

Uncovering Lustre Performance Issues in Operational Weather Forecasting at DMI with View for ClusterStor



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- Keywords
 - Reliable and timely production
 - System wide I/O accounting for identifying hot spots
 - Merging PBSPro and ALPS events with lustre jobstats
 - Evaluating View for ClusterStor
- Presenters
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Agenda and intro

- The task of a meteorological service
- Supercomputer and I/O overview
- History of I/O monitoring and accounting
- View experiences : Installation and operation
- View experiences : Usability and cases
- Evaluation and future outlook

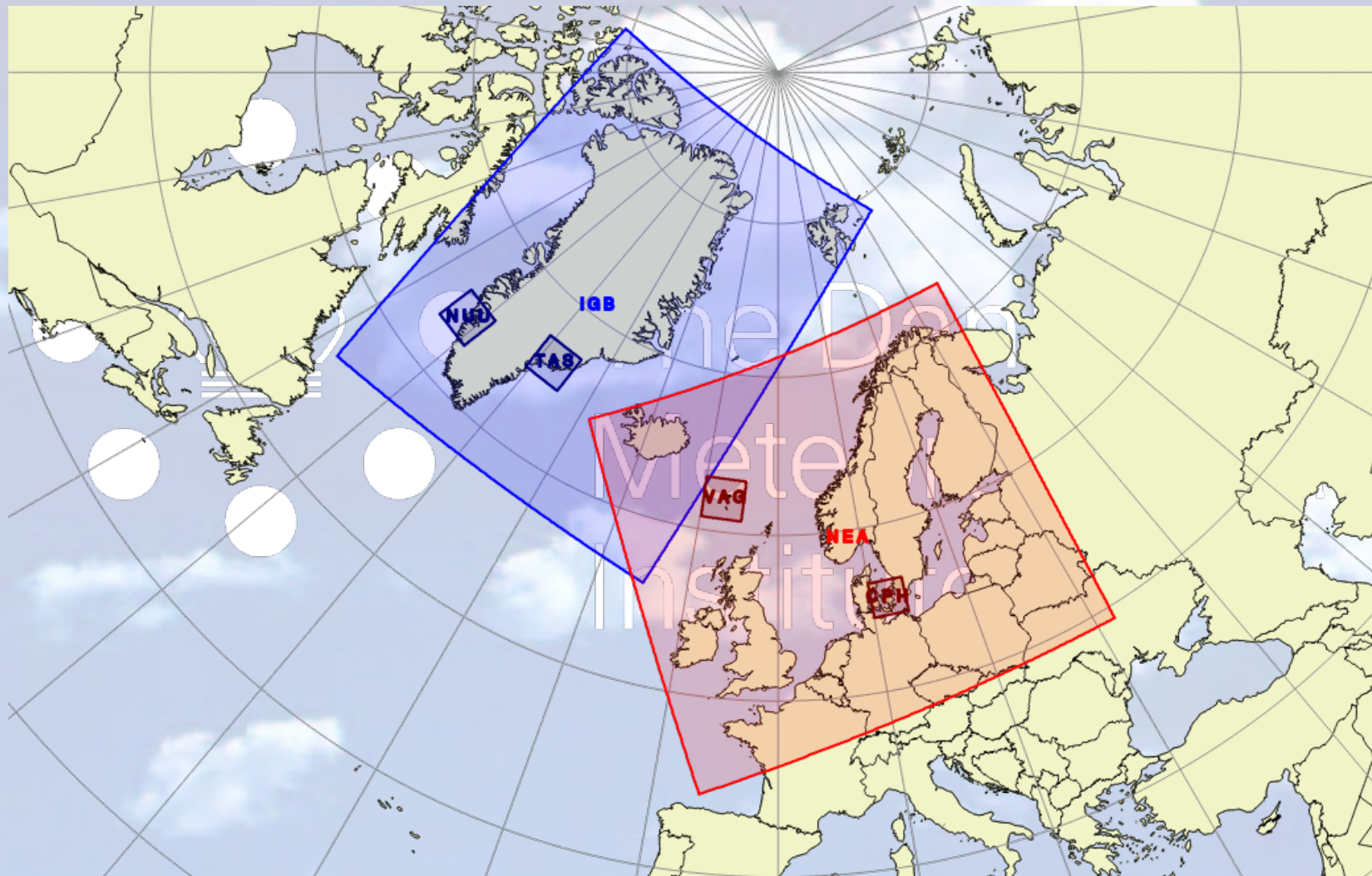
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The task of a meteorological service

- The Danish Meteorological Institute obligates to forecast evolution of weather and ocean for the Kingdom of Denmark
- The Kingdom of Denmark is not just Denmark but includes Greenland as well
- Timely forecasts require supercomputing power
- Resiliency mandate redundancy, either " $2*N$ " or " $N+1$ "
- Two XC50 systems, one for production and one for research and development, with shared Sonexion and Netapp
- Hosted at the Icelandic Meteorological Office in a joint partnership

