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Machine Learning Diagnostics Using Oracle Autonomous Health Framework

ORACLE OPEN WORLD

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SAN FRANCISCO, CA

Mark V. Scardina – Director of Product Management
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Oracle Autonomous Health Framework
October 4, 2017

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Program Agenda

1. Introducing Applied Machine Learning for Operations
2. Applied Machine Learning for Real-time Prevention
3. Applied Machine Learning for Rapid Recovery
4. ODA Management Appliance Profile
5. For Further Information / Q & A

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Program Agenda with Highlight

1. Introducing Applied Machine Learning for Diagnostics
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Why **Applied** Machine Learning?

- Brings an application's perspective versus a platform toolkit viewpoint
- Brings data science, algorithms, and domain expertise together
- Packages machine learning into usable, real-world operational algorithms and models that are applied at runtime
- Produces results and recommendations easily understood and trusted by non-data scientist/analyst end-users

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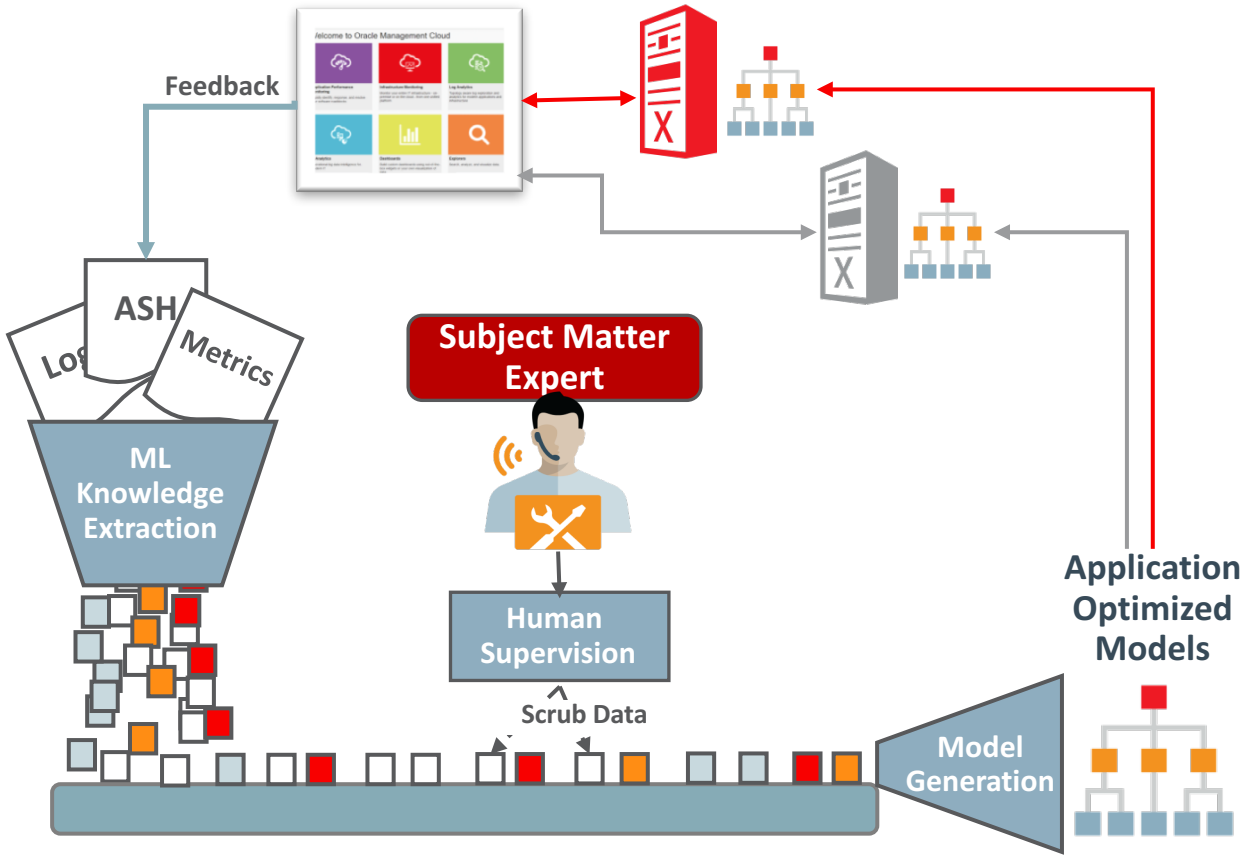
Applied Machine Learning for Diagnostics

- Generic ML-extracted Data Clusters are insufficient for diagnostics
- Operational data correlation does not determine root cause
- Trusted root cause determination critical to swift corrective actions
- Algorithms selected and models built require domain expertise
- Models refined via field feedback



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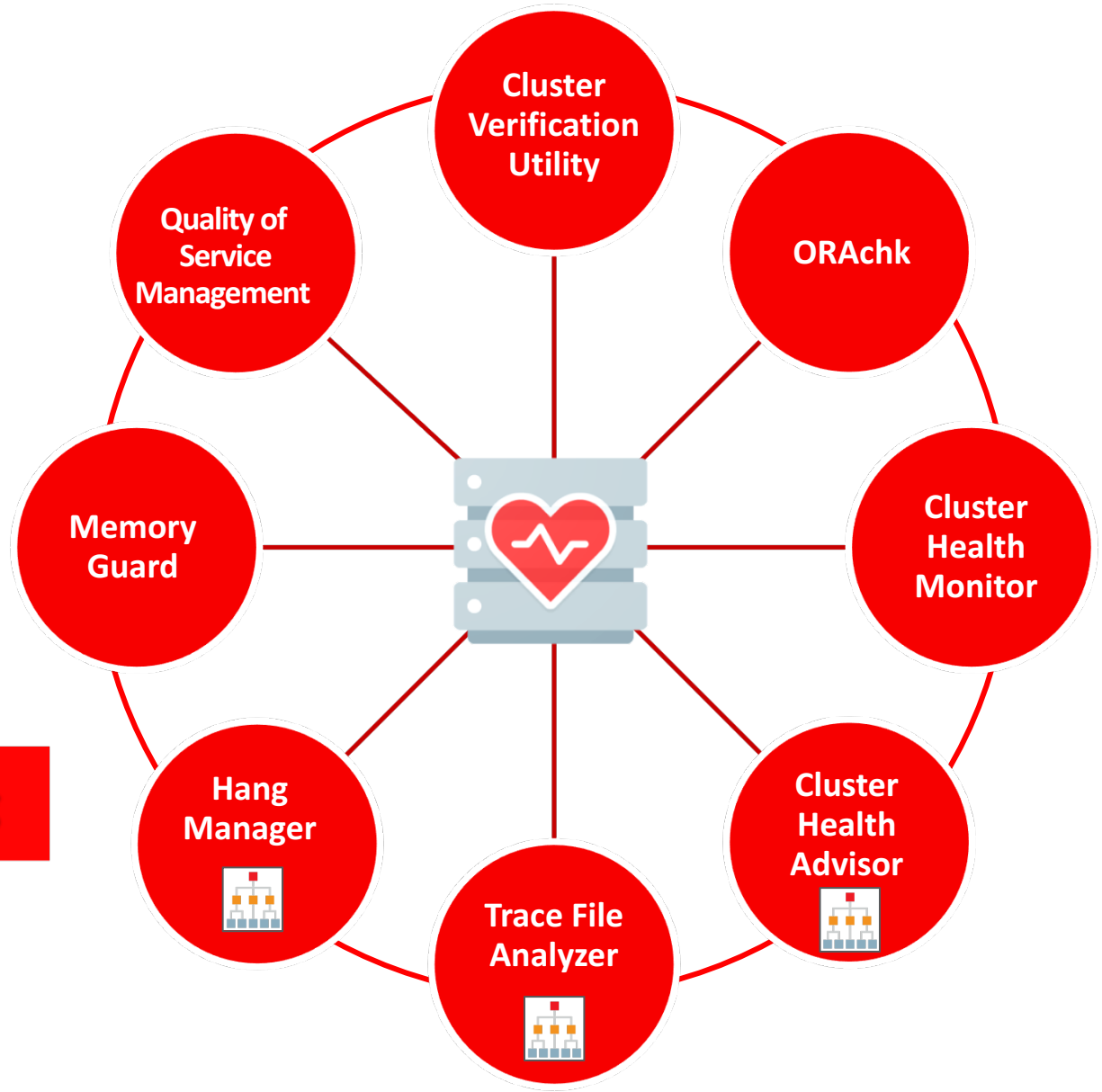
Oracle 12c Autonomous Health Framework



Powered by Applied Machine Learning

Managed Centrally by ODA DSC

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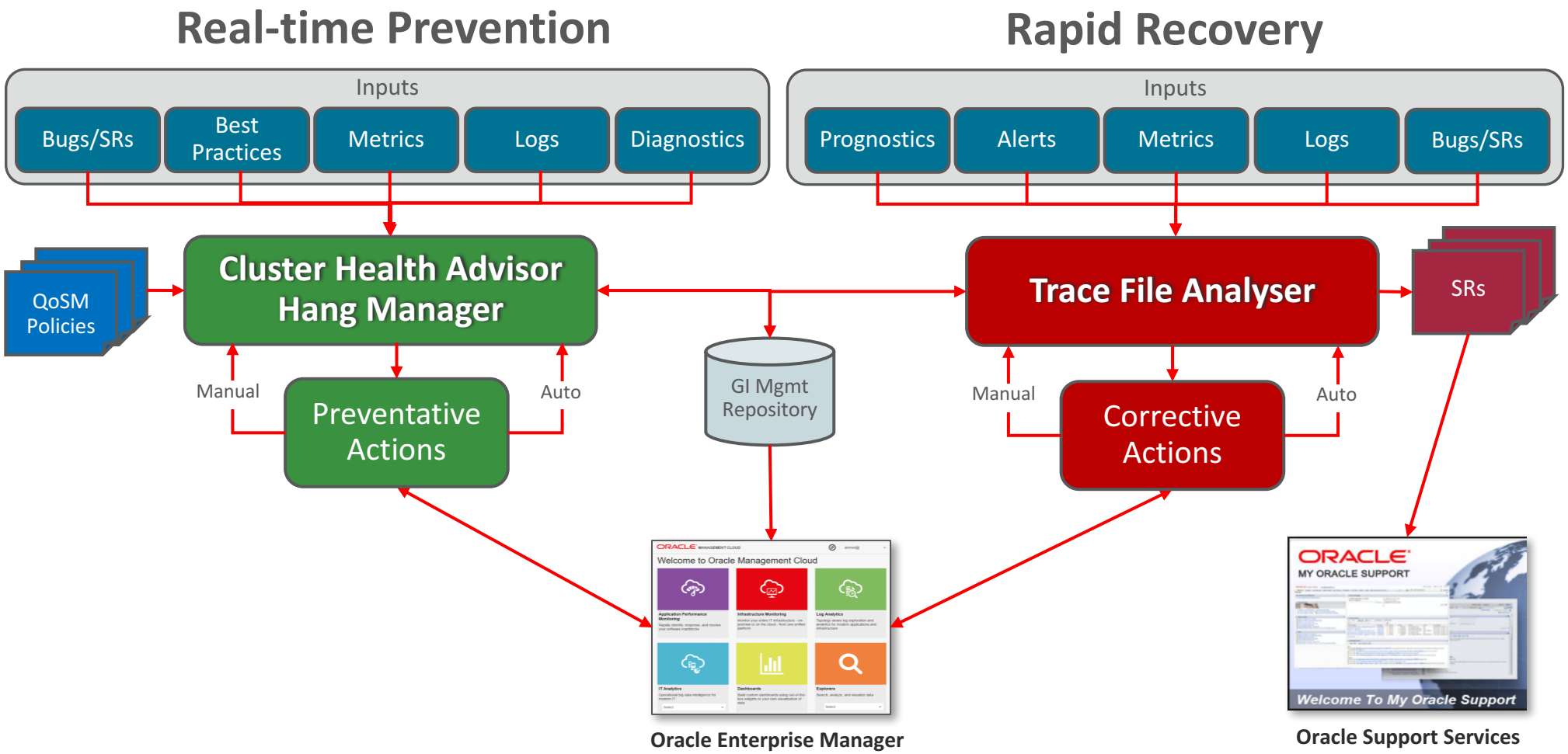
Applied ML in Oracle Autonomous Health Framework



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Applied Machine Learning – Cluster Health Advisor (CHA)

- Monitors in real-time Oracle database* systems and their hosts
  - Detects early impending as well as ongoing system faults
  - Diagnoses and identifies the most likely root causes
  - Provides targeted actions for prevention or escalation of DB/server problems
  - Generates relevant alerts and notifications for rapid response
- Released in 12.2 and currently under test by major RAC customers for production

* Currently RAC/R1N Databases only

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Cluster Health Advisor - Scope of Problem Detection

Best Effort Immediate Guided Diagnosis

- Over 30 node and database problems have been modeled
- Over 150 OS and DB metric predictors identified
- Problem network model created based upon its signature
- Problem Detection in 12.2.0.1 includes
  - Interconnect , Global Cache and Cluster Problems
  - Host CPU and Memory , PGA Memory stress
  - IO and Storage Performance issues
  - Reconfiguration and Recovery issues
  - Workload and Session abnormal variations

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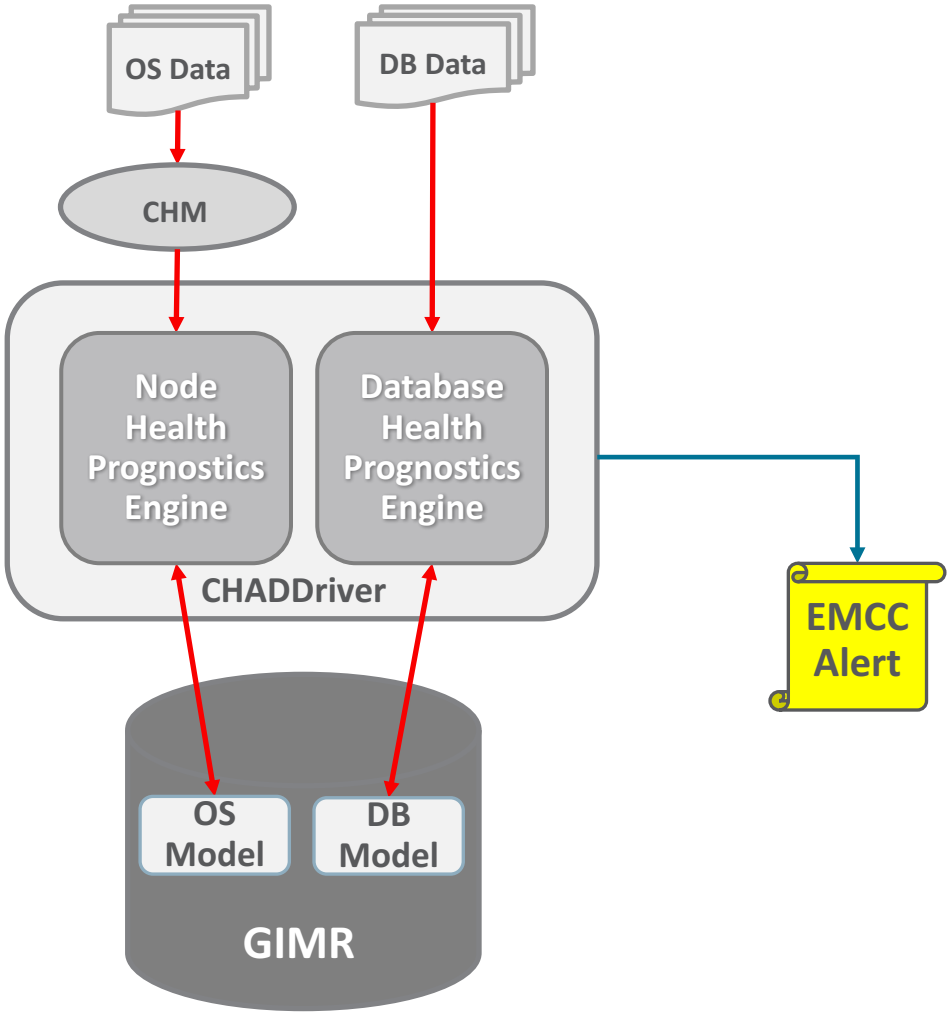
Cluster Health Advisor (CHA) Architecture Overview

- **cha** – Cluster node resource
- Single Java oracle.cha.server.CHADDriver daemon per node
- Reads Cluster Health Monitor data directly from memory
- Reads DB ASH data from SMR w/o DB connection
- Uses OS and DB models and data to perform prognostics
- Stores analysis and evidence in the GI Management Repository
- Sends alerts to EMCC Incident Manager per target



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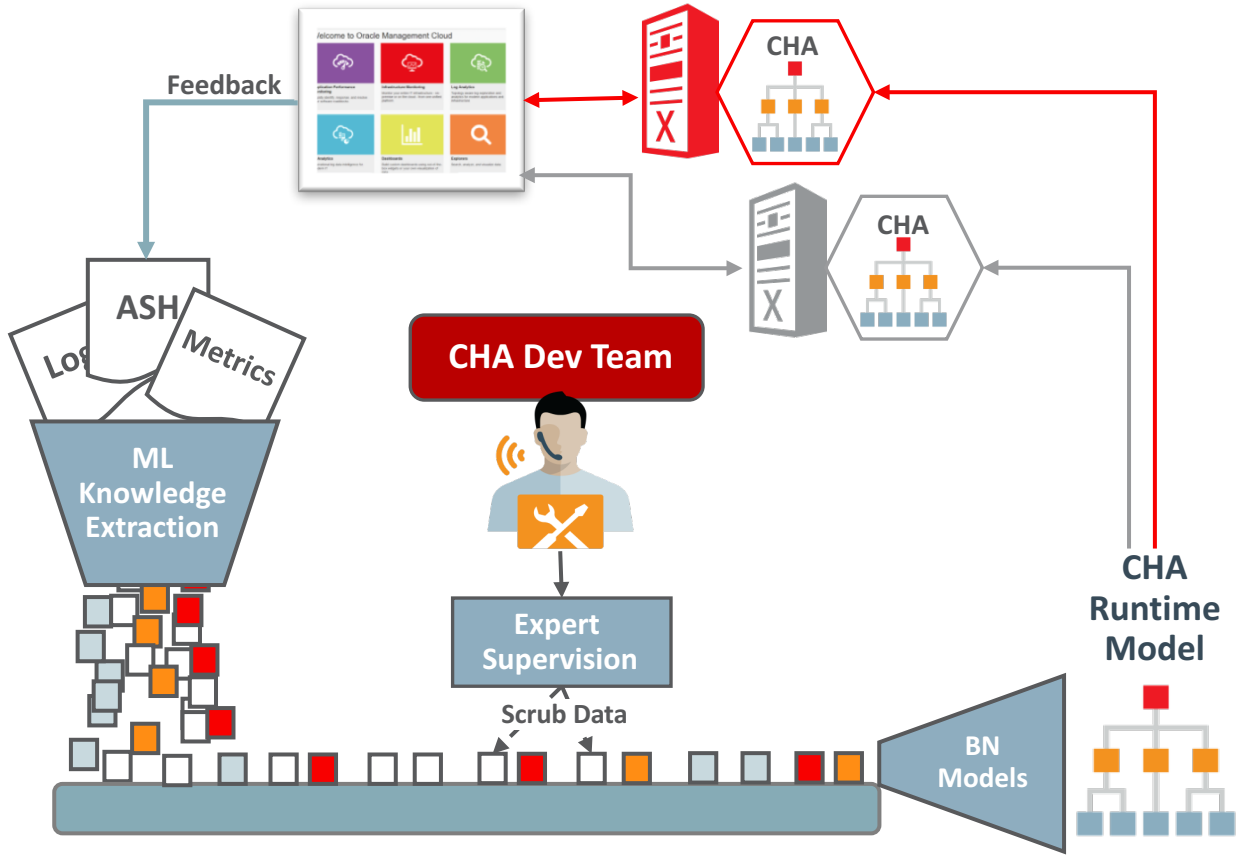
Applied Machine Learning – Cluster Health Advisor

