Monitoring Cray Cooling Systems

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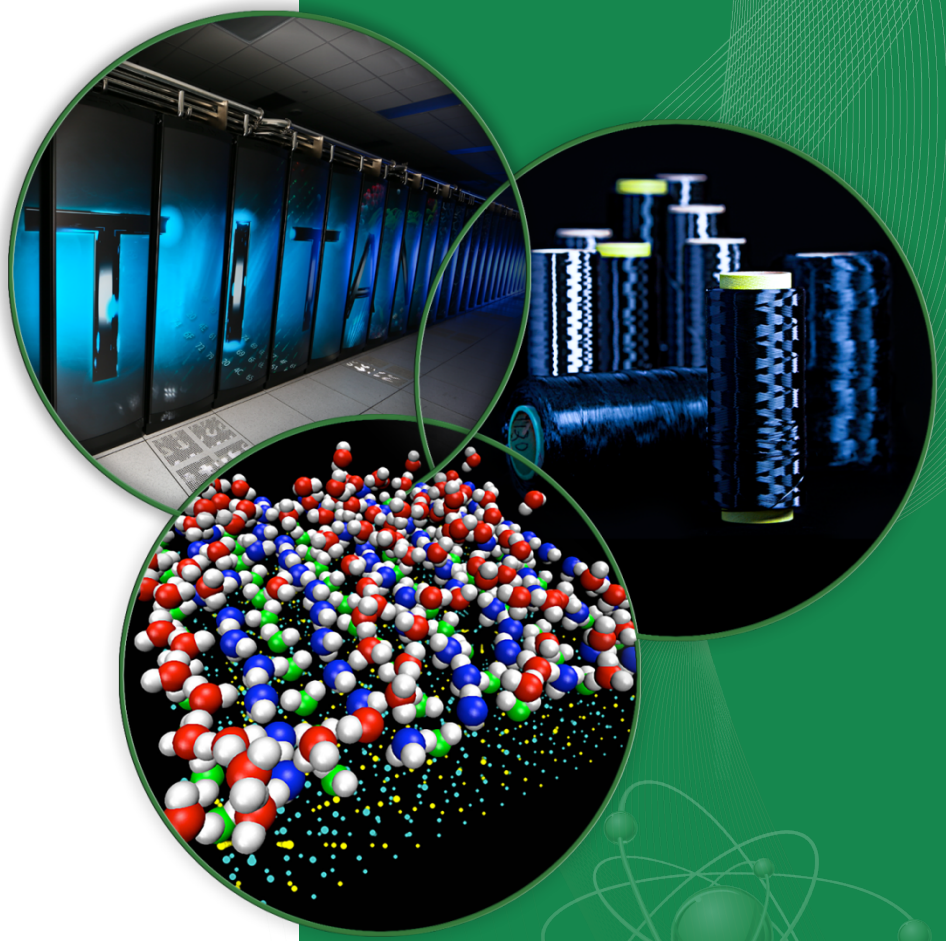

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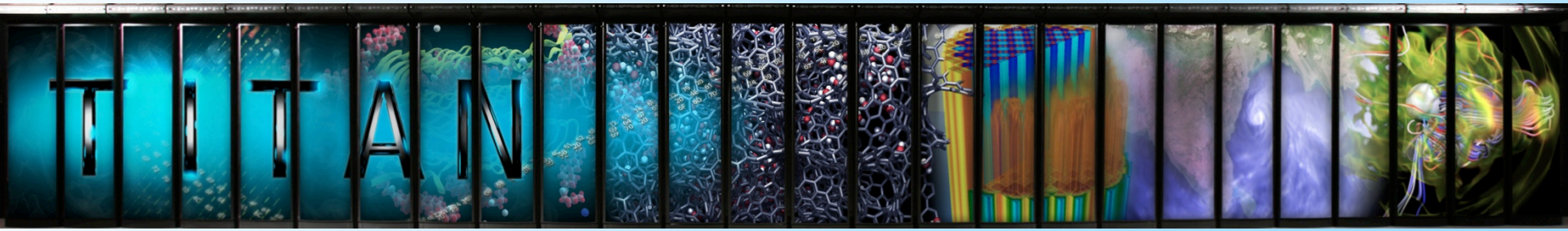
Titan