The task of a meteorological service

Deterministic models



The task of a meteorological service

Ensemble models



The task of a meteorological service

The site



The task of a meteorological service

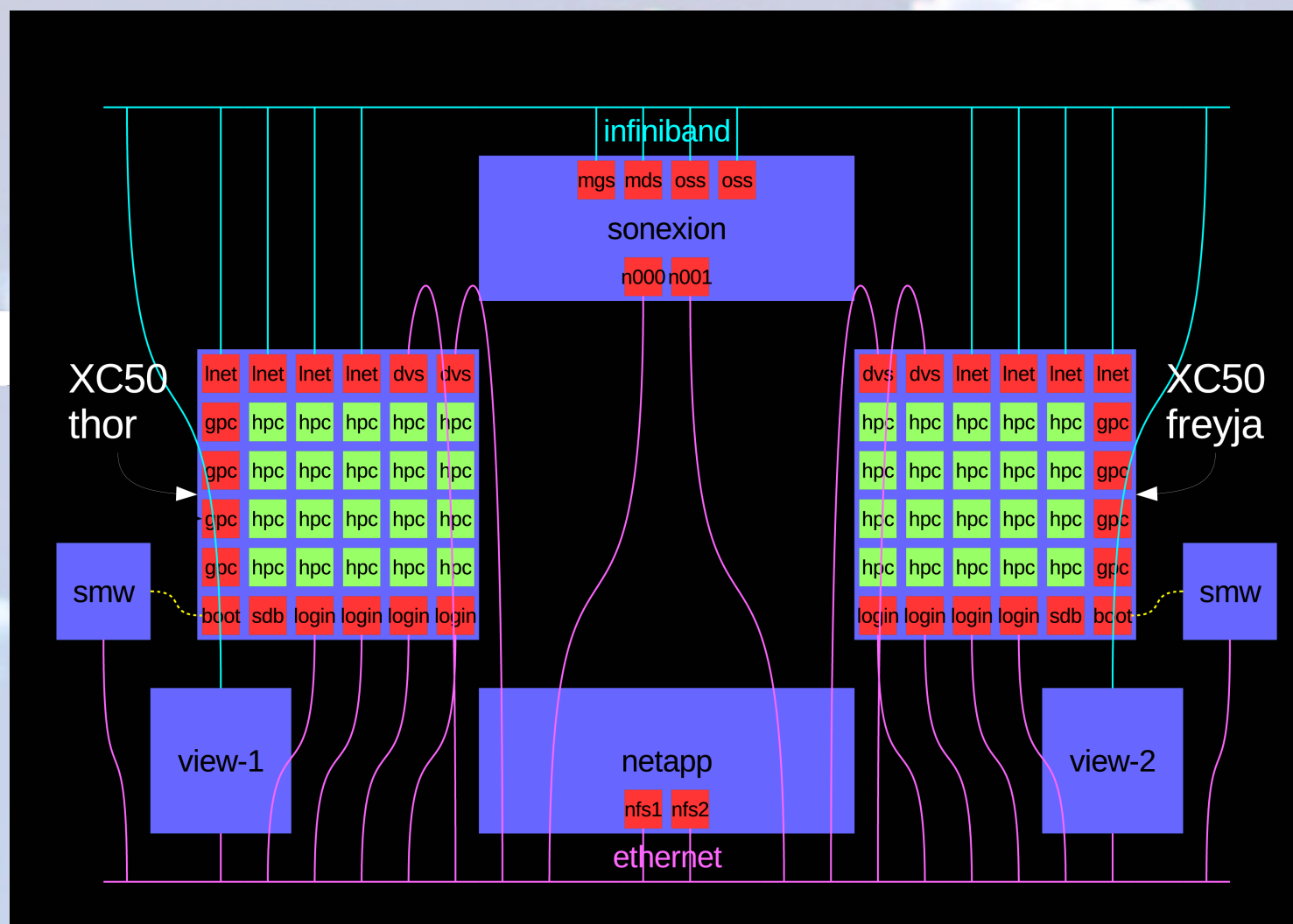
System utilization



Supercomputer and I/O overview

- Two XC50 systems and their shared storage
 - hpcopr : System for timecritical operational production
 - hpcdev : System for research and development
 - sonexion2000 : A single shared lustre file system
- Each XC50 system has three different user faced node types
 - Traditional compute nodes : Scheduled via ALPS via PBSPro
 - Repurposed compute nodes : Scheduled via PBSPro
 - Login nodes : Interactive and scheduled via PBSPro
- Sonexion mds shared between opr and dev
- Sonexion osses separated between opr and dev via lustre pools