Discovers Potential Cluster & DB Problems

- Actual Internal and External customer data drives model development
- Applied purpose-built Applied ML for knowledge extraction
- Expert Dev team scrubs data
- Generates Bayesian Network-based diagnostic root-cause models
- Uses BN-based run-time models to perform real-time prognostics



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Cluster Health Advisor

Data Sources and Data Points

A CHA *Data Point* contains > 150 signals (statistics and events) from *multiple sources*

Time	CPU	ASM IOPS	Network % util	Network_ Packets Dropped	Log file sync	Log file parallel write	GC CR request	GC current request	GC current block 2-way	GC current block busy	Enq: CF - contention	…
15:16:00	0.90	4100	13%	0	2 ms	600 us	0	0	300 us	1.5 ms	0	

Statistics are collected at a ***1 second internal sampling*** rate , synchronized, smoothed and aggregated to a Data Point ***every 5 seconds***

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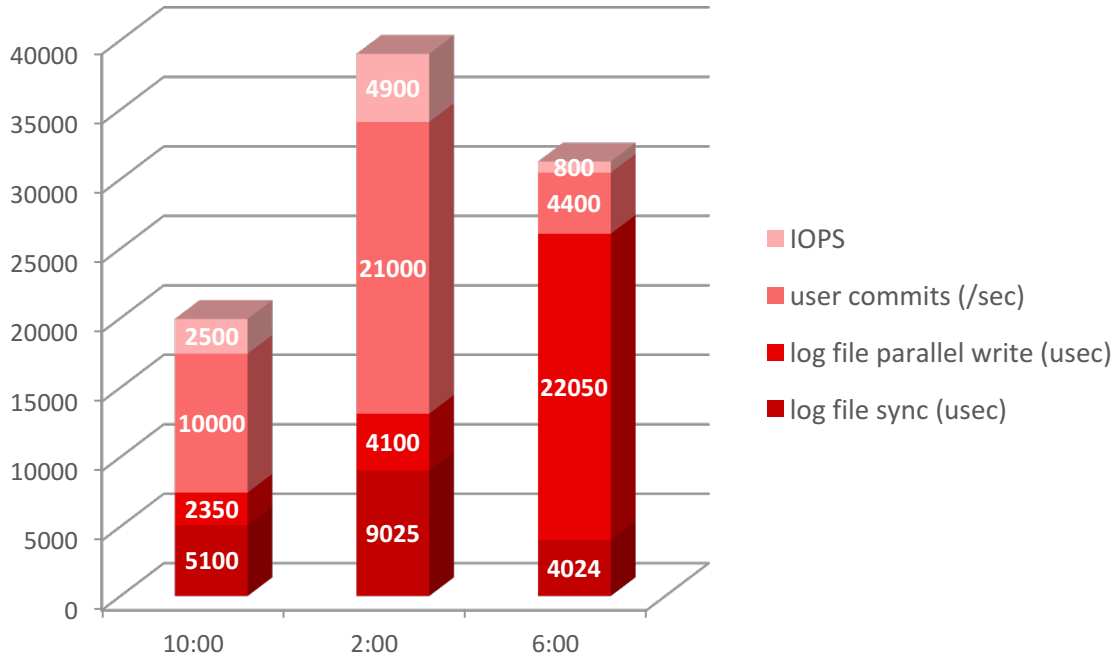
Models Capture all Normal Operating Modes

Models Capture the Dynamic Behavior of all Normal Operation



In-Memory Reference Matrix
(*Part of "Normality" Model*)

IOPS	####	2500	4900	800	####
User Commits	####	10000	21000	4400	####
Log File Parallel Write	####	2350	4100	22050	####
Log File Sync	####	5100	9025	4024	####
…	…	…	…	…	…

A model captures *the* ***normal load phases*** and their statistics over time , and thus the characteristics for all load intensities and profiles . During monitoring , ***any data point similar*** to one of the vectors is NORMAL. One could say **that *the model REMEMBERS the normal operational dynamics over time***

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Cluster Health Advisor

CHA Model: Find Similarity with Normal Values

In-Memory Reference Matrix (*Part of "Normality" Model*)

IOPS	####	2500	4900	800	####
User Commits	####	10000	21000	4400	####
Log File Parallel Write	####	2350	4100	22050	####
Log File Sync	####	5100	9025	4024	####
…	…	…	…	…	…

Observed values (*Part of a Data Point*)

10500
20000
4050
10250
…

Observed - Predicted =

Residual Values (*Part of a Data Point*)

5600
-1000
-50
325
…

CHA estimator/predictor (ESEE): "*based on my normality model, the value of IOPS should be in the vicinity of ~ 4900, but it is reported as 10500, this is causing a residual of ~ 5600 in magnitude*",

CHA fault detector: "*such high magnitude of residuals should be tracked carefully! I'll keep an eye on the incoming sequence of this signal IOPS and if it remains deviant I'll generate a fault on it*".

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Cluster Health Advisor

Inline and Immediate Fault Detection and Diagnostic Inference

Input : Data Point at Time *t*

Time	CPU	ASM IOPS	Network % util	Network_ Packets Dropped	Log file sync	Log file parallel write	GC CR request	GC current request	GC current block 2-way	GC current block busy	Enq: CF - contention	…
15:16:00	0.90	4100	88%	105	2 ms	600 us	504 ms	513 ms	2 ms	5.9 ms	0	

Fault Detection and Classification

15:16:00	OK	OK	HIGH 1	HIGH 2	OK	OK	HIGH 3	HIGH 3	HIGH 4	HIGH 4	OK	

Diagnostic Inference

15:16:00

Symptoms

1. Network Bandwidth Utilization
2. Network Packet Loss
3. Global Cache Requests Incomplete
4. Global Cache Message Latency

Root Cause
(Target of Corrective Action)

Network Bandwidth Utilization

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rwsbi0508-mb2

rwsbi05.us.oracle.com

Cluster ▾ Administration ▾

Page Refreshed **Sep 29, 2017 7:06:56 PM GMT**

Summary

Status	Up
Cluster Name	rwsbi0508-mb2
Hosts Status	2
Clusterware Status	2
Cluster Mode	Flex Cluster
Reconfiguration Activities	Happened

Configuration Changes

Configuration Changes 11

Patch Recommendations

View by Classification Target Type

Patch recommendations are not available.

My Oracle Support refresh job has not run successfully in 72 hours.
Patch Recommendations information may be stale or unavailable.Either set the preferred My Oracle Support credentials in online mode or manually upload the metadata required in offline mode to submit a 'Refresh From My Oracle Support' job.

No recommendations to report Learn More

Job Activity

Summary of jobs whose start date is within the last 7 days.

Show Latest Run

Show Jobs

Clusterware

View Clusterware View Hub

View ▾ Detach

Name	Status	Incidents				Compliance Score(%)	Host
		⚠	✖	⛔	⚑		
has_rwsbi05.us.oracle.com	↑	0	0	0	0		rwsbi05.us.oracle.com
has_rwsbi06.us.oracle.com	↑	0	0	0	0		rwsbi06.us.oracle.com

Incidents

View ▾ Target Local target and Related targets Category All ⛔0 ✖0 ⚠6 ⚑0

Summary	Tar	Se	Sta	Es Le	Type	Time Since Last Update
ASM Cluster-wide Disk Utilization on Host rwsbi06 Database/Cluster rwsbi0508-mb2 Instance . The Cluster…		⚠	…	-	Incident	0 days 0 hours
DB Log File IO Performance on Host rwsbi06 Database/Cluster proddb Instance proddb1. The Cluste…		⚠	…	-	Incident	0 days 0 hours
DB Log File IO Performance on Host rwsbi05 Database/Cluster proddb Instance proddb2. The Cluster Heal…		⚠	…	-	Incident	0 days 0 hours
DB Log File IO Performance on Host rwsbi06 Database/Cluster hcmdb Instance hcmdb1. The Cluster Healt…		⚠	…	-	Incident	0 days 0 hours
DB Log File IO Performance on Host rwsbi05 Database/Cluster hcmdb Instance hcmdb2. The Cluster Healt…		⚠	…	-	Incident	0 days 0 hours

Columns Hidden 14 Updated in the last 31 days

Cluster Managed Resources

View Cluster Databases

View ▾ Detach

Incidents

rwsbi0508-mb2

rwsbi05.us.oracle.com

Cluster ▾ Administration ▾

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Name	Status	Incidents				Compliance Score(%)	Host
		⚠	✖	⊖	⚑		
has_rwsbi05.us.oracle.com	↑	0	0	0	0		rwsbi05.us.oracle.com
has_rwsbi06.us.oracle.com	↑	0	0	0	0		rwsbi06.us.oracle.com

Incidents

View ▾ Target Local target and Related targets Category All ⊖0 ✖0 ⚠6 ⚑0

Summary	Tar	Se	Sta	Es Le	Type	Time Since Last Update
ASM Cluster-wide Disk Utilization on Host rwsbi06 Database/Cluster rwsbi0508-mb2 Instance . The Cluster		⚠	…	-	Incident	0 days 0 hours
DB Log File IO Performance on Host rwsbi06 Database/Cluster proddb Instance proddb1. The Cluster Heal…		⚠	…	-	Incident	0 days 0 hours
DB Log File IO Performance on Host rwsbi05 Data… r Heal…		⚠	…	-	Incident	0 days 0 hours
DB Log File IO Performance on Host rwsbi06 Data… r Healt…		⚠	…	-	Incident	0 days 0 hours
DB Log File IO Performance on Host rwsbi05 Data… r Healt…		⚠	…	-	Incident	0 days 0 hours

DB Log File IO Performance on Host rwsbi06 Database/Cluster proddb Instance proddb1. The Cluster Health Advisory (CHA) detected that the writes to the redo logs slowed down because the data disk group IO rate has increased. Separate the redo logs from the other database files. Move the redo logs to faster disks or Solid State Devices. Check logs and ASM statistics for signs of device errors and differences in performance between the redo logs, and replace the malfunctioning disks.

Columns Hidden 14

Updated in the last 31 days

Cluster Managed Resources

View Cluster Databases

View ▾ Detach

Open #https://den01nrp.us.oracle.com:4473/em/faces/cluster-home-flex?adf-Page-Id=36&target=rwsbi0508-mb2&type=cluster# on this page in a new tab

rwsbi0508-mb2

rwsbi05.us.oracle.com

Cluster ▾ Administration ▾

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has_rwsbi05.us.oracle.com	↑	0	0	0	0		rwsbi05.us.oracle.com
has_rwsbi06.us.oracle.com	↑	0	0	0	0		rwsbi06.us.oracle.com

Incidents

View ▾ Target Local target and Related targets Category All ⊖0 ✖0 ⚠6 ⚑0

Summary	Tar	Se	Sta	Es Le	Type	Time Since Last Update
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DB Log File IO Performance on Host rwsbi05 Database/Cluster proddb Instance pr					ident	0 days 0 hours
DB Log File IO Performance on Host rwsbi06 Database/Cluster hcmdb Instance hc					ident	0 days 0 hours
DB Log File IO Performance on Host rwsbi05 Database/Cluster hcmdb Instance hc					ident	0 days 0 hours

Columns Hidden 14

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ASM Cluster-wide Disk Utilization on Host rwsbi06 Database/Cluster rwsbi0508-mb2 Instance . The Cluster Health Advisor (CHA) detected slower than expected disk performance because the high disk I/O demand from the other servers increased the utilization of the shared disks. Review the CHA findings and corrective actions from the other servers and database instances in the cluster for IO issues. Add disks to the database disk groups.

Cluster Managed Resources

View Cluster Databases

View ▾ Detach

Incident Manager

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ASM Cluster-wide Disk Utilization on Host rwsbi06 Database/Cluster rwsbi0508-mb2 Instance . The Cluster Health Advisor (CHA) detected slower tl...

Open in new tab

Unassigned, Not acknowledged

Incident Details

ID	766
Metric	Alert Level
Metric Group	CHA Alerts
Key	CHA_INCIDENT_STATE_CHANGE_CLUSTERWARE_rwsbi0508-mb2__CHA_...
Target	rwsbi0508-mb2 (Cluster)
Incident Created	Sep 29, 2017 7:06:45 PM GMT
Last Updated	Sep 29, 2017 7:06:45 PM GMT
Summary	ASM Cluster-wide Disk Utilization on Host rwsbi06 Database/Cluster rwsbi0508-mb2 Instance . The Cluster Health Advisor (CHA) detected slower than expected disk performance because the high disk I/O demand from the other servers increased the utilization of the shared disks. Review the CHA findings and corrective actions from the other servers and database instances in the cluster for IO issues. Add disks to the database disk groups.
Internal Event Name	cha_alerts:cha_alert_level
Event Type	Metric Alert
Category	Unclassified

Show internal values for attributes ...

Metric Data

Critical Threshold	Not Applicable
Warning Threshold	Not Applicable
Number of Occurrences	0
Last Known Value	Critical

Tracking

Acknowledge | Add Comment ... | Manage ... | More

Escalated	No	**Owner**	-
Priority	None	**Acknowledged**	No
Status	New		

Last Comment Incident created by rule (Name = Incident management rule set for all targets, Create incident for critical metric alerts [System generated rule]).: on Sep 29, 2017 7:06:45 PM GMT

This incident will be automatically cleared when the underlying issue is resolved.

Guided Resolution

Diagnostics	Actions	Corrective Actions
Problem Analysis	Edit Thresholds	No corrective action defined.
View Metric Help		Add corrective action

Incident Manager

Page Refreshed **Sep 29, 2017 12:08:13 PM PDT**

ASM Cluster-wide Disk Utilization on Host rwsbi06 Database/Cluster rwsbi0508-mb2 Instance . The Cluster Health Advisor (CHA) detected slower tl...

Open in new tab

Unassigned, Not acknowledged

Incident Details

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Guided Resolution

Diagnostics	Actions	Corrective Actions
Problem Analysis	Edit Thresholds	No corrective action defined.
View Metric Help		Add corrective action

Cluster Health Advisor

Problem	The degradation is caused by a higher than expected utilization of shared storage devices for this database. No evidence of significant increase in I/O demand on the local node.
Confidence	95.17%
Action	Validate whether there is increase in I/O demand on other nodes than the local and find I/O intensive SQL . Add more disks to disk group or move database to faster disks.

Oracle Cluster Health Advisor (CHA)

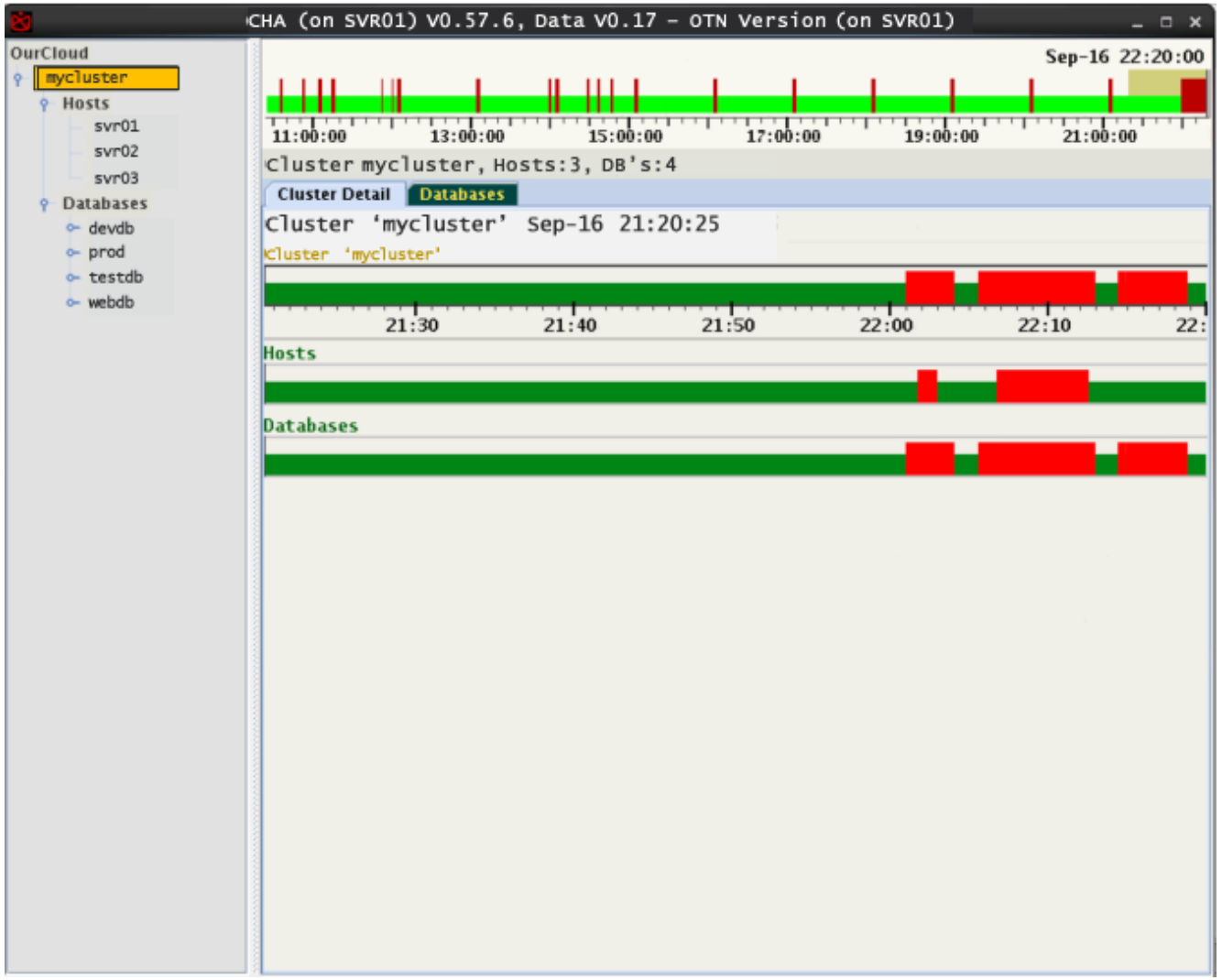
Standalone Data Exploration Tool

- Standalone Java GUI Client
- Must be run on local cluster node
- Can be run against live GIMR or MDB (dump) file

```
chactl export repository -format
mdb -start '2017-05-01 00:00:00'
-end '2017-05-10 00:00:00'
```

- Used internally for development
- Will be available and maintained on Oracle Technology Network