200 Cabinet Cray XK7

18688 AMD Interlagos CPUs

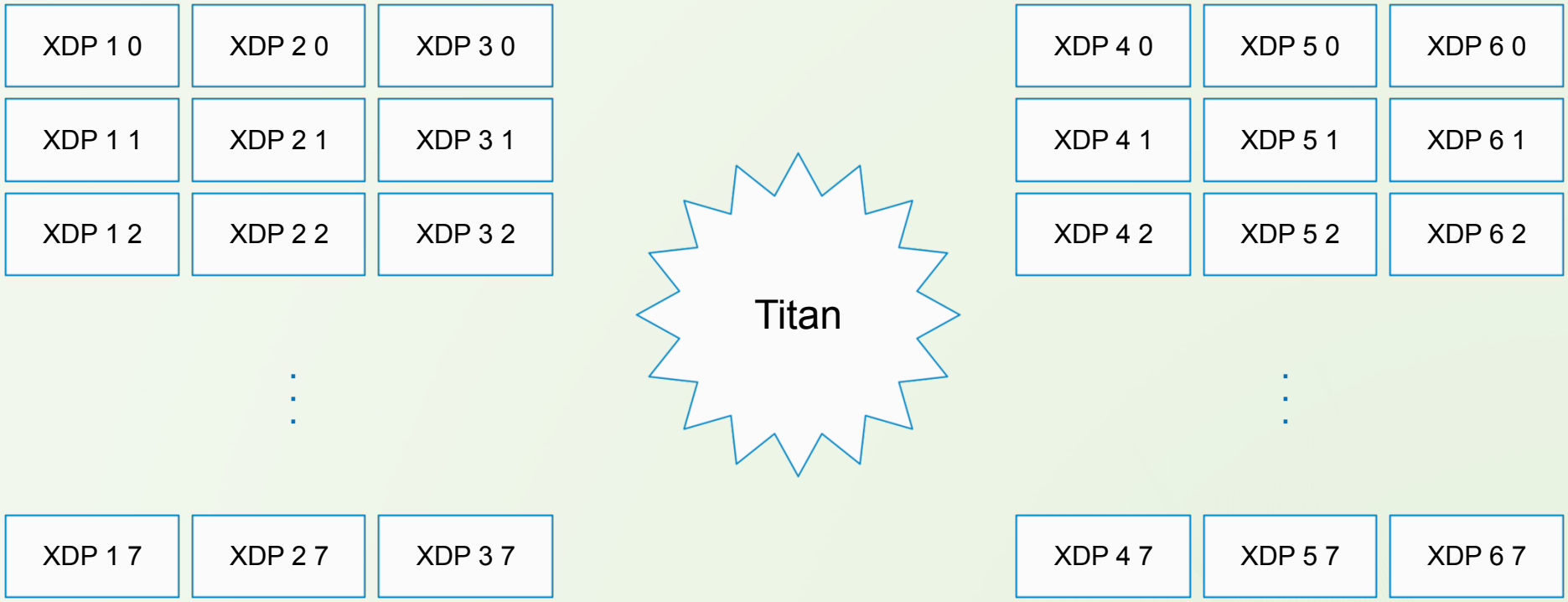
18688 Nvidia Kepler GPUs

512 Service Nodes (440 Lustre Routers)

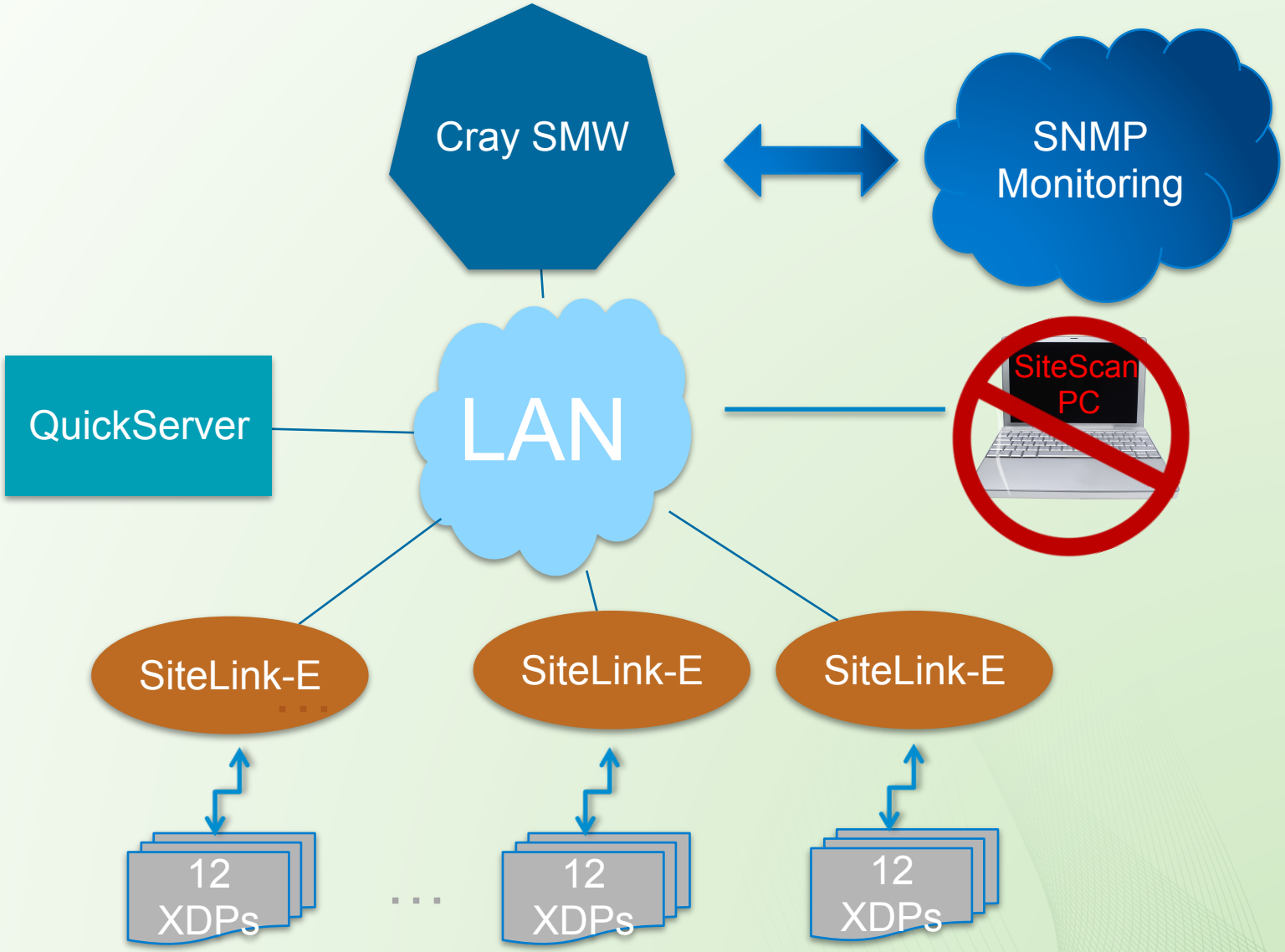
27PF Theoretical Peak

48 Liebert XDPs

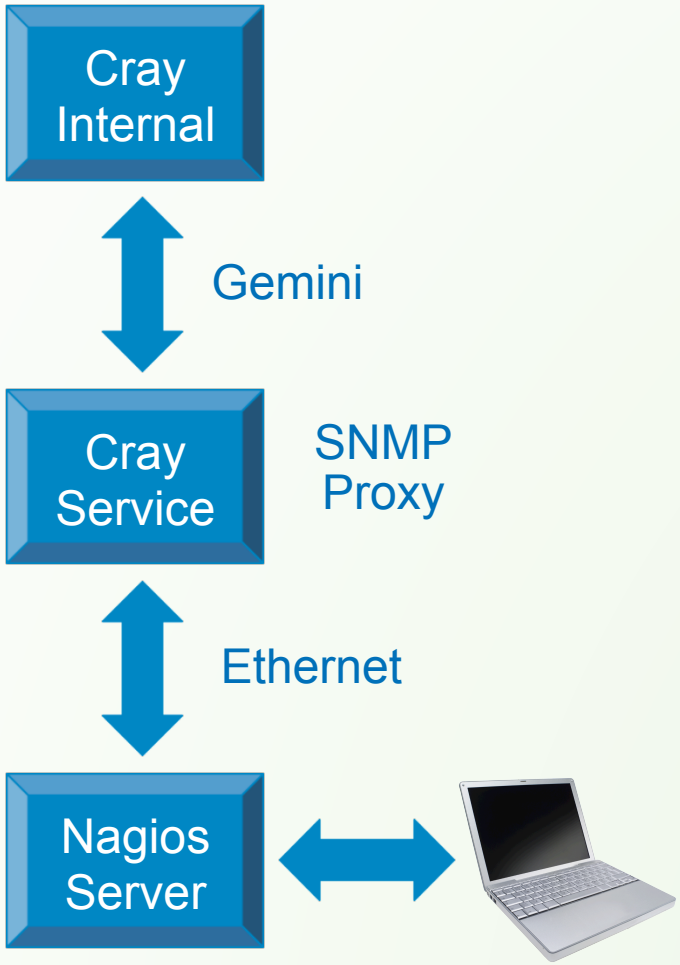
Titan Liebert XDP Layout



Titan Liebert XDP Network



OLCF Monitoring with Nagios®



- 24x7 monitoring by operators with GUI and email alerts to systems staff
- Primarily SNMP
- Custom scripts particularly for Crays
- Use SNMP proxies for accessing non-routed networks

FieldServer Technologies QuickServer