Supercomputer and I/O overview

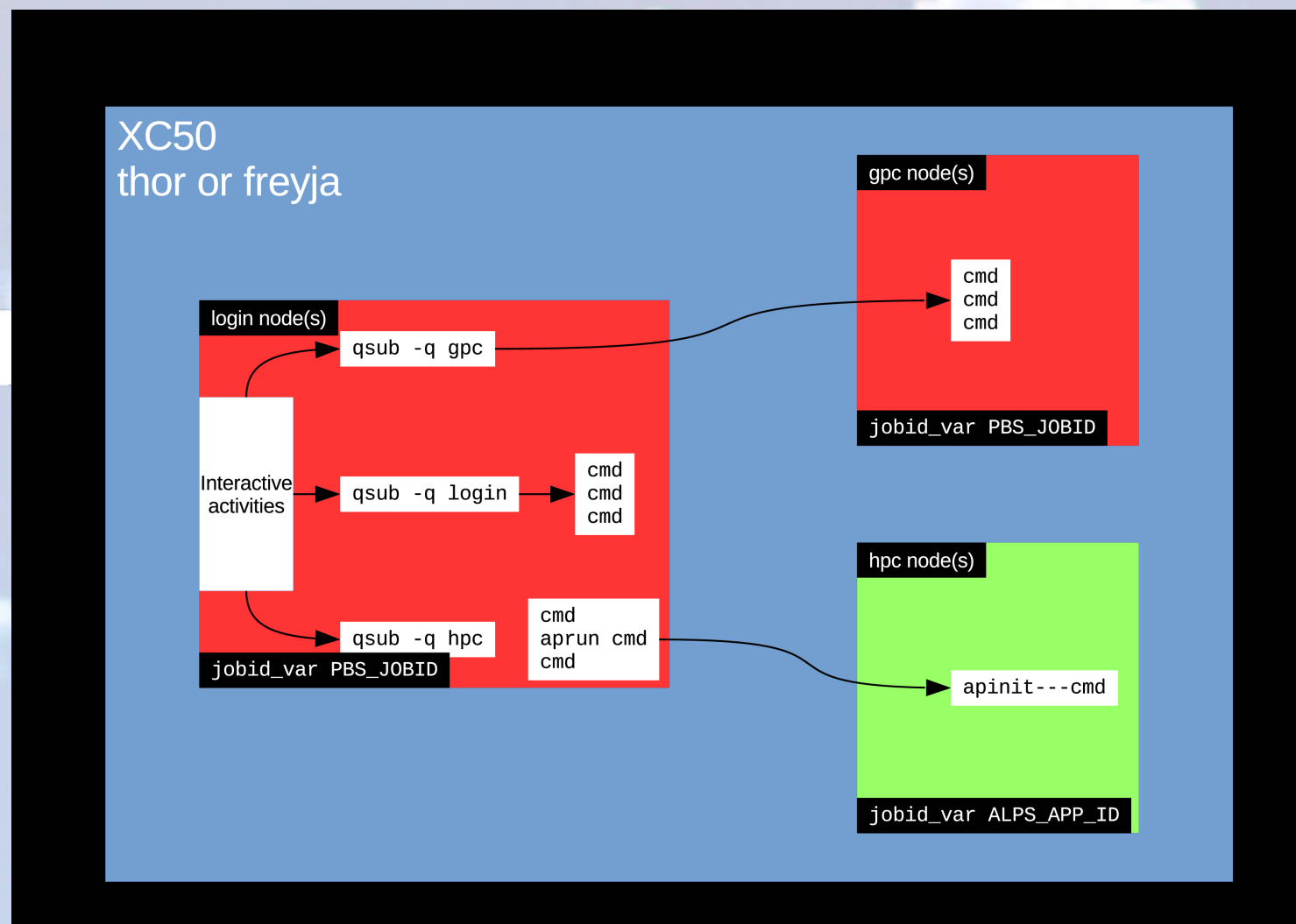


Supercomputer and I/O overview

- Potential pitfalls of the lustre setup
 - Shared resources between opr and dev
 - Insufficient resources
- Monthly raid consistency checks incur a bit of production delay
 - Implies that resource usage is maxed out already
 - Either acquire more or assess on the applications

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Supercomputer and I/O overview



Supercomputer and I/O overview

- Desire to map out the I/O usage profile of all user activities
- Two purposes served
 - User approach : Asses the I/O characteristics of a particular job
 - Sysadm approach : Spot jobs with bad I/O characteristics potentially impacting other jobs
- The latter approach is the focus of this presentation
- The I/O usage profiles may be explicitly or implicitly useful
 - Some outliers may be spotted directly from the sampled metrics
 - Other outliers surface when coupled with knowledge and expectation of job characteristics