DEMO



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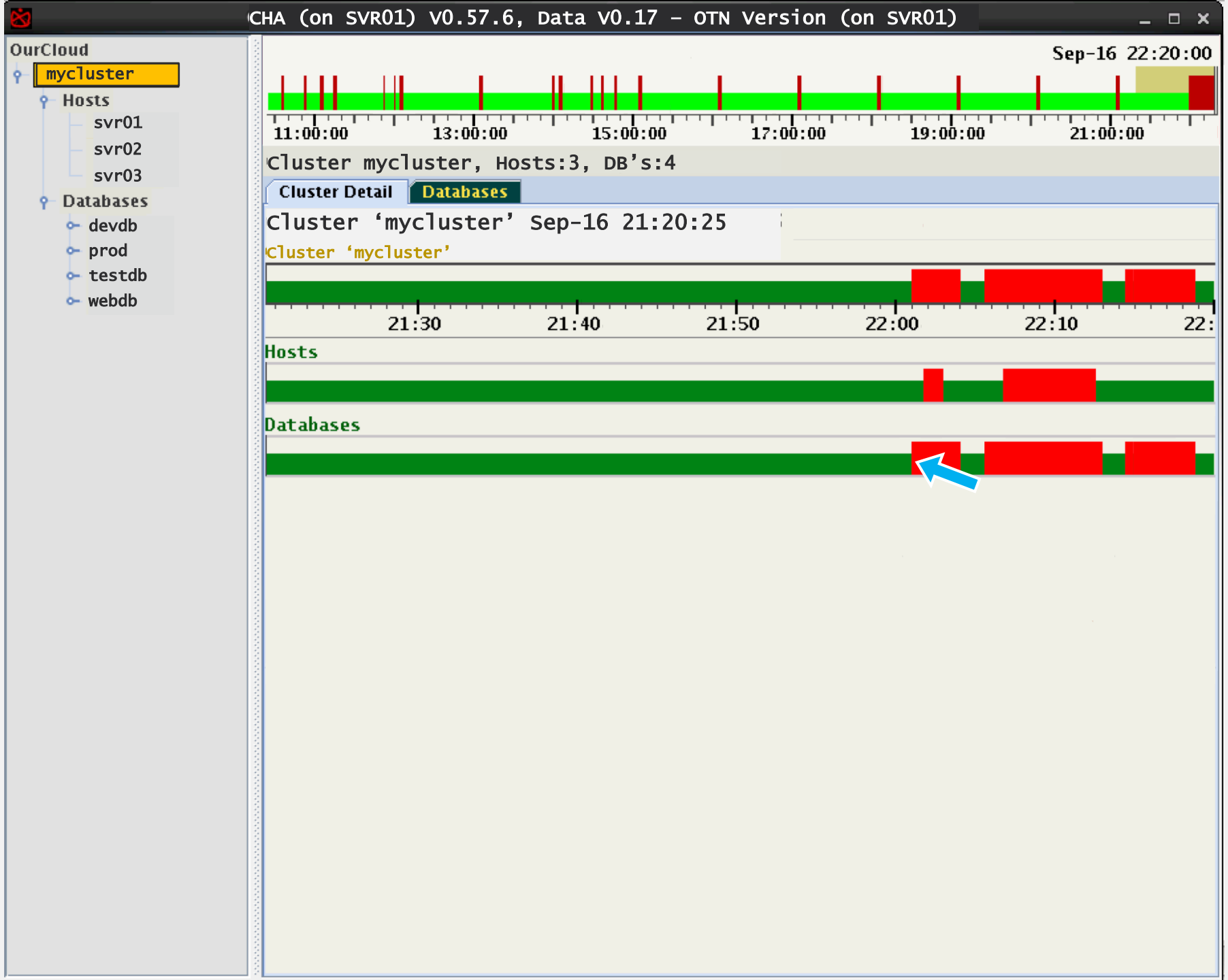
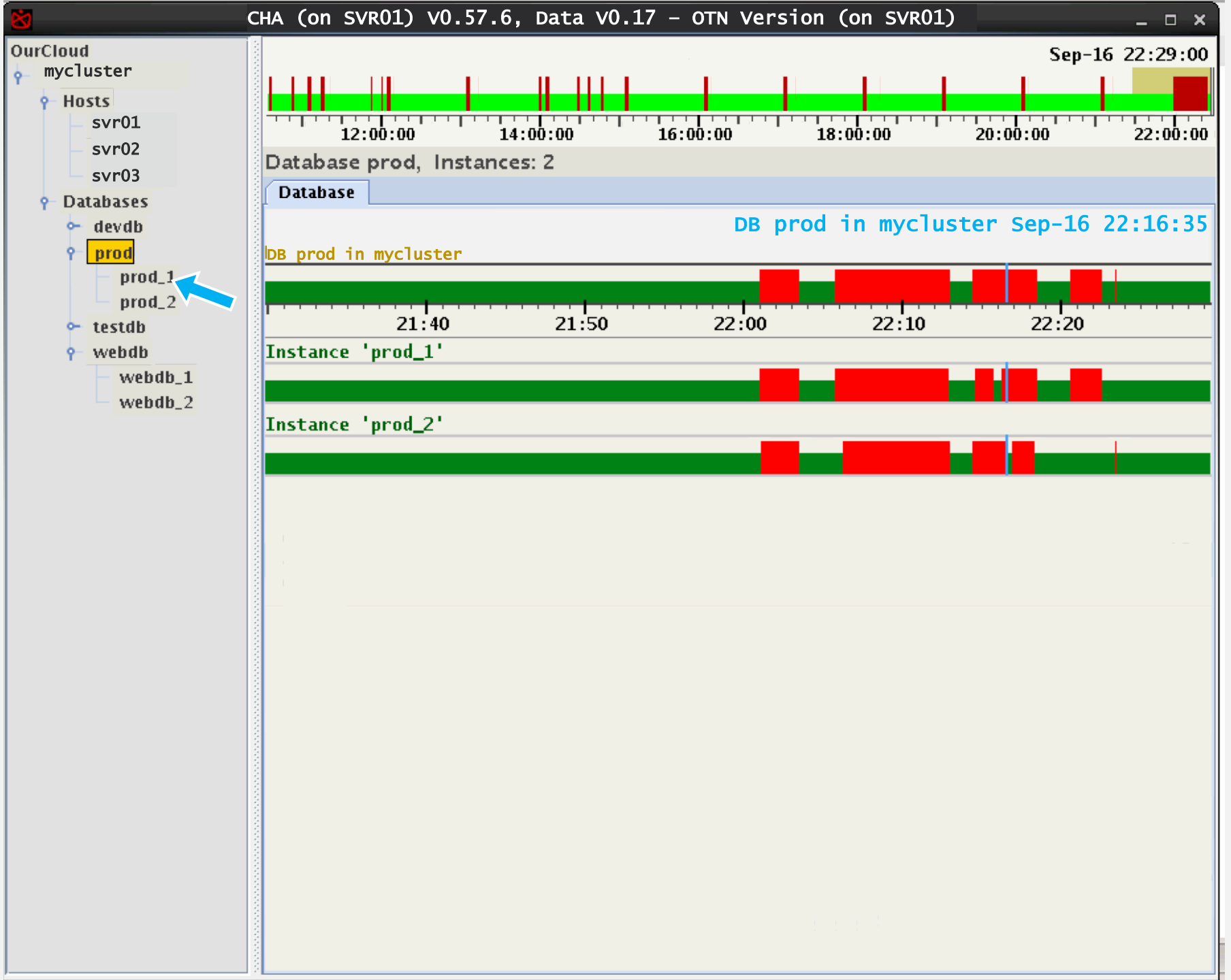

