Catching rogue jobs before they overload shared storage: An I/O profiling case study

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The I/O Profiling Company - Protect. Balance. Optimise.

www.ellexus.com

Who we are

Ellexus is the I/O profiling company.

We work in HPC and wide-scale computing. Our latest tool Mistral has been developed with ARM.

This case study is taken from a real customer deployment using LSF and Spectrum Scale.

Customers include:

wellcome trust sanger institute

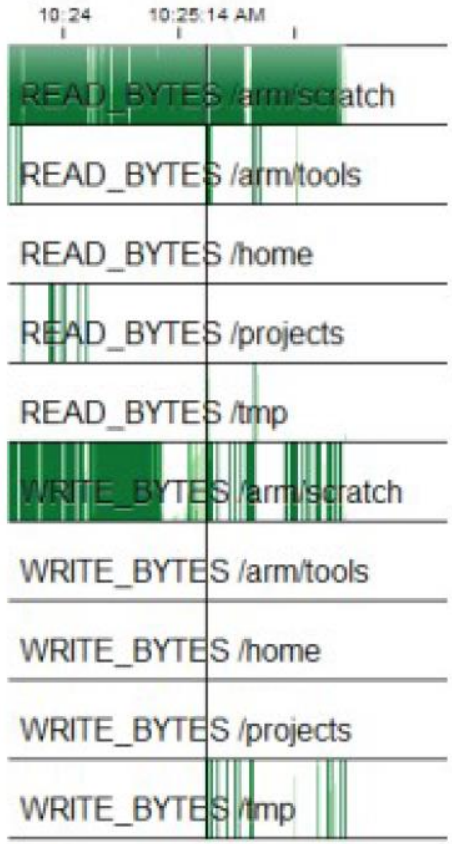
Mentor Graphics

ARM

CANCER RESEARCH UK

Mistral:
Solving the noisy neighbour problem

In a compute cluster it is possible for a small number of jobs to overload the shared file system. **Example of a rogue job from ARM:**



Lots of data is written to remote storage (/scratch).

But almost nothing is written to local storage (/tmp).

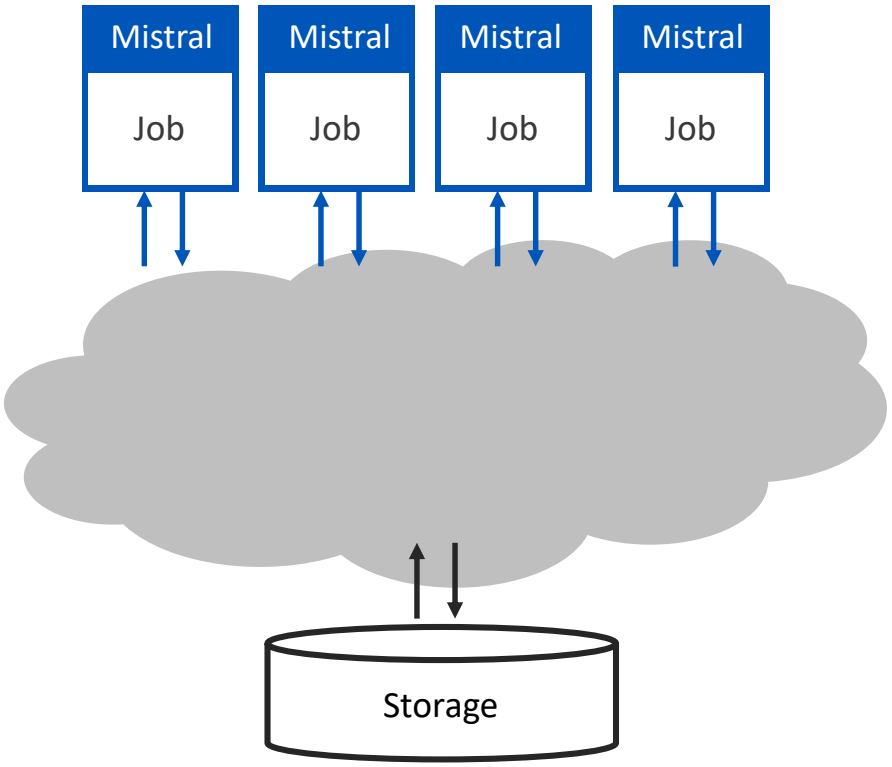
Mistral

Protect your storage from bad I/O patterns and rogue jobs.

