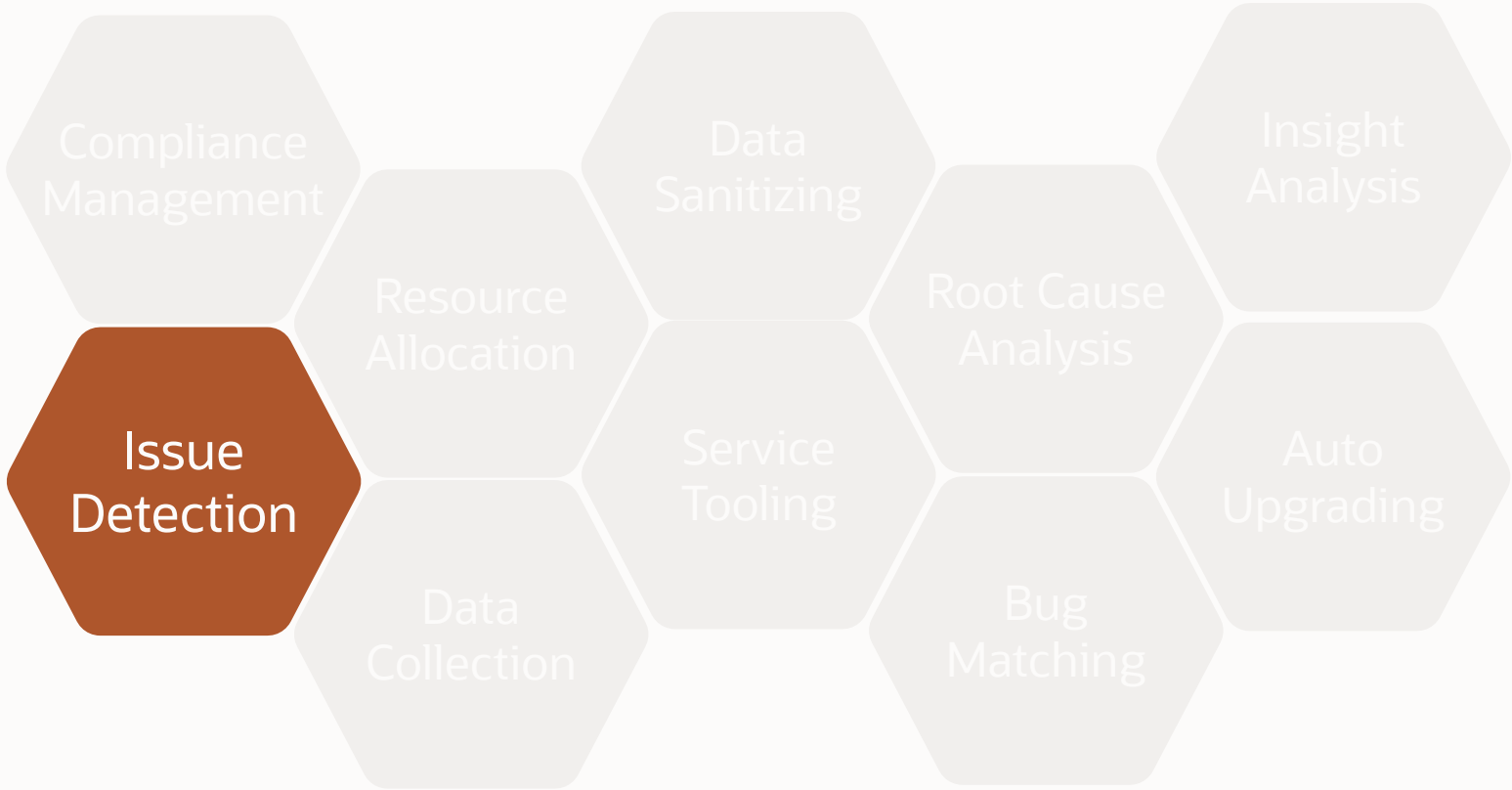
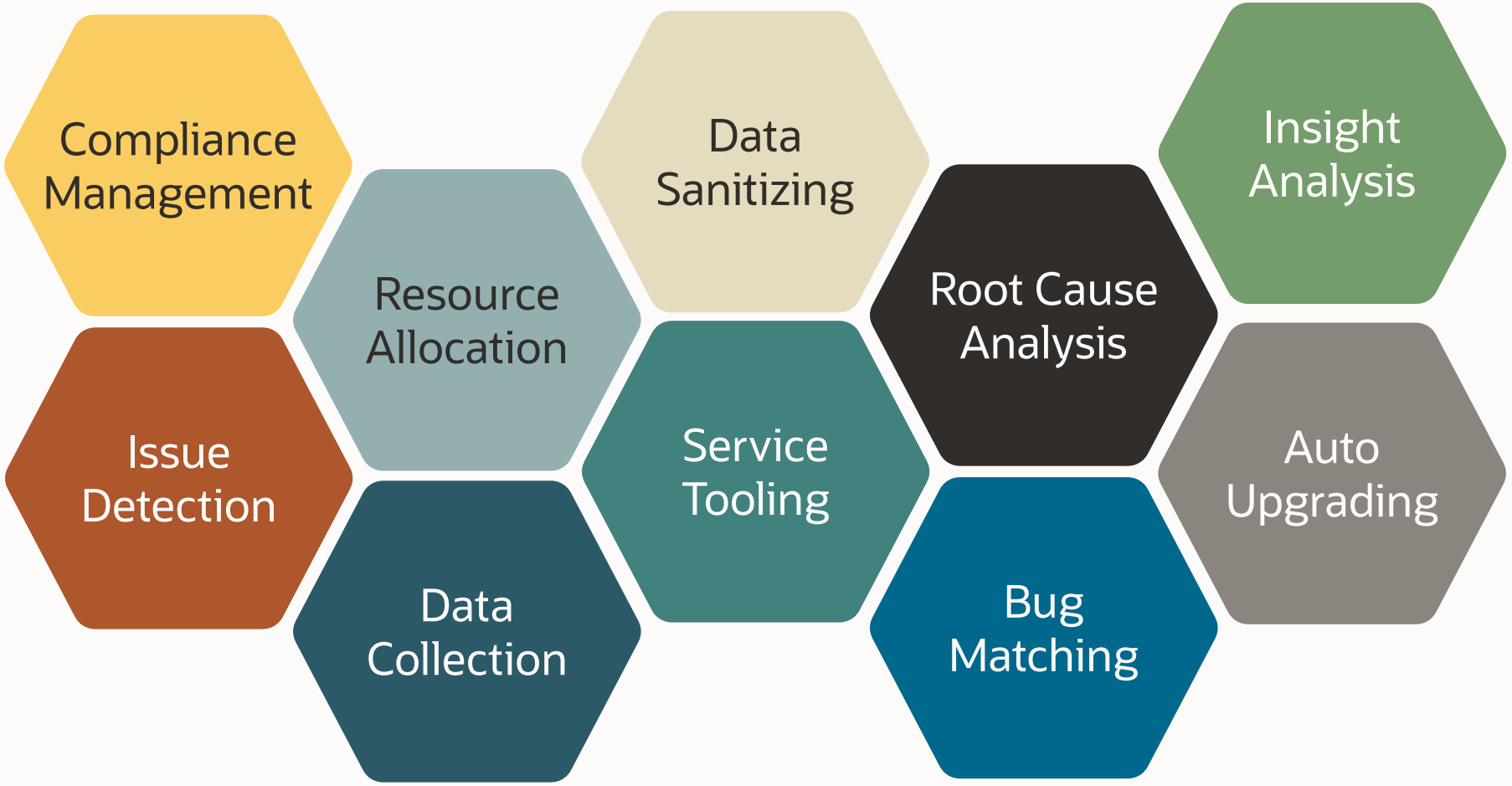
ORACLE