CHA (on SVR01) V0.57.6, Data V0.17 - OTN Version (on SVR01)
OurCloud
mycluster
Hosts
svr01
svr02
svr03
Databases
devdb
prod
testdb
webdb
Sep-16 22:20:00
11:00:00
13:00:00
15:00:00
17:00:00
19:00:00
21:00:00
Cluster mycluster, Hosts:3, DB's:4
Cluster Detail
Databases
Cluster 'mycluster' Sep-16 21:20:25
Cluster 'mycluster'
21:30
21:40
21:50
22:00
22:10
22:
Hosts
Databases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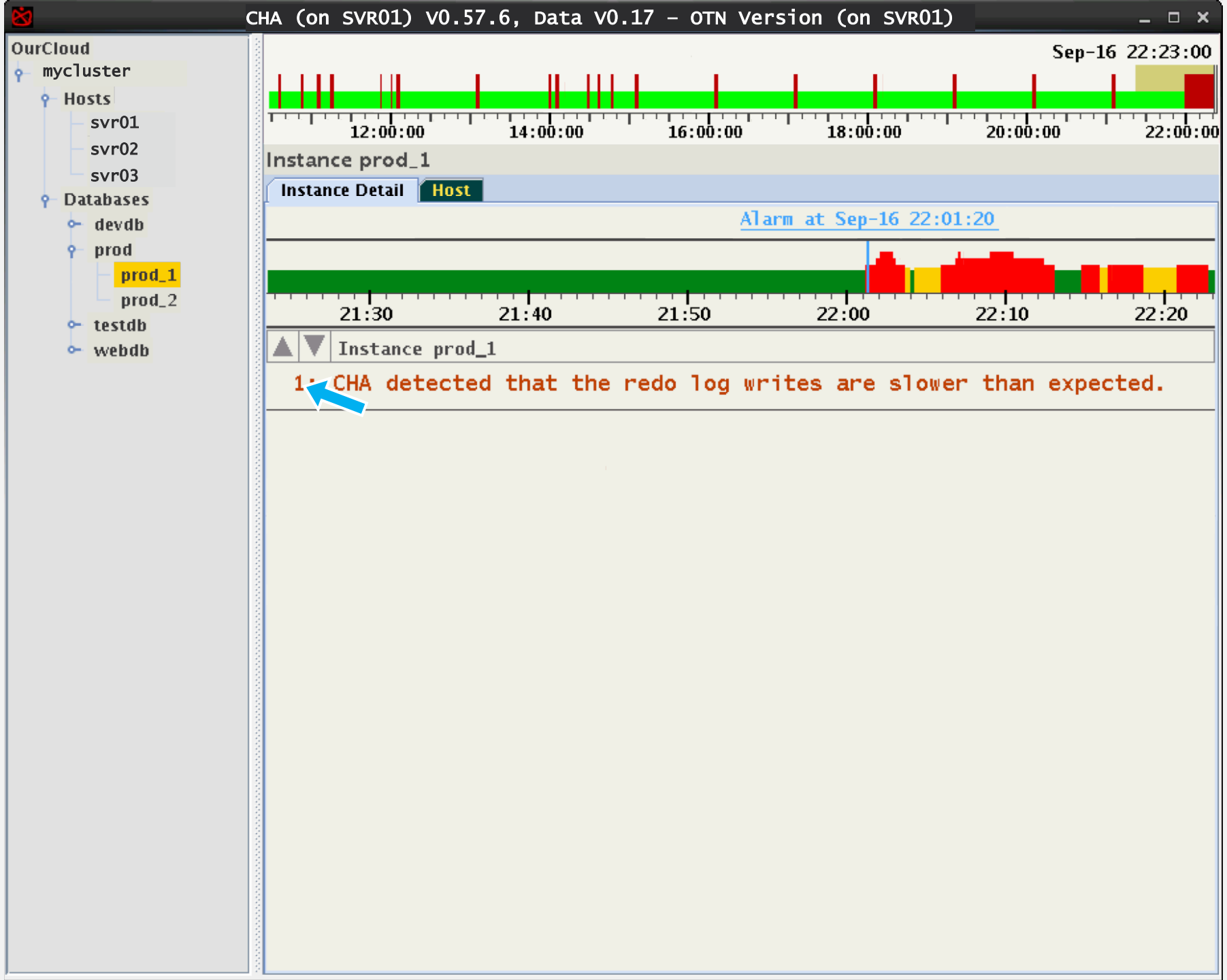
svr03
Databases
devdb
prod
prod_1
prod_2
testdb
webdb
webdb_1
webdb_2
Sep-16 22:29:00
12:00:00
14:00:00
16:00:00
18:00:00
20:00:00
22:00:00
Database prod, Instances: 2
Database
DB prod in mycluster Sep-16 22:16:35
DB prod in mycluster
21:40
21:50
22:00
22:10
22:20
Instance 'prod_1'
Instance 'prod_2'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prod_2
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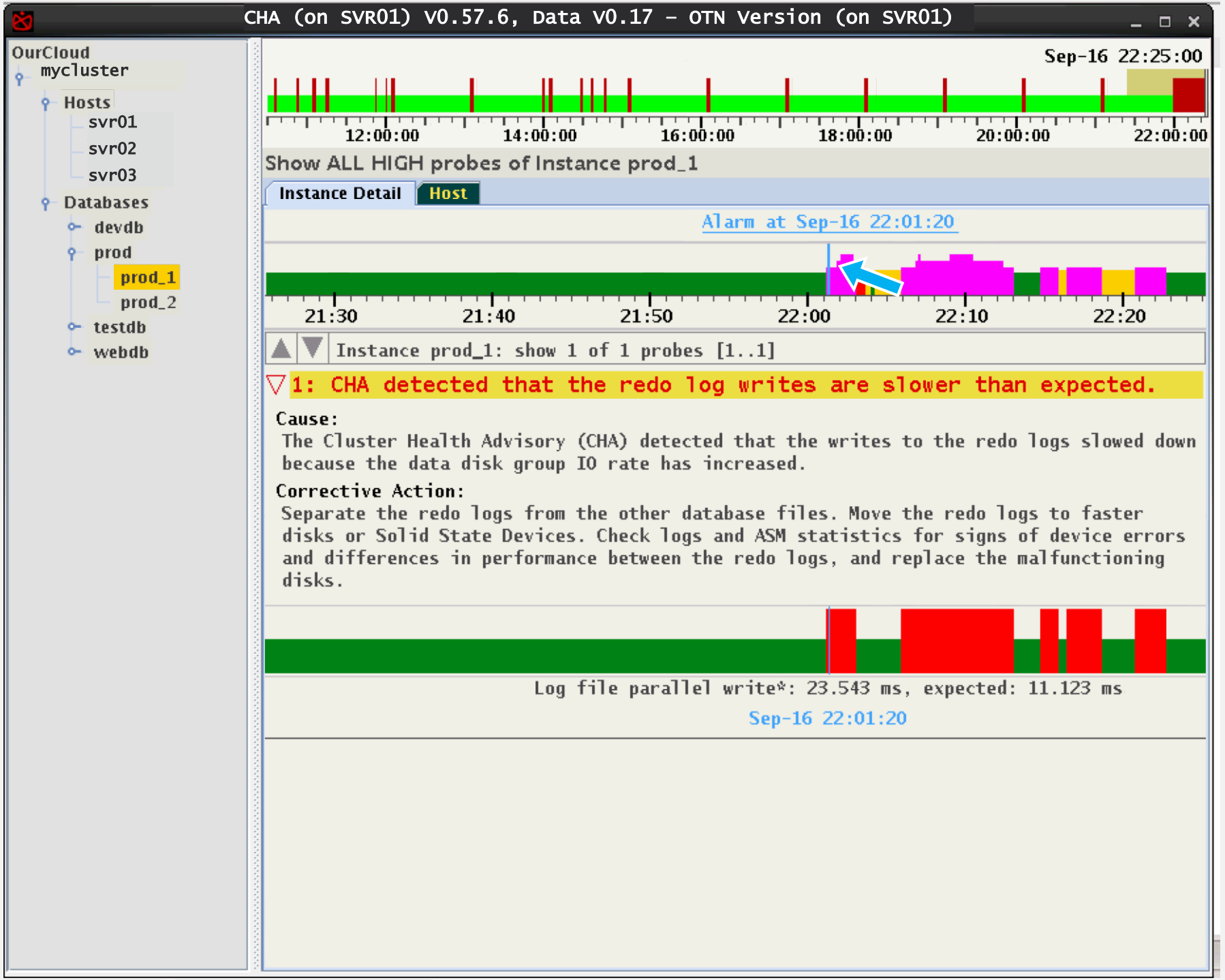
Sep-16 22:23:00
12:00:00
14:00:00
16:00:00
18:00:00
20:00:00
22:00:00
Instance prod_1
Instance Detail
Host
Alarm at Sep-16 22:01:20
21:30
21:40
21:50
22:00
22:10
22:20
Instance prod_1
1: CHA detected that the redo log writes are slower than expected.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OurCloud
mycluster
Hosts
svr01
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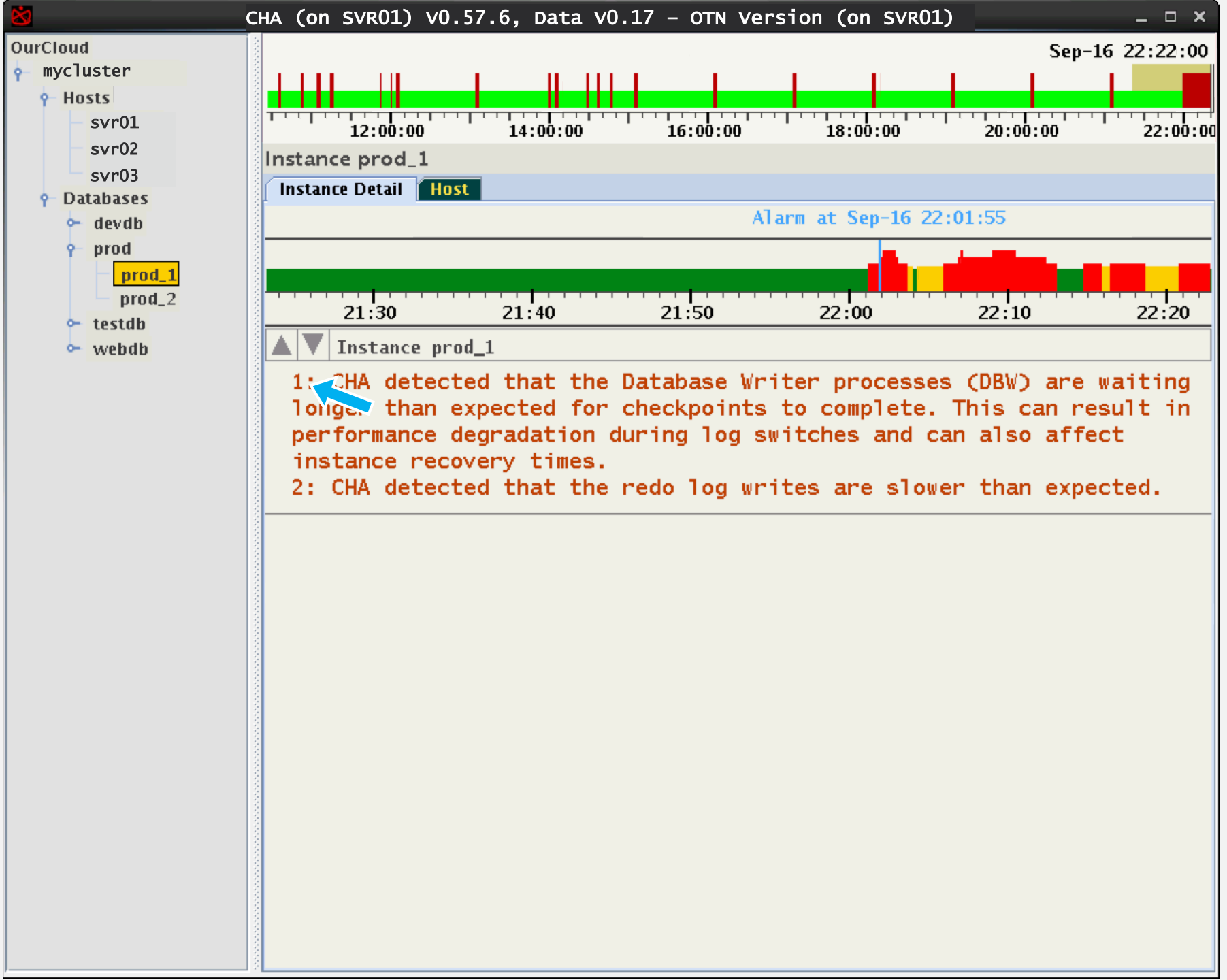
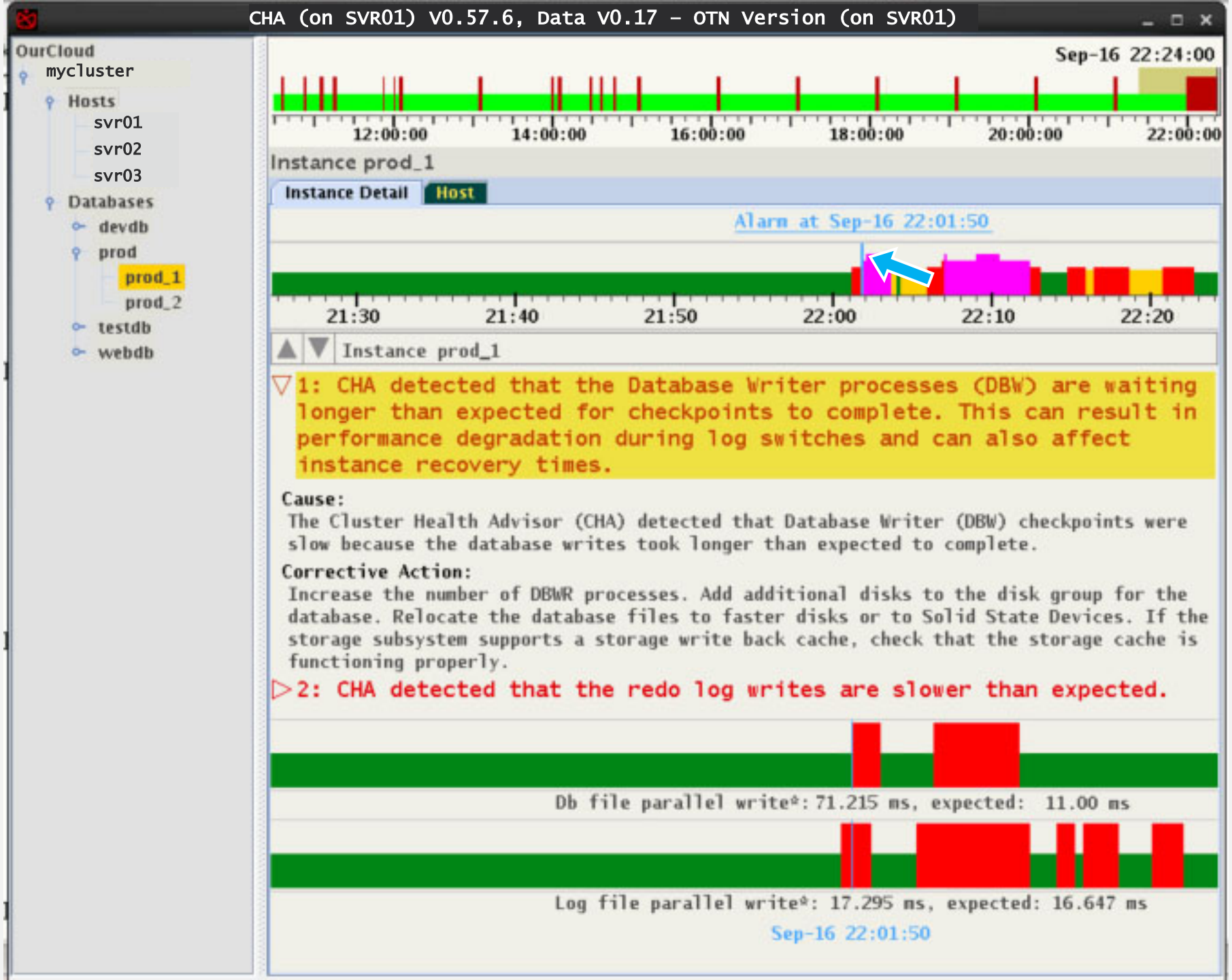
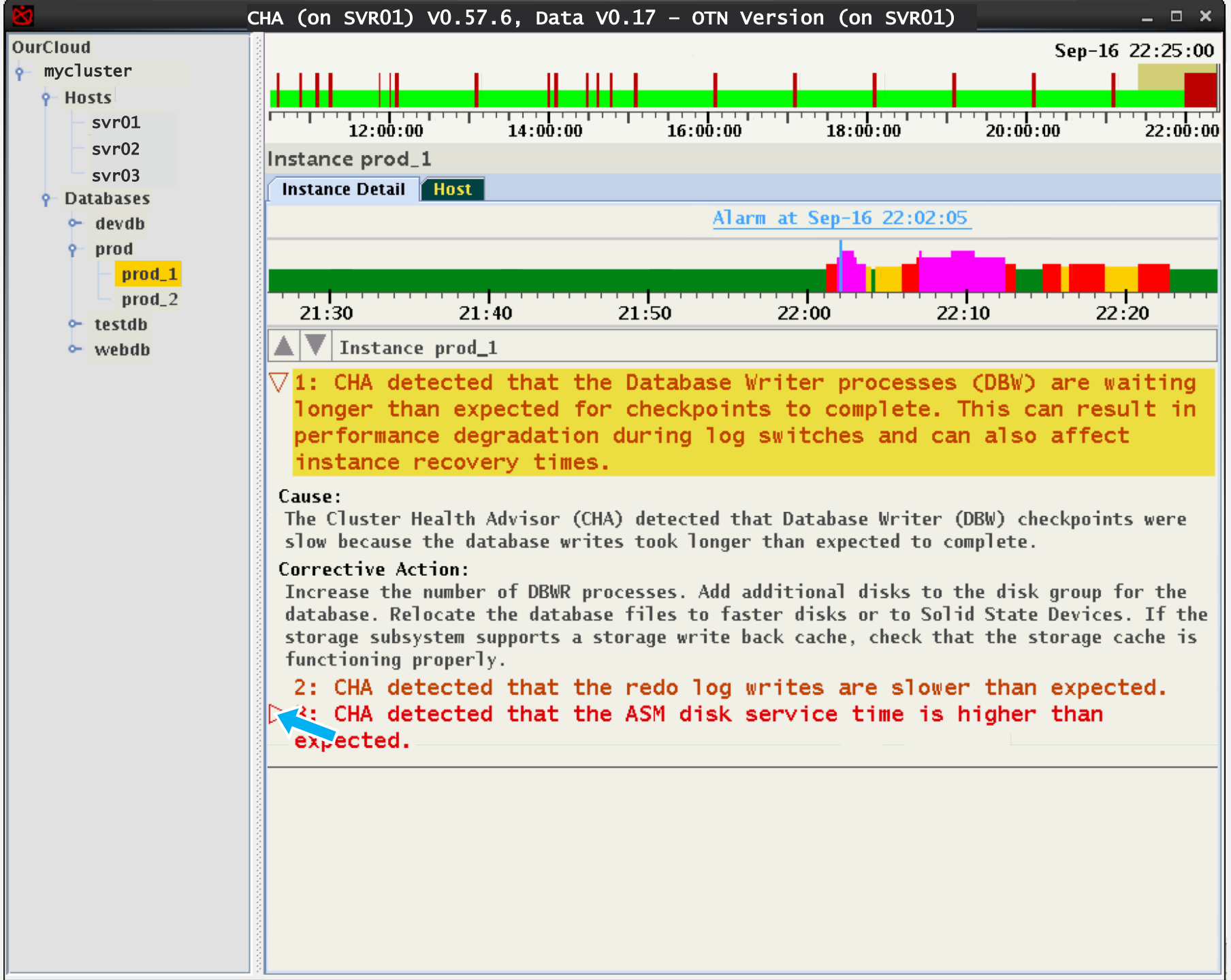
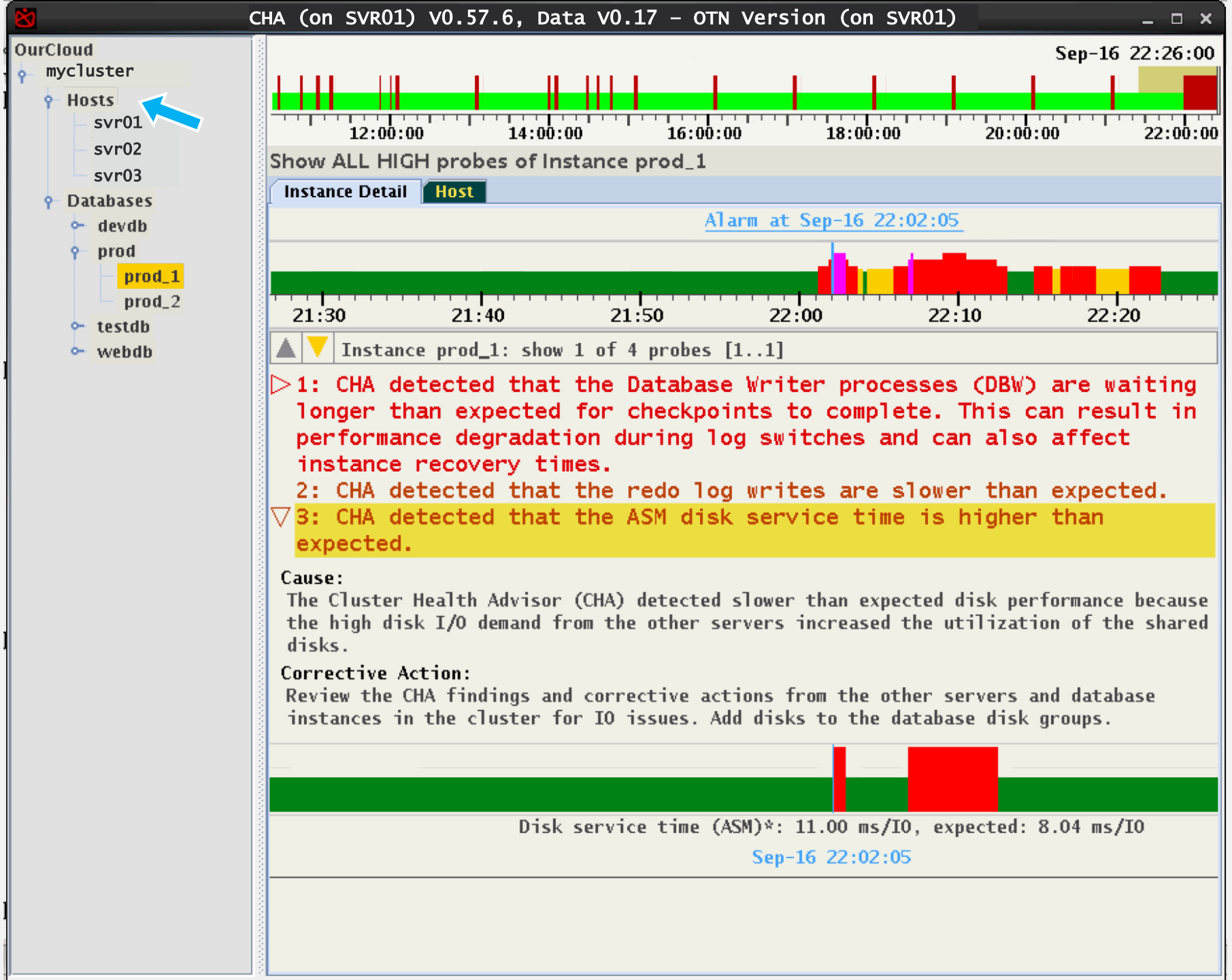
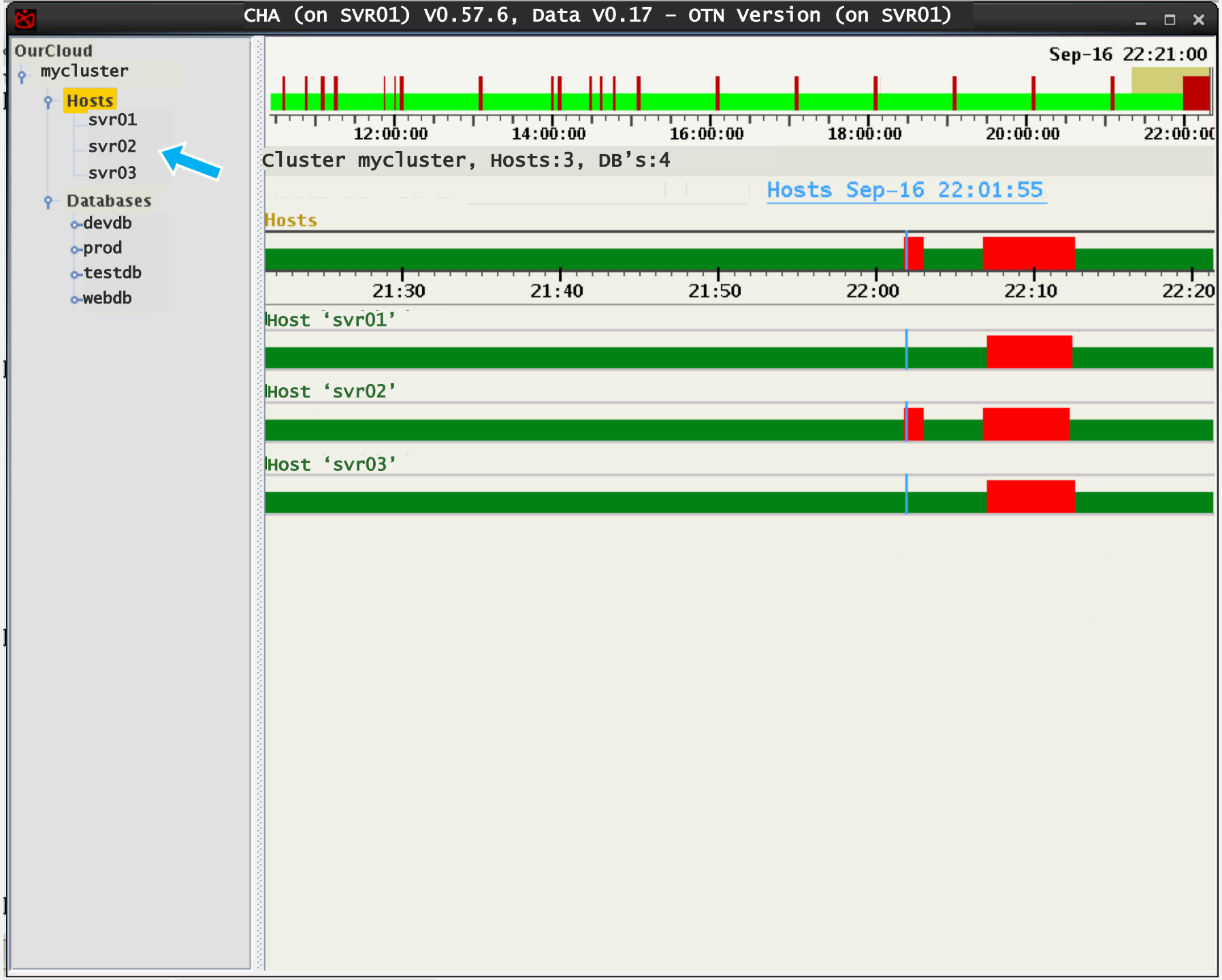
svr03
Databases
devdb
prod
prod_1
prod_2
testdb
webdb
Sep-16 22:25:00
12:00:00
14:00:00
16:00:00
18:00:00
20:00:00
22:00:00
Show ALL HIGH probes of Instance prod_1
Instance Detail
Host
Alarm at Sep-16 22:01:20
21:30
21:40
21:50
22:00
22:10
22:20
Instance prod_1: show 1 of 1 probes [1..1]
1: CHA detected that the redo log writes are slower than expected.
Cause:
The Cluster Health Advisory (CHA) detected that the writes to the redo logs slowed down because the data disk group IO rate has increased.
Corrective Action:
Separate the redo logs from the other database files. Move the redo logs to faster disks or Solid State Devices. Check logs and ASM statistics for signs of device errors and differences in performance between the redo logs, and replace the malfunctioning disks.
Log file parallel write*: 23.543 ms, expected: 11.123 ms
Sep-16 22:01:20

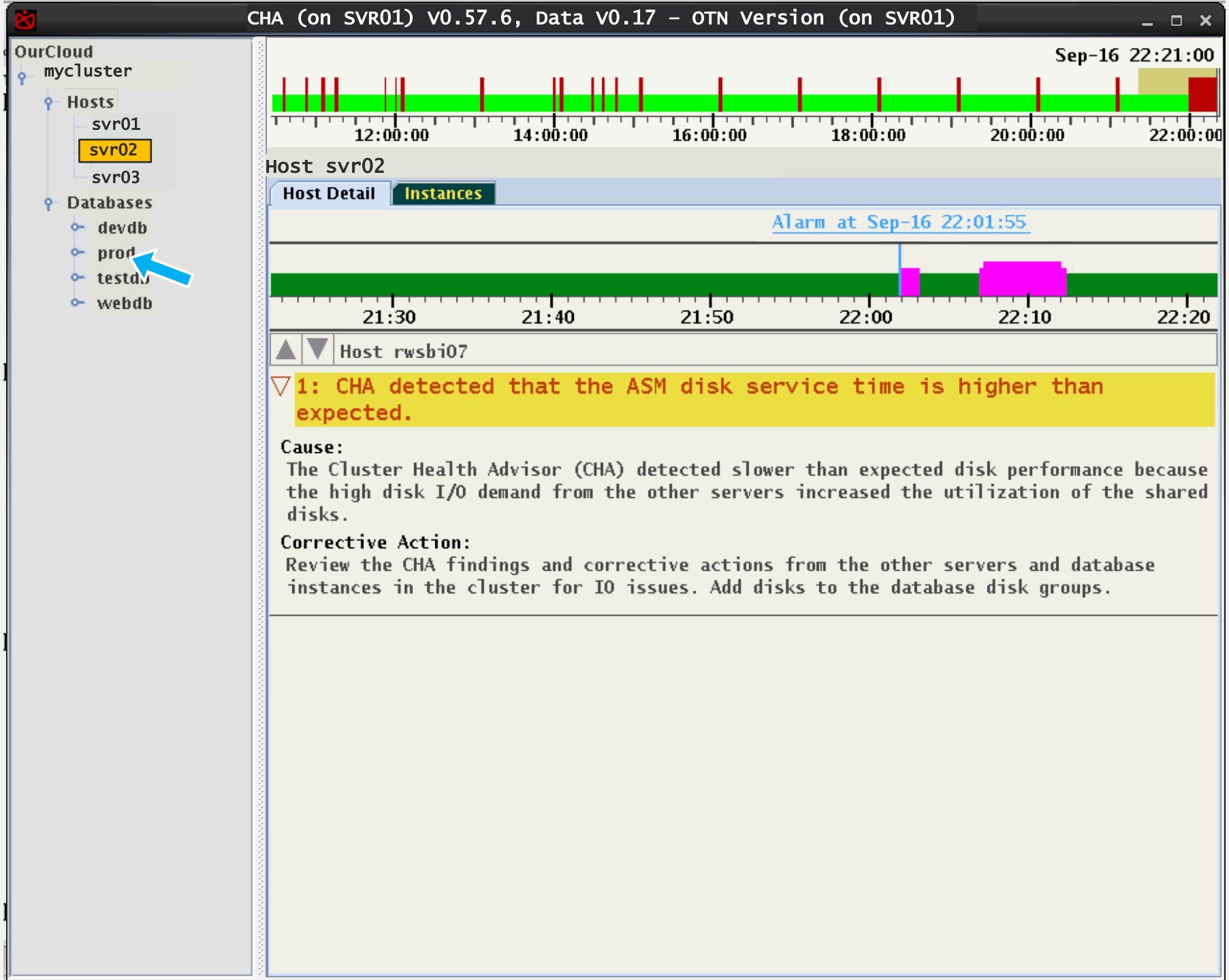

CHA (on SVR01) V0.57.6, Data V0.17 - OTN Version (on SVR01)
OurCloud
mycluster
Hosts
svr01
svr02
svr03
Databases
devdb
prod
prod_1
prod_2
testdb
webdb
Sep-16 22:22:00
12:00:00
14:00:00
16:00:00
18:00:00
20:00:00
22:00:00
Instance prod_1
Instance Detail
Host
Alarm at Sep-16 22:01:55
21:30
21:40
21:50
22:00
22:10
22:20
Instance prod_1
1: CHA detected that the Database Writer processes (DBW) are waiting
than expected for checkpoints to complete. This can result in
performance degradation during log switches and can also affect
instance recovery times.
2: CHA detected that the redo log writes are slower than expected.