Load balance your storage for good quality of service.

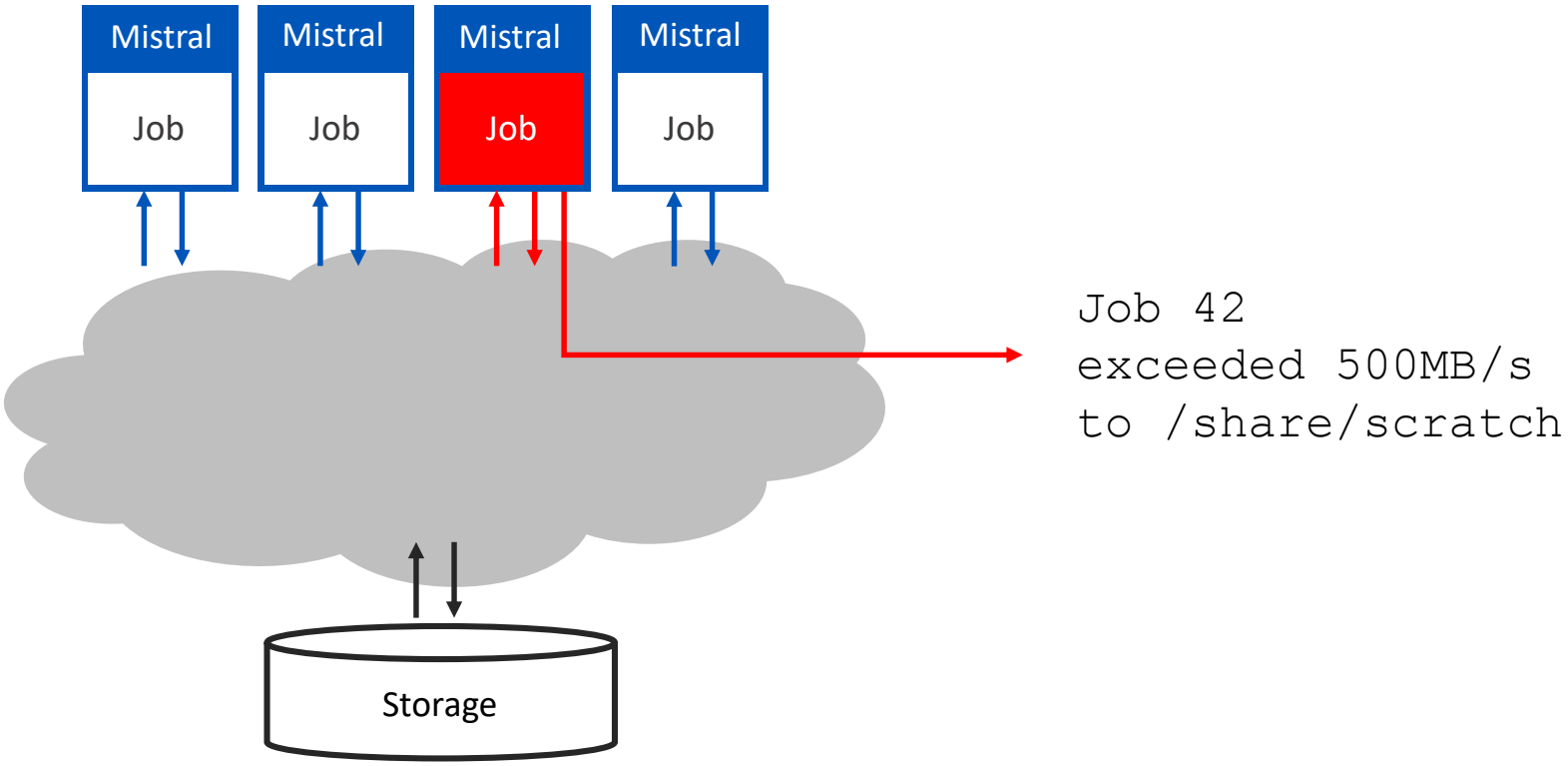
Optimise your applications for the storage and your infrastructure for your jobs.

Mistral:
How does it work?



Mistral sits at the application level.