Autonomous Health Framework

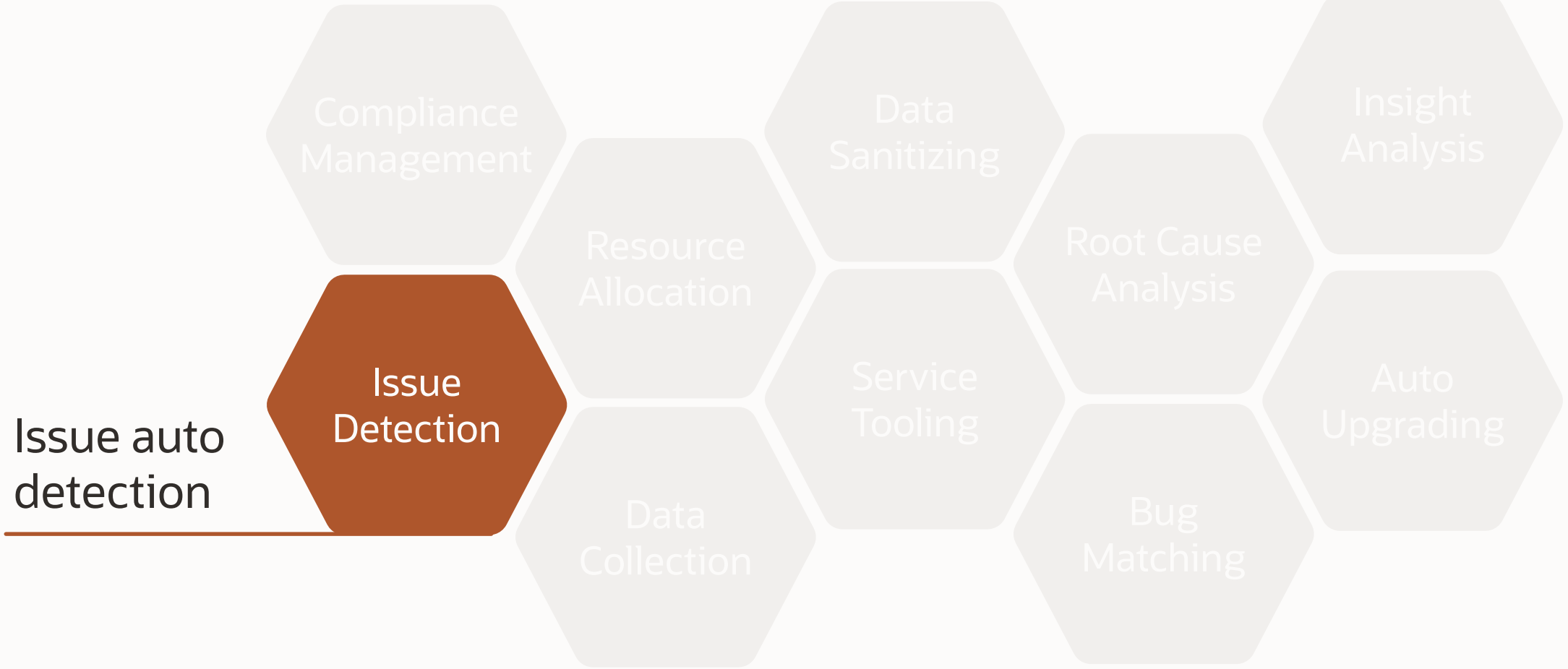
Issue Detection



Oracle Autonomous Health Framework

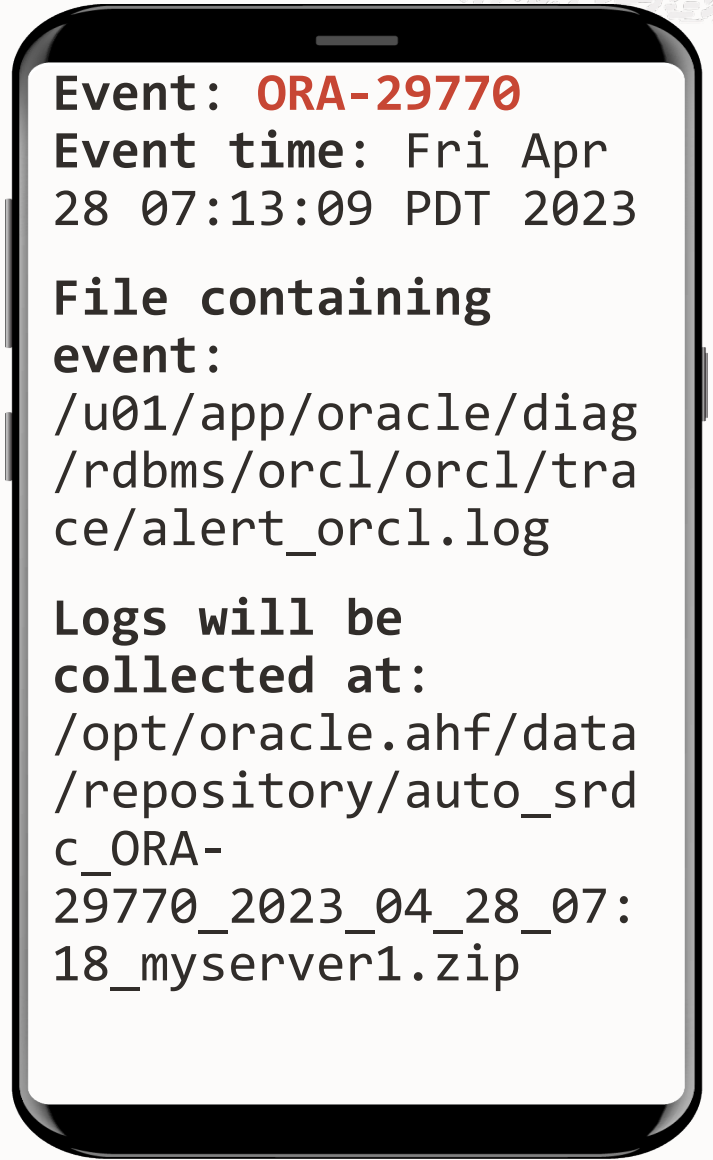


Oracle Autonomous Health Framework

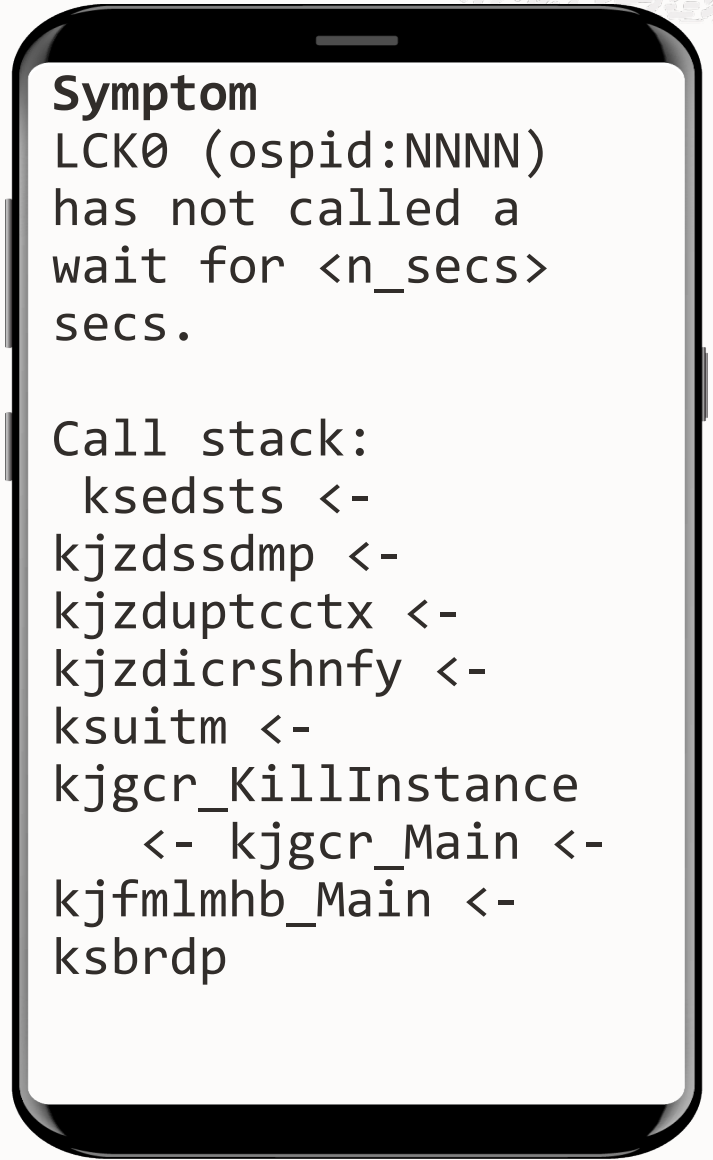


Issue auto detection

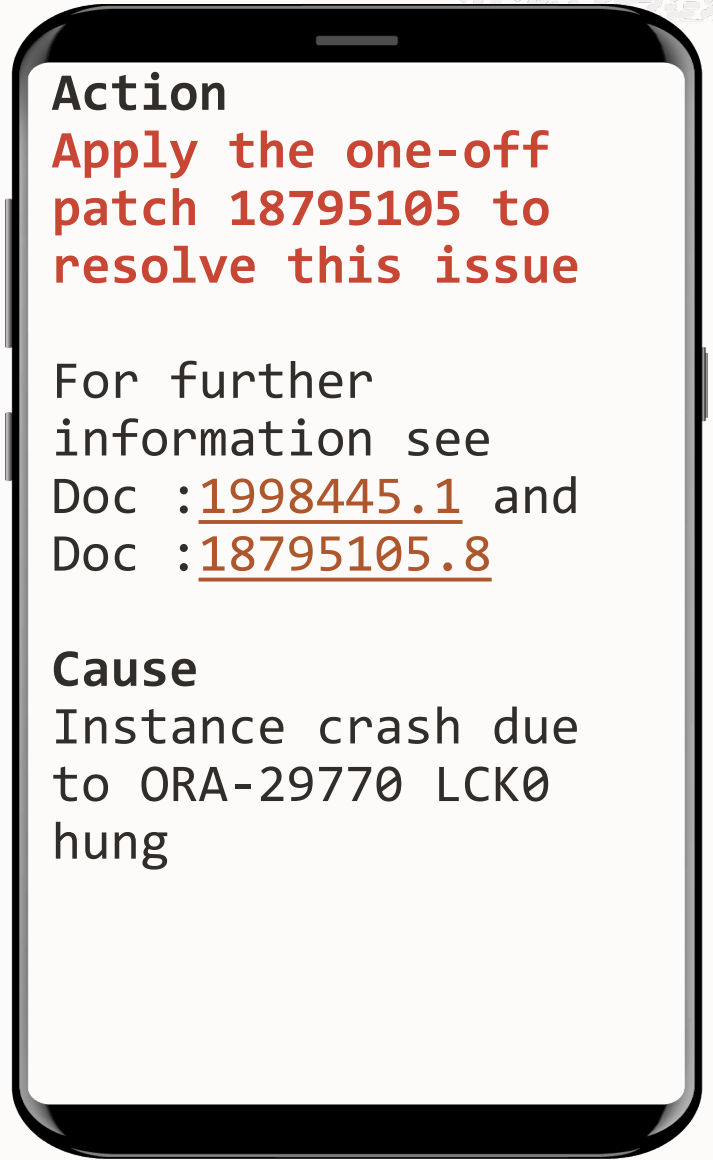
Critical event notification



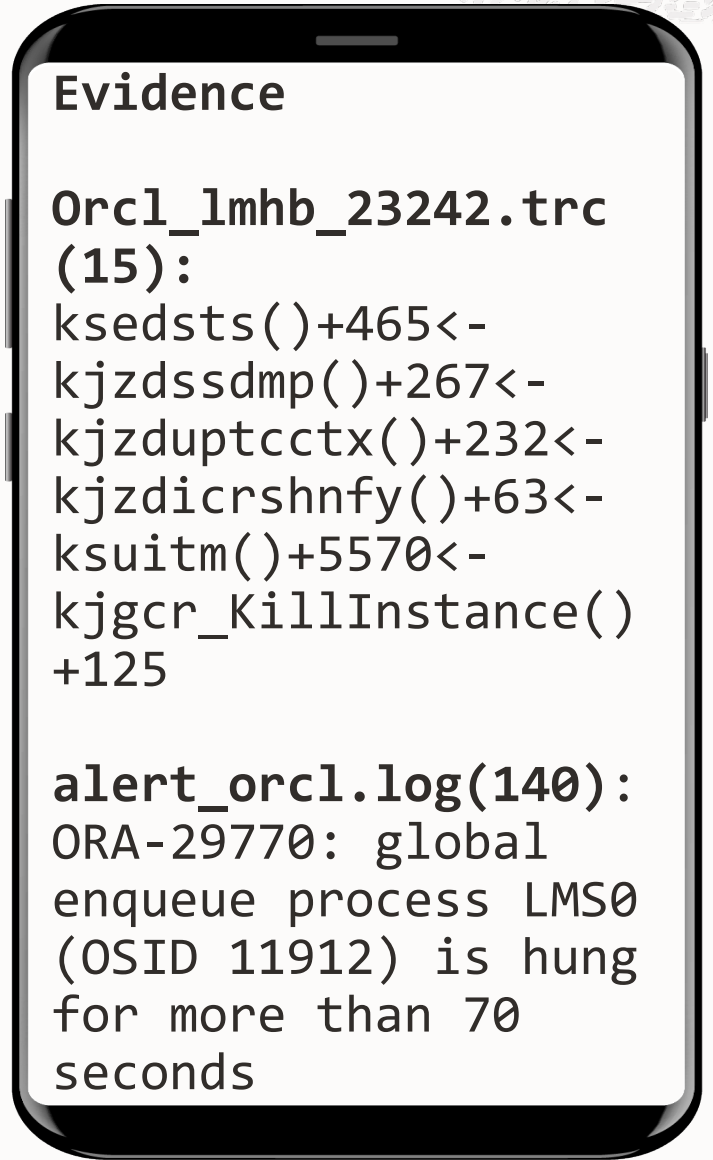
