

# ESS deployment

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# What we done have done

- Reduced number of commands
  - From over 400 on 2.5.0 to just two on 6.1.2
- Unified package, single from Fix Central
  - With three OS versions and three processor architectures
- Moving into VMs (CES on ESS 3500, BYOE, Utility Node, ESS 6000)
- Moving into API (essrun 6.1.6)
- Safety over speed of updates; fire and forget
  - Serial option became the default on 6.1.3
- **Faster offline updates, up to 100 ESS in parallel**

# What we done have done

- Provide the XCAT most used commands
  - rpower -> essrpower
  - rconsole -> esscongo
  - rvitals, rinv -> not documented command ;) esshwinvmon.py
- Trim documentation whenever possible
  - Quick sheet – 1 pager
  - Quick deployment guide ~5 pages
  - Deployment guide over 100 pages
- And many more things ...
  - Bare metal images for EMS
  - Add checks on ... everything we can
  - ...

KISS

UFIBL

# What we want to do

- Upgrades with GUI
- Real unified package (DAE + DME)
- Merge all documentation to ONE per version
- Do as much as possible with automation, fire and forget
  - All firmware
  - NTP
  - Serial console
  - “easy” setup with defaults

Thank you for using  
IBM Storage Scale!



# IBM ESS 6.1.8 Fabric Hospital

Jonathan Turner | GNR development

# Overview

- Problem Statement
- Introducing the ESS 6.1.8 Fabric Hospital
- Architecture
- Setup instructions
- Monitoring events
- Limitations
- Future Work

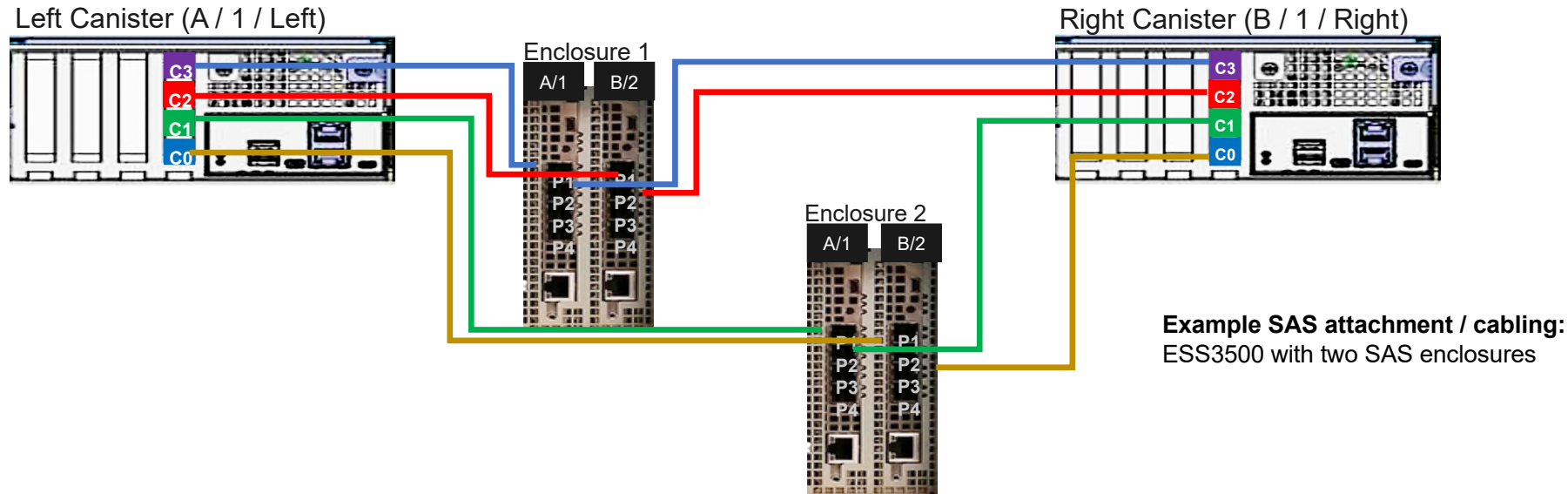


# Problem Statement

- Going beyond the disks to identify problems
- (Previously) Non disk problems can cause I/O errors that can disrupt service
  - Disk Hospital is still forced to remove the disks from service and investigate before releasing the drives
  - If the problem is truly not a disk problem, then no action or proper alerts will be raised
- Platform code has knowledge of the topology:
  - We can exploit that to isolate problems!

