Experience In Power Measurements for Green500 Submission BADW-LRZ

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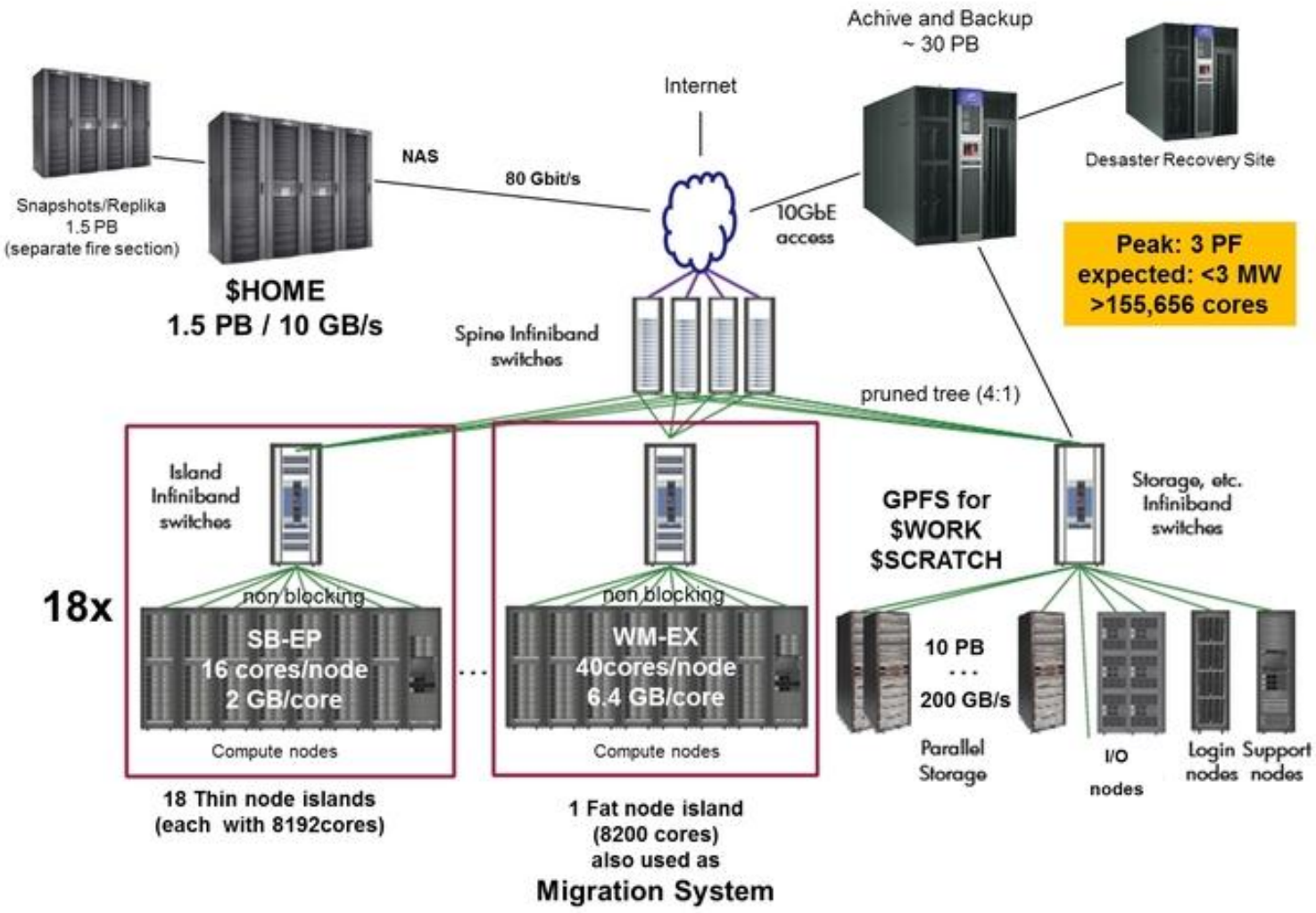
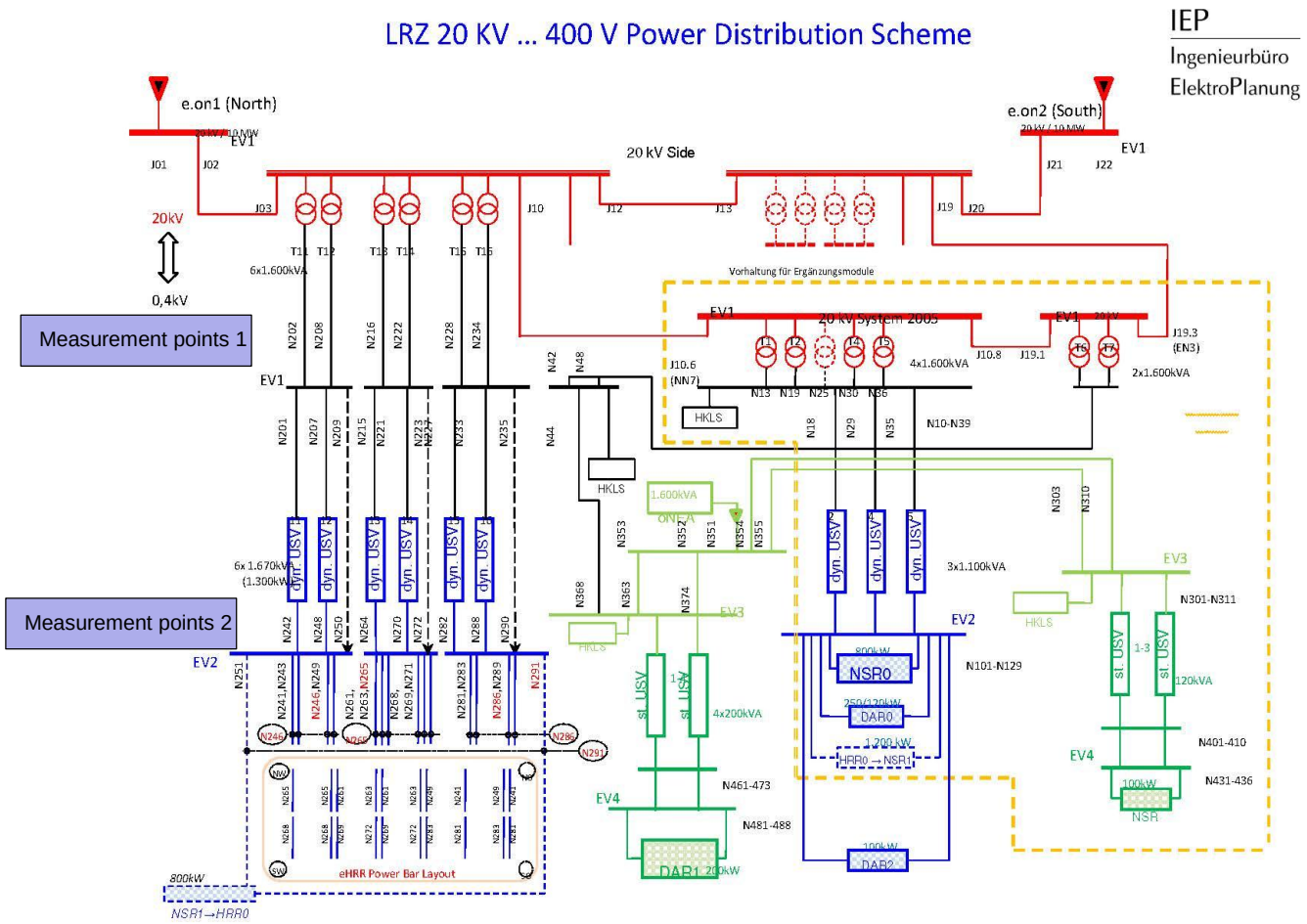
BADW-LRZ SuperMUC Setup