Critical event notification



Critical event notification



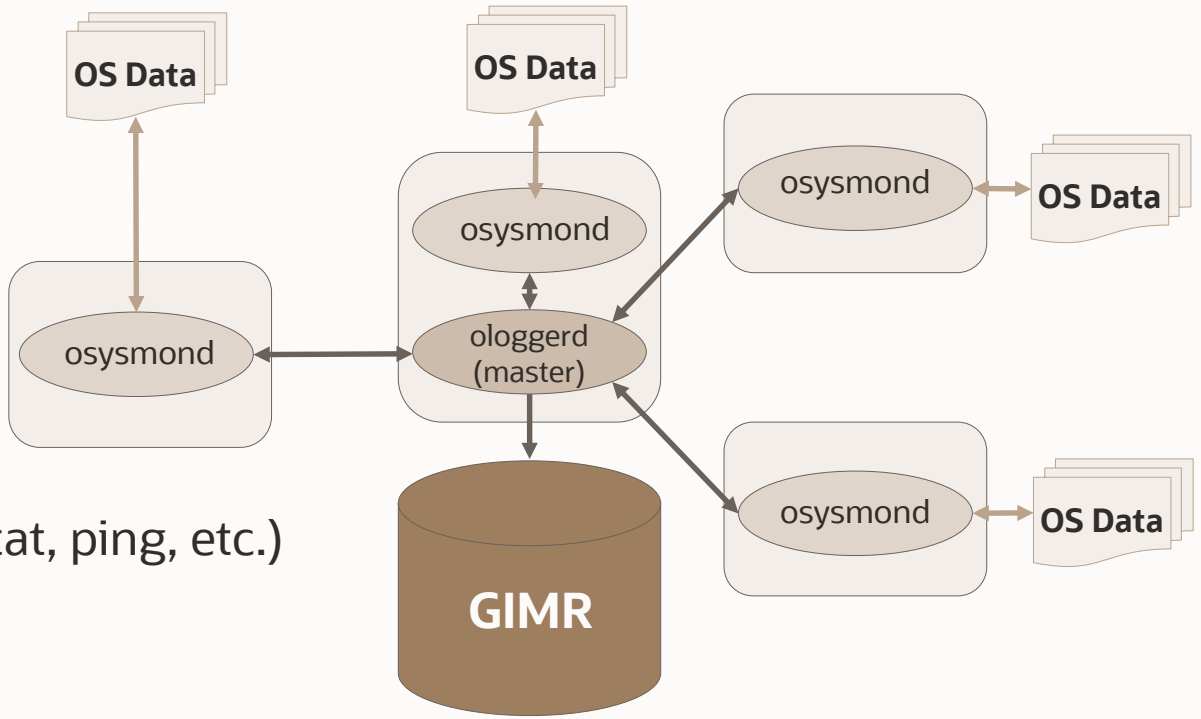
Critical event notification



Cluster Health Monitoring (CHM)

Generate view of Cluster and Database diagnostic metrics

- Always on - Enabled by default
- Provides Detailed OS Resource Metrics
- Assists Node eviction analysis
- Locally logs all process data
- User can define pinned processes
- Listens to CSS and GIPC events
- Categorizes processes by type
- Supports plug-in collectors (ex. traceroute, netstat, ping, etc.)
- New CSV output for ease of analysis



12c Grid Infrastructure
Management Repository

Cluster Health Monitoring (CHM)

```
----------------------------------------
Node: slc02wso Clock: '2023-04-23 19.57.11-0700' SerialNo:10285'
----------------------------------------
```