# ESS Fabric Hospital

The ESS Fabric Hospital is designed to identify and isolate problems that are impacting I/O availability.



- Collects new metric *gpfs\_fabhospital\_errorIOCount* per Canister/Adapter/Port/Enclosure/Slot
- Leverages *mmhealth custom thresholds* to group I/O error information based on hardware topology and allow users to configure warning/error threshold levels.
  - *SASPortErrorThreshold* → all enclosures/slots attached to this port see errors
  - *SASEnclosureErrorThreshold* → all slots in an enclosure see errors

ESS Fabric Hospital is only supported on the ESS 3500 platform and later models and is currently limited to SAS-based error monitoring.

# Architecture

- ESS Fabric Hospital split into 3 conceptual parts:
  - Data collection layer
    - Incrementally sample real time I/O and other system information
  - Data Saving layer
    - Persistently store and format data collection
  - Analysis + Event Presentation layer
    - Respond to events in real time and surface events to users

# Architecture Cont.

- 6.1.8 delivers the data collection and data saving layer and an abbreviated form of analysis.
  - I/O data and I/O errors collected from the GNR daemon in real time
  - Topology information (via mmgetpdisktoplogy + topsummary) is collected and stored in HAL
  - Pmsensor proxy called HAL, HAL combines topology data and daemon data into a consistent view, and data is stored on the Pmcollector node (for ESS, this should be the EMS node)
  - Analysis is done with “user-defined” thresholds (via mmhealth thresholds code)

# Setup Instructions

- The general flow is this:
  1. Prerequisite of having the gui deployed via the ess deployment scripts (this installs necessary Zimon packages and initial config of the collector)
  2. Installing the sensor (a sample script is provided in `/usr/lpp/mmfs/samples/vdisk/install_essfabrichospital_sensor`)
  3. Installing the thresholds

# Sensor Install

- Needs to avoid time skew:
  - Daemon will continue to collect data even if it isn't being sampled
  - The first time the Zimon sensor is installed, an initial collection will run, and Zimon will think that all this data has been recorded in the past 15 minutes (even if it has been much long). Can lead to false positives.
- So, it is required to reset the daemon data first to get a clean slate
  - Can be done manually (steps published on the knowledge center) via the `tsgnrgethospdata <rg> --reap` command
  - However, we need to wait > 150 seconds after the reset for the data to populate again
  - GNR rate limits data collection, so if you don't wait, the next sample will be **invalid**
- Best practice:
  - Use the `/usr/lpp/mmfs/samples/vdisk/install_essfabrichospital_sensor` script, which does the resets and adds appropriate sleep time
  - Run I/O (don't have the system idle) while installing the sensors
  - If all else fails, wait a period of 15 minutes after installing the sensors before going to the next step

# Install sensor demo

```
root@c145f13san01a:/usr/lpp/mmfs/samples/vdisk
root@c145f13san01a:/usr/lpp/mmfs/samples/vdisk (ssh)

[root@c145f13san01a ~]# mmperfmon config show | grep -i gpfsfabrichospital -A3
[root@c145f13san01a ~]# cd /usr/lpp/mmfs/samples/vdisk
[root@c145f13san01a vdisk]# ls
chdrawer          gnrcallback.sh          mkp7rginput          README              tsfindbadfile.sh
ckp7portcard      gnrhealthcheck          mkrinput             replace-at-location  vdisk.stanza
dasEDFTool.py     hospitalPathDataSample.py mmgetpdisktopology    topselect            viostat
decodePdiskState  install_essfabrichospital_sensor netappdc mreboot.sh  topsummary

[root@c145f13san01a vdisk]# ./install_essfabrichospital_sensor
usage: install_essfabrichospital_sensor [-h] [-f FILE]
                                         [--override-sleep OVERRIDE_SLEEP]
                                         node_class_list

install_essfabrichospital_sensor: error: the following arguments are required: node_class_list
[root@c145f13san01a vdisk]# ./install_essfabrichospital_sensor nc1
['ssh', 'c145f13san01b-ib', '/usr/lpp/mmfs/bin/tsgnrcollectserverpathdata', '--reap']
['ssh', 'c145f13san01a-ib', '/usr/lpp/mmfs/bin/tsgnrcollectserverpathdata', '--reap']
Sleeping for 31 second(s) to synchronize sensors with GNR daemon...
NOTE: make sure I/O is running on your system during this period.
I/O activity will ensure that the Zimon collector receives the correct data
mmperfmon: Propagating the cluster configuration data to all
         affected nodes. This is an asynchronous process.
Proceed to installing user-defined thresholds for the gpfs_fabhospital_errorIOCount metric if not already done
[root@c145f13san01a vdisk]# mmperfmon config show | grep -i gpfsfabrichospital -A3
      name = "GPFSFabrichospital"
      period = 900
      restrict = "nsdNodes"
      type = "Generic"
[root@c145f13san01a vdisk]#
```

