.  
Apr 17 15:57:35 bur-7430 AUTO-RESPONSE: FMD topology will be updated.  
Apr 17 15:57:35 bur-7430 IMPACT: System impact depends on the type of FRU.  
Apr 17 15:57:35 bur-7430 REC-ACTION: Use 'fmadm faulty' to provide a more detailed  
view of this event. Please refer to the associated reference document at  
http://support.oracle.com/msg/FMD-8000-CV for the latest service procedures and  
policies regarding this diagnosis.
```

When you are notified of a diagnosis, consult the recommended knowledge article for additional details. The recommended knowledge article is listed in the last line of the output, which is labeled REC-ACTION for recommended action. The knowledge article might contain actions that you or a service provider should take in addition to other actions listed in the REC-ACTION line.

◆◆◆ CHAPTER 2

Displaying Fault, Defect, and Alert Information

This chapter shows how to display detailed information about diagnoses made by the fault management system.

- The `fmadm list` command and the `fmadm faulty` commands display all active faults, defects, and alerts.
- The `fmadm list-fault` command displays all active faults.
- The `fmadm list-defect` command displays all active defects.
- The `fmadm list-alert` command displays all active alerts.

Displaying Information About Faulted Hardware

Use the `fmadm list-fault` command to display fault information and determine which FRUs are involved. The `fmadm list-fault` command displays active fault diagnoses. The `fmdump` command displays the contents of log files associated with the Fault Manager daemon and is more useful as a historical log of errors, observations, and diagnoses on the system.

Tip - Base your administrative action on output from the `fmadm list-fault` command. Log files output by the `fmdump` command contain a historical record of events and do not necessarily present active or open diagnoses. Log files output by `fmdump -e` are a historical record of error telemetry and might not have been diagnosed into faults.

The `fmadm list-fault` command displays status information for resources that the Fault Manager identifies as faulty. The `fmadm list-fault` command has many options for displaying different information or displaying information in different formats. See the [fmadm\(1M\)](#) man page for information about all the `fmadm list-fault` options.

EXAMPLE 1 `fmadm list-fault` Output Showing a Faulty Disk

In the following example output, the section labeled FRU identifies the faulted component. The Location string shown in quotation marks, `"/SUN-Storage-J4410.1051QCQ08A/HDD23"`, should match the chassis type and serial number of the chassis containing the faulty disk and the label of the disk bay in that chassis. For a location in the main system chassis, the location string would be something like `"/SYS/HDD3"`. If no location is available, the Fault Management Resource Identifier (FMRI) of the FRU is shown. See [“Fault Management Glossary” on page 14](#) for definitions of chassis and FMRI.

The Status line in the FRU section of the output shows the state as `faulty`.

Above the FRU section, the lines labeled Affects identify components that are affected by the fault and their relative state. In this example, a single disk is affected. The disk is faulted but is still in service.

Perhaps the most useful piece of information in this output is the MSG-ID. Follow the instructions in the Action section at the end of the report to access more information about `DISK-8000-0X`. The Action section might include specific actions in addition to references to documents on the support site.

Every diagnosis can be mapped to a specific MSG-ID. Diagnoses may have one or more suspects. If only one suspect is identified, then the MSG-ID can be mapped to a single fault class or diagnosis class. If more than one suspect is identified, then the MSG-ID maps to more than one diagnosis class. See [“Fault Management Glossary” on page 14](#) for the definition of diagnosis class.

fmadm list-fault

TIME	EVENT-ID	MSG-ID	SEVERITY
Apr 08 08:36:50	91cfc113-eacc-44d0-8236-9e2ed3926fd3	DISK-8000-0X	Major

```

Problem Status      : open
Diag Engine        : eft / 1.16
System
  Manufacturer     : Oracle Corporation
  Name             : Sun Netra X4270 M3
  Part_Number      : NILE-P1LRQT-8
  Serial_Number    : 1211FM200D

System Component
  Manufacturer     : Oracle
  Name             : Sun Netra X4270 M3
  Part_Number      : NILE-P1LRQT-8
  Serial_Number    : 1211FM200D
    
```

Host_ID : 008167b1

```

-----
Suspect 1 of 1 :
  Problem class : fault.io.disk.predictive-failure
  Certainty    : 100%
  Affects      : dev:///dev:devid=id1,sd@n5000a7203002c0f2//scsi_vhci/
disk@5000a7203002c0f2
  Status       : faulted but still in service
    