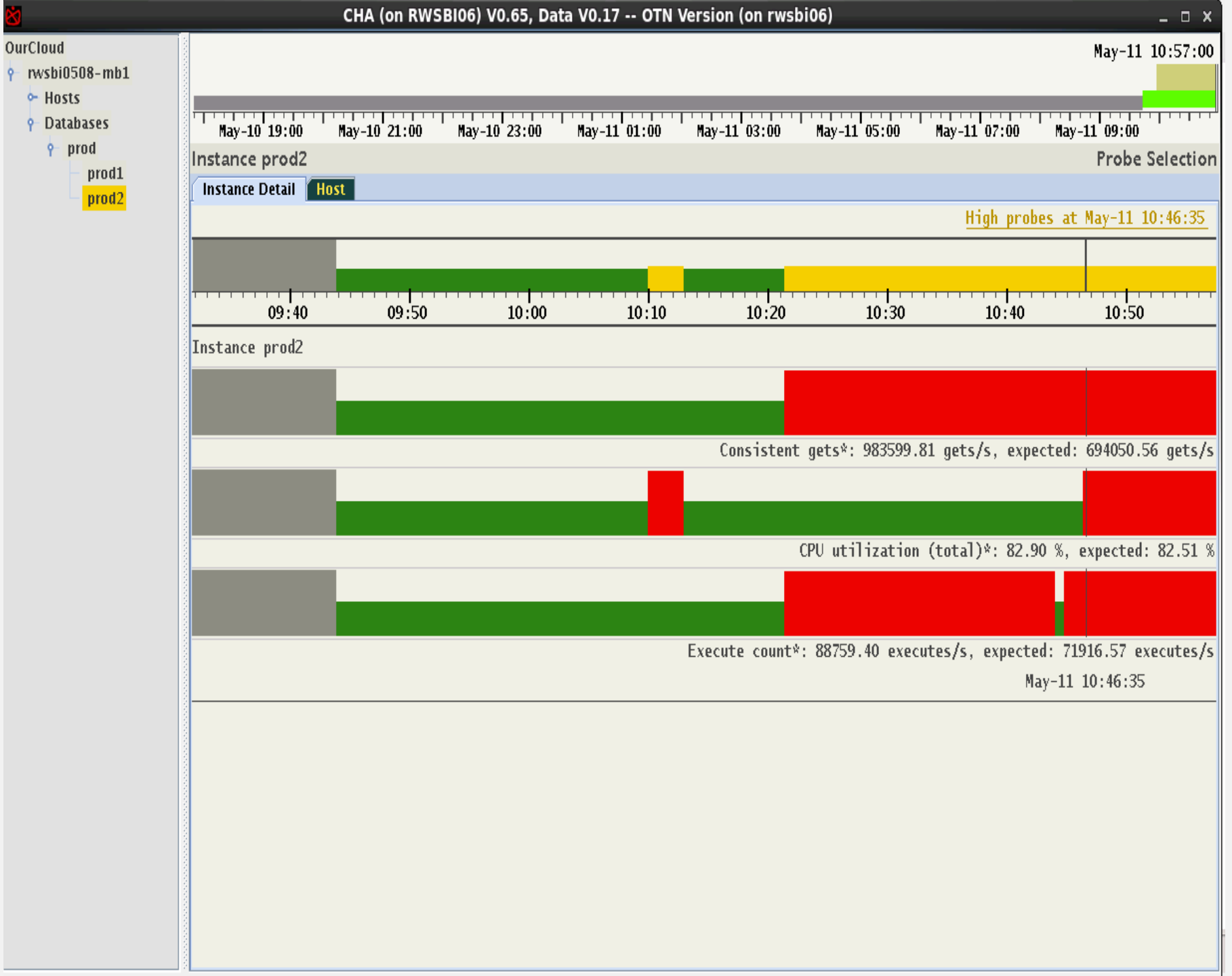

CHA (on SVR01) V0.57.6, Data V0.17 - OTN Version (on SVR01)
OurCloud
mycluster
Hosts
svr01
svr02
svr03
Databases
devdb
prod
prod_1
prod_2
testdb
webdb
Sep-16 22:24:00
12:00:00
14:00:00
16:00:00
18:00:00
20:00:00
22:00:00
Instance prod_1
Instance Detail
Host
Alarm at Sep-16 22:01:50
21:30
21:40
21:50
22:00
22:10
22:20
Instance prod_1
1: CHA detected that the Database Writer processes (DBW) are waiting longer than expected for checkpoints to complete. This can result in performance degradation during log switches and can also affect instance recovery times.
Cause:
The Cluster Health Advisor (CHA) detected that Database Writer (DBW) checkpoints were slow because the database writes took longer than expected to complete.
Corrective Action:
Increase the number of DBWR processes. Add additional disks to the disk group for the database. Relocate the database files to faster disks or to Solid State Devices. If the storage subsystem supports a storage write back cache, check that the storage cache is functioning properly.
2: CHA detected that the redo log writes are slower than expected.
Db file parallel write*: 71.215 ms, expected: 11.00 ms
Log file parallel write*: 17.295 ms, expected: 16.647 ms
Sep-16 22:01:50

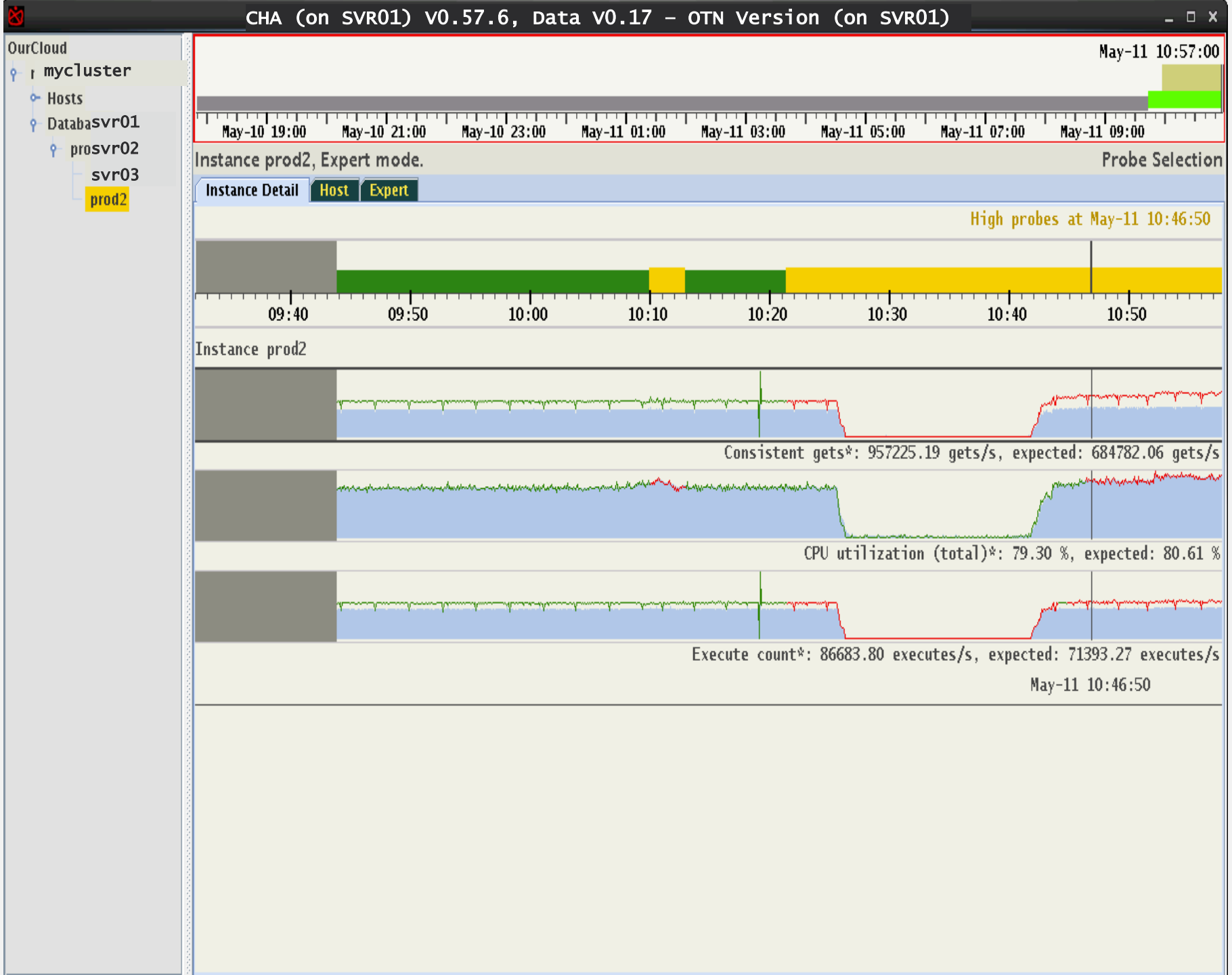

CHA (on SVR01) V0.57.6, Data V0.17 - OTN Version (on SVR01)
OurCloud
mycluster
Hosts
svr01
svr02
svr03
Databases
devdb
prod
prod_1
prod_2
testdb
webdb
Sep-16 22:25:00
12:00:00
14:00:00
16:00:00
18:00:00
20:00:00
22:00:00
Instance prod_1
Instance Detail
Host
Alarm at Sep-16 22:02:05
21:30
21:40
21:50
22:00
22:10
22:20
Instance prod_1
1: CHA detected that the Database Writer processes (DBW) are waiting longer than expected for checkpoints to complete. This can result in performance degradation during log switches and can also affect instance recovery times.
Cause:
The Cluster Health Advisor (CHA) detected that Database Writer (DBW) checkpoints were slow because the database writes took longer than expected to complete.
Corrective Action:
Increase the number of DBWR processes. Add additional disks to the disk group for the database. Relocate the database files to faster disks or to Solid State Devices. If the storage subsystem supports a storage write back cache, check that the storage cache is functioning properly.
2: CHA detected that the redo log writes are slower than expected.
3: CHA detected that the ASM disk service time is higher than expected.


CHA (on SVR01) V0.57.6, Data V0.17 - OTN Version (on SVR01)
OurCloud
mycluster
Hosts
svr01
svr02
svr03
Databases
devdb
prod
prod_1
prod_2
testdb
webdb
Sep-16 22:26:00
12:00:00
14:00:00
16:00:00
18:00:00
20:00:00
22:00:00
Show ALL HIGH probes of Instance prod_1
Instance Detail
Host
Alarm at Sep-16 22:02:05
21:30
21:40
21:50
22:00
22:10
22:20
Instance prod_1: show 1 of 4 probes [1..1]
1: CHA detected that the Database Writer processes (DBW) are waiting longer than expected for checkpoints to complete. This can result in performance degradation during log switches and can also affect instance recovery times.
2: CHA detected that the redo log writes are slower than expected.
3: CHA detected that the ASM disk service time is higher than expected.
Cause:
The Cluster Health Advisor (CHA) detected slower than expected disk performance because the high disk I/O demand from the other servers increased the utilization of the shared disks.
Corrective Action:
Review the CHA findings and corrective actions from the other servers and database instances in the cluster for IO issues. Add disks to the database disk groups.
Disk service time (ASM)*: 11.00 ms/IO, expected: 8.04 ms/IO
Sep-16 22:02:05


CHA (on SVR01) V0.57.6, Data V0.17 - OTN Version (on SVR01)
OurCloud
mycluster
Hosts
svr01
svr02
svr03
Databases
devdb
prod
testdb
webdb
Sep-16 22:21:00
12:00:00
14:00:00
16:00:00
18:00:00
20:00:00
22:00:00
Cluster mycluster, Hosts:3, DB's:4
Hosts Sep-16 22:01:55
Hosts
21:30
21:40
21:50
22:00
22:10
22:20
Host 'svr01'
Host 'svr02'
Host 'svr03'


CHA (on SVR01) V0.57.6, Data V0.17 - OTN Version (on SVR01)
OurCloud
mycluster
Hosts
svr01
svr02
svr03
Databases
devdb
prod
testdb
webdb
Sep-16 22:21:00
12:00:00
14:00:00
16:00:00
18:00:00
20:00:00
22:00:00
Host svr02
Host Detail
Instances
Alarm at Sep-16 22:01:55
21:30
21:40
21:50
22:00
22:10
22:20
Host rwsbi07
1: CHA detected that the ASM disk service time is higher than expected.
Cause:
The Cluster Health Advisor (CHA) detected slower than expected disk performance because the high disk I/O demand from the other servers increased the utilization of the shared disks.
Corrective Action:
Review the CHA findings and corrective actions from the other servers and database instances in the cluster for IO issues. Add disks to the database disk groups.


CHA (on RWSBI06) V0.65, Data V0.17 -- OTN Version (on rwsbi06)
OurCloud
rwsbi0508-mb1
Hosts
Databases
prod
prod1
prod2
May-11 10:57:00
May-10 19:00
May-10 21:00
May-10 23:00
May-11 01:00
May-11 03:00
May-11 05:00
May-11 07:00
May-11 09:00
Instance prod2
Probe Selection
Instance Detail
Host
High probes at May-11 10:46:35
09:40
09:50
10:00
10:10
10:20
10:30
10:40
10:50
Instance prod2
Consistent gets*: 983599.81 gets/s, expected: 694050.56 gets/s
CPU utilization (total)*: 82.90 %, expected: 82.51 %
Execute count*: 88759.40 executes/s, expected: 71916.57 executes/s
May-11 10:46:35


CHA (on SVR01) V0.57.6, Data V0.17 - OTN Version (on SVR01)
OurCloud
mycluster
Hosts
Databasvr01
prosvr02
svr03
prod2
May-11 10:57:00
May-10 19:00
May-10 21:00
May-10 23:00
May-11 01:00
May-11 03:00
May-11 05:00
May-11 07:00
May-11 09:00
Instance prod2, Expert mode.
Probe Selection
Instance Detail
Host
Expert
High probes at May-11 10:46:50
09:40
09:50
10:00
10:10
10:20
10:30
10:40
10:50
Instance prod2
Consistent gets*: 957225.19 gets/s, expected: 684782.06 gets/s
CPU utilization (total)*: 79.30 %, expected: 80.61 %
Execute count*: 86683.80 executes/s, expected: 71393.27 executes/s
May-11 10:46:50

Oracle Cluster Health Advisor Coming Features

- Cross Cluster Problem Support
  - Inter-Instance Problem Detection
  - Inter-Database Problem Detection
- Portable HTML Report
  - Consolidated diagnosis output
  - Easy to send and review

```
2017-02-06 09:40:55.0  Database oltpacdb  DB Multi Block
Read I/O Performance (oltpacdb_1) [detected]
Top Instances/PDBs by : IOs per sec
Database oltpacdb  Host slcac455  Instance total  2228.80
Database oltpacdb  Host slcac455  PDB OLTPA  308.40
Database oltpacdb  Host slcac455  PDB OLTPA1  12.80
Database oltpacdb  Host slcac455  PDB OLTPA5  11.60
Database oltpacdb  Host slcac455  PDB OLTPA4  7.60
Database oltpacdb  Host slcac455  PDB OLTPA2  4.00
Database oltpacdb  Host slcac454  Instance total  1136.20
Database oltpacdb  Host slcac454  PDB OLTPA  784.20
Database oltpacdb  Host slcac454  PDB OLTPA4  428.00
Database oltpacdb  Host slcac454  PDB OLTPA2  21.80
Database oltpbcdb  Host slcac455  Instance total  0.20
Database oltpccdb  Host slcac455  Instance total  0.00
Database oltpbcdb  Host slcac454  Instance total  0.00
```

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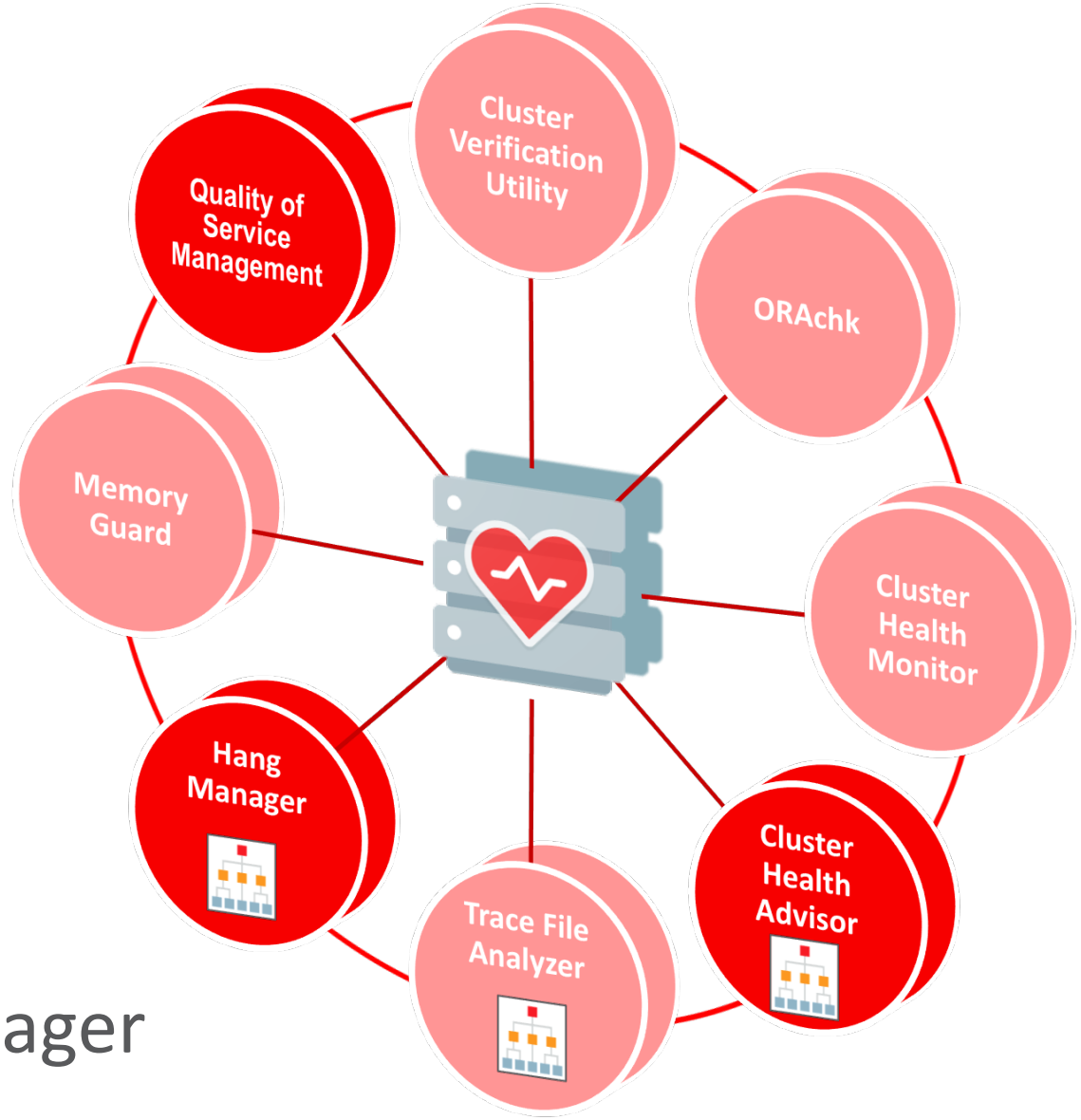
Autonomously Preserves Database Availability and Performance