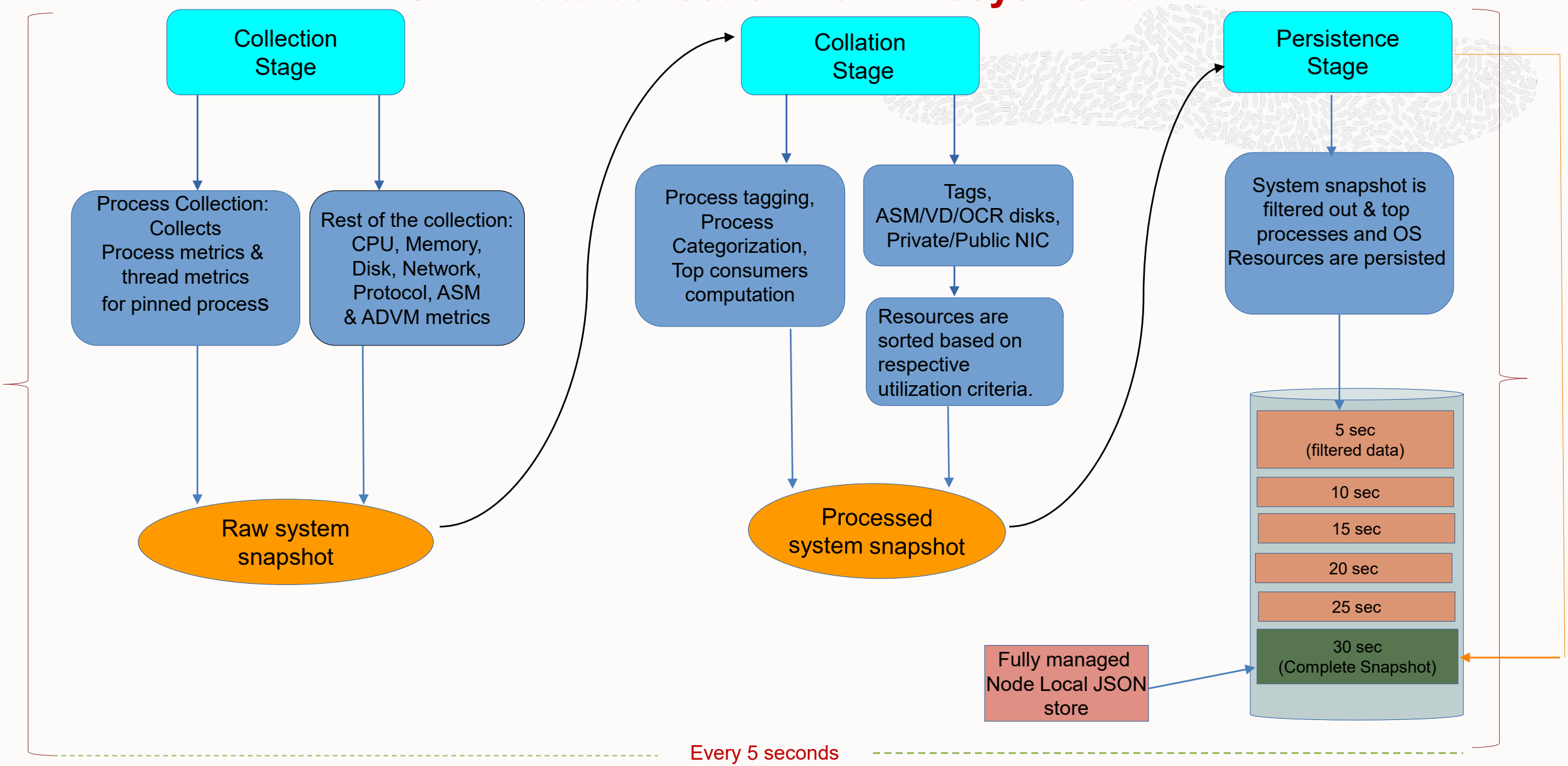
cpuusage	privatemem[KB]	maxshmem[KB]	#threads	#fd	#processes	category	sid
0.00	604088	26812	344	344	24	DBBG	rdbms1
0.00	604148	26824	344	344	24	DBBG	rdbms2
0.00	0	0	0	0	0	DBFG	rdbms1
0.00	0	0	0	0	0	DBFG	rdbms2
0.18	2385368	524504	433	433	42	MDBBG	
0.00	546796	290788	56	56	4	MDBFG	
0.00	817712	32116	334	334	28	ASMBG	
0.00	191356	33564	84	84	6	ASMFG	
99.62	1112096	88912	2066	2066	25	CLUST	
0.18	530344	12664	898	898	151	OTHER	

Oclumon CLI or full integration with EM Cloud Control

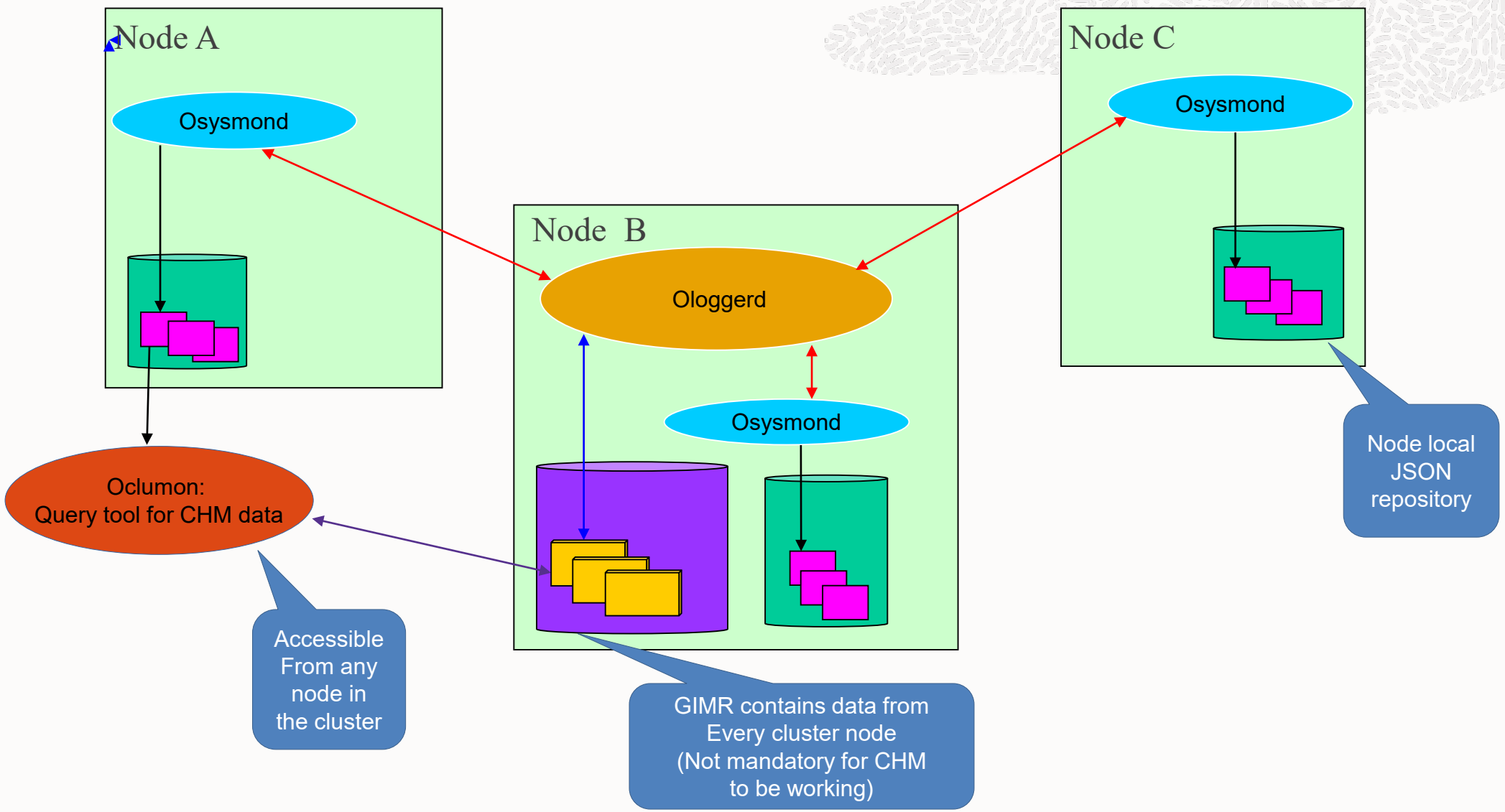
Cluster Health Monitoring (CHM)