Mistral:
How does it work?

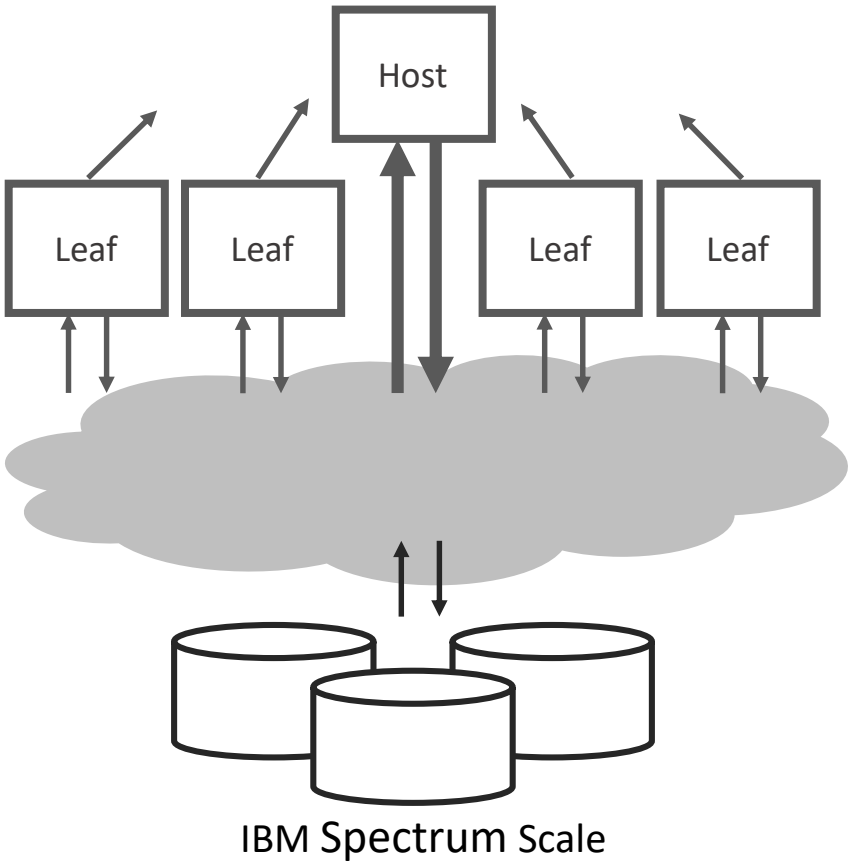



```
Job 42
exceeded 500MB/s
to /share/scratch
```

Customer case study: Catching rogue jobs

… stories from a Silicon Valley software ‘startup’