Oracle 12c Database Hang Manager

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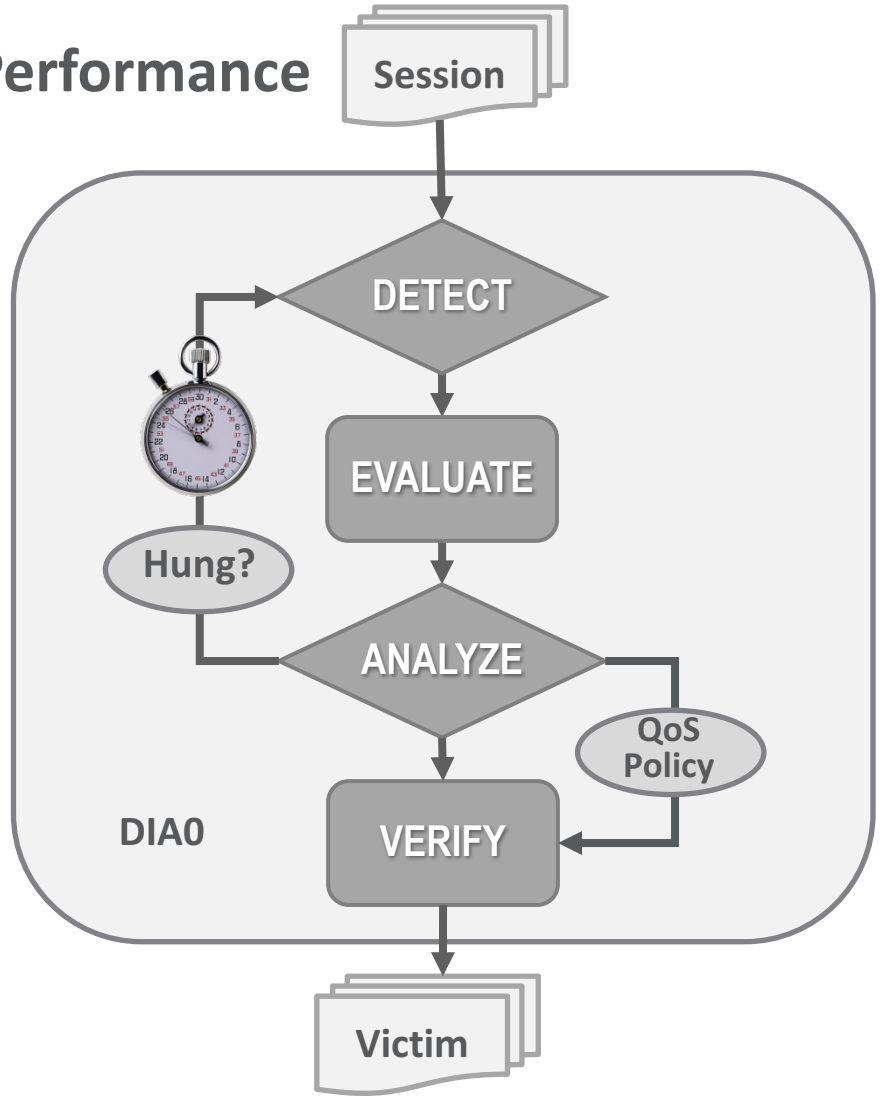
Oracle 12c Hang Manager

Autonomously Preserves Database Availability and Performance

- Always on - Enabled by default
- Reliably detects database hangs and deadlocks
- Autonomously resolves them
- Supports QoS Performance Classes, Ranks and Policies to maintain SLAs
- Logs all detections and resolutions
- New SQL interface to configure sensitivity (Normal/High) and trace file sizes

NEW IN 12.2



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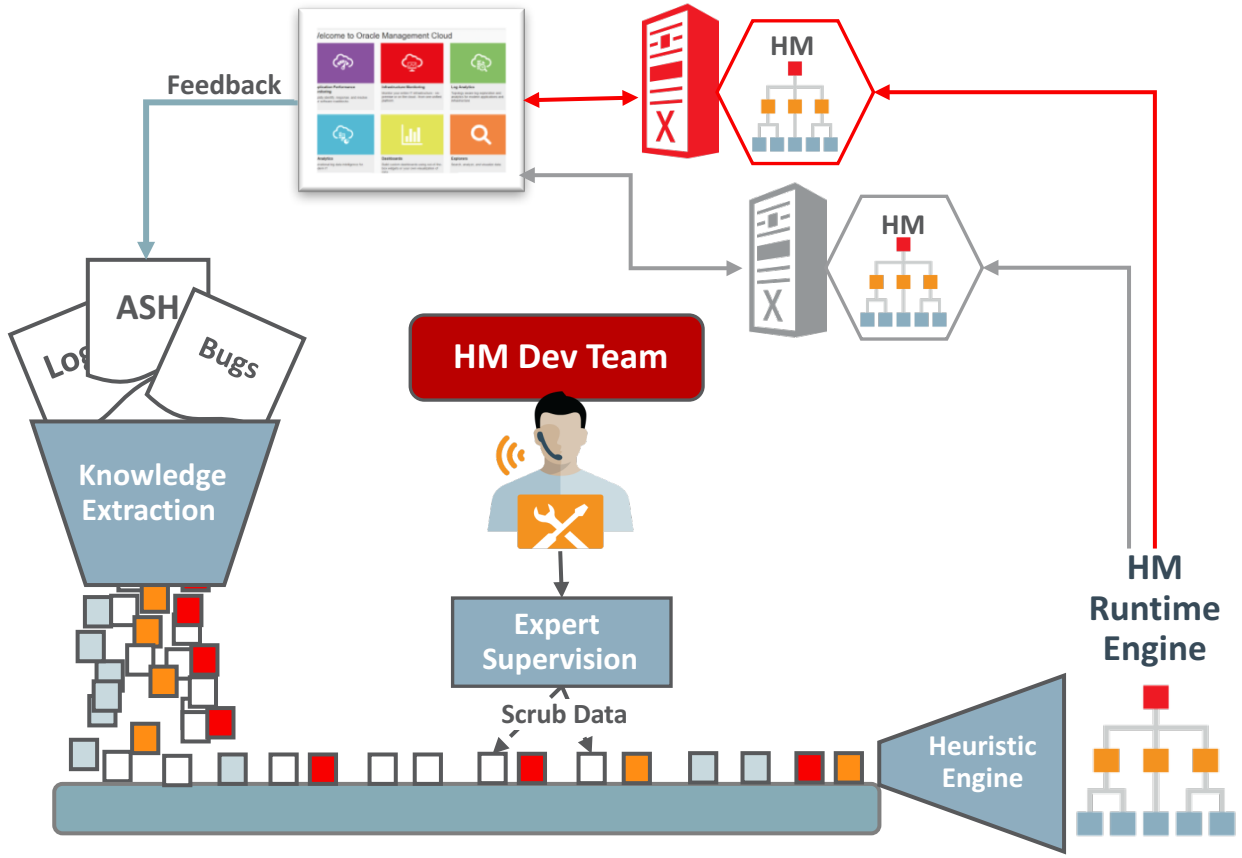
Oracle Database Hang Manager – Applied Machine Learning

Discovers and Resolves Runtime Database Hangs

- Actual Internal and External customer data drives model development
- Purpose-built diagnostic technology used for knowledge extraction
- Expert Dev team scrubs data
- Hang Heuristic Engine created and deployed @Customer
- HM uses run-time engine to perform real-time DB hang detection and resolution



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Oracle 12c Hang Manager

Full Resolution Dump Trace File and DB Alert Log Audit Reports

```
Dump file …/diag/rdbms/hm6/hm62/incident/incdir_5753/hm62_dia0_12656_i5753.trc
Oracle Database 12c Enterprise Edition Release 12.2.0.0.0 - 64bit Beta
With the Partitioning, Real Application Clusters, OLAP, Advanced Analytics
and Real Application Testing options
Build label:    RDBMS_MAIN_LINUX.X64_151013
ORACLE_HOME:    …/3775268204/oracle
System name:                Linux
Node name:    slc05kyr
Release:      2.6.39-400.211.1.el6uek.x86_64
Version:      #1 SMP Fri Nov 15 13:39:16 PST 2013
Machine:      x86_64
VM name:      Xen Version: 3.4 (PVM)
Instance name: hm62
Redo thread mounted by this instance: 2
Oracle process number: 19
Unix process pid: 12656, image: oracle@slc05kyr (DIA0)


*** 2015-10-13T16:47:59.541509+17:00
*** SESSION ID:(96.41299) 2015-10-13T16:47:59.541519+17:00
*** CLIENT ID:() 2015-10-13T16:47:59.541529+17:00
*** SERVICE NAME:(SYS$BACKGROUND) 2015-10-13T16:47:59.541538+17:00
*** MODULE NAME:() 2015-10-13T16:47:59.541547+17:00
*** ACTION NAME:() 2015-10-13T16:47:59.541556+17:00
*** CLIENT DRIVER:() 2015-10-13T16:47:59.541565+17:00
```

```
2015-10-13T16:47:59.435039+17:00
Errors in file /oracle/log/diag/rdbms/hm6/hm6/trace/hm6_dia0_12433.trc (incident=7353):
ORA-32701: Possible hangs up to hang ID=1 detected
Incident details in: …/diag/rdbms/hm6/hm6/incident/incdir_7353/hm6_dia0_12433_i7353.trc
2015-10-13T16:47:59.506775+17:00
DIA0 requesting termination of session sid:40 with serial # 43179 (ospid:13031) on instance 2
    due to a GLOBAL, HIGH confidence hang with ID=1.
    Hang Resolution Reason: Automatic hang resolution was
   significant number of affected sessions.
DIA0: Examine the alert log on instance 2 for session termination status of hang with ID=1.

In the alert log on the instance local to the session (instance 2 in this case),
we see the following:

2015-10-13T16:47:59.538673+17:00
Errors in file …/diag/rdbms/hm6/hm62/trace/hm62_dia0_12656.trc (incident=5753):
ORA-32701: Possible hangs up to hang ID=1 detected
Incident details in: …/diag/rdbms/hm6/hm62/incident/incdir_5753/hm62_dia0_12656_i5753.trc

2015-10-13T16:48:04.222661+17:00
DIA0 terminating blocker (ospid: 13031 sid: 40 ser#: 43179) of hang with ID = 1
    requested by master DIA0 process on instance 1
    Hang Resolution Reason: Automatic hang resolution
   significant number of affected sessions.
    by terminating session sid:40 with serial # 43179 (ospid:13031)
```

Hang detected by hang manager

Session victim identified & terminated

Identified blocker session

Blocker session terminated

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Program Agenda

1. Introducing Applied Machine Learning for Diagnostics
2. Applied Machine Learning for Real-time Prevention
3. Applied Machine Learning for Rapid Recovery
4. ODA Management Appliance Profile
5. For Further Information / Q & A

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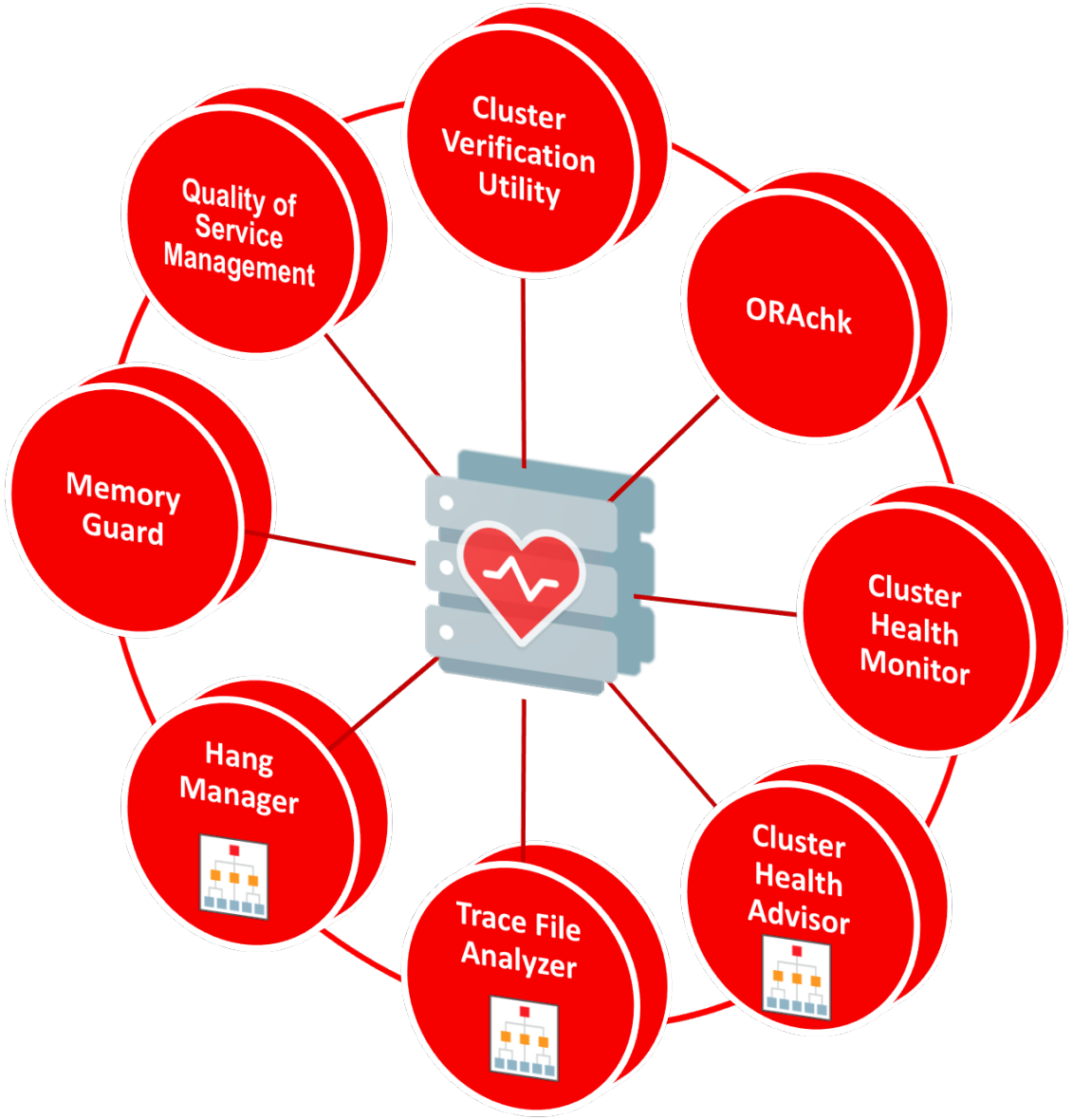
Speeds Issue Diagnosis, Triage and Resolution

Oracle 12c Trace File Analyzer



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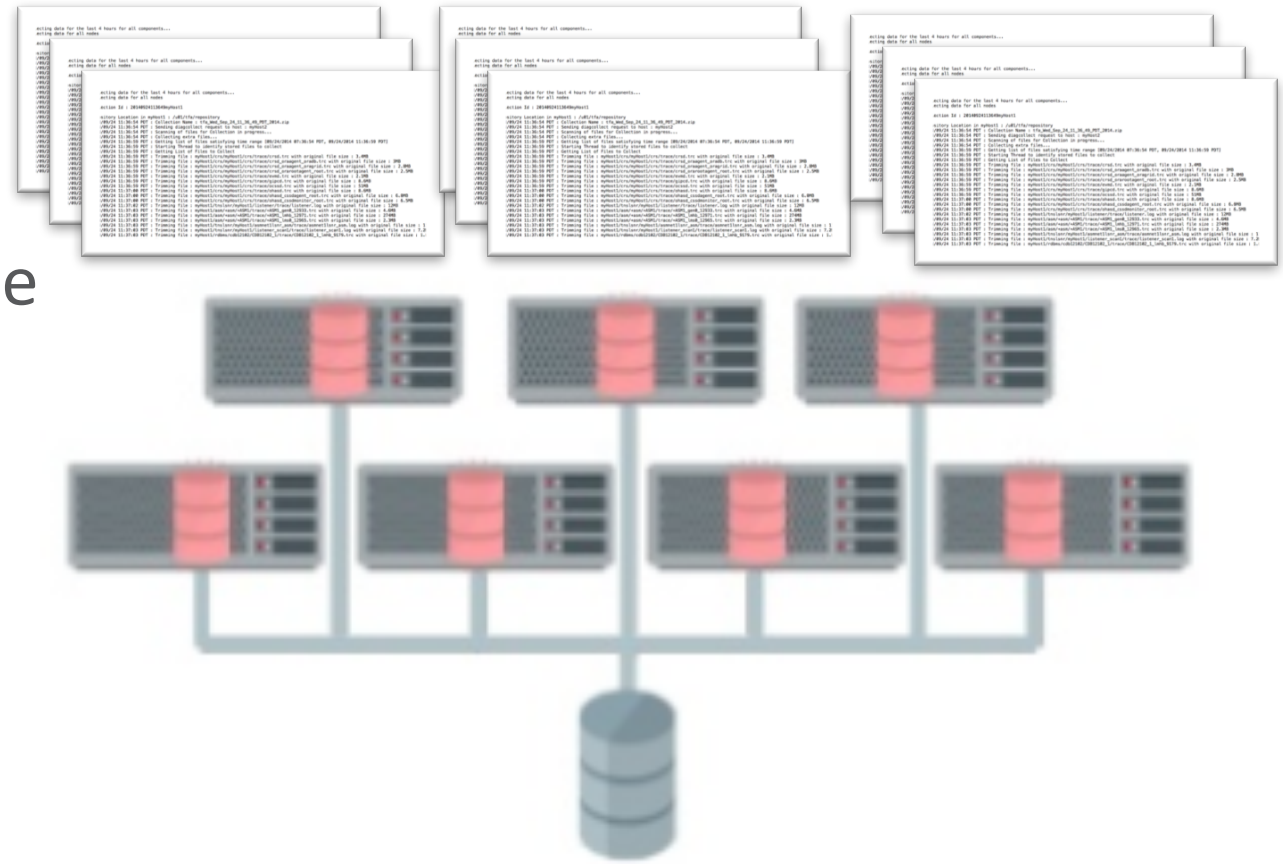
Challenges in Failure Recovery

- GBs of logs generated everyday
- Distributed across cluster nodes
- Diagnosing an issue can be “a needle in the haystack” problem
- Manual issue diagnosis can be tedious and time-consuming
- Any delay in issue diagnosis can adversely impact the business



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Rapid Recovery with Trace File Analyzer (TFA)

- Autonomously collects data intelligently (Smart Collection)
  - Autonomously and intelligently collects only relevant logs
  - Reduces log files to small set of potential candidates
- Autonomously finds relevant information for issue at hand
  - Anomaly Timeline Generation
  - Identifies errors associated with the issue
  - Generates list of potential problems across the system ordered by time
- Speeds issue diagnosis with Oracle Support Services (OSS) for unknown issues