CHM	Typical OS Collector
Last man standing - daemon runs memory locked, RT scheduling class ensuring consistent data collection under system load	Inconsistent data dropouts due to scheduling delays under system load
High fidelity data sampling rate, **5 seconds** . Very low resource usage profile at 5 second sampling rates.	Executing multiple utilities creates additional overhead on system being monitored, worsens with higher sampling rates.
High Availability daemon, collated data collections across multiple resource categories. Highly optimized collector(data read directly from OS, same source as utilities).	Set of scripts/command line utilities (ex. top, ps, vmstat, iostat …) re-directing their output to one or more files every collection sample.
Collected data is collated into a system snapshot overview ("*Nodeview*") on every sample, nodeview's also contains additional summarization and analysis of the collected data across multiple resource categories.	System snapshot overview across different resource categories are very tedious to collate.
Significant inline analysis and summarization during data collection and collation into the nodeview's greatly reduces tedious, manual, time consuming analysis to drive meaningful insights immediately as well as for historical analysis.	Analysis is time consuming and processing intensive as output of various utilities across multiple files needs to be collated, parsed, interpreted and then analyzed for meaningful insights.
Performs Cluster ware specific metrics collection (Process Aggregates, ASM/OCR/VD disk tagging, Private/Public NIC tagging). Also provides extensive tool set for in-depth data analysis and visualization.	

CHM Data collection flow in osysmond



CHM Architecture



CHM OS Data: CPU Metric Set

Contains metrics from all CPU core's ordered by usage %

Metric Name [Units]	Description
system [%]	Percentage of CPU utilization that occurred while executing at the system level (kernel)
user [%]	Percentage of CPU utilization that occurred while executing at the user level (application)
usage [%]	Total utilization (system[%] + user[%])
nice [%]	Percentage of CPU utilization that occurred while executing at the user level with nice priority.
ioWait [%]	Percentage of time that the CPU were idle during which the system had an outstanding disk I/O request.
steal [%]	Percentage of time spent in involuntary wait by the virtual CPU while the hypervisor was servicing another virtual processor

CHM OS Data: Device Metric Set

Contains metrics from **all** disk devices/partitions ordered by their **service time** in milliseconds

Metric Name [Units]	Description
ioR [KB/s]	Amount of data read from the device
ioW [KB/s]	Amount of data written to the device
numIOs [#/s]	Average disk I/O operations
qLen [#]	Number of I/O queued requests (ie in wait state)
aWait [msec]	Average wait time per I/O
svcTm [msec]	Average service time per I/O request
util [%]	Percent utilization of the device (same as '%util metric from 'iostat -x' command. Represent the percentage of time device was active)

CHM OS Data: Process Metric Set

Contains multiple categories of summarized metric data computed across **all** system processes

- ✓ Top 25 CPU consumers (idle processes not reported)
- ✓ Top 25 Memory consumers (RSS < 1% of total RAM not reported)
- ✓ Top 25 IO consumers
- ✓ Top 25 File Descriptors consumers (helps identify top inode consumers) *
- ✓ Process Aggregation: Metrics summarized by FG/BG processes for all DB/ASM instances (details later)

* Updated every 30 seconds

… Continued …

Metric Name [Units]	Description
pid	Process id
pri	Process priority (Raw value from the OS)
psr	Processor that process is currently assigned to/running on
pPid	Parent process id
nice	Nice value of process
state	State of process. eg: R -> Running , S-> Interruptible sleep etc.
class	scheduling class of the process. eg: RR->RobinRound, FF->First in First out, B->Batch scheduling etc.
fd [#]	Number of file descriptors open by this process *
name	Process name
cpu [%]	Process CPU utilization across cores **
thrds [#]	Number of threads created by this process

*Updated every 30 seconds

** 50% => 50% of singe core, 400% => 100% usage of 4 cores

… Continued …

Metrics Name [Units]	Description
vmem [KB]	Process virtual memory usage (KB)
shMem [KB]	Process shared memory usage (KB)
rss [KB]	Process Memory Resident Set Size (KB)
ioR [KB/s]	IO read in kilobytes per second
ioW [KB/s]	IO write in kilobytes per second
ioT [KB/s]	IO total in kilobytes per second
cswch [#/s]	Context switch per second *
nvcswch [#/s]	Non-voluntary context switch per second *
cumulativeCpu [µs]	The amount of cpu used so far by the process in microseconds

* Collected only for few critical DB processes

CHM OS Data: NIC Metric Set

Contains metrics from all network interfaces ordered by their total rate in Kbps

* All metrics in below set are representative of values in the current sample interval

Metric Name [Units]	Description
name	The name of the interface
tag	Tag for the interface e.g. public, private etc
mtu [B]	Size of maximum transmission unit in bytes supported for the interface
rx [Kbps]	Average network receive rate
tx [Kbps]	Average network send rate
total [Kbps]	Average network transmission rate (rx[Kb/s] + tx[Kb/s])
rxPkt [#/s]	Average incoming packet rate
txPkt [#/s]	Average outgoing packet rate
pkt [#/s]	Average rate of packet transmission (rxPkt[#/s] + txPkt[#/s])