Customer case study: system architecture



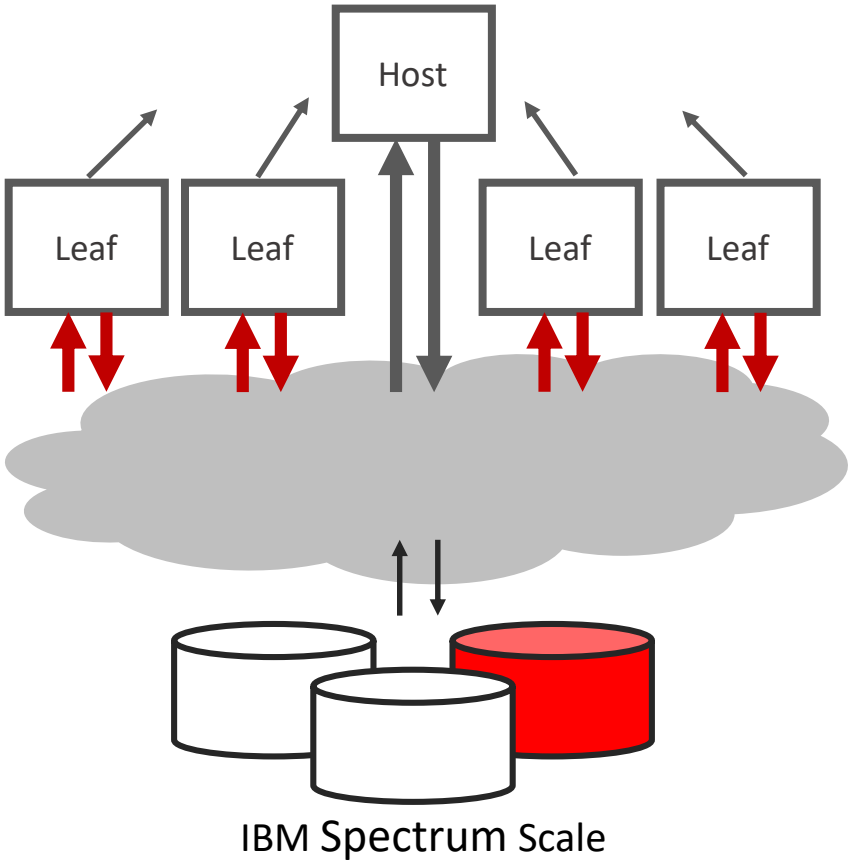
Host-Leaf architecture

Host compute nodes:
- Native Spectrum Scale
- 4 Gigabit/s Infiniband
- 32 Slots

Leaf compute nodes:
- Send data over RCP to host nodes
- Clustered NFS

Storage:
- 8 Spectrum Scale servers

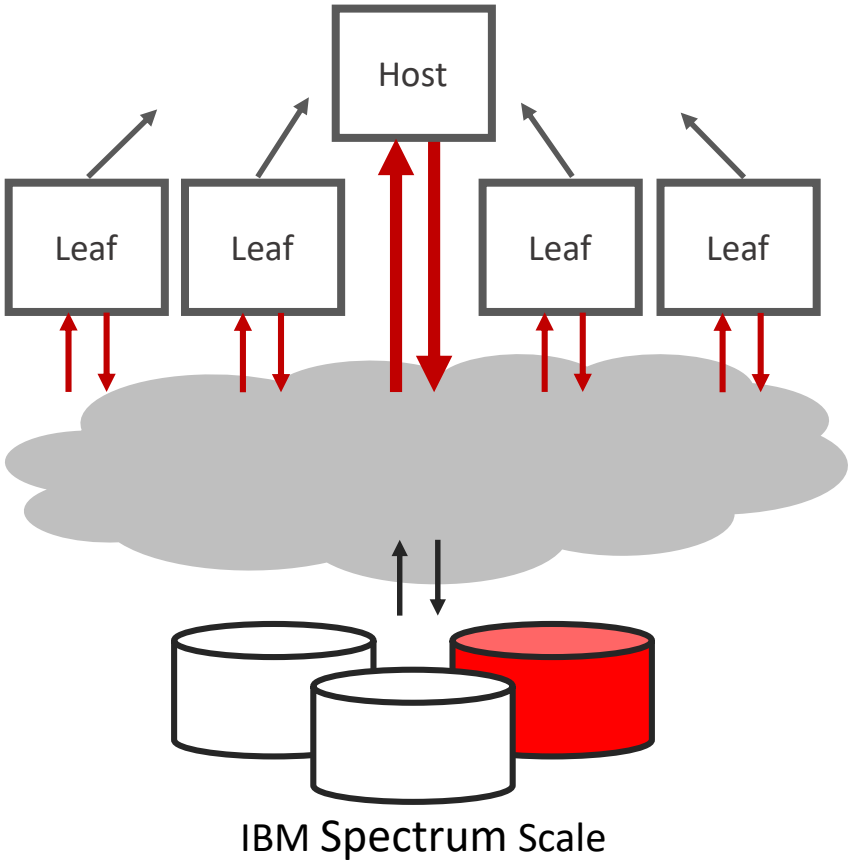
Customer case study
Problem 1: Bad working practices



Jobs sometimes write from the leaf nodes instead of from the host.

If they hammer a particular mount point that can overload one of the filers.