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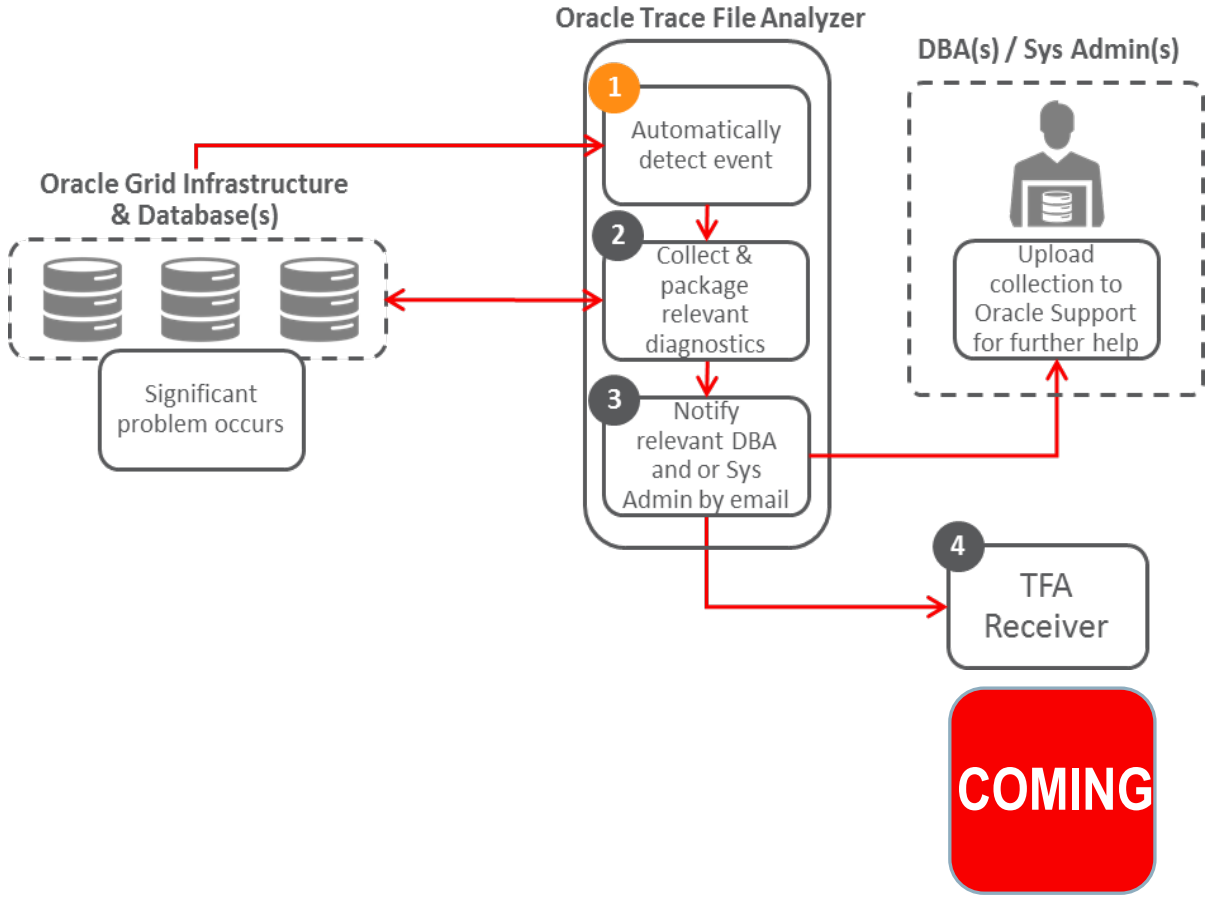
Rapid Recovery with TFA

Smart Collection with TFA Collector

- Always on
- Collects comprehensive first failure diagnostics on each node
- Filters and packages relevant diagnostic data using Applied ML model
- Automatically notifies DBAs and Sys Admins of errors
- Optionally allows quick issue resolution with Oracle Support
- Transfers data to centralized storage for detailed analysis with TFA Receiver



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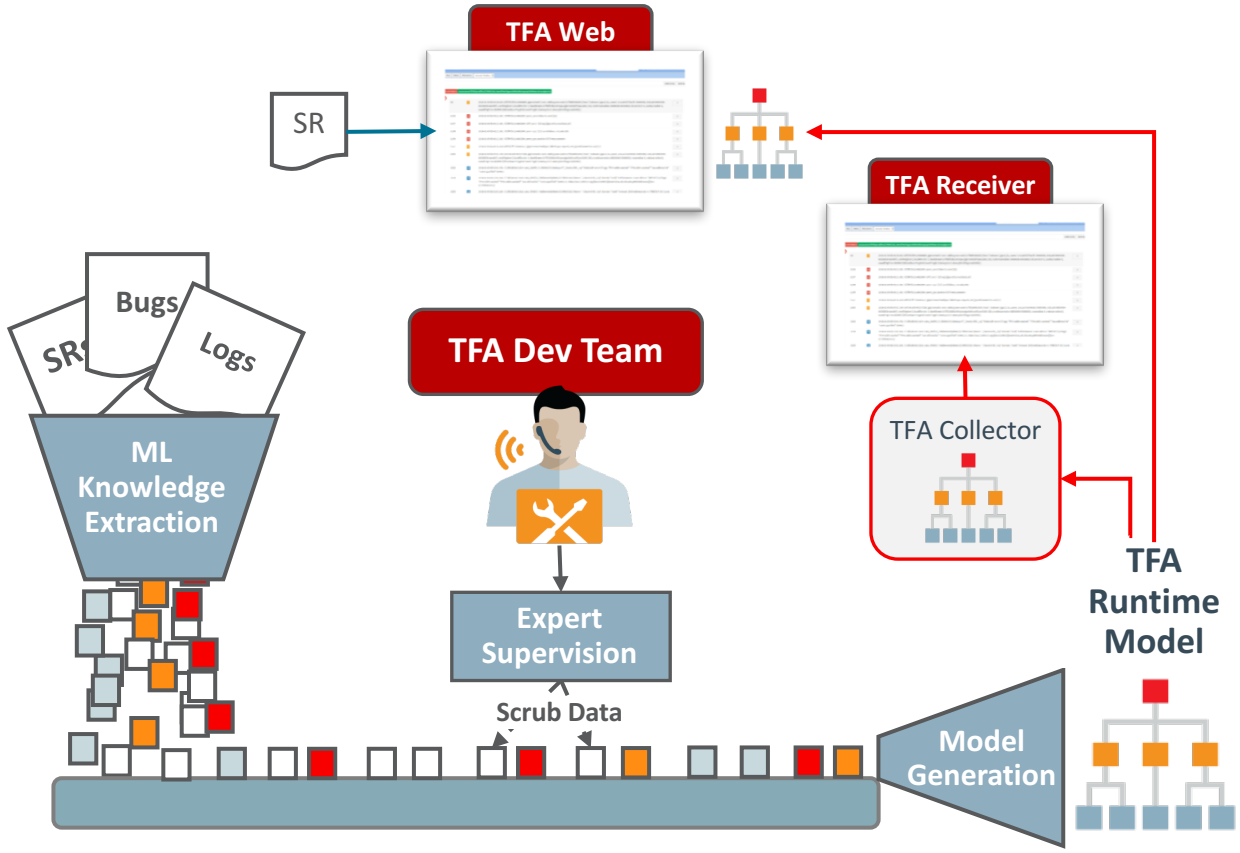
Trace File Analyzer – Applied Machine Learning

Speeds Issue Diagnosis, Triage and Resolution

- ML-based Knowledge Extraction of Logs, SRs and Bugs
- Expert training refines data training set
- Knowledge is embedded into the run-time model
- Model is shipped in TFA Collector to work with the live logs on the Cluster
- Log anomaly detection is performed with TFA Receiver
- No model training required by user
- Model is updated regularly



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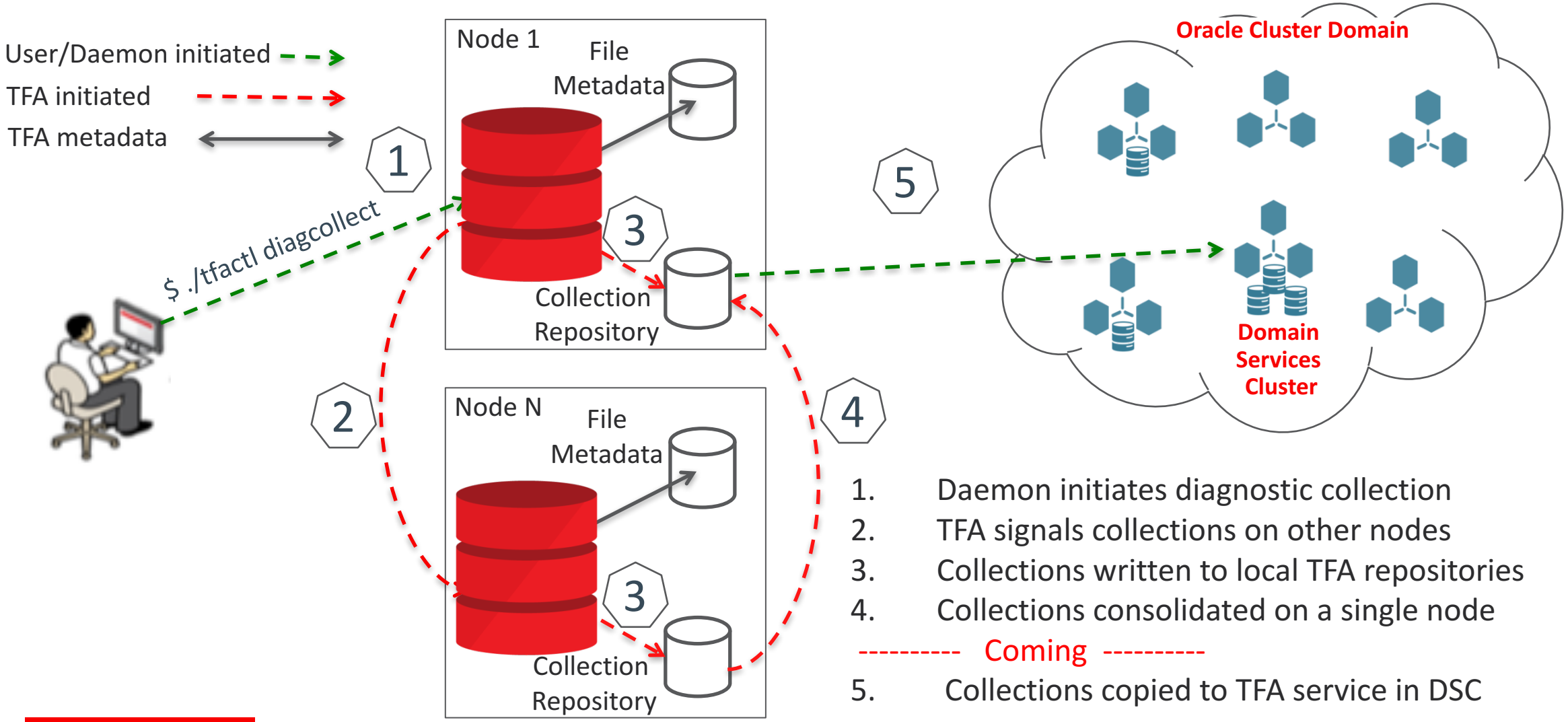
Oracle TFA in Cluster Domain Design Overview



1. Daemon initiates diagnostic collection
2. TFA signals collections on other nodes
3. Collections written to local TFA repositories
4. Collections consolidated on a single node

---------- Coming ----------

5. Collections copied to TFA service in DSC

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Rapid Recovery with TFA

Detailed Issue Analysis using TFA Receiver

COMING

- Centralized aggregator in the Cluster Domain
- Mines logs and errors from all nodes registered with it
- Browser-Based UI
  - Supports browsing errors
  - Viewing associated logs
  - Easily construct timelines

DEMO

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ORACLE Trace File Analyzer

Admin

Datacenters	Clusters	Databases	Hosts	Critical Events
1	4	5	7	84

Cluster Summary Report

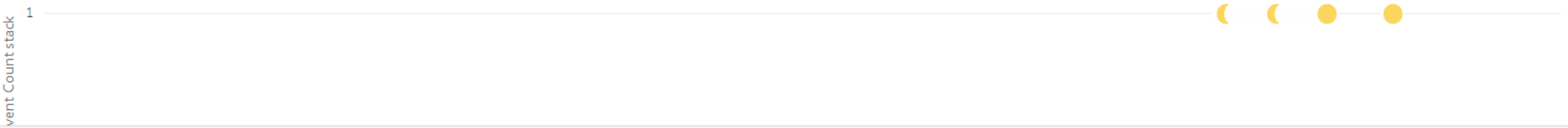
Warn

Cluster Health Heat Map

Component Health | Utilization

	Operating System	Clusterware	ASM	Database
adc01drw				
rwsbi0508-mb2				
slc05evp				
slc05knm				

Events Frequency Drop Chart



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ORACLE Trace File Analyzer

Admin

Datacenters	Clusters	Databases	Hosts	Critical Events
1	4	5	7	84

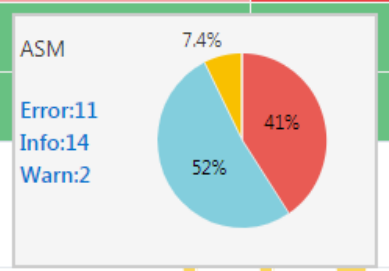
Cluster Summary Report

Warn

Cluster Health Heat Map

Component Health | Utilization

	Operating System	Clusterware	ASM	Database
adc01drw				
rwsbi0508-mb2				
slc05evp				
slc05knm				



Events Frequency Drop Chart

ORACLE

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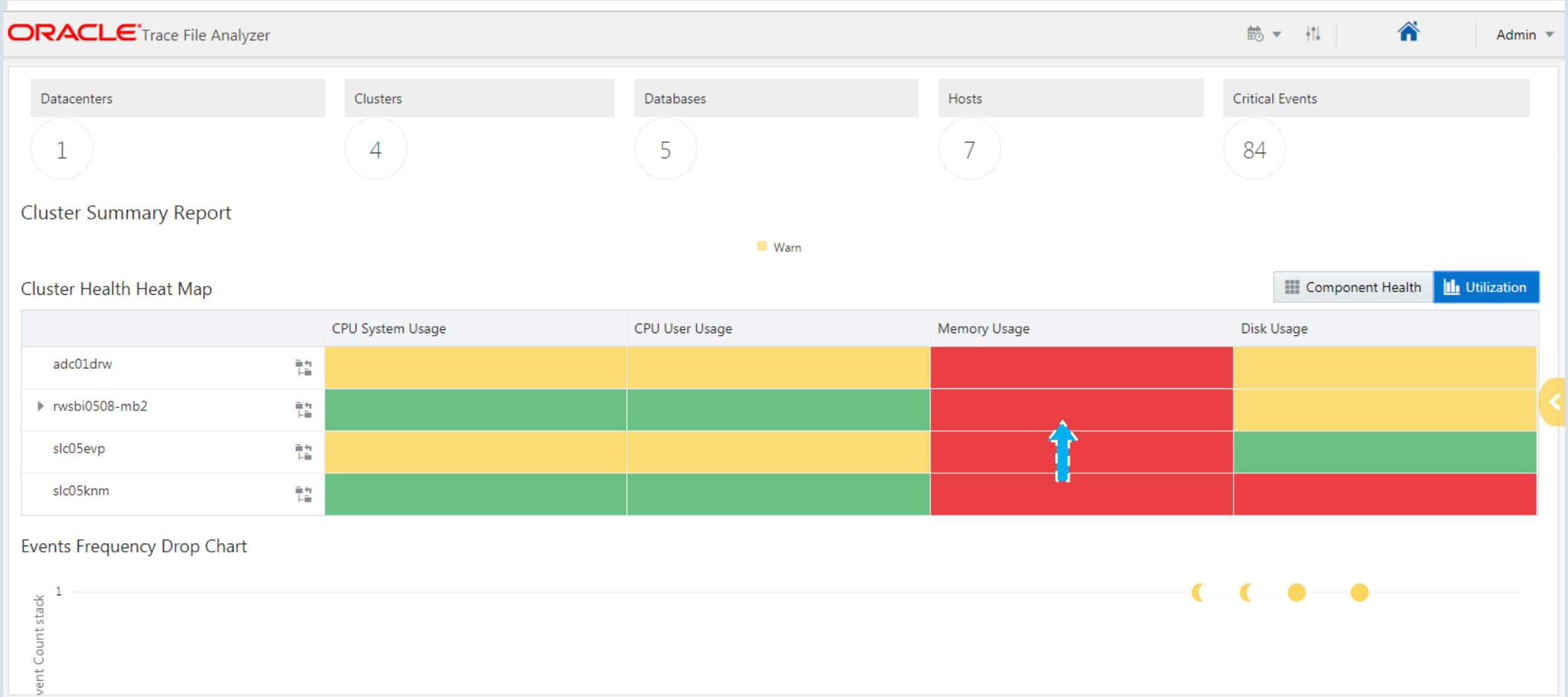

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ORACLE Trace File Analyzer

Admin

Datacenters	Clusters	Databases	Hosts	Critical Events
1	4	5	7	84

Cluster Summary Report

Warn

Cluster Health Heat Map

Component Health | Utilization

	CPU System Usage	CPU User Usage	Memory Usage	Disk Usage
adc01drw				
rwsbi0508-mb2				
slc05evp				
slc05knm				

Memory Usage
status:up
value:95
95%

Events Frequency Drop Chart

1

Count stack

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ORACLE Trace File Analyzer

Admin

Datacenters	Clusters	Databases	Hosts	Critical Events
1	4	5	7	84

Cluster Summary Report

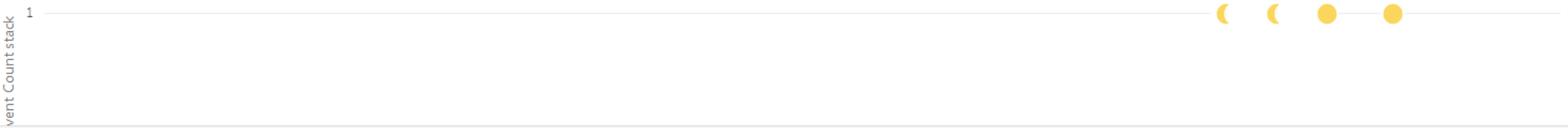
Warn

Cluster Health Heat Map

Component Health | Utilization

	Operating System	Clusterware	ASM	Database
adc01drw				
rwsbi0508-mb2				
slc05evp				
slc05knm				

Events Frequency Drop Chart



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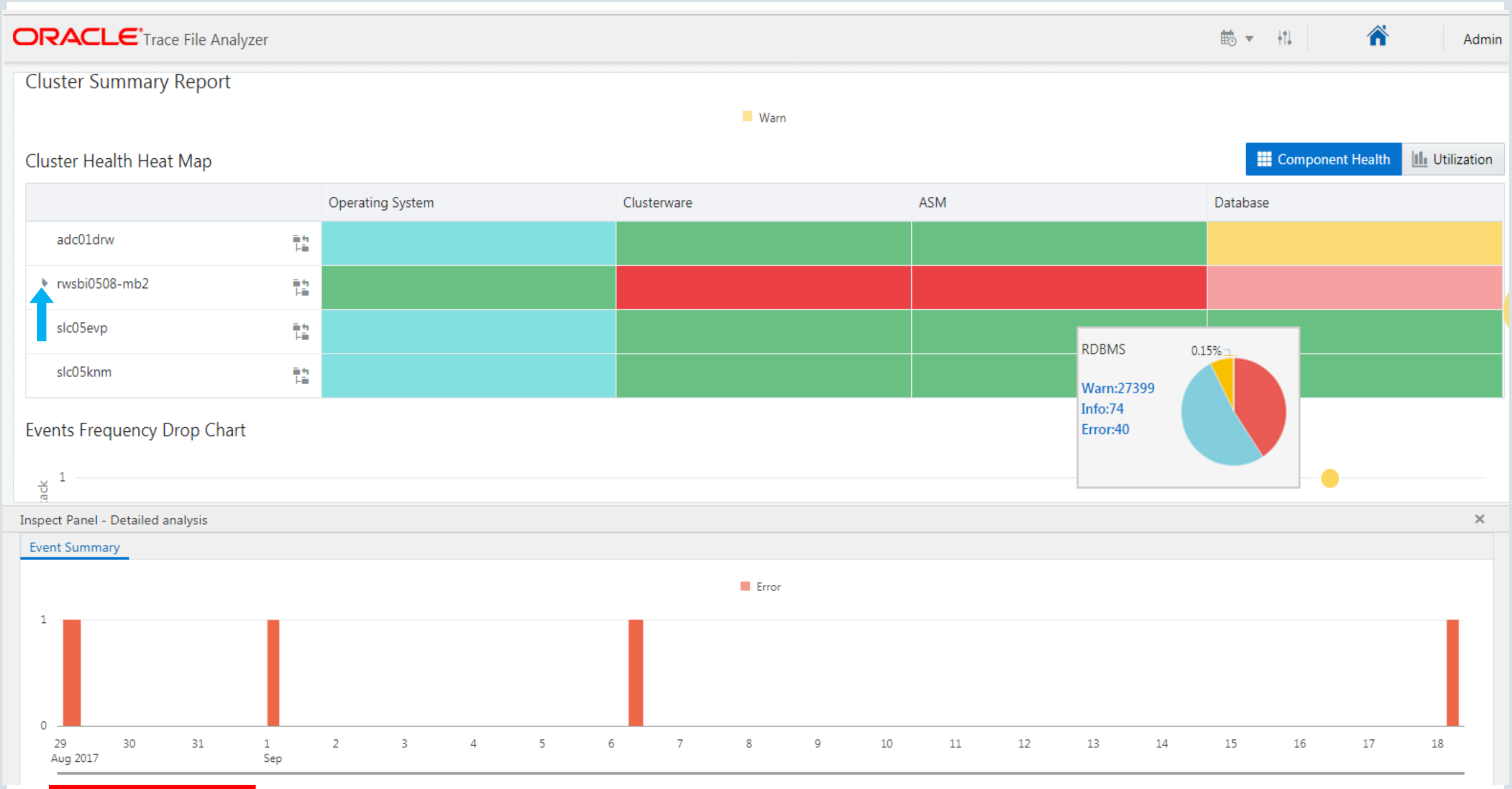