# Threshold install

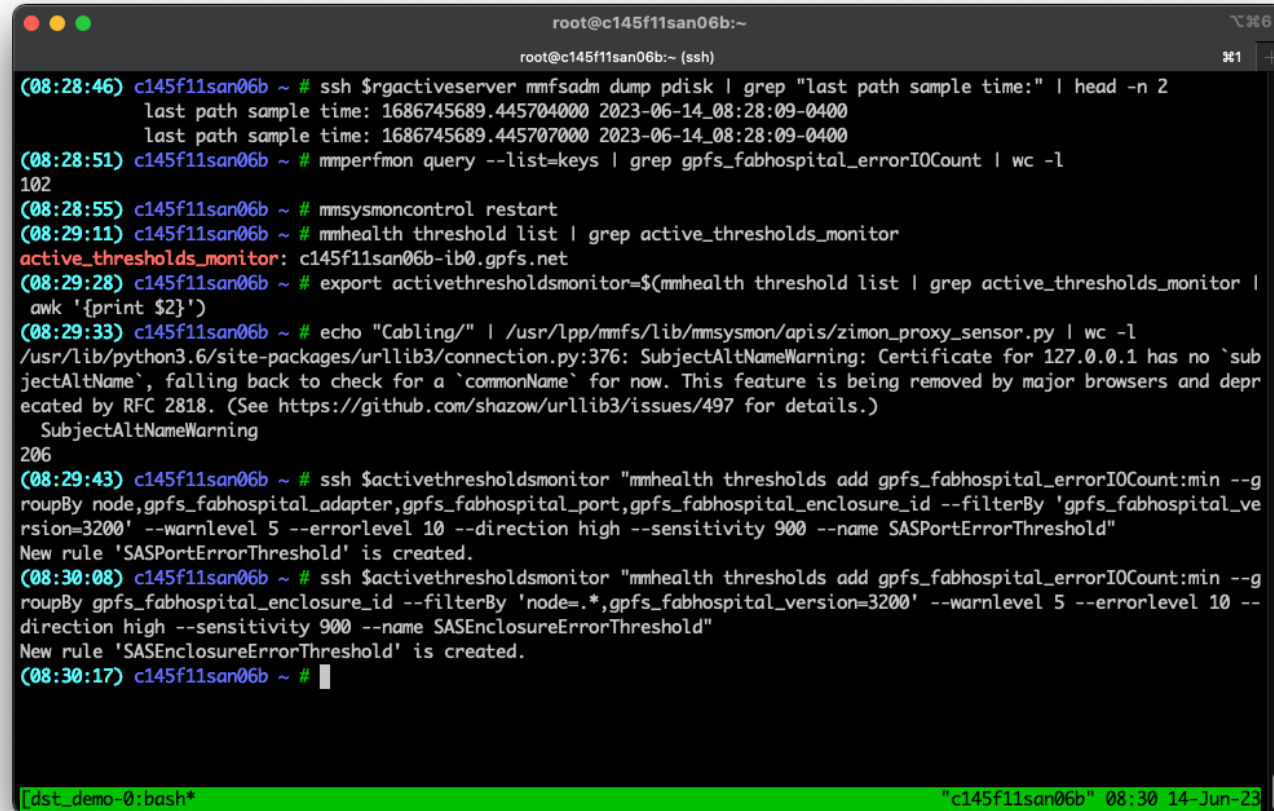
- User defined thresholds via mmhealth require samples of ESS hospital data to already be found in Zimon before being configured
  - There is no default provided schema, so you need a valid sample fist
  - This is why the sample install script inserts an extra wait
- Prior to doing the install, requires mmsysmon reset (mmsysmoncontrol restart)
  - Known issue, future versions won't have this issue.

```
mmhealth thresholds add gpfs_fabhospital_errorIOCount:min --groupBy  
node,gpfs_fabhospital_adapter,gpfs_fabhospital_port,gpfs_fabhospital_enclosure_id --filterBy 'gpfs_fabhospital_version=3200' --warnlevel  
5 --errorlevel 10 --sensitivity 900 --name SASPortErrorThreshold
```

```
mmhealth thresholds add gpfs_fabhospital_errorIOCount:min --groupBy gpfs_fabhospital_enclosure_id --filterBy  
'node=.*,gpfs_fabhospital_version=3200' --warnlevel 5 --errorlevel 10 --sensitivity 900 --name SASEnclosureErrorThreshold
```