Kbps : Kilobits per second

… Continued …

Metric Name [Units]	Description
rxDscrd [#/s]	Average rate of dropped/discarded incoming packets
txDscrd [#/s]	Average rate of dropped/discarded outgoing packets
rxUnicast [#/s]	Average rate of unicast packets received
rxNonUnicast [#/s]	Average rate of multicast packets received
dscrd [#/s]	Average rate of total discarded packets (rxDscrd + txDscrd)
rxErr [#/s]	Average error rate for incoming packets
txErr [#/s]	Average error rate for outgoing packets
Err [#/s]	Average error rate of total transmission (rxErr[#/s] + txErr[#/s])

CHM OS Data: Protocol Metric Set

- Contains specific metrics for protocol groups **TCP, UDP and IP** .
- * Metric values are cumulative since system starts

TCP: Metric Name [Units]	Descrption
failedConnErr [#]	Number of times that TCP connections have made a direct transition to the CLOSED state from either the SYN-SENT state or the SYN-RCVD state, plus the number of times that TCP connections have made a direct transition to the LISTEN state from the SYN-RCVD state
estResetErr [#]	Number of times that TCP connections have made a direct transition to the CLOSED state from either the ESTABLISHED state or the CLOSE-WAIT state
segRetransErr [#]	Total number of TCP segments retransmitted
rxSeg [#]	Total number of TCP segments received on TCP layer
txSeg [#]	Total number of TCP segments sent from TCP layer

… Continued …

UDP: Metric Name [Units]	Description
unkPortErr [#]	Total number of received datagrams for which there was no application at the destination port
rxErr [#]	Number of received datagrams that could not be delivered for reasons other than the lack of an application at the destination port
rxPkt [#]	Total number of packets received
txPkt [#]	Total number of packets sent

… Continued …

IP: Metric Name [Units]	Description
ipHdrErr [#]	Number of input datagrams discarded due to errors in their IPv4 headers
addrErr [#]	Number of input datagrams discarded because the IPv4 address in their IPv4 header's destination field was not a valid address to be received at this entity
unkProtoErr [#]	Number of locally-addressed datagrams received successfully but discarded because of an unknown or unsupported protocol
reasFailErr [#]	Number of failures detected by the IPv4 reassembly algorithm
fragFailErr [#]	Number of IPv4 discarded datagrams due to fragmentation failures
rxPkt [#]	Total number of packets received on IP layer
txPkt [#]	Total number of packets sent from IP layer

CHM OS Data: Process Aggregates Metric Set

- Contains aggregated metrics for **all** processes by process groups

Catagory	Description
DBBG	User oracle database background process group
DBFG	User oracle database foreground process group
MDBBG	MGMTDB background processes group
MDBFG	MGMTDB foreground processes group
ASMBG	ASM background processes group
ASMFG	ASM foreground processes group
IOXBG	IOS background processes group
IOXFG	IOS foreground processes group
APXBG	APX background processes group.
APXFG	APX foreground processes group
CLUST	Clusterware processes group
OTHER	Default group

… Continued …

- For each group, the below metrics are aggregated to report a group summary

Metric Name [Units]	Description
processes [#]	Total number of processes in the group
cpu [%]	Aggregated CPU utilization
rss [KB]	Aggregated Resident Set Size
shMem [KB]	Aggregated Shared memory usage
thrds [#]	Aggregated thread count
fds [#]	Aggregated open file-descriptor
cpuWeight [%]	Contribution of the group in overall CPU utilization of the machine.

CHM OS Data: FileSystem Metric Set

- Contains metrics for filesystem utilization.

Metric Name [Units]	Description
mount	Mount point
type	Filesystem type (e.g. etx4)
tag	Filsystem tag (e.g. GRID_HOME)
total [KB]	Total amount of space (KB)
used [KB]	Amount of used space (KB)
avbl [KB]	Amount of available space (KB)
used [%]	Percentage of used space
ifree [%]	Percentage of free file nodes

*currently collected for GRID_HOME FS only, can be configured

CHM OS Data: NFS Metric Set

- Contains metrics across **all** Network file systems ordered by **round trip time**

Metric Name [Units]	Description
op [#/s]	Number of read/write operations issued to a filesystem per second
bytes [#/sec]	Number of bytes read/write per second from a filesystem
rtt [s]	This is the duration from the time that client's kernel sends the RPC request until the time it receives the reply
exe [s]	This is the duration from that NFS client does the RPC request to its kernel until the RPC request is completed, this includes the RTT time above.
retrains [%]	This is the retransmission's frequency in percentage

This metric set is updated once every 30 seconds

CHM OS Data : SYSTEM Metric Set

Summarized metric set of critical system resource utilization

- CPU Metrics
- Memory Metrics
- Process Metrics
- Device Metrics
- NIC Metrics
- NFS Metric

SYSTEM – CPU Metrics

CPU Metrics: These are system wide CPU utilization statistics.

Metric Name [Units]	Description
pCpus [#]	Number of physical processing units in the system
Cores [#]	Number of cores for all cpu in the system
vCpus [#]	Number of logical processing units in the system
cpuHt	CPU Hyperthreading enabled (Y) / disabled (N)
osName	Name of the Operating System running on
chipName	The chipname of the Processing Unit
system [%]	Percentage of CPUs utilization that occurred while executing at the system level (kernel).
user [%]	Percentage of CPUs utilization that occurred while executing atthe user level (application)
usage [%]	Total CPU utilization (system[%] + user[%])

… Continued …

Metric Name[Units]	Description
nice [%]	Percentage of CPUs utilization that occurred while executing at the user level with nice priority.
ioWait [%]	Percentage of time that the CPUs were idle during which the system had an outstanding disk I/O request.
Steal [%]	Percentage of time spent in involuntary wait by the virtual CPUs while the hypervisor was servicing another virtual processor.
cpuQ [#]	Number of processes waiting in the run queue within the current sample interval
loadAvg1	Average system load calculated over of time of 1 minute
loadAvg5	Average system load calculated over of time of 5 minutes
loadAvg15	Average system load calculated over of time of 15 minutes. High load averages imply that a system is overloaded; many processes are waiting for CPU time
Intr [#/s]	Number of interrupts occured per second in system
ctxSwitch [#/s]	Number of context switches occured per second in system

SYSTEM-Memory Metrics

Memory Metrics: These are system wide Memory statistics

Metric Name[Units]	Description
totalMem [KB]	Amount of total usable RAM (KB)
freeMem [KB]	Amount of free RAM (KB)
avblMem [KB]	The amount of memory available to start a new process without swapping
shMem [KB]	Memory used (mostly) by tmpfs
swapTotal [KB]	Total amount of physical swap memory (KB)
swapFree [KB]	Amount of swap memory free (KB)
swpIn [KB/s]	Average swap in rate within the current sampleinterval (KB/sec)
swpOut [KB/s]	Average swap out rate within the current sample interval (KB/sec)
pgIn [#/s]	Average page in rate within the current sample interval (pages/sec)
pgOut [#/s]	Average page out rate within the current sample interval (pages/sec)