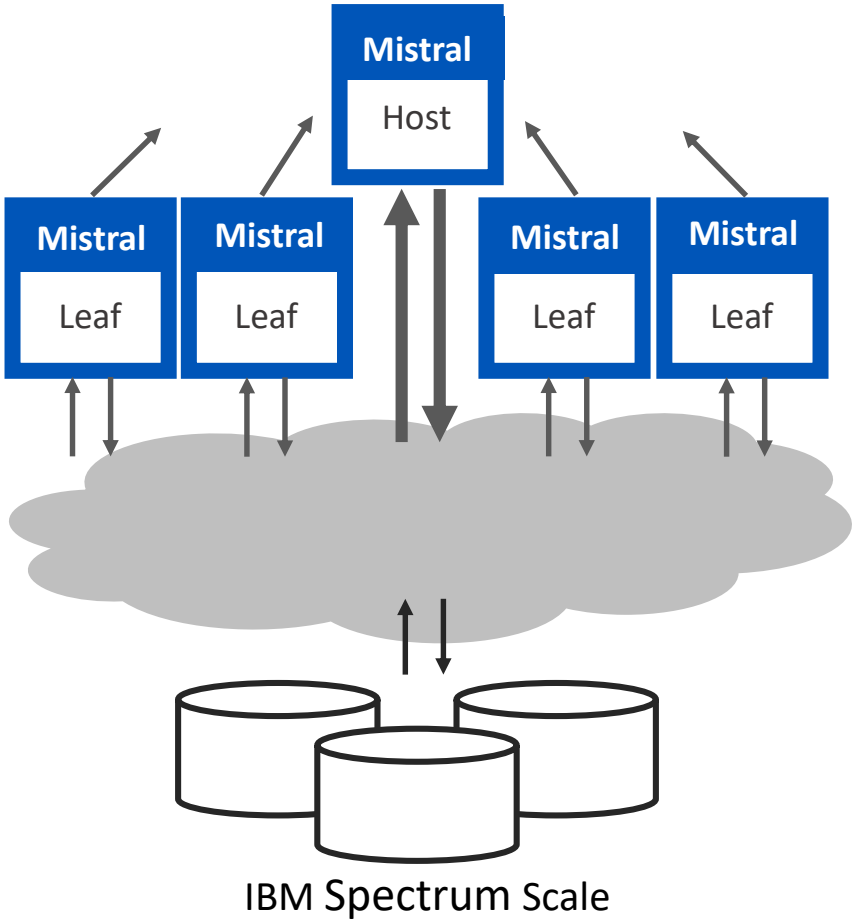
Customer case study
Problem 2: Debug flag left on



Job is debugged on one core then handed over to run at scale
– debug flag left on accidentally.

This happens weekly.

Customer Case Study: Mistral deployment



Production jobs are wrapped in Mistral via an LSF job starter.

Mistral generates an alert if:

- Leaf nodes write to the file system
- Host nodes write too much data

Two use cases:

- My house is on fire
- My house was on fire, but I missed it

Integration with RTM makes this possible.

Example contracts

Example contract:

```
monitoringtimeframe,60s
NAME   PATH/MOUNT POINT    IO TYPE              LIMIT
M1,    /gpfs/,             read,                500MB
M2,    /gpfs/,             write                500MB
M3,    /gpfs/,             create+delete,       2000
```

Example alert:

TIME	RULE	VIOLATION	PID	PROGRAM	FILE	JOB ID
17:30:05	M1	643MB/60s,	2784,	/tools/bin,	/gpfs/tools/config,	12
17:30:05	M2	505MB/60s,	2784,	/tools/bin,	/gpfs/data/file01,	12
17:30:06	M3	7405/60s,	2784,	/tools/bin,	/gpfs/data/set05,	12

Mistral RTM integration: Goals

A way for LSF administrators to profile new workflows.

At-a-glance monitoring exceptions delivered by Mistral.

To integrate with RTM's Fault Management framework.

To give users the ability to review the storage profile of their applications.

To keep the R&D environment "clean"