```

```

FRU
  Status       : faulty
  Location     : "/SUN-Storage-J4410.1051QCQ08A/HDD23"
  Manufacturer : STEC
  Name        : ZeusIOPs
  Part_Number  : STEC-ZeusIOPs
  Revision    : 9007
  Serial_Number : STM00011EDCA
  Chassis
    Manufacturer : SUN
    Name        : SUN-Storage J4410
    Part_Number  : 3753659
    Serial_Number : 1051QCQ08A
    
```

Description : SMART health-monitoring firmware reported that a disk failure is imminent.

Response : A hot-spare disk may have been activated.

Impact : It is likely that the continued operation of this disk will result in data loss.

Action : Use 'fmadm faulty' to provide a more detailed view of this event. Please refer to the associated reference document at <http://support.oracle.com/msg/DISK-8000-0X> for the latest service procedures and policies regarding this diagnosis.

In the following sample output, a single CPU strand is affected. That CPU strand is faulted and has been taken out of service by the Fault Manager.

fmadm list-fault

```

-----
TIME          EVENT-ID                               MSG-ID        SEVERITY
-----
Apr 24 10:41:32 662ec53e-3aff-41d1-a836-ad7d1795705a  SUN4V-8002-6E  Major
    
```

```

Problem Status : isolated
Diag Engine    : eft / 1.16
System
    
```

Manufacturer : Oracle Corporation
Name : ORCL,SPARC-T4-1
Part_Number : 602-4918-02
Serial_Number : 1315BDY5D8
Host_ID : 862e0f5e

Suspect 1 of 1 :

Problem class : fault.cpu.generic-sparc.strand
Certainty : 100%
Affects : cpu:///cpuid=0/serial=15a02807e0b026b
Status : faulted and taken out of service

FRU

Status : faulty
Location : "/SYS/MB"
Manufacturer : Oracle Corporation
Name : PCA,MB,SPARC_T4-1
Part_Number : 7047134
Revision : 02
Serial_Number : 465769T+1309BW0V8E
Chassis
Manufacturer : Oracle Corporation
Name : ORCL,SPARC-T4-1
Part_Number : 31538783+1+1
Serial_Number : 1315BDY5D8

Description : The number of correctable errors associated with this strand has exceeded acceptable levels.

Response : The fault manager will attempt to remove the affected strand from service.

Impact : System performance may be affected.

Action : Use 'fmadm faulty' to provide a more detailed view of this event. Please refer to the associated reference document at <http://support.oracle.com/msg/SUN4V-8002-6E> for the latest service procedures and policies regarding this diagnosis.

EXAMPLE 2 fmadm list-fault Output Showing Multiple Faults

In the following output, all three suspect PCI devices are described as "faulted but still in service". The unknown values indicate that no identity information is available for these devices.

fmadm list-fault

TIME	EVENT-ID	MSG-ID	SEVERITY
Apr 23 02:48:15	a9445995-0eee-460b-82ba-d8ddb29cda71	PCIEX-8000-35	Critical

Problem Status : open
 Diag Engine : eft / 1.16
 System
 Manufacturer : Oracle Corporation
 Name : Sun Netra X4270 M3
 Part_Number : NILE-P1LRQT-8
 Serial_Number : 1211FM200D

System Component
 Manufacturer : Oracle
 Name : Sun Netra X4270 M3
 Part_Number : NILE-P1LRQT-8
 Serial_Number : 1211FM200D
 Host_ID : 008167b1

 Suspect 1 of 3 :
 Problem class : fault.io.pciex.device-interr
 Certainty : 50%
 Affects : dev:///pci@0,0/pci8086,3c04@2/pci1000,3050@0
 Status : faulted but still in service

FRU
 Status : faulty
 Location : "/SYS/MB/PCIE1"
 Manufacturer : unknown
 Name : pciex8086,1522.108e.7b19.1
 Part_Number : 7014747-Rev.01
 Revision : G29837-009
 Serial_Number : 159048B+1206A0369F048B54
 Chassis
 Manufacturer : Oracle
 Name : Sun Netra X4270 M3
 Part_Number : NILE-P1LRQT-8
 Serial_Number : 1211FM200D

 Suspect 2 of 3 :
 Problem class : fault.io.pciex.bus-linkerr
 Certainty : 25%
 Affects : dev:///pci@0,0/pci8086,3c04@2/pci1000,3050@0
 Status : faulted but still in service

FRU
 Status : faulty

Location : "/SYS/MB/PCIE1"
Manufacturer : unknown
Name : pciex8086,1522.108e.7b19.1
Part_Number : 7014747-Rev.01
Revision : G29837-009
Serial_Number : 159048B+1206A0369F048B54
Chassis
 Manufacturer : Oracle
 Name : Sun Netra X4270 M3
 Part_Number : NILE-P1LRQT-8
 Serial_Number : 1211FM200D

Suspect 3 of 3 :

Problem class : fault.io.pciex.device-interr
Certainty : 25%

FRU

Status : faulty
Location : "/SYS/MB"
Manufacturer : Oracle
Name : unknown
Part_Number : 7016786
Revision : Rev-03
Serial_Number : 489089M+1208UU003X
Chassis
 Manufacturer : Oracle
 Name : Sun Netra X4270 M3
 Part_Number : NILE-P1LRQT-8
 Serial_Number : 1211FM200D

Resource

Location : "/SYS/MB/PCIE1"
Status : faulted but still in service

Description : A problem has been detected on one of the specified devices or on one of the specified connecting buses.

Response : One or more device instances may be disabled

Impact : Loss of services provided by the device instances associated with this fault

Action : Use 'fmadm faulty' to provide a more detailed view of this event. If a plug-in card is involved check for badly-seated cards or bent pins. Please refer to the associated reference document at <http://support.oracle.com/msg/PCIEX-8000-3S> for the latest service procedures and policies regarding this diagnosis.

In the following example, two CPU strands are faulted and have been removed from service by the Fault Manager.

