Experience In Power Measurements for Green500 Submission NCAR

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The NCAR Computing Environment

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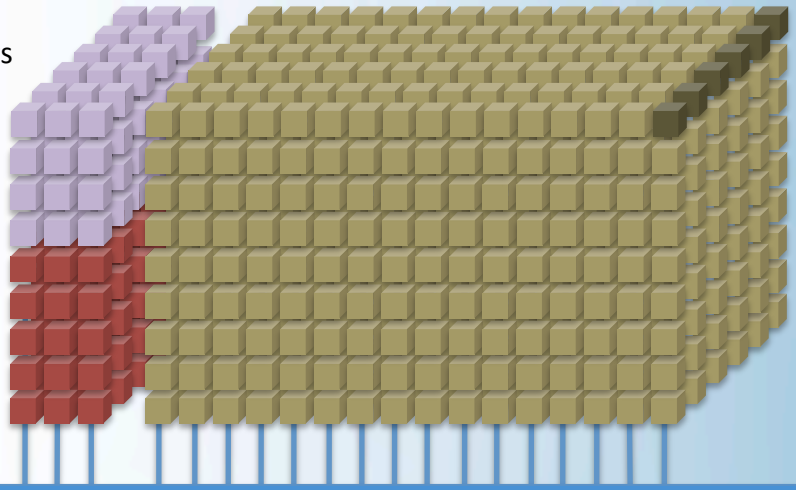
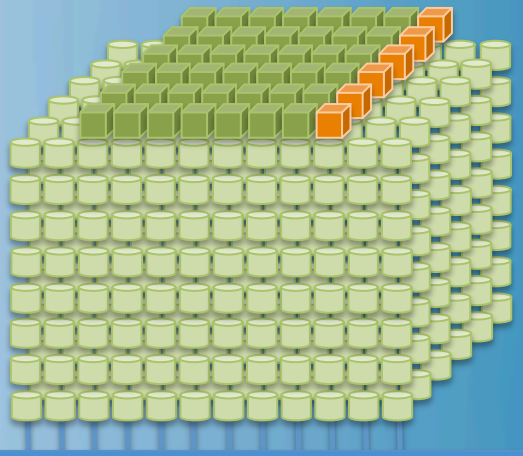
Geyser & Caldera
DAV clusters

Yellowstone
HPC resource, *1.50 PFLOPS peak*

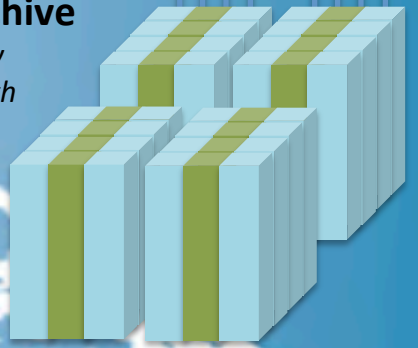


GLADE
Central disk resource
11 PB (2012), 16.4 PB (2014)



High Bandwidth Low Latency HPC and I/O Networks
FDR InfiniBand and 10Gb Ethernet

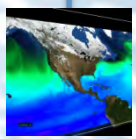
NCAR HPSS Archive
100 PB capacity
~15 PB/yr growth



1Gb/10Gb Ethernet (40Gb+ future)