# Threshold install demo



```
root@c145f11san06b:~  
root@c145f11san06b:~ (ssh)  
(08:28:46) c145f11san06b ~ # ssh $rgactiveserver mmfsadm dump pdisk | grep "last path sample time:" | head -n 2  
last path sample time: 1686745689.445704000 2023-06-14_08:28:09-0400  
last path sample time: 1686745689.445707000 2023-06-14_08:28:09-0400  
(08:28:51) c145f11san06b ~ # mmpfmon query --list=keys | grep gpfs_fabhospital_errorIOCount | wc -l  
102  
(08:28:55) c145f11san06b ~ # mmsysmoncontrol restart  
(08:29:11) c145f11san06b ~ # mmhealth threshold list | grep active_thresholds_monitor  
active_thresholds_monitor: c145f11san06b-ib0.gpfs.net  
(08:29:28) c145f11san06b ~ # export activethresholdsmonitor=$(mmhealth threshold list | grep active_thresholds_monitor |  
awk '{print $2}')  
(08:29:33) c145f11san06b ~ # echo "Cabling/" | /usr/lpp/mmfs/lib/mmsysmon/apis/zimon_proxy_sensor.py | wc -l  
/usr/lib/python3.6/site-packages/urllib3/connection.py:376: SubjectAltNameWarning: Certificate for 127.0.0.1 has no `sub  
jectAltName`, falling back to check for a `commonName` for now. This feature is being removed by major browsers and depr  
ecated by RFC 2818. (See https://github.com/shazow/urllib3/issues/497 for details.)  
SubjectAltNameWarning  
206  
(08:29:43) c145f11san06b ~ # ssh $activethresholdsmonitor "mmhealth thresholds add gpfs_fabhospital_errorIOCount:min --g  
roupBy node,gpfs_fabhospital_adapter,gpfs_fabhospital_port,gpfs_fabhospital_enclosure_id --filterBy 'gpfs_fabhospital_ve  
rsion=3200' --warnlevel 5 --errorlevel 10 --direction high --sensitivity 900 --name SASPortErrorThreshold"  
New rule 'SASPortErrorThreshold' is created.  
(08:30:08) c145f11san06b ~ # ssh $activethresholdsmonitor "mmhealth thresholds add gpfs_fabhospital_errorIOCount:min --g  
roupBy gpfs_fabhospital_enclosure_id --filterBy 'node=.*,gpfs_fabhospital_version=3200' --warnlevel 5 --errorlevel 10 --  
direction high --sensitivity 900 --name SASEnclosureErrorThreshold"  
New rule 'SASEnclosureErrorThreshold' is created.  
(08:30:17) c145f11san06b ~ #  
[dst_demo-0:~] bash* "c145f11san06b" 08:30 14-Jun-23
```