```
# fmadm list-fault
```

```
-----
TIME          EVENT-ID          MSG-ID          SEVERITY
-----
Apr 24 10:49:18 1479f457-d99a-4c55-9373-b33621d3aaee SUN4V-8002-6E Major
```

```
Problem Status : isolated
Diag Engine    : eft / 1.16
System
  Manufacturer : Oracle Corporation
  Name         : ORCL,SPARC-T4-1
  Part_Number  : 602-4918-02
  Serial_Number : 1315BDY5D8
  Host_ID     : 862e0f5e
```

```
-----
Suspect 1 of 2 :
  Problem class : fault.cpu.generic-sparc.strand
  Certainty    : 50%
  Affects      : cpu:///cpuid=0/serial=SERIAL1
  Status       : faulted and taken out of service
```

```
FRU
  Status       : faulty
  Location     : "/SYS/MB"
  Manufacturer : Oracle Corporation
  Name        : PCA,MB,SPARC_T4-1
  Part_Number  : 7047134
  Revision    : 02
  Serial_Number : 465769T+1309BW0V8E
  Chassis
    Manufacturer : Oracle Corporation
    Name         : ORCL,SPARC-T4-1
    Part_Number  : 31538783+1+1
    Serial_Number : 1315BDY5D8
```

```
-----
Suspect 2 of 2 :
  Problem class : fault.cpu.generic-sparc.strand
  Certainty    : 50%
  Affects      : cpu:///cpuid=1/serial=SERIAL2
  Status       : faulted and taken out of service
```

```
FRU
  Status       : faulty
  Location     : "/SYS/MB"
```

```

Manufacturer      : Oracle Corporation
Name              : PCA,MB,SPARC_T4-1
Part_Number       : 7047134
Revision          : 02
Serial_Number     : 465769T+1309BW0V8E
Chassis
  Manufacturer    : Oracle Corporation
  Name            : ORCL,SPARC-T4-1
  Part_Number     : 31538783+1+1
  Serial_Number   : 1315BDY5D8
    
```

Description : The number of correctable errors associated with this strand has exceeded acceptable levels.

Response : The fault manager will attempt to remove the affected strand from service.

Impact : System performance may be affected.

Action : Use 'fmadm faulty' to provide a more detailed view of this event. Please refer to the associated reference document at <http://support.oracle.com/msg/SUN4V-8002-6E> for the latest service procedures and policies regarding this diagnosis.

EXAMPLE 3 fmdump Fault Reports

Some console messages and knowledge articles might instruct you to use the `fmdump` command to display fault information, as shown in the following example. The information about the affected components is in the Affects line. The FRU Location value presents the human-readable FRU string. The FRU line and the Problem in line show the FMRIs. Note that the output lines in this example are artificially divided to improve readability.