- BACnet ⇔ SNMP
- PC/Windows for configuration
- BACnet explorer to find data points
- Upload configuration using management app on PC
- SNMP MIB supplied

BACpypes

```
smw$ ~/bacpypes/samples/ReadProperty.py
> help read
read <addr> <type> <inst> <prop> [ <indx> ]
> read 192.168.168.2 analogValue 10 description
> Fluid Temp
> read 192.168.168.2 analogValue 10 presentValue
> 53.2000007629
> read 192.168.168.2 analogValue 10 units
> degreesFahrenheit
> read 192.168.168.2 binaryValue 11 description
> High Refrigerant Temp
> read 192.168.168.2 binaryValue 11 presentValue
> inactive
> exit
Exiting...
```

- Open Source BACnet application library
- Python
- Communicate directly with SiteLink-E devices
- Sample scripts provided are very useful

Comparison of BACnet Solutions

QuickServer

- Custom configuration for each installation
- Support must be involved to create or change configuration
- Limited data points due to licensing (11 per XDP)
- No problems once setup

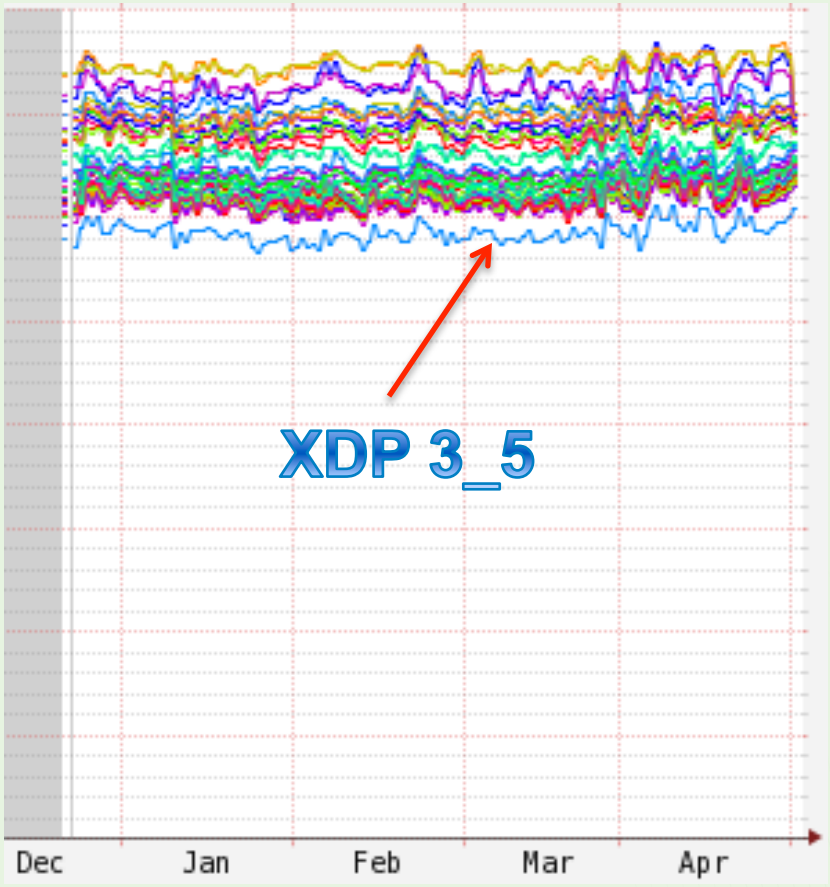
BACpypes

- Open Source
- No additional hardware
- Easy to add clients or data points to monitor
- Sample scripts provided