… Continued …

Metric Name[Units]	Description
slabReclaim [KB]	The part of the Slab that might be reclaimed (such as caches)
buffer [KB]	Memory used by kernel buffers
Cache [KB]	Memory used by the page cache and slabs
bufferAndCache [KB]	Total size of buffer and cache (buffer[KB] +cache[KB])
hugePageTotal [#]	Total number of hugepages present in system for the current sample interval
hugePageFree [KB]	Total number of free hugepages in system for the current sample interval
hugePageSize [KB]	Size of one huge page in KB, depends on OS version, Typically same for all samples for a particular host

CHM OS SYSTEM - Device and NFS Metrics

- **Device Metrics**: These are system wide device statistics (distinct from individual devices metric set)

Metric Name[Units]	Description
disks [#]	Number of disks configured in system.
ioR [KB/s]	Aggregate read rate across all devices
ioW [KB/s]	Aggregate write rate across all devices.
numIOs [#/s]	Aggregate I/O operation rate across all devices.

NFS Metrics: Total NFS Devices *

Metric Name[Units]	Description
nfs [#]:	Total NFS devices

* Collected once every 30 seconds

CHM OS SYSTEM - Process Metrics

Process Metrics: System wide unique process metrics.

Metric Name[Units]	Description
fds [#]	Number of open file structs in system
procs [#]	Number of processes
rtProcs [#]	Number of real-time processes
procsInDState	Number of processes in unterruptible sleep
sysFdLimit [#]	System limit on number of file structs
procsOnCpu [#]	Number of processes currently running on cpu
procsBlocked [#]	Number of processes waiting for some event/resource become available, such as for the completion of an I/O operation.

Cluster Health Advisor (CHA)*

Always on - Enabled by default

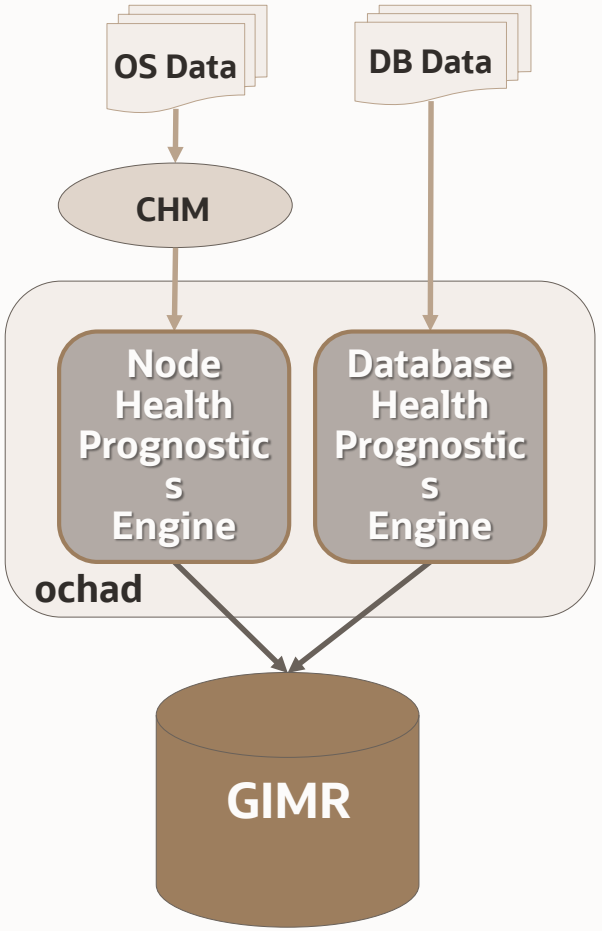
Detects node and database performance problems

Provides early-warning alerts and corrective action

Supports on-site calibration to improve sensitivity

Integrated into EMCC Incident Manager and notifications

Standalone Interactive GUI Tool



Calibrating CHA to your RAC deployment

Choosing a Data Set for Calibration – Defining “normal”

```
chactl query calibration –cluster –timeranges ‘start=2023-04-23 07:00:00,end=2023-04-23 13:00:00’
Cluster name : mycluster
Start time : 2023-04-23 07:00:00
End time : 2023-04-23 13:00:00
Total Samples : 11524
Percentage of filtered data : 100%

1)  Disk read (ASM) (Mbyte/sec)
        MEAN      MEDIAN    STDDEV    MIN       MAX
        0.11      0.00      2.62      0.00      114.66
        <25       <50       <75       <100      >=100
        99.87%    0.08%     0.00%     0.02%     0.03%
...
```

Calibrating CHA to your RAC deployment

Choosing a Data Set for Calibration – Defining “normal”

```
...
2) Disk write (ASM) (Mbyte/sec)
        MEAN      MEDIAN    STDDEV    MIN       MAX
        0.01      0.00      0.15      0.00      6.77
        <50       <100      <150      <200      >=200
        100.00%   0.00%     0.00%     0.00%     0.00%
...
```

Calibrating CHA to your RAC deployment

Choosing a Data Set for Calibration – Defining “normal”

```
...
3) Disk throughput (ASM) (IO/sec)
        MEAN      MEDIAN    STDDEV    MIN       MAX
        2.20      0.00      31.17     0.00      1100.00
        <5000     <10000    <15000    <20000    >=20000
        100.00%   0.00%     0.00%     0.00%     0.00%

4) CPU utilization (total) (%)
        MEAN      MEDIAN    STDDEV    MIN       MAX
        9.62      9.30      7.95      1.80      77.90
        <20       <40       <60       <80       >=80
        92.67%    6.17%     1.11%     0.05%     0.00%
...
```

Calibrating CHA to your RAC deployment

Create and store a new model

```
chactl query calibrate cluster –model daytime –timeranges ‘start=2023-04-23 07:00:00,
end= 2023-04-23 13:00:00’
```

Begin using the new model

```
chactl monitor cluster –model daytime
```

Confirm the new model is working

```
chactl status –verbose

monitoring nodes svr01, svr02 using model daytime
monitoring database qoltpacdb, instances oltpacdb_1, oltpacdb_2 using model DEFAULT_DB
```

Command line operations

Enable CHA monitoring on RAC database with optional model

```
chactl monitor database -db oltpacdb [-model model_name]
```

Enable CHA monitoring on RAC database with optional verbose

```
chactl status -verbose
monitoring nodes svr01, svr02 using model DEFAULT_CLUSTER
monitoring database oltpacdb, instances oltpacdb_1, oltpacdb_2 using model DEFAULT_DB
```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