```

$ fmdump -vu 91cfc113-eacc-44d0-8236-9e2ed3926fd3
TIME                UUID                                SUNW-MSG-ID  EVENT
Apr 08 08:36:50.1418 91cfc113-eacc-44d0-8236-9e2ed3926fd3 DISK-8000-0X Diagnosed
100% fault.io.disk.predictive-failure

Problem in: hc://:chassis-mfg=SUN:chassis-name=SUN-Storage-J4410
           :chassis-part=3753659:chassis-serial=1051QCQ08A:fru-mfg=STEC
           :fru-name=ZeusIOPs:fru-serial=STM00011EDCA:fru-part=STEC-ZeusIOPs
           :fru-revision=9007:devid=id1,sd@n5000a7203002c0f2/ses-enclosure=
           0/bay=23/disk=0

Affects: dev:///:devid=id1,sd@n5000a7203002c0f2//scsi_vhci/
disk@g5000a7203002c0f2
FRU: hc://:chassis-mfg=SUN:chassis-name=SUN-Storage-J4410
     :chassis-part=3753659:chassis-serial=1051QCQ08A:fru-mfg=STEC
    
```

```

:fru-name=ZeusIOPs:fru-serial=STM00011EDCA:fru-part=STEC-ZeusIOPs
:fru-revision=9007:devid=id1,sd@n5000a7203002c0f2/ses-enclosure=
0/bay=23/disk=0
FRU Location: /SUN-Storage-J4410.1051QCQ08A/HDD23

```

To see the severity, descriptive text, and action in the `fmdump` output, use the `-m` option. See the [fmdump\(1M\)](#) man page for more information.

The following `fmdump` output is for two CPU devices:

```

$ fmdump -vu 662ec53e-3aff-41d1-a836-ad7d1795705a
TIME                UUID                                SUNW-MSG-ID  EVENT
Apr 24 10:41:32.7511 662ec53e-3aff-41d1-a836-ad7d1795705a SUN4V-8002-6E Diagnosed

100%  fault.cpu.generic-sparc.strand

Problem in: hc://:chassis-mfg=Oracle-Corporation:chassis-name=ORCL,SPARC-T4-1
           :chassis-part=31538783+1+1:chassis-serial=1315BDY5D8/chassis=0
           /motherboard=0/chip=0/core=0/strand=0
Affects:  cpu:///cpuid=0/serial=15a02807e0b026b
FRU:      hc://:chassis-mfg=Oracle-Corporation:chassis-name=ORCL,SPARC-T4-1
           :chassis-part=31538783+1+1:chassis-serial=1315BDY5D8
           :fru-serial=465769T+1309BW0V8E:fru-part=7047134
           :fru-revision=02/chassis=0/motherboard=0
FRU Location: /SYS/MB

Apr 24 10:41:32.7732 662ec53e-3aff-41d1-a836-ad7d1795705a FMD-8000-9L  Isolated
100%  fault.cpu.generic-sparc.strand

Problem in: hc://:chassis-mfg=Oracle-Corporation:chassis-name=ORCL,SPARC-T4-1
           :chassis-part=31538783+1+1:chassis-serial=1315BDY5D8/chassis=0
           /motherboard=0/chip=0/core=0/strand=0
Affects:  cpu:///cpuid=0/serial=15a02807e0b026b
FRU:      hc://:chassis-mfg=Oracle-Corporation:chassis-name=ORCL,SPARC-T4-1
           :chassis-part=31538783+1+1:chassis-serial=1315BDY5D8
           :fru-serial=465769T+1309BW0V8E:fru-part=7047134
           :fru-revision=02/chassis=0/motherboard=0
FRU Location: /SYS/MB

```

EXAMPLE 4 Identifying Which CPUs Are Offline

Use the `psrinfo` command to display information about the CPUs:

```

$ psrinfo
0      faulted   since 04/24/2015 10:41:32
1      on-line   since 04/23/2015 14:52:03

```

The faulted state in this example indicates that the CPU has been taken offline by a Fault Manager response agent.

Displaying Information About Defective Services

The `fmadm list-defect` command can display information about problems in SMF services.

EXAMPLE 5 `fmadm list-defect` Output

The following example shows that the `devchassis daemon` SMF service has transitioned into the maintenance state:

```
# fmadm list-defect
-----
TIME          EVENT-ID          MSG-ID          SEVERITY
-----
Apr 23 02:33:12 bca0052c-5aa4-4ebf-b9c7-92ce645cf3af SMF-8000-YX    major

Problem Status      : isolated
Diag Engine         : software-diagnosis / 0.1
System
  Manufacturer      : Oracle Corporation
  Name              : Sun Netra X4270 M3
  Part_Number       : NILE-P1LRQT-8
  Serial_Number     : 1211FM200D

System Component
  Manufacturer      : Oracle
  Name              : Sun Netra X4270 M3
  Part_Number       : NILE-P1LRQT-8
  Serial_Number     : 1211FM200D
  Host_ID           : 008167b1

-----
Suspect 1 of 1 :
  Problem class    : defect.sunos.smf.svc.maintenance
  Certainty       : 100%
  Affects         : svc:///system/devchassis:daemon
  Status          : faulted and taken out of service