History of I/O monitoring and accounting

- System installed end 2015 with SU10 and lustre 2.5.x
- Setup supported LMT and web interface for real time monitor
- However, SU10 not immediately supporting jobstats despite jobstats being available in lustre 2.5.x
- Also, LMT carried a limited number of lustre usage counters with desire for more
- The Cstream aka SeaStream application programming interface announced to be available in SU23
- Planning challenges due to only a single sonexion being available precluded upgrade until SU31

History of I/O monitoring and accounting

- Fall 2016 and spring 2017 featured a joint effort with DMI and Cray on an alternative approach
- The Open XDMoD was crafted to integrate to XC systems
- By means of ruc plugins PBSPro account logs were amended with lustre stats for ALPS jobs
- Plain PBSPro jobs on repurposed compute nodes more difficult, since such nodes are used by several jobs
- Also, going the way of Open XDMoD required a significant amount of work for local adaption
- Better have a purpose built tool, if only such existed

History of I/O monitoring and accounting

- At CUG-2017, when DMI and Cray presented their Open XDMoD experiences, Caribou was also presented
- Many similarities were seen, but whereas Open XDMoD needed tweaking, Caribou was born tightly integrated to XC
- At CUG-2018 the renamed View for ClusterStor product was presented
- In autumn 2018 DMI and Cray made an agreement with DMI evaluating View for ClusterStor and providing feedback to Cray

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View experiences : Installation and operation

- Fetched View tar ball via crayport.cray.com and follow the installation instruction as found on pubs.cray.com
- Minimal centos sufficed, since tar ball contains all dependencies for docker containers, which View makes heavy use of
- Installation instructions are comprehensive and easy to follow
- No unpleasant surprises
- For ALPS (jobeventd on smw), things worked mostly out of the box
- For PBSPro (jobeventd on sdb), some additional tweakings were needed

View experiences : Installation and operation

- By default there is no external network on sdb
- Proof of concept established via ssh port forwarding via login
- Version 13.0.408 of PBSPro still uses ancient python 2.5.1
- The jobevent prologue uses the runjob hook
- The hooks framework has the runjob hook as an obvious prologue hook on the pbs server. Unfortunately no obvious epilogue hook exists, which executes on the pbs server
- Hence jobevent epilogue is essentially a polling mechanism looking for finished jobs, which details are then fetched via the tracejob tool. This carries overhead and is not scalable

View experiences : Usability and cases

VIEW for CLUSTERSTOR™

admin Admin

Overview

Alarms

Alarms definitions

snx11183

OST / IO

| | |
|----------------------------------|-----------------------------------|
| GB/s 2.06 Avg. read | GB/s 1.34 Avg. write |
|----------------------------------|-----------------------------------|

Metadata ops

k/s
7.28
Requests

Capacity

201 TB
13.00%
Free

Jobs

1710 / 365
Total / Warning

OST

8 / 0
Total / Warning

Health **Alarms** **Logs**

✓

🔔

📄

View for ClusterStor™ 12.0 build 1321 201812050941

+

View experiences : Usability and cases

VIEW for CLUSTERSTOR™

Overview | Alarms | Alarms definitions

Filter Last 15 minutes 1754 jobs loaded in 11.749 seconds a few secs ago

Host Name Job ID AppID User ID Application Start Time End Time Duration Avg I/O Size Metadata Ops

new-thor-smw
new-thor-smw
new-freyja-smw
new-freyja-smw
new-freyja-smw
new-freyja-smw
new-freyja-smw
new-freyja-smw
new-freyja-smw
new-freyja-smw
new-freyja-sdb
new-thor-sdb
new-freyja-sdb
find.2611

Filter Jobs

Filter by host name
Filter by job ID
Filter by user ID
Filter by apid
Filter by app name

Filter by job duration
Filter by avg. I/O size
Filter by metadata ops
Limit search to time range
5m Last 15m 30m 1h 3h
Set custom time range