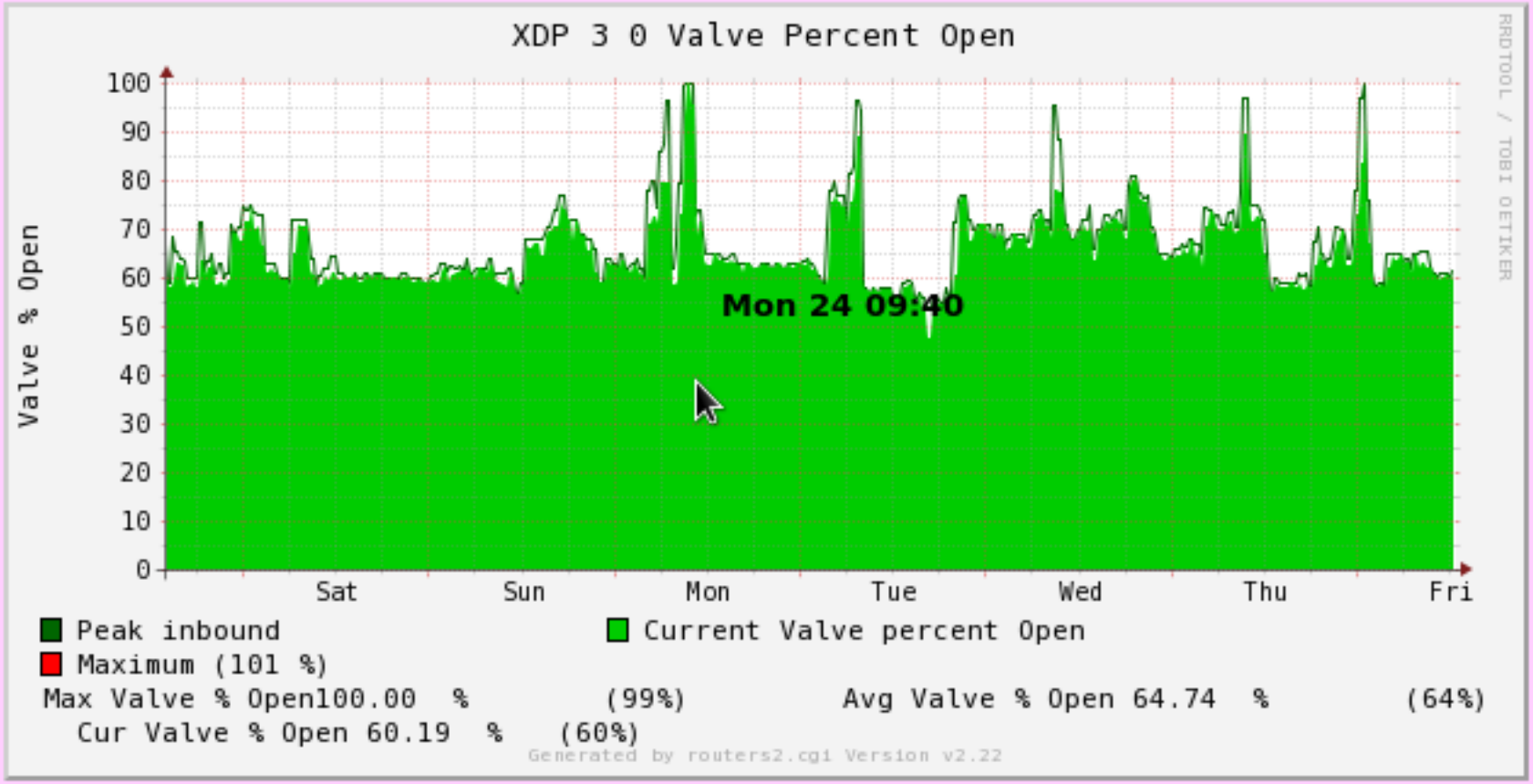
Results of XDP Monitoring System

- No catastrophic alarms so far
- Two types of alarms required some investigation
  - Local Temperature always below threshold on one XPD during downtime
  - Chilled water valve open to 100% on 3 occasions
- Using MRTG to graph XDP data points
  - Visual to spot outliers and trends
  - Not only visual but provides CSV data capture
  - Useful in investigation of alarms