Mistral RTM integration: Per job events

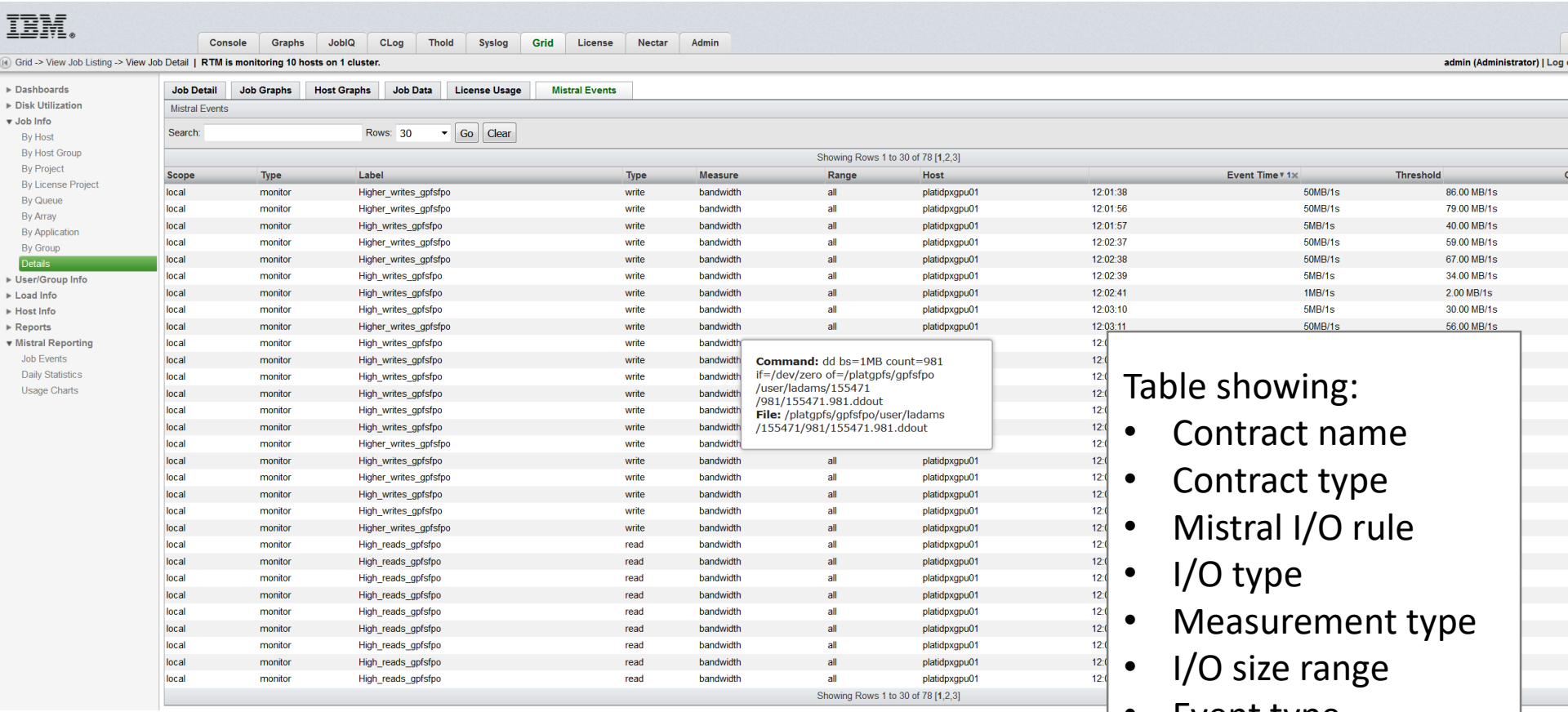


Table showing:

- Contract name
- Contract type
- Mistral I/O rule
- I/O type
- Measurement type
- I/O size range
- Event type
- Threshold
- Observed I/O

Mistral RTM integration: Who is using the storage?