Submit Cancel

0s 14d
0B 10GB
0 10m

N/A
658
3.41m
2.43m
1.41m
295
295
12k
12k
90.2k
114
N/A
7.64k
2.61m

View for Clusterstor™ 1.2.0 build 132720181205094

View experiences : Usability and cases

VIEW for CLUSTERSTOR™

Overview

Alarms

Alarms definitions

admin

Admin

Filter

2019-04-25 00:00 - 2019-04-26 00:00

4

Showing 7429 of 121267 jobs

a few secs ago

Host Name

Job ID

Apid

User ID

Application

1 Start Time

End Time

Duration

1 Avg. I/O Size

1 Metadata Ops

new-freyja-sdb

3904851.sdb

1088

runtmp4

2019-04-25 04:52:14

2019-04-25 14:14:34

9h 22m 20s

219KB

7.19m

new-freyja-sdb

3904848.sdb

1088

runmonitor

2019-04-25 04:52:14

2019-04-25 12:54:17

8h 2m 3s

202KB

6.11m

new-freyja-sdb

3904850.sdb

1088

runtmp3

2019-04-25 04:52:14

2019-04-25 14:36:03

9h 43m 49s

263KB

5.7m

new-freyja-sdb

3919896.sdb

2640

runmonitor.sh

2019-04-25 12:14:27

2019-04-26 07:37:58

19h 23m 31s

267KB

4.19m

new-freyja-smw

3911959.sdb

22888209

1089

run_xios_runoff

2019-04-25 08:26:04

2019-04-25 10:51:04

2h 25m

3.06MB

4.13m

new-freyja-smw

3907992.sdb

22882196

1089

run_xios_runoff

2019-04-25 06:32:49

2019-04-25 08:57:01

2h 24m 12s

3.01MB

4.13m

new-freyja-smw

3911727.sdb

22887758

1089

run_xios_runoff

2019-04-25 08:15:57

2019-04-25 10:39:44

2h 23m 47s

3.04MB

4.13m

new-freyja-smw

3906752.sdb

22879435

1089

run_xios_runoff

2019-04-25 05:48:43

2019-04-25 08:12:17

2h 23m 34s

3.1MB

4.12m