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ORACLE Trace File Analyzer

Admin

Datacenters	Clusters	Databases	Hosts	Critical Events
1	4	5	7	84

Cluster Summary Report

Warn

Cluster Health Heat Map

Component Health | Utilization

	Operating System	Clusterware	ASM	Database
adc01drw				
rwsbi0508-mb2				
rwsbi05				
rwsbi06				
slc05evp				
slc05knm				

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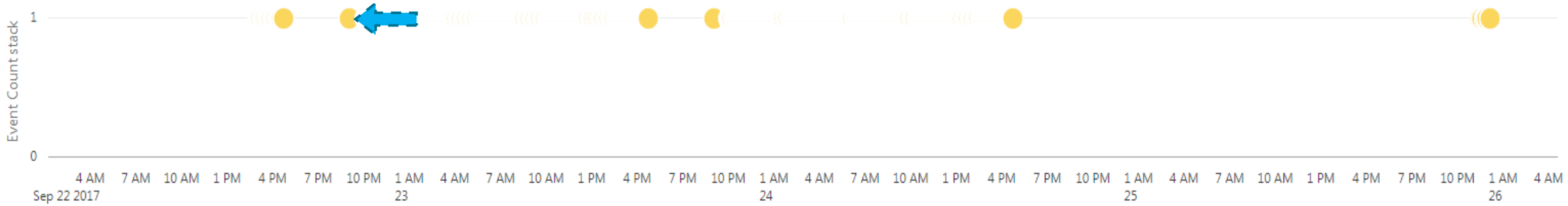
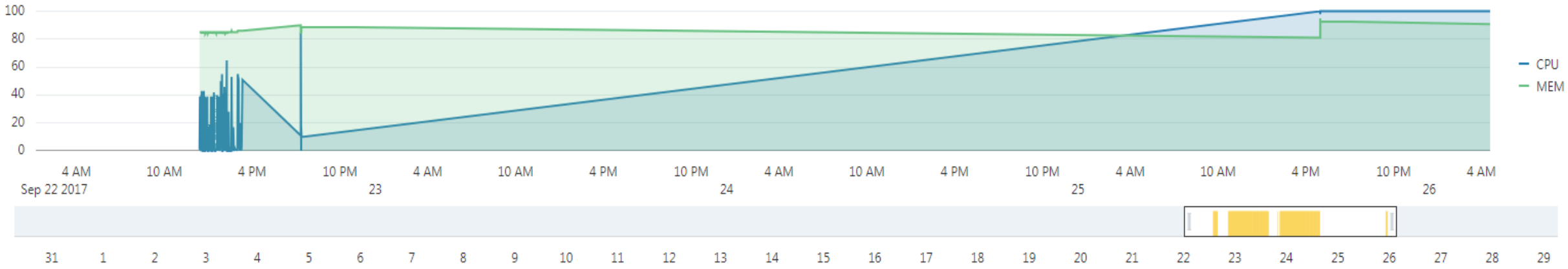
Events Frequency Drop Chart



CPU and Memory Utilization Chart



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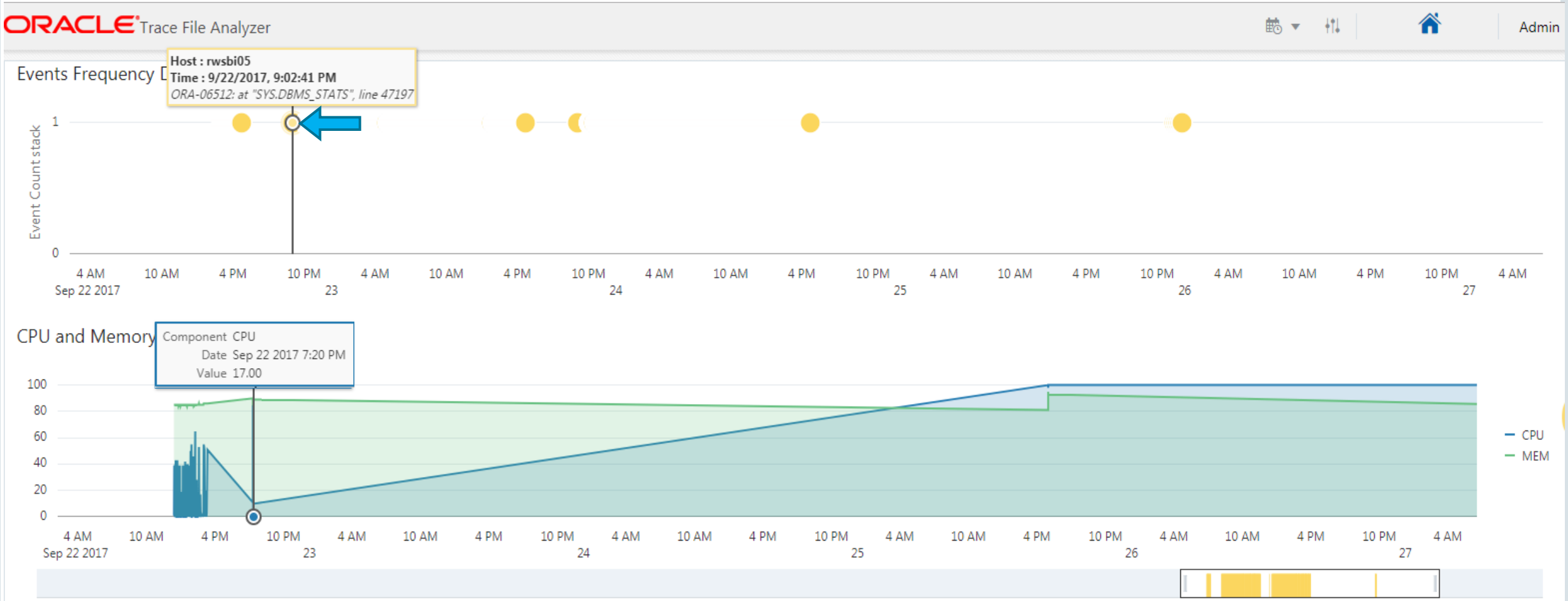

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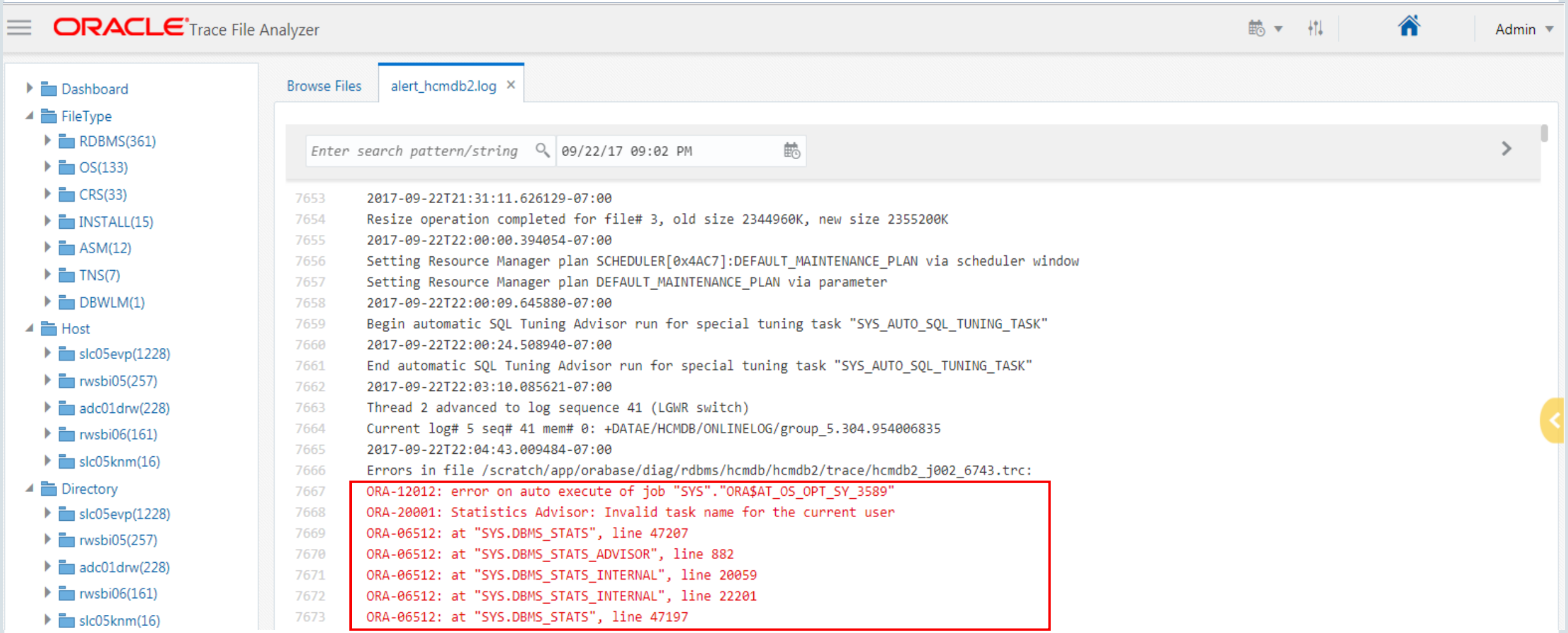

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Program Agenda

1. Introducing Applied Machine Learning for Diagnostics
2. Applied Machine Learning for Real-time Prevention
3. Applied Machine Learning for Rapid Recovery
4. ODA Management Appliance Profile
5. For Further Information / Q & A

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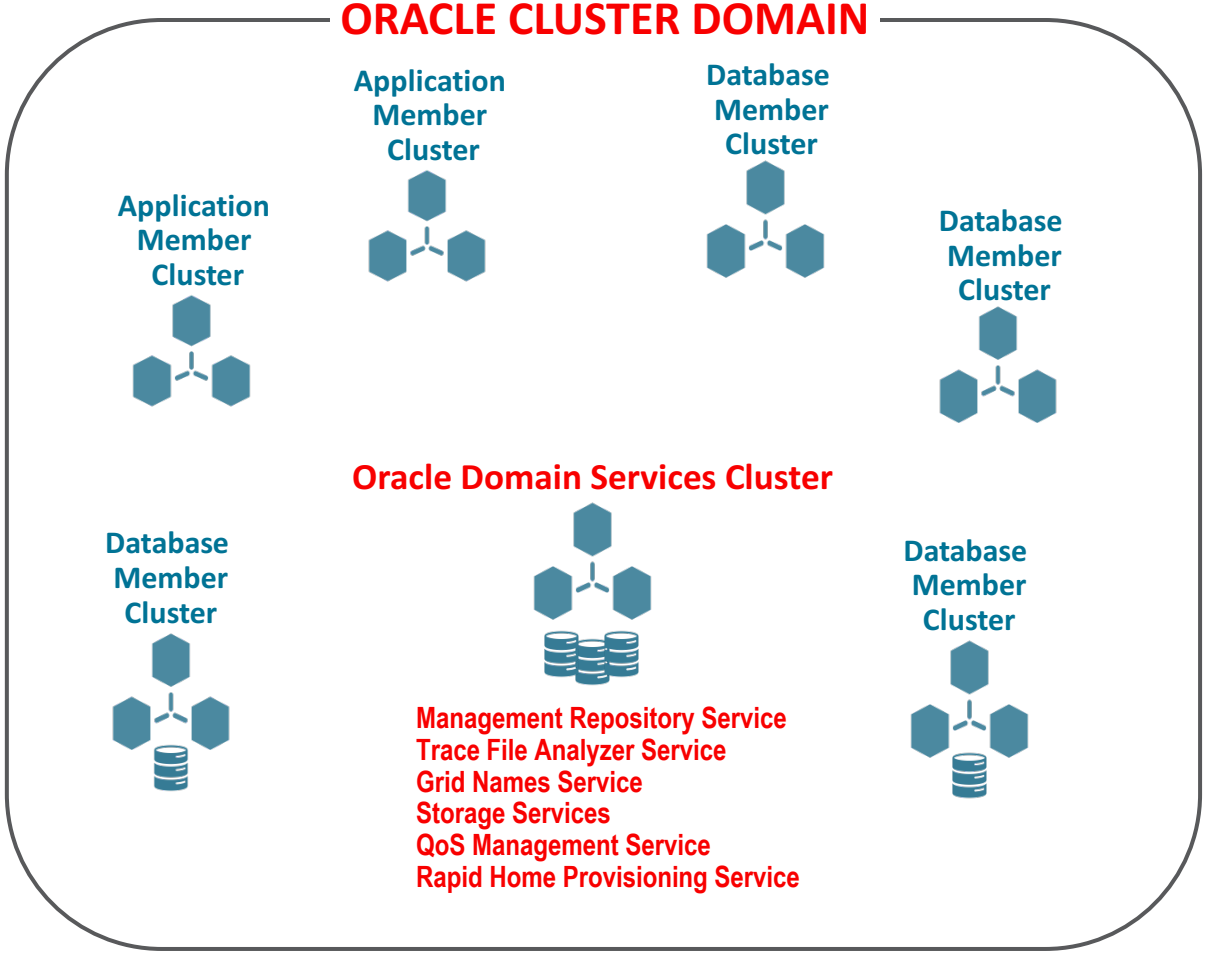
Oracle 12c Domain Services Cluster

Deploy with Minimum Footprint and Maximum Manageability

NEW IN 12.2

- Hosts Framework as Services
- Reduces local resource footprint
- Centralizes management
- Speeds deployment and patching
- Optional Shared Storage
- Supports multiple versions and platforms going forward



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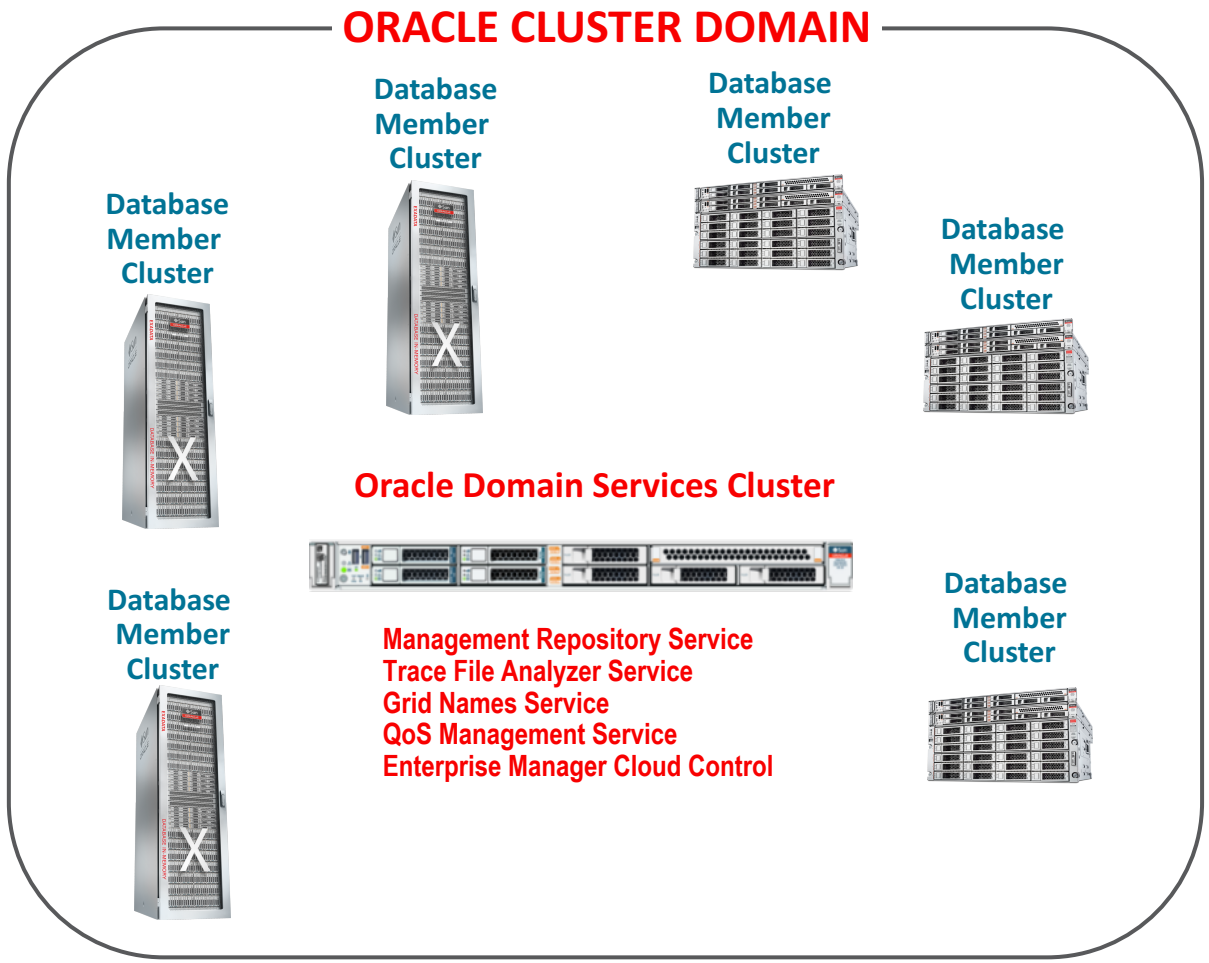
Oracle Database Appliance – Management Appliance Profile

Domain Services Management Engineered Solution

COMING

- Ideal Management Solution for Oracle Engineered Systems
- Reduces diagnostic footprint
- Centralizes management function
- Does not interfere with provisioning and patching
- Pay only for ODA hardware (S/M/L)
- No additional software license fees



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For Further Information

- Oracle 12c Autonomous Health Framework User's Guide
- Oracle 12c Clusterware Adminstration and Deployment Guide
- Oracle Autonomus Health Framework on OTN
- Oracle QoS Management 12c User's Guide
- Oracle QoS Management on OTN
- Oracle 12c ORAchk
- Oracle 12c Trace File Analyzer

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