# Checking threshold install

```
root@c145f11san06b:~
root@c145f11san06b:~ (ssh)

(08:30:40) c145f11san06b ~ # ssh $activethresholdsmonitor 'mmhealth thresholds list'

active_thresholds_monitor: c145f11san06b-ib0.gpfs.net
### Threshold Rules ###
rule_name      metric      error warn direction filterBy
groupBy                                     sensitivity
-----
MemFree_Rule   MemoryAvailable_percent  None  5.0  low
node                                     300-min
DataCapUtil_Rule DataPool_capUtil      90.0  80.0  high
gpfs_cluster_name,gpfs_fs_name,gpfs_diskpool_name 300
MetaDataCapUtil_Rule MetaDataPool_capUtil  90.0  80.0  high
gpfs_cluster_name,gpfs_fs_name,gpfs_diskpool_name 300
InodeCapUtil_Rule Filesset_inode      90.0  80.0  high
gpfs_cluster_name,gpfs_fs_name,gpfs_fset_name 300
SMBConnPerNode_Rule current_connections  3000  None  high
node                                     300
SMBConnTotal_Rule current_connections  20000 None  high
node                                     300
AFMInQueue_Rule AFMInQueueMemory_percent 90.0  80.0  high
node                                     300
SASPortErrorThreshold gpfs_fabhospital_errorIOCount 10  5  high gpfs_fabhospital_version=3200
node,gpfs_fabhospital_adapter,gpfs_fabhospital_port,gpfs_fabhospital_enclosure_id 900
SASEnclosureErrorThreshold gpfs_fabhospital_errorIOCount 10  5  high node=.*,gpfs_fabhospital_version=3200
gpfs_fabhospital_enclosure_id 900
(08:30:52) c145f11san06b ~ #
```

```
root@c145f11san06b:~
root@c145f11san06b:~ (ssh)

(08:32:29) c145f11san06b ~ # mmhealth node show threshold -N $nodeclass

Node name:      c145f11san06a-ib0.gpfs.net

Component      Status      Status Change      Reasons & Notices
-----
THRESHOLD      HEALTHY      2 min. ago      -

There are no active error events for the component THRESHOLD on this node (c145f11san06a-ib0.gpfs.net).

Node name:      c145f11san06b-ib0.gpfs.net

Component      Status      Status Change      Reasons & Notices
-----
THRESHOLD      HEALTHY      3 min. ago      -
MemFree_Rule   HEALTHY      2 min. ago      -
SASEnclosureErrorThreshold HEALTHY      1 min. ago      -
active_thresh_monitor HEALTHY      3 min. ago      -

There are no active error events for the component THRESHOLD on this node (c145f11san06b-ib0.gpfs.net).
(08:32:33) c145f11san06b ~ #
(08:32:41) c145f11san06b ~ #
(08:32:45) c145f11san06b ~ #
(08:32:45) c145f11san06b ~ #
(08:32:45) c145f11san06b ~ #
(08:32:45) c145f11san06b ~ #
(08:32:45) c145f11san06b ~ #
(08:32:46) c145f11san06b ~ #
(08:32:46) c145f11san06b ~ #
```

# Intuition behind thresholds

- If an upstream storage component (e.g. an HBA port) is being reported by a component downstream (e.g. a specific pdisk path), then the expectation is that ALL downstream components will report some minimum impact.
  - The current threshold uses a “min” and groups by enclosures and by SAS ports
  - SAS Ports are for individual connections between nodes, adapters + ports, enclosures, and disk slots.
  - Enclosure thresholds are for IO events at the enclosure level.
  - Default is to warn for 5 errors per component and raise error at 10 errors per component every 10 minutes