new-freyja-smw

3929110.sdb

22914953

1089

run_xios_runoff

2019-04-25 16:52:59

2019-04-25 19:10:05

2h 17m 6s

3.1MB

4.12m

new-freyja-smw

3907198.sdb

22880360

1089

run_xios_runoff

2019-04-25 06:01:58

2019-04-25 08:25:56

2h 23m 58s

3.08MB

4.12m

new-freyja-smw

3906916.sdb

22879669

1089

run_xios_runoff

2019-04-25 05:51:41

2019-04-25 08:15:49

2h 24m 8s

3.06MB

4.12m

new-freyja-smw

3911631.sdb

22887601

1089

run_xios_runoff

2019-04-25 08:12:24

2019-04-25 10:36:04

2h 23m 40s

3.01MB

4.11m

new-freyja-smw

3891599.sdb

22854213

1089

run_xios_runoff

2019-04-24 22:43:39

2019-04-25 01:04:47

2h 21m 8s

3.1MB

4.11m

new-freyja-smw

3916958.sdb

22896464

1089

run_xios_runoff

2019-04-25 10:45:04

2019-04-25 13:07:35

2h 22m 31s

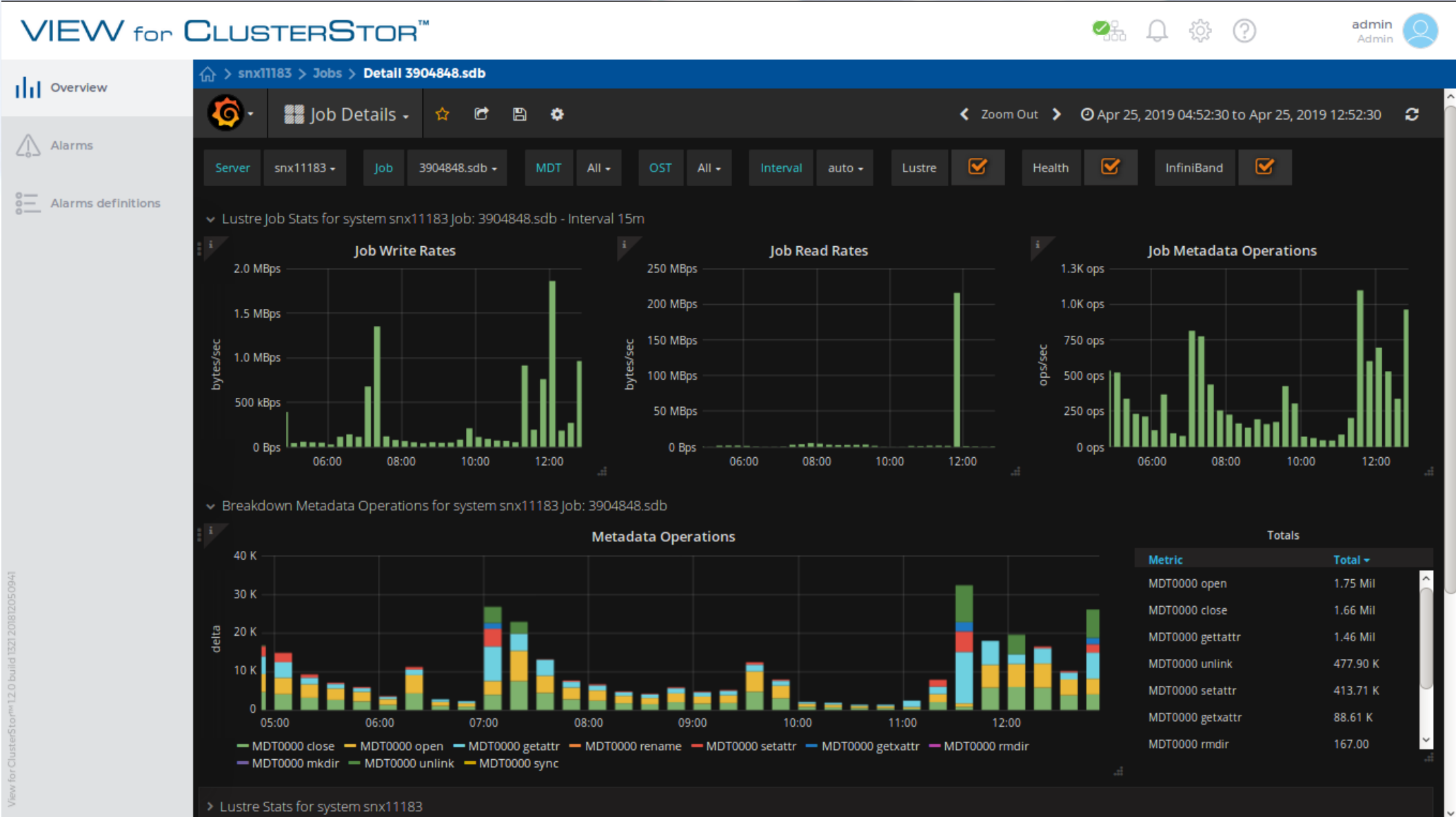
3.06MB

4.11m

Details

View for ClusterStor™ 12.0 build 1321 201812050941

View experiences : Usability and cases



View experiences : Usability and cases

VIEW for CLUSTERSTOR™

Overview

Alarms

Alarms definitions

Filter

2019-04-25 00:00 - 2019-04-26 00:00

4

Showing 70 of 121267 jobs

a few secs ago

admin

Admin

Host Name

Job ID

Apid

User ID

Application

1 Start Time

End Time

Duration

1 Avg. I/O Size

1 Metadata Ops

new-freyja-sdb

3902164.sdb

1169

plotROT.csh

2019-04-25 03:50:01

2019-04-25 03:55:00

4m 59s

423.22B

251k

new-freyja-sdb

3912043.sdb

1169

plotROT.csh

2019-04-25 08:30:01

2019-04-25 08:34:21

4m 20s

422.79B