XDP Local Temps



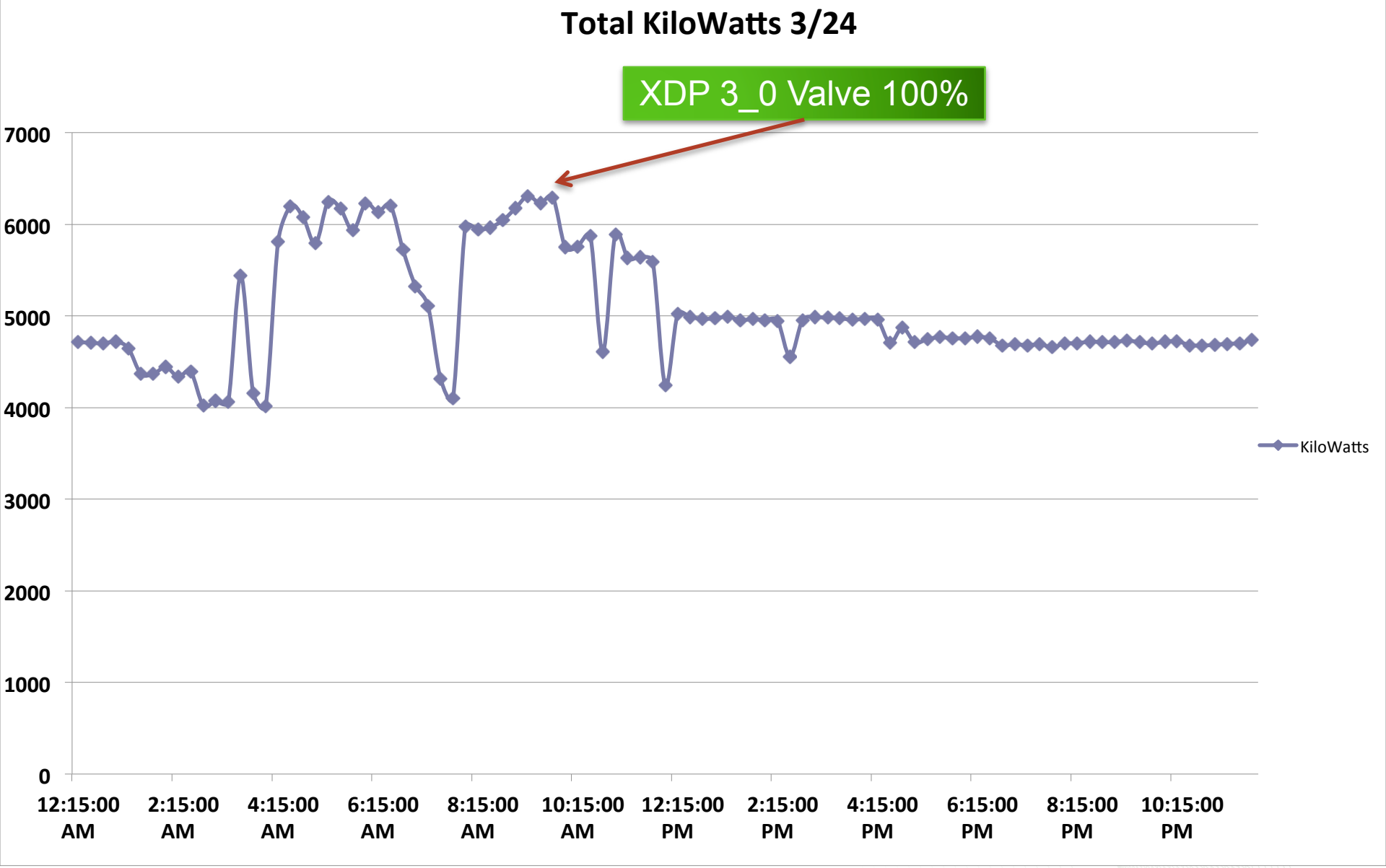
Weekly



Last update: Fri Apr 4 12:20:00 2014

Total over previous 7 days: Valve % Open 39.18 M%

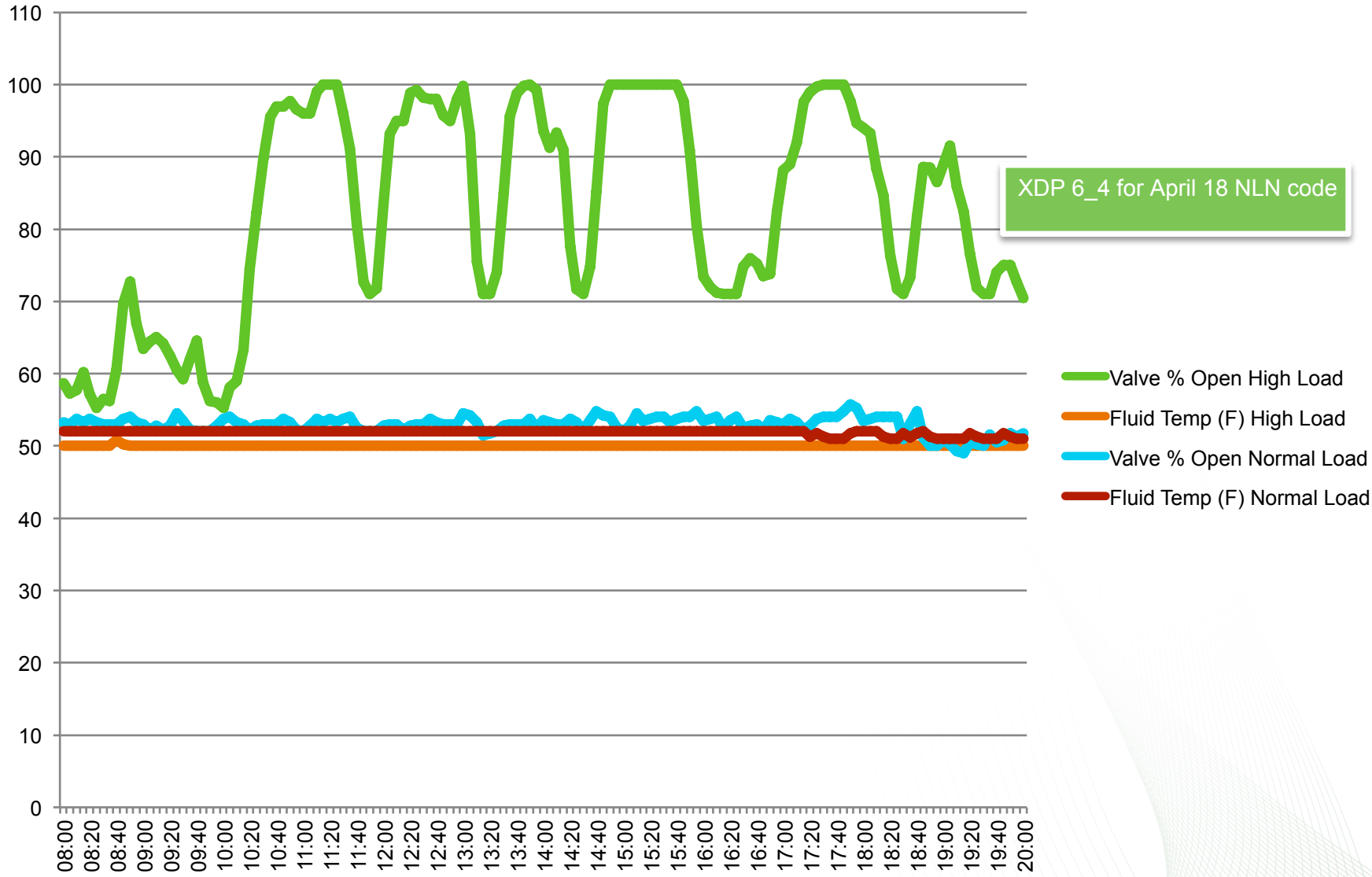
95th Percentile for previous 7 days: Valve % Open 77 % (76.24 %)


Total KiloWatts 3/24
XDP 3_0 Valve 100%
7000
6000
5000
4000
3000
2000
1000
0
12:15:00 AM
2:15:00 AM
4:15:00 AM
6:15:00 AM
8:15:00 AM
10:15:00 AM
12:15:00 PM
2:15:00 PM
4:15:00 PM
6:15:00 PM
8:15:00 PM
10:15:00 PM
KiloWatts