Science Gateways
RDA, ESG

Data Transfer Services



Remote Vis

Partner Sites

XSEDE Sites

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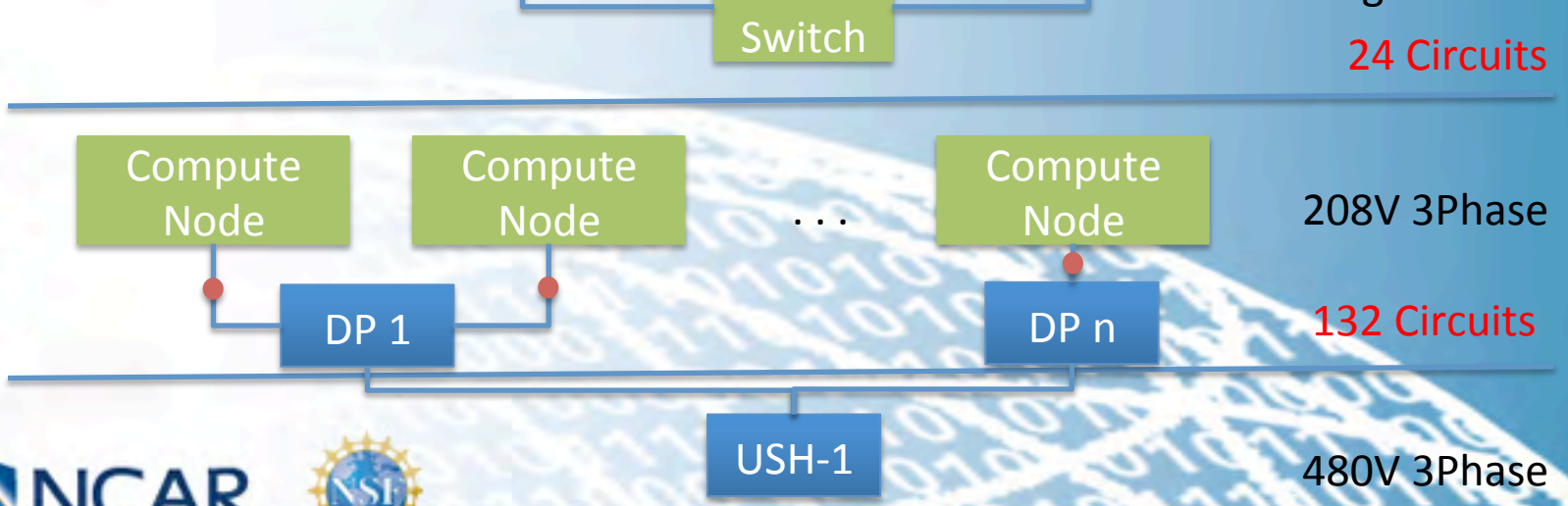
What We Initially Set Out To Do

- Not a Utility Grade Meter
- Accuracy
  - Current: 2% (2-60A)
  - Voltage: 1%
  - KW& KVA: 3% (2-60A)