Resource
  FMRI            : "svc:///system/devchassis:daemon"
  Status          : faulted and taken out of service
```

Description : A service failed - a method is failing in a retryable manner but too often.

Response : The service has been placed into the maintenance state.

Impact : svc:/system/devchassis:daemon is unavailable.

Action : Run 'svcs -xv svc:/system/devchassis:daemon' to determine the generic reason why the service failed, the location of any logfiles, and a list of other services impacted. Please refer to the associated reference document at <http://support.oracle.com/msg/SMF-8000-YX> for the latest service procedures and policies regarding this diagnosis.

EXAMPLE 6 Showing Information About a Defective Service

Follow the instructions given in the Action section in the `fmadm` output to display information about the defective service. The references in the See lines provide more information about this problem.

```
$ svcs -xv svc:/system/devchassis:daemon
svc:/system/devchassis:daemon (/dev/chassis namespace support service)
  State: maintenance since Thu Apr 23 02:33:12 2015
Reason: Start method failed repeatedly, last exited with status 127.
  See: http://support.oracle.com/msg/SMF-8000-KS
  See: man -M /usr/share/man/ -s 7FS devchassis
  See: /var/svc/log/system-devchassis:daemon.log
Impact: This service is not running.
```

In addition to the `svcs -xv` command described above, you can use the `svcs -xL` command to display the full path name of the log file and the last few lines of the log file, and you can use the `svcs -Lv` command to display the entire log file.

Displaying Information About Alerts

An *alert* is information of interest that is neither a fault nor a defect. An alert might report a problem or might be simply informational. A problem that is reported by an alert is a misconfiguration or other problem that the administrator can resolve without assistance from a response agent. An example of this type of problem is a DIMM plugged into the wrong slot. An example of an informational message reported by an alert is a message that a shadow migration has completed. The following list provides examples of alert messages:

- Threshold alerts – Temperature is high, storage is at capacity, a zpool is at 80% or 90% capacity, a quota is exceeded, the path count to a chassis or disk has changed. These kinds of alerts can predict a performance impact.
- Configuration checks – An FRU has been added or removed, SAS cabling is incorrect, a DIMM is plugged into the wrong slot, a datalink changed, a link went up or down, ILOM is misconfigured, MTU (Maximum Transmission Unit - TCP/IP) is misconfigured.
- Interesting events – A reboot occurred, file system events occurred, firmware has been upgraded, save core failed, ZFS deduplication failed, shadow migration completed.

Alerts can be in one of the following states:

- `active` – The alert has not been cleared.
- `cleared` – The alert has been cleared. The `cleared` state for alerts can be compared to the `resolved` state for faults and defects. See the following description of persistent and transient alerts for more information about clearing an alert.

Alerts can be persistent or transient.

- A persistent alert is active until it is manually cleared as shown in [“`fmadm clear Command`” on page 36](#).
- A transient alert clears after a specified timeout period or is cleared by a service such as a network monitor.

Tip - Base your administrative action on output from the `fmadm list-alert` command. Log files output by the `fmdump` command contain a historical record of events and do not necessarily present active or open diagnoses. Log files output by `fmdump -i` are a historical record of telemetry and might not have been diagnosed into alerts.

EXAMPLE 7 `fmadm list-alert` Output

Use the `fmadm list-alert` command to list all alerts that have not been cleared. The following alert shows that a disk has been removed from the system. The Problem Status has the value `open`, which is an active state. Problem Status can be `open`, `isolated`, `repaired`, or `resolved`. The Problem class indicates that the FRU has been removed. The Impact indicates that the severity of the impact depends on the importance of this device in your environment. Perhaps the most useful piece of information in this output is the MSG-ID. Follow the instructions in the Action at the end of the alert to access more information about `FMD-8000-CV`.

`fmadm list-alert`