# Monitoring Events

- Via “mmhealth node show threshold”
- Via “mmhealth node eventlog”
- Via GUI

# Flagging problems

```
root@c145f11san06b:~  
root@c145f11san06b:~ (ssh)  
(08:38:14) c145f11san06b ~ # mmlsrecoverygroupevents $rg | head -15  
Wed Jun 14 08:38:15.675 2023 c145f11san06b-ib0 ST [I] Start rebalance of DA DA2 in RG rg1.  
Wed Jun 14 08:38:15.660 2023 c145f11san06b-ib0 ST [I] End readmitting 1/3-degraded tracks of RG001LG005VS002.  
Wed Jun 14 08:38:15.660 2023 c145f11san06b-ib0 ST [I] Start readmitting 1/3-degraded tracks of RG001LG005VS002.  
Wed Jun 14 08:38:15.609 2023 c145f11san06b-ib0 ST [I] Finished repairing RGD/VCD in RG rg1.  
Wed Jun 14 08:38:15.601 2023 c145f11san06b-ib0 ST [D] Pdisk e2s008 of RG rg1 state changed from ok/00000.000 to diagnosi  
ng/00020.000.  
Wed Jun 14 08:38:15.601 2023 c145f11san06b-ib0 ST [E] Pdisk e2s008 of RG rg1 path /dev/sdzh: I/O error on write: sector  
14122480432 length 4112 err 5.  
Wed Jun 14 08:38:15.558 2023 c145f11san06b-ib0 ST [I] Start repairing RGD/VCD in RG rg1.  
Wed Jun 14 08:38:15.539 2023 c145f11san06b-ib0 ST [I] Abort rebalance of DA DA2 in RG rg1.  
Wed Jun 14 08:38:15.539 2023 c145f11san06b-ib0 ST [D] Pdisk e2s093 of RG rg1 state changed from diagnosing/00020.000 to  
ok/00000.000.  
Wed Jun 14 08:38:15.539 2023 c145f11san06b-ib0 ST [D] Pdisk e2s070 of RG rg1 state changed from ok/00000.000 to diagnosi  
ng/00020.000.  
Wed Jun 14 08:38:15.508 2023 c145f11san06b-ib0 ST [I] Start rebalance of DA DA2 in RG rg1.  
Wed Jun 14 08:38:15.482 2023 c145f11san06b-ib0 ST [I] Finished repairing RGD/VCD in RG rg1.  
Wed Jun 14 08:38:15.428 2023 c145f11san06b-ib0 ST [E] Pdisk e2s070 of RG rg1 path /dev/sdgt: I/O error on write: sector  
7558526320 length 4112 err 5.  
Wed Jun 14 08:38:15.427 2023 c145f11san06b-ib0 ST [I] Start repairing RGD/VCD in RG rg1.  
Wed Jun 14 08:38:15.427 2023 c145f11san06b-ib0 ST [D] Pdisk e2s045 of RG rg1 state changed from ok/00000.000 to diagnosi  
ng/00020.000.  
(08:38:24) c145f11san06b ~ #
```

```
root@c145f11san06b:~  
root@c145f11san06b:~ (ssh)  
(08:59:07) c145f11san06b ~ # mmhealth node eventlog -N all | egrep "thresholds_warn|thresholds_error" | awk -F',' '{prin  
t $1" ... "$NF}'  
2023-06-14 08:54:43.653900 EDT thresholds_error ERROR The value of gpfs_fabhospital_errorIO  
Count for the component(s) SASEnclosureErrorThreshold/(c145f11san06b-ib0.gpfs.net/3200/4/1/CFNH032/82 ... c145f11san06b-  
ib0.gpfs.net/3200/4/1/CFNH032/1) exceeded the threshold error level 2 defined in SASEnclosureErrorThreshold.  
2023-06-14 08:58:58.761517 EDT thresholds_error ERROR The value of gpfs_fabhospital_errorIO  
Count for the component(s) SASPortErrorThreshold/(c145f11san06b-ib0.gpfs.net/3200/4/1/CFNH032/6 ... c145f11san06b-ib0.gp  
fs.net/3200/4/1/CFNH032/1) exceeded the threshold error level 2 defined in SASPortErrorThreshold.  
2023-06-14 08:58:58.781557 EDT thresholds_error ERROR The value of gpfs_fabhospital_errorIO  
Count for the component(s) SASPortErrorThreshold/(c145f11san06b-ib0.gpfs.net/3200/4/2/CFNH032/3 ... c145f11san06b-ib0.gp  
fs.net/3200/4/2/CFNH032/95) exceeded the threshold error level 2 defined in SASPortErrorThreshold.  
(08:59:09) c145f11san06b ~ #
```