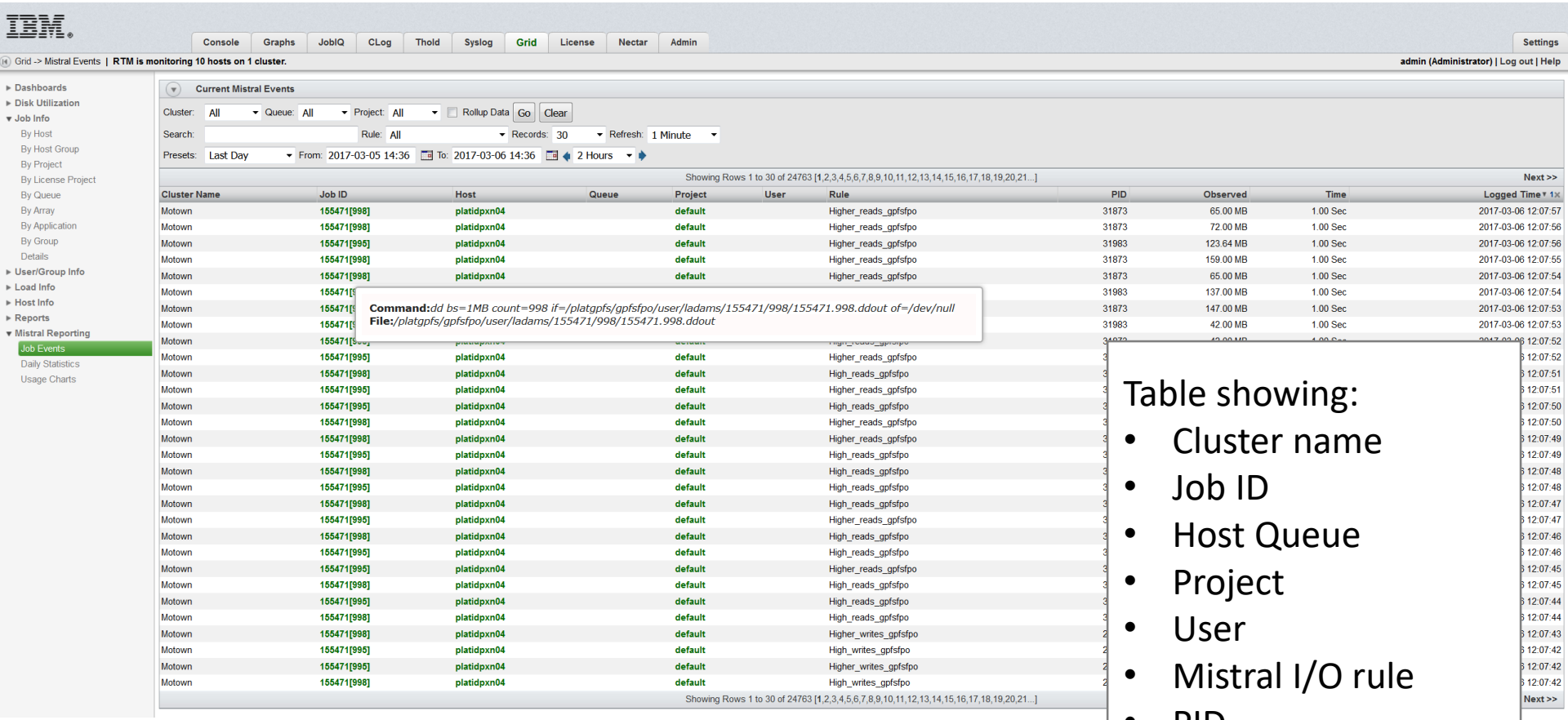


Table showing:

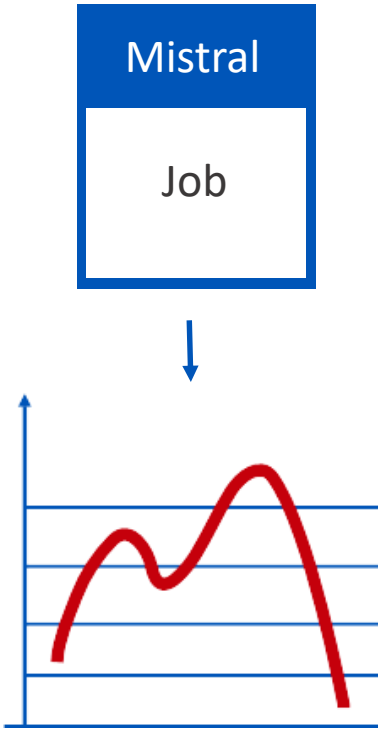
- Cluster name
- Job ID
- Host Queue
- Project
- User
- Mistral I/O rule
- PID
- I/O observed (MB)
- Time frame
- Log time

Customer case study:
Protecting the file system from R&D jobs

R&D jobs often seg fault and this exposes Mistral.
How to protect the storage without changing the R&D environment?

Solution
1. Guess which job is causing the problem the old way
2. Check problem jobs by profiling I/O in detail

Set up a special LSF queue with a detailed Mistral I/O profiling contract.



Make every user an I/O expert

Summary

Profile profile profile.

Protect your storage by monitoring the whole cluster for rogue jobs. Prevent bad I/O patterns by running health checks on new work flows.

Optimise applications for shared storage and optimise the compute and storage infrastructure for the jobs.

Thank you

Please get in touch for more information.

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