```

-----
TIME                EVENT-ID                MSG-ID                SEVERITY
-----
Apr 23 02:15:12 a7921317-8ba2-4ab1-b1c3-b0fb8822c000 FMD-8000-CV Minor

```

Problem Status : open
 Diag Engine : software-diagnosis / 0.1
 System
 Manufacturer : Oracle Corporation
 Name : Sun Netra X4270 M3
 Part_Number : NILE-P1LRQT-8
 Serial_Number : 1211FM200D

System Component
 Manufacturer : Oracle
 Name : Sun Netra X4270 M3
 Part_Number : NILE-P1LRQT-8
 Serial_Number : 1211FM200D
 Host_ID : 008167b1

 Suspect 1 of 1 :
 Problem class : alert.oracle.solaris.fmd.fru-monitor.fru-remove
 Certainty : 100%

FRU
 Status : faulty/not present
 Location : "/SUN-Storage-J4410.1051QCQ08A/HDD13"
 Manufacturer : SEAGATE
 Name : ST330057SSUN300G
 Part_Number : SEAGATE-ST330057SSUN300G
 Revision : 0B25
 Serial_Number : 001117G1LC1S-----6SJ1LC1S
 Chassis
 Manufacturer : SUN
 Name : SUN-Storage-J4410
 Part_Number : 3753659
 Serial_Number : 1051QCQ08A

Resource
 Status : faulty/not present

Description : FRU '/SUN-Storage-J4410.1051QCQ08A/HDD13' has been removed from the system.

Response : FMD topology will be updated.

Impact : System impact depends on the type of FRU.

Action : Use 'fmadm faulty' to provide a more detailed view of this event. Please refer to the associated reference document at <http://support.oracle.com/msg/FMD-8000-CV> for the latest service procedures and policies regarding this diagnosis.

Repairing Faults and Defects and Clearing Alerts

This chapter discusses the following topics:

- How to repair faults and defects
- How to clear alerts

Repairing Faults or Defects

You can configure Oracle Auto Service Request (ASR) to automatically request Oracle service when specific hardware problems occur. See the [Oracle Auto Service Request \(ASR\)](#) support document for more information.

When a component in your system has faulted, the Fault Manager can repair the component implicitly or you can repair the component explicitly.

Implicit repair

An *implicit repair* can occur when the faulty component is replaced if the component has serial number information that the Fault Manager daemon (`fmd`) can track. On many systems, serial number information is included in the FMRI so that `fmd` can determine when components have been replaced. When `fmd` determines that a component has been replaced and the replacement has been successfully brought into service, then the Fault Manager no longer displays that component in `fmadm list` output. The component is maintained in the Fault Manager internal resource cache until the fault event is 30 days old.

When `fmd` faults a piece of hardware, that hardware might be taken out of service so that it does not adversely affect the system. Hardware removal from service can occur whether Oracle Solaris or ILOM diagnosed the problem. Hardware removal from service is usually reported in the Response section of the diagnosis message.

Explicit repair

Sometimes no FRU serial number information is available even though the FMRI includes a chassis identifier. In this case, `fmd` cannot detect an FRU replacement, and you must perform an *explicit repair* by using the `fmadm` command with the `replaced`, `repaired`, or `acquit` subcommand as shown in the following sections. You should perform explicit repairs only at the direction of a specific documented repair procedure.

These `fmadm` commands take the following operands:

- The *UUID*, also shown as the `EVENT-ID` in Fault Manager output, identifies the fault event. The *UUID* can only be used with the `fmadm` `acquit` command. You can specify that the entire event can be safely ignored, or you can specify that a particular resource is not a suspect in this event.
- The *FMRI* and the *label* identify the suspect faulted resource. Examples of the FMRI and label of a resource are shown in [Example 1, “fmadm list-fault Output Showing a Faulty Disk,” on page 20](#). Typically, the label is easier to use than the FMRI.

A case is considered repaired when the fault event UUID is acquitted or when all suspect resources have been repaired, replaced, or acquitted. A case that is repaired moves into the repaired state, and the Fault Manager generates a `list.repaired` event.

fmadm replaced Command

Use the `fmadm` `replaced` command to indicate that the suspect FRU has been replaced. If multiple faults are currently reported against one FRU, the FRU shows as replaced in all cases.

```
fmadm replaced FMRI | label
```

When an FRU is replaced, the serial number of the FRU changes. If `fmd` automatically detects that the serial number of an FRU has changed, the Fault Manager behaves in the same way as if you had entered the `fmadm` `replaced` command. If `fmd` cannot detect whether the serial number of the FRU has changed, then you must enter the `fmadm` `replaced` command if you have replaced the FRU. If `fmd` detects that the serial number of the FRU has not changed, then the `fmadm` `replaced` command exits with an error.

If you remove the FRU but do not replace the FRU, the Fault Manager displays the suspect as `not present`.

fmadm repaired Command

Use the `fmadm repaired` command when you have performed a physical repair other than replacement of the FRU to resolve the problem. Examples of such repairs include reseating a card or straightening a bent pin. If multiple faults are currently reported against one FRU, the FRU shows as repaired in all cases.