233k

new-freyja-sdb

3903674.sdb

1169

plotROT.csh

2019-04-25 04:30:01

2019-04-25 04:34:40

4m 39s

413.49B

228k

new-freyja-sdb

3930030.sdb

1169

plotROT.csh

2019-04-25 17:30:03

2019-04-25 17:32:42

2m 39s

478.31B

226k

new-freyja-sdb

3897256.sdb

1169

plotROT.csh

2019-04-25 01:30:01

2019-04-25 01:34:17

4m 16s

413.18B

225k

new-freyja-sdb

3919299.sdb

1169

plotROT.csh

2019-04-25 11:50:01

2019-04-25 11:51:12

1m 11s

907.58B

225k

new-freyja-sdb

3920289.sdb

1169

plotROT.csh

2019-04-25 12:30:01

2019-04-25 12:33:01

3m

460.52B

224k

new-freyja-sdb

3941310.sdb

1169

plotROT.csh

2019-04-25 23:30:01

2019-04-25 23:34:07

4m 6s

413.49B

224k

new-freyja-sdb

3935739.sdb

1169

plotROT.csh

2019-04-25 20:30:01

2019-04-25 20:34:10

4m 9s

413.18B

224k

new-freyja-sdb

3914886.sdb

1169

plotROT.csh

2019-04-25 09:50:02

2019-04-25 09:54:06

4m 4s

422.79B

223k

new-freyja-sdb

3934785.sdb

1169

plotROT.csh

2019-04-25 19:50:03

2019-04-25 19:52:37

2m 34s

480.02B

223k

new-freyja-sdb

3918576.sdb

1169

plotROT.csh

2019-04-25 11:30:02

2019-04-25 11:34:07

4m 5s

415.53B

223k

new-freyja-sdb

3910024.sdb

1169

plotROT.csh

2019-04-25 07:30:01

2019-04-25 07:33:52

3m 51s

417.93B

223k

new-freyja-sdb

3905967.sdb

1169

plotROT.csh

2019-04-25 05:30:01

2019-04-25 05:35:36

5m 35s

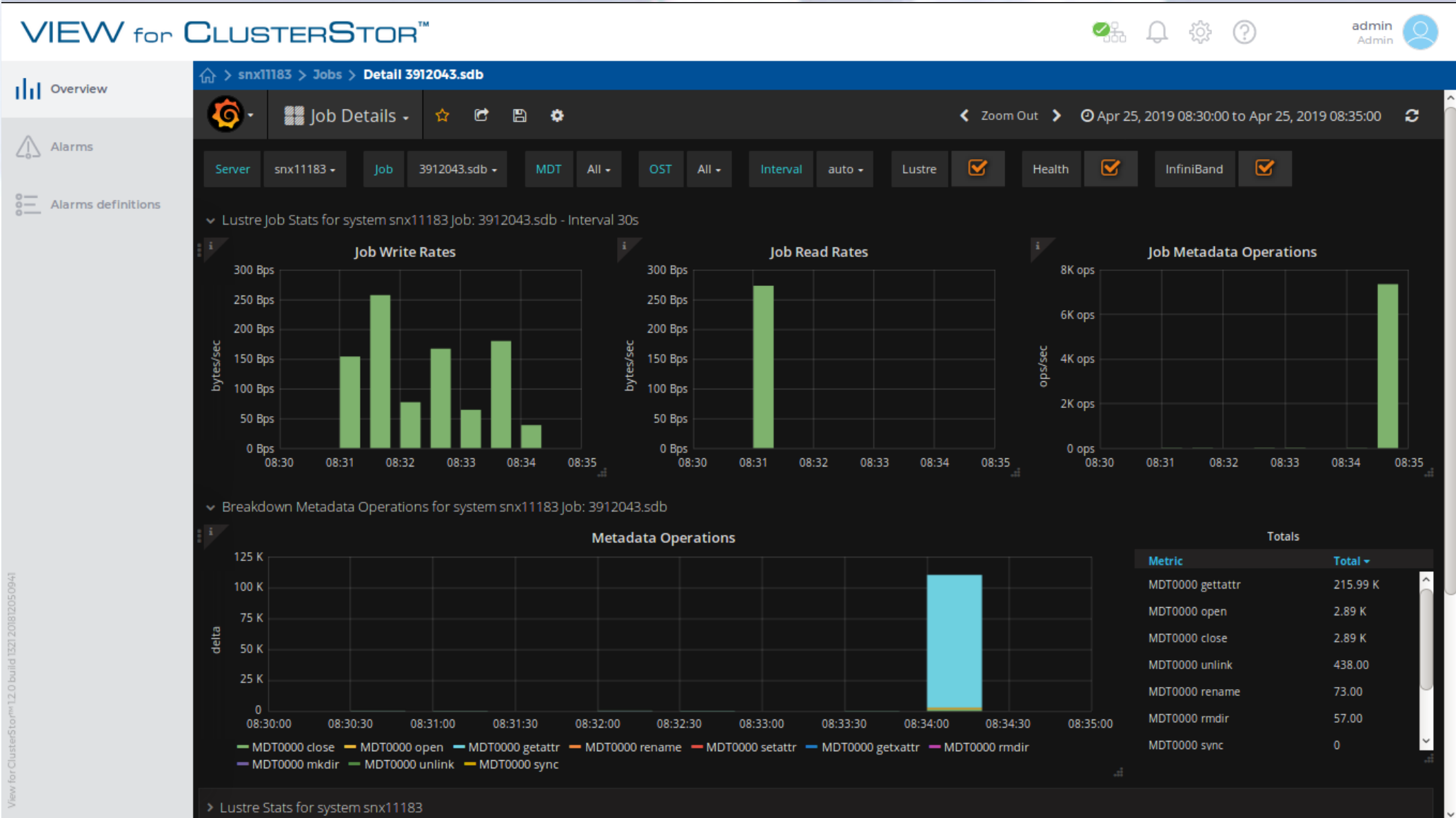
409.06B

222k

Details

View for ClusterStor™ 12.0 build 1321 (20181205094)