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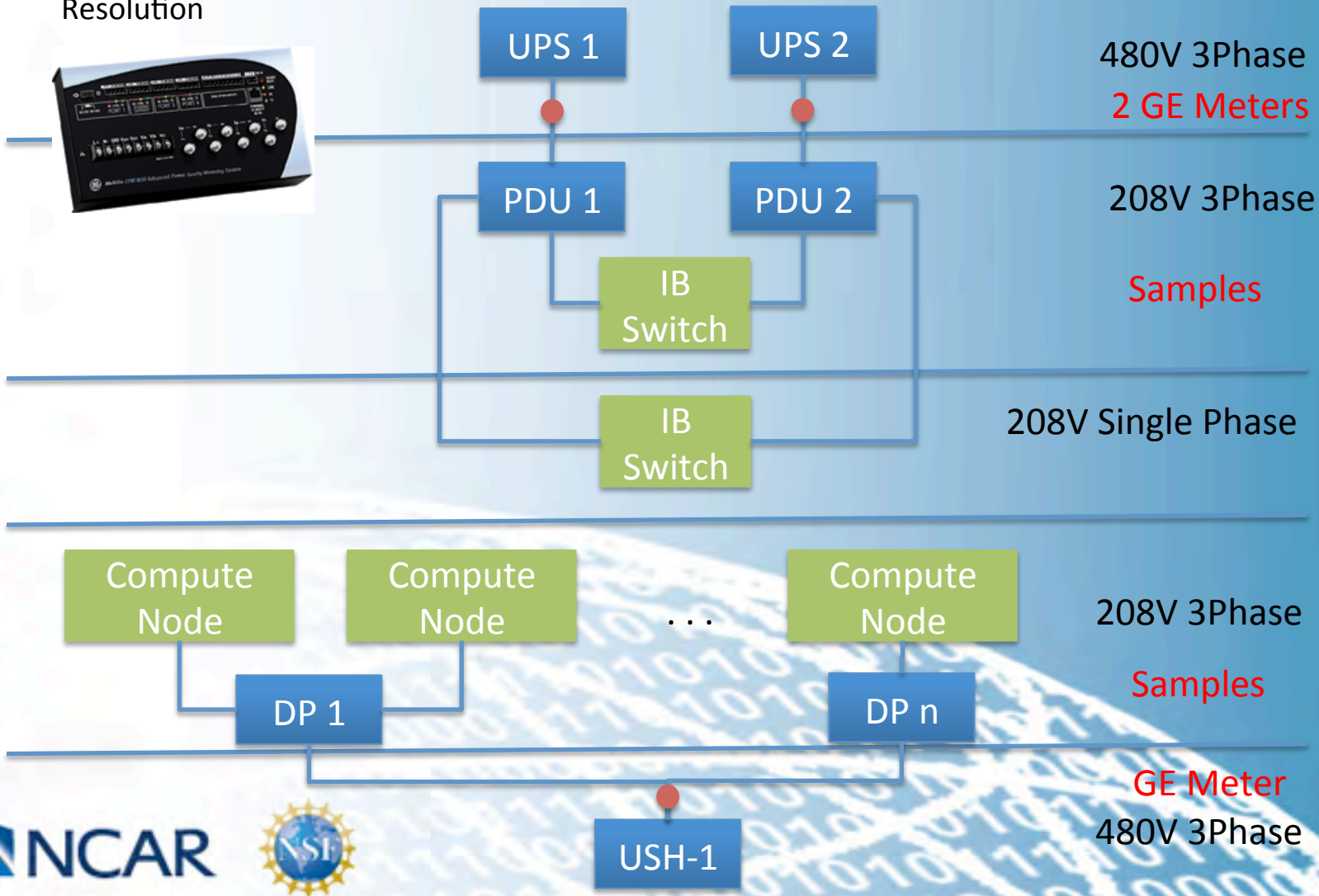
Problems Encountered

- Set to 1 second reporting interval
  - Polling and clock skew introduced sub second gaps
- Integration issues between the Meter and Johnson Controls Inc. System
- Lower quality meter had several fail during the submission runs
    - Fail silently
    - Continuously report the same value with no change

What We Did

- Revenue Grade Meter
- Power/Energy better than 0.4%
- Up to 512 Sample per Cycle Resolution



NCAR Green500 Submission

Table 1: Summary of Aspects and Quality Levels

Aspect	Level 1	Level 2	Level 3
Aspect 1a: granularity of power measurements	1 instantaneous power sampling per second	1 instantaneous power sampling per second ✔	continuously integrated total energy (actually hundreds or even thousands of samples per second)
Aspect 1b: timespan of power measurements	at least one power-averaged measurement covering at least 20% of the run or lasting for one minute, whichever is longer	a time series of equally spaced power averaged measurements ✔	a time series of equally spaced integrated total energy values
Aspect 1c: reported measurements	core phase average power	core phase average power, at least 10 power measurements within the core phase, whole application average power, idle power	core phase average power, at least 10 energy measurements within the core phase, whole application average power, ✔ idle power
Aspect 2: machine fraction	the greater of 1/64 of the machine or 1 kW	the greater of ⅛ of the machine or 10 kW	whole machine ✔
Aspect 3: subsystems included	Only the compute-node subsystem	all participating subsystems, either measured or estimated	all participating subsystems must be measured ✔
Aspect 4: power measurement point	upstream of power conversion OR power conversion loss modeled with manufacturer data	upstream of power conversion OR power conversion loss modeled with off-line measurements of single power supply	upstream of power conversion OR power conversion measured simultaneously during the same run ✔

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Comparison

	L2	L3
Total	1,437 kW	12,448 KWhr (1,497 kW)
Elapsed Time	500:39	500:39
Flops/Watt	875.33	840.29
Green500 Ranking	57	83
Flops	1257.6	1257.6

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