```
fmadm repaired FMRI | label
```

fmadm acquit Command

Use the `acquit` subcommand if you determine that the indicated resource is not the cause of the fault. Usually the Fault Manager automatically acquits some suspects in a multi-element suspect list. Acquittal can occur implicitly as the Fault Manager refines the diagnosis, for example if additional error events occur. Sometimes Support Services gives you instructions to perform a manual acquittal.

Replacement takes precedence over repair, and both replacement and repair take precedence over acquittal. Thus, you can acquit a component and then subsequently repair the component, but you cannot acquit a component that has already been repaired.

If you do not specify any *FMRI* or *label* with the *UUID*, then the entire event is identified as able to be ignored. A case is considered repaired when the fault event *UUID* is acquitted.

```
fmadm acquit UUID
```

Acquit by *FMRI* or *label* with no *UUID* only if you determine that the resource is not a factor in any current cases in which that resource is a suspect. If multiple faults are currently reported against one FRU, the FRU shows as acquitted in all cases.

```
fmadm acquit FMRI  
fmadm acquit label
```

To acquit a resource in one case and keep that resource as a suspect in other cases, specify both the fault event *UUID* and the resource *FMRI* or both the *UUID* and the resource *label*, as shown in the following examples:

```
fmadm acquit FMRI UUID  
fmadm acquit label UUID
```

Clearing Alerts

Use the `fmadm list-alert` command to list all alerts that have not been cleared. See [“Displaying Information About Alerts” on page 29](#) for example output from the `fmadm list-alert` command.

Similar to faults, alerts can be repaired implicitly or explicitly. Because alerts do not necessarily represent problems that must be fixed, alerts are said to be cleared rather than repaired. An alert that is cleared is no longer active and no longer displayed by the `fmadm list` or `fmadm list-alert` commands.

Implicit clear

An *implicit clear* occurs when the alert clears with no administrative action. For example, an alert that an FRU has been removed is automatically cleared by an alert that the same FRU has been added, and an alert that an FRU has been added automatically clears after 30 seconds.

Explicit clear

Use the `fmadm clear` command to notify the Fault Manager that the specified alert event should be cleared.

`fmadm clear` Command

The `fmadm clear` command requires one of the following arguments:

```
fmadm clear UUID | location | class@resource
```

For the following examples, refer to the output from the `fmadm list-alert` command in [“Displaying Information About Alerts” on page 29](#).

In the following example, *UUID* is the value of the EVENT-ID field at the top of the `fmadm list-alert` output:

```
# fmadm clear a7921317-8ba2-4ab1-b1c3-b0fb8822c000
```

In the following example, *location* is the value of the FRU Location field in the `fmadm list-alert` output. This location is also referred to as the label.

```
# fmadm clear "/SUN-Storage-J4410.1051QCQ08A/HDD13"  
fmadm: cleared alert /SUN-Storage-J4410.1051QCQ08A/HDD13
```

In the following example, *class* is the value of the Problem class field of the suspect, and *resource* is the value of the resource FMRI, which can be found using the `fmddump -vu UUID` command as shown in [Example 3, “fmddump Fault Reports,” on page 26](#). Note that the command line in this example is artificially divided to improve readability.

```
# fmadm clear alert.oracle.solaris.fmd.fru-monitor.fru-remove@
hc://:chassis-mfg=SUN:chassis-name=SUN-Storage-J4410:chassis-part=3753659
:chassis-serial=1051QCQ08A:fru-mfg=SEAGATE:fru-name=ST330057SSUN300G
:fru-serial=001117G1LC1S-----6SJ1LC1S:fru-part=SEAGATE-ST330057SSUN300G
:fru-revision=0B25:devid=id1,sd@n5000c5003a26c717/ses-enclosure=0/bay=13/disk=0
```


Log Files and Statistics

This chapter discusses the following topics:

- What information the various fault management log files contain
- How to view those log files
- How to view information about Fault Manager modules

Fault Management Log Files

The Fault Manager daemon records information in several log files.

- Error events. The `errlog` log file records error telemetry consisting of ereports.
- Informational events.
 - The `infolog_hival` log file records high-value ireports.
 - The `infolog` log file records all other informational ireports.
- Diagnosis events. The `fltlog` log file records fault, defect, and alert diagnosis events.

The log files are stored in `/var/fm/fmd`. To view these log files, use the `fmdump` command. See [Example 3, “fmdump Fault Reports,” on page 26](#). See the `fmdump(1M)` man page for more information.

Tip - Base your administrative action on output from the `fmadm list` command. Log files output by the `fmdump` command can contain old diagnosis events and ereports or ireports that are not associated with any current diagnosis.

See [Chapter 2, “Displaying Fault, Defect, and Alert Information”](#) for information about using the `fmadm list` command.

The log files are automatically rotated. See the `logadm(1M)` man page for more information.

Fault Manager and Module Statistics

The Fault Manager daemon and many of its modules gather statistics. The `fmadm config` command shows the status of Fault Manager modules. The `fmstat` command reports statistics gathered by these modules.

EXAMPLE 8 `fmadm config` Output