View experiences : Usability and cases



View experiences : Usability and cases

VIEW for CLUSTERSTOR™

admin Admin

Overview

Alarms

Alarms definitions

Filter 2019-04-25 05:50 - 2019-04-25 09:10 4

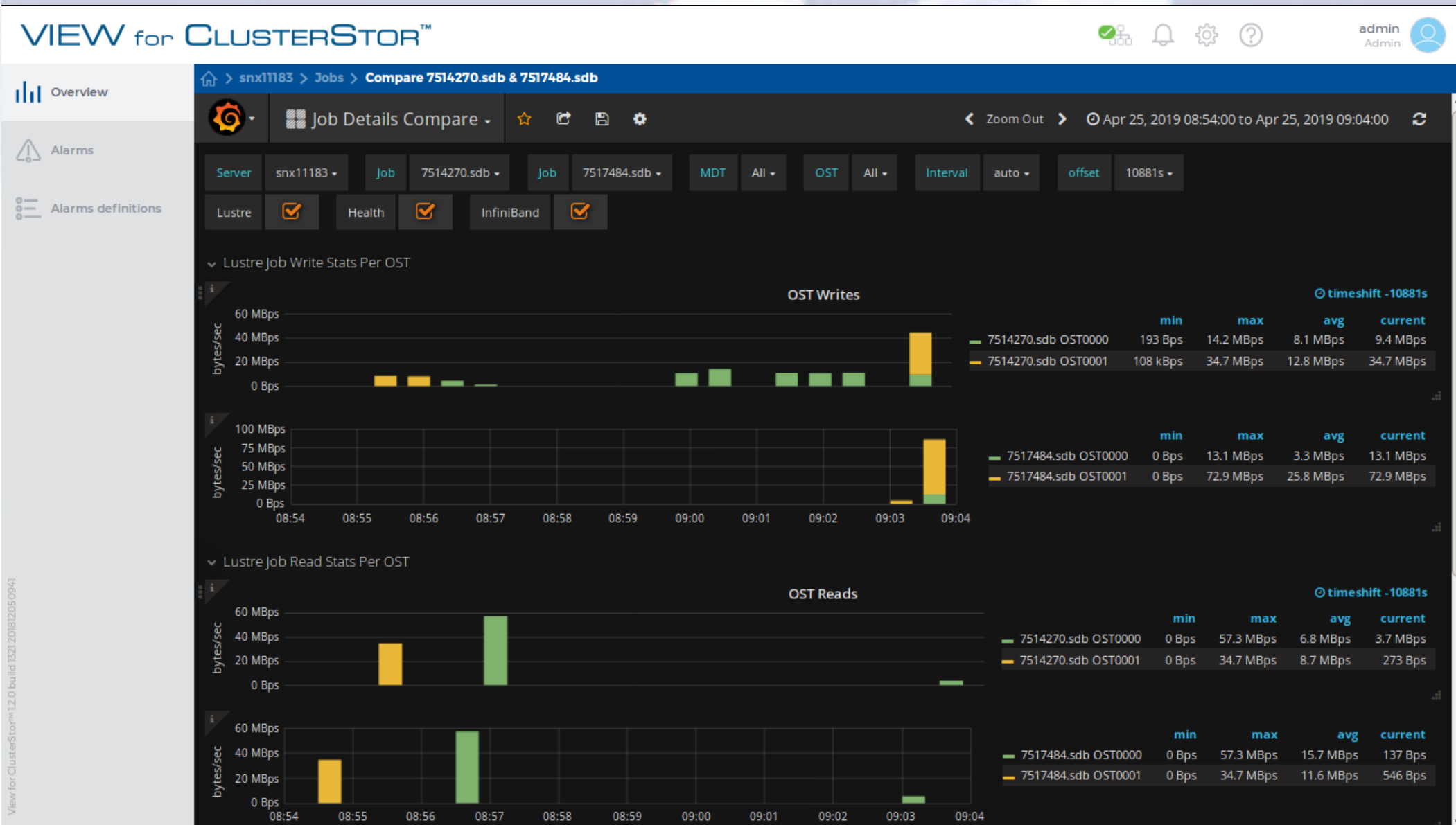
Showing 2 of

Compare selected jobs

| Host Name | Job ID | ApId | User ID | Application | Start Time | End Time | Duration | Avg. I/O Size | Metadata Ops |
|--------------|-------------|------|---------|-------------|---------------------|---------------------|----------|---------------|--------------|
| new-thor-sdb | 7514270.sdb | | 10020 | Mkgrb_001 | 2019-04-25 05:53:17 | 2019-04-25 06:02:18 | 9m 1s | 2.42MB | 579 |
| new-thor-sdb | 7517484.sdb | | 10020 | Mkgrb_001 | 2019-04-25 08:54:38 | 2019-04-25 09:03:18 | 8m 40s | 2.03MB | 112 |

View for ClusterStor™ 12.0 build 1321 201812050941

View experiences : Usability and cases



Evaluation and future outlook

- View glues lustre stats and jobstats with PBSPro and ALPS job events to give a comprehensive system wide I/O account
- View is an out of the box experience for ALPS, but for PBSPro workarounds have been needed, and the setup is less scalable
- The dashboard of the detailed job view is customizable, but the overall job view table lacks this ability
- Apparent misses of jobs or account for I/O activities in the web interface have been spotted and reported
- However, the View tool seems good and intuitive in getting overview of I/O activities, both system wide and per job
- Hence View can make a positive difference for sites in need of doing detailed I/O analysis at the level of individual jobs

Summary and outro

- The task of a meteorological service
- Supercomputer and I/O overview
- History of I/O monitoring and accounting
- View experiences : Installation and operation
- View experiences : Usability and cases
- Evaluation and future outlook

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