# mmhealth node show threshold

Node name: c145f11san06a-ib0.gpfs.net

Component	Status	Status Change	Reasons & Notices
THRESHOLD	DEGRADED	14 min. ago	thresholds_warn(SASEnclosureErrorThreshold, SASPortErrorThreshold, SASPortErrorThreshold)
MemFree_Rule	HEALTHY	1 day ago	-
SASEnclosureErrorThreshold	DEGRADED	14 min. ago	thresholds_warn(SASEnclosureErrorThreshold)
SASPortErrorThreshold	DEGRADED	4 min. ago	thresholds_warn(SASPortErrorThreshold, SASPortErrorThreshold)
active_thresh_monitor	HEALTHY	1 day ago	-

Event	Parameter	Severity	Active Since	Event Message
thresholds_warn	SASEnclosureErrorThreshold	WARNING	14 min. ago	The value of gpfs_fabhospital_errorIOCount for the component(s) SASEnclosureErrorThreshold/(c145f11san06a-ib0.gpfs.net/3200/4/1/CFNH032/49,c145f11san06b-ib0.gpfs.net/3200/4/1/CFNH032/83,c145f11san06a-ib0.gpfs.net/3200/4/1/CFNH032/52,c145f11san06a-ib0.gpfs.net/3200/4/1/CFNH032/55,c145f11san06a-ib0.gpfs.net/3200/4/1/CFNH032/46,c145f11san06a-ib0.gpfs.net/3200/4/1/CFNH032/13,c145f11san06a-ib0.gpfs.net/3200/4/1/CFNH032/88,c145f11san06a-ib0.gpfs.net/3200/4/1/CFNH032/10,c145f11san06a-ib0.gpfs.net/3200/4/1/CFNH032/6,c145f11san06a-ib0.gpfs.net/3200/4/1/CFNH032/11,c145f11san06a-ib0.gpfs.net/3200/4/1/CFNH032/7,c145f11san06a-ib0.gpfs.net/3200/4/1/CFNH032/5,c145f11san06a-ib0.gpfs.net/3200/4/1/CFNH032/91,c145f11san06a-ib0.gpfs.net/3200/4/1/CFNH032/70,c145f11san06a-ib0.gpfs.net/3200/4/1/CFNH032/86,c145f11san06a-ib0.gpfs.net/3200/4/1/CFNH032/71,c145f11san06a-ib0.gpfs.net/3200/4/1/CFNH032/3,c145f11san06a-ib0.gpfs.net/3200/4/1/CFNH032/53,c145f11san06a-ib0.gpfs.net/3200/4/1/CFNH032/97,c145f11san06a-ib0.gpfs.net/3200/4/1/CFNH032/96,c145f11san06a-ib0.gpfs.net/3200/4/1/CFNH032/45,c145f11san06a-ib0.gpfs.net/3200/4/1/CFNH032/15,c145f11san06a-ib0.gpfs.net/3200/4/1/CFNH032/48,c145f11san06a-ib0.gpfs.net/3200/4/1/CFNH032/82,c145f11san06a-ib0.gpfs.net/3200/4/1/CFNH032/4,c145f11san06a-ib0.gpfs.net/3200/4/1/CFNH032/2,c145f11san06a-ib0.gpfs.net/3200/4/1/CFNH032/87,c145f11san06a-ib0.gpfs.net/3200/4/1/CFNH032/47,c145f11san06a-ib0.gpfs.net/3200/4/1/CFNH032/44,c145f11san06a-ib0.gpfs.net/3200/4/1/CFNH032/100,c145f11san06a-ib0.gpfs.net/3200/4/1/CFNH032/56,c145f11san06a-ib0.gpfs.net/3200/4/1/CFNH032/8,c145f11san06a-ib0.gpfs.net/3200/4/1/CFNH032/90,c145f11san06a-ib0.gpfs.net/3200/4/1/CFNH032/81,c145f11san06a-ib0.gpfs.net/3200/4/1/CFNH032/89,c145f11san06a-ib0.gpfs.net/3200/4/1/CFNH032/9,c145f11san06a-ib0.gpfs.net/3200/4/1/CFNH032/95,c145f11san06a-ib0.gpfs.net/3200/4/1/CFNH032/101,c145f11san06a-ib0.gpfs.net/3200/4/1/CFNH032/54) exceeded the threshold warning level 5 defined in SASEnclosureErrorThreshold.