```
# fmadm config
MODULE          VERSION STATUS DESCRIPTION
cpumem-retire   1.1    active CPU/Memory Retire Agent
disk-diagnosis  0.1    active Disk Diagnosis engine
disk-transport  2.1    active Disk Transport Agent
eft             1.16   active eft diagnosis engine
ext-event-transport 0.2    active External FM event transport
fabric-xlate    1.0    active Fabric Ereport Translater
fmd-self-diagnosis 1.0    active Fault Manager Self-Diagnosis
fru-monitor     1.1    active FRU Monitor
io-retire       2.0    active I/O Retire Agent
network-monitor 1.0    active Network monitor
sensor-transport 1.2    active Sensor Transport Agent
ses-log-transport 1.0    active SES Log Transport Agent
software-diagnosis 0.1    active Software Diagnosis engine
software-response 0.1    active Software Response Agent
sysevent-transport 1.0    active SysEvent Transport Agent
syslog-msgs     1.1    active Syslog Messaging Agent
zfs-diagnosis   1.0    active ZFS Diagnosis Engine
zfs-retire      1.0    active ZFS Retire Agent
```

EXAMPLE 9 `fmstat` Output Showing All Loaded Modules

Without options, the `fmstat` command provides a high-level overview of the events, processing times, and memory usage of all loaded modules.

```
# fmstat
module          ev_recv ev_acpt wait  svc_t   %w  %b  open solve  memsz  bufisz
cpumem-retire   0       0  0.0  10010.0  0  0   0   0    0    0
disk-diagnosis  0       0  0.0  10007.7  0  0   0   0    0    0
disk-transport  0       0  0.9  1811945.5 92  0   0   0    52b  0
eft             0       0  0.0  4278.0   0  0   3   0    1.6M 58b
ext-event-transport 6       0  0.0  860.8   0  0   0   0    46b  2.0K
fabric-xlate    0       0  0.0  4.8     0  0   0   0    0    0
fmd-self-diagnosis 393     0  0.0  25.5    0  0   0   0    0    0
fru-monitor     2       0  0.0  42.4    0  0   0   0    880b  0
```

io-retire	1	0	0.0	5003.8	0	0	0	0	0	0
network-monitor	0	0	0.0	13.2	0	0	0	0	664b	0
sensor-transport	0	0	0.0	38.3	0	0	0	0	40b	0
ses-log-transport	0	0	0.0	23.8	0	0	0	0	40b	0
software-diagnosis	0	0	0.0	10010.0	0	0	0	0	316b	0
software-response	0	0	0.0	10006.8	0	0	0	0	14K	14K
sysevent-transport	0	0	0.0	6125.0	0	0	0	0	0	0
syslog-msgs	2	0	0.0	3337.2	0	0	0	0	0	0
zfs-diagnosis	4	0	0.0	2002.0	0	0	0	0	0	0
zfs-retire	4	0	0.0	2715.1	0	0	0	0	4b	0

ev_recv	The number of telemetry events received by the module.
ev_acpt	The number of telemetry events accepted by the module as relevant to a diagnosis.
wait	The average number of telemetry events waiting to be examined by the module.
svc_t	The average service time for telemetry events received by the module, in milliseconds.
%w	The percentage of time that telemetry events were waiting to be examined by the module.
%b	The percentage of time that the module was busy processing telemetry events.
open	The number of active cases (open problem investigations) owned by the module. The open column applies only to fault management cases, which are created and solved only by diagnosis engines. This column does not apply to other modules, such as response agents.
solve	The total number of cases solved by this module since it was loaded. The solve column applies only to fault management cases, which are created and solved only by diagnosis engines. This column does not apply to other modules, such as response agents.
memsz	The amount of dynamic memory currently allocated by this module.
bufsz	The amount of persistent buffer space currently allocated by this module.

EXAMPLE 10 fmstat Output Showing a Single Module

Different statistics and columns are displayed when you specify different options.

To display statistics on an individual module, use the `-m module` option. The `-z` option suppresses zero-valued statistics. The following example shows that the `cpumem-retire` response agent successfully processed a request to take a CPU offline.

```
# fmstat -z -m cpumem-retire
NAME      VALUE      DESCRIPTION
cpu_flts  1          cpu faults resolved
```

See the [fmstat\(1M\)](#) man page for information about other options.

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