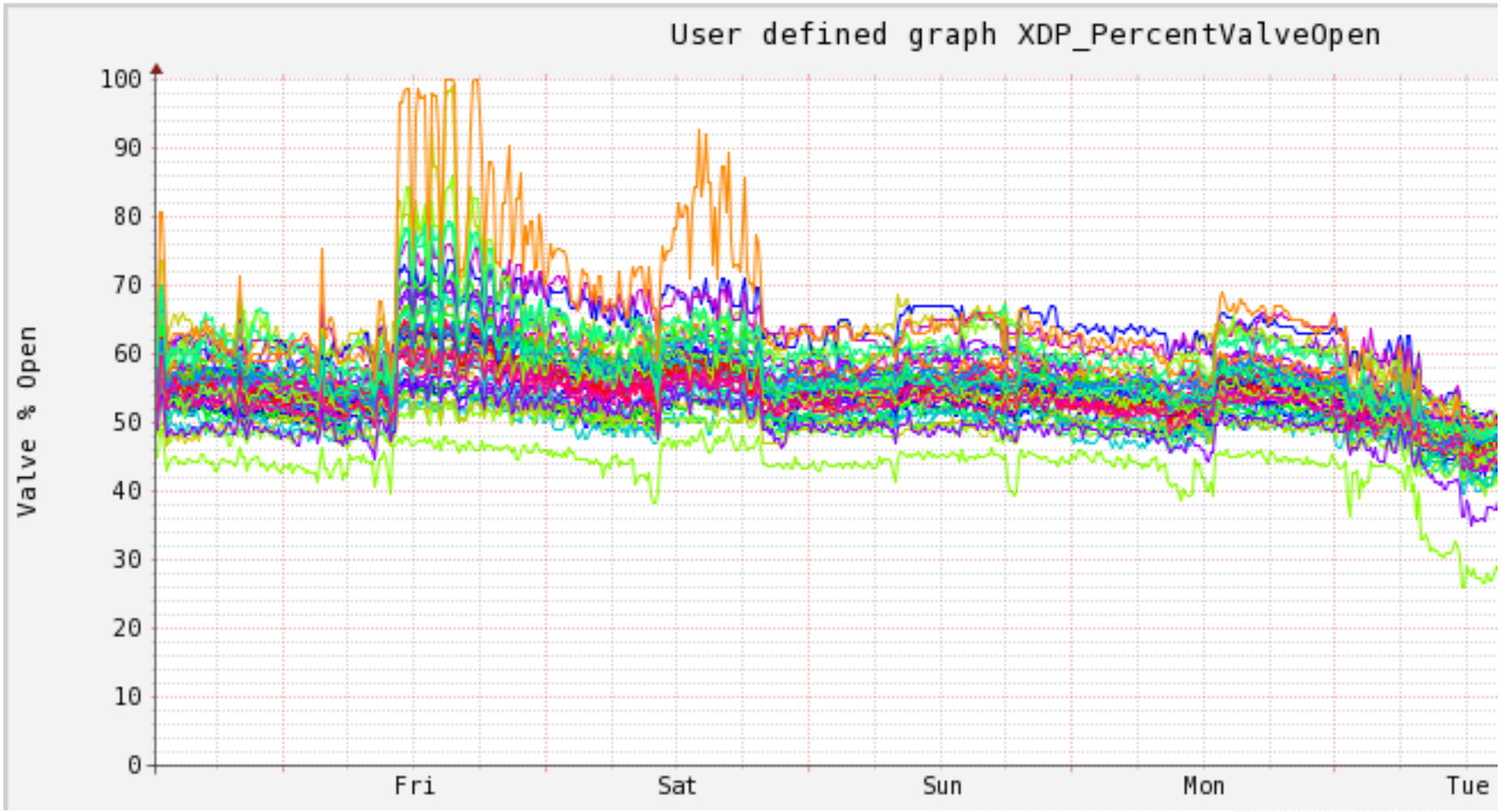
Periods of Valve 100% Open

Start and End Times	Alarms	Code	Size (Nodes)
03/24/2014 05:38:53 **03/24/2014 09:53:03**	6	DCA_GPU	1024
03/28/2014 00:47:56 **03/28/2014 01:29:29**	4	DCA_GPU	1024
04/18/2014 11:19:00 **04/18/2014 17:34:54**	5	NLN.CUDAXK7-MPI	12288

Fluid Temperature vs. Valve Percent Open



Valve Percent Open For NLN Run



Cray XC30 Cooling System Monitoring

```
smw> xtcheckhss –detail=f
```

Component	Module	Sensor	FRSH	HLMN	SLMN	DATA	UNIT	SLMX	HLMX
c0-0	blower_cabinet	speed0	1452	0	1550	3113	rpm	3150	3200
c0-0	blower_cabinet	temp0	1452	0	10	41	degc	80	100
c0-0	cabinet	blower_power_state	n/a	n/a	n/a	1	bool	n/a	n/a
c0-0	compute_cabinet	water_temp_in	1406	40	60	93	degc*10	250	300

- 4-cabinet Cray XC30
- Little investigation so far
- Same principles and methods
- Summer work