thresholds_warn	SASPortErrorThreshold	WARNING	4 min. ago	The value of gpfs_fabhospital_errorIOCount for the component(s) SASPortErrorThreshold/(c145f11san06a-ib0.gpfs.net/3200/4/2/CFNH032/5,c145f11san06a-ib0.gpfs.net/3200/4/2/CFNH032/12,c145f11san06a-ib0.gpfs.net/3200/4/2/CFNH032/49,c145f11san06a-ib0.gpfs.net/3200/4/2/CFNH032/94,c145f11san06a-ib0.gpfs.net/3200/4/2/CFNH032/13,c145f11san06a-ib0.gpfs.net/3200/4/2/CFNH032/48,c145f11san06a-ib0.gpfs.net/3200/4/2/CFNH032/98,c145f11san06a-ib0.gpfs.net/3200/4/2/CFNH032/89,c145f11san06a-ib0.gpfs.net/3200/4/2/CFNH032/8,c145f11san06a-ib0.gpfs.net/3200/4/2/CFNH032/93,c145f11san06a-ib0.gpfs.net/3200/4/2/CFNH032/96,c145f11san06a-ib0.gpfs.net/3200/4/2/CFNH032/7,c145f11san06a-ib0.gpfs.net/3200/4/2/CFNH032/97,c145f11san06a-ib0.gpfs.net/3200/4/2/CFNH032/53,c145f11san06a-ib0.gpfs.net/3200/4/2/CFNH032/87,c145f11san06a-ib0.gpfs.net/3200/4/2/CFNH032/99,c145f11san06a-ib0.gpfs.net/3200/4/2/CFNH032/11,c145f11san06a-ib0.gpfs.net/3200/4/2/CFNH032/92,c145f11san06a-ib0.gpfs.net/3200/4/2/CFNH032/82,c145f11san06a-ib0.gpfs.net/3200/4/2/CFNH032/45,c145f11san06a-ib0.gpfs.net/3200/4/2/CFNH032/102,c145f11san06a-ib0.gpfs.net/3200/4/2/CFNH032/84,c145f11san06a-ib0.gpfs.net/3200/4/2/CFNH032/101,c145f11san06a-ib0.gpfs.net/3200/4/2/CFNH032/100,c145f11san06a-ib0.gpfs.net/3200/4/2/CFNH032/14,c145f11san06a-ib0.gpfs.net/3200/4/2/CFNH032/52,c145f11san06a-ib0.gpfs.net/3200/4/2/CFNH032/71,c145f11san06a-ib0.gpfs.net/3200/4/2/CFNH032/1,c145f11san06a-ib0.gpfs.net/3200/4/2/CFNH032/95,c145f11san06a-ib0.gpfs.net/3200/4/2/CFNH032/88,c145f11san06a-ib0.gpfs.net/3200/4/2/CFNH032/90,c145f11san06a-ib0.gpfs.net/3200/4/2/CFNH032/10,c145f11san06a-ib0.gpfs.net/3200/4/2/CFNH032/47,c145f11san06a-ib0.gpfs.net/3200/4/2/CFNH032/3,c145f11san06a-ib0.gpfs.net/3200/4/2/CFNH032/85,c145f11san06a-ib0.gpfs.net/3200/4/2/CFNH032/46,c145f11san06a-ib0.gpfs.net/3200/4/2/CFNH032/9,c145f11san06a-ib0.gpfs.net/3200/4/2/CFNH032/54,c145f11san06a-ib0.gpfs.net/3200/4/2/CFNH032/44) exceeded the threshold warning level 5 defined in SASPortErrorThreshold.

same

same

# Limitations

- Design setup has timing issues, even with provided setup tools and instructions
- Zimon data collection limited to 5-10 building blocks
  - Can be limited via custom Zimon sensor config file with user-defined nodeclass when building the sensor. Knowledge Center documents these steps.
- HAL is collecting topology once per 24 hours
  - If this gets stale, then it will take time for the rest of the system to catch up

# Future Work

- Improve set up process.
- Improve RAS event output (easier to interpret).
- Improve scaling beyond 5-10 nodes.
- Include other component monitoring.