LRZ Infrastructure Power and Energy Measurement Points



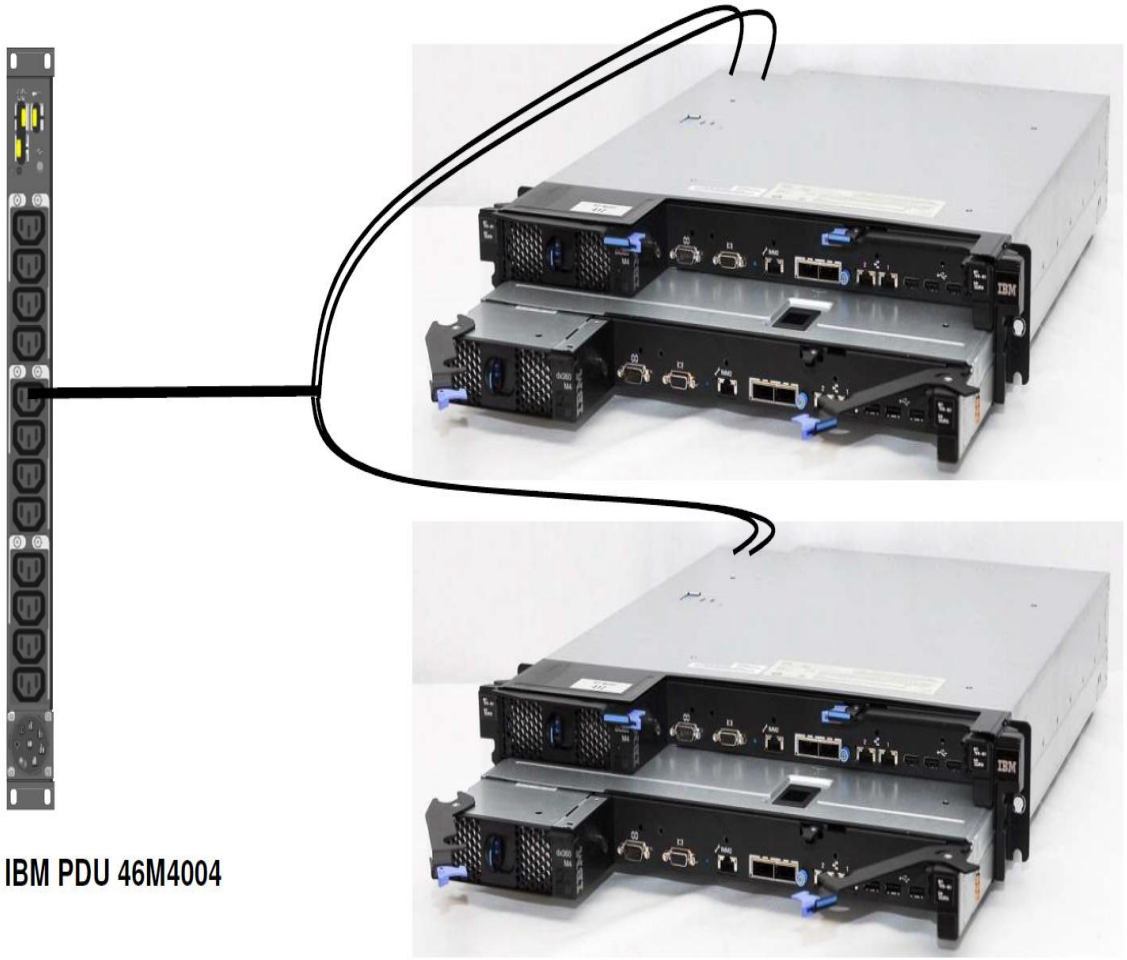
Socomec Diris A40/A41 meters at measurement points 1 and 2

Multi-function digital power & continuously integrating energy meter (15 minutes readout interval)

IEC 61557-12 certified

Measurements up to the 63th harmonic

SuperMUC Power and Energy Measurement Points



IBM PDU 46M4004

IBM 46M4004 PDUs are sampling Voltage, Current and power with 120 Hz frequency.
Power values are averaged over a 60 measurement seconds interval
One PDU outlet provides power to 4 SuperMUC compute node
One minute readout interval

Different Levels

❑ Level 1

- One PDU outlet with 8 nodes

❑ Level 2

- 1 rack (>10kW)
- >=1/8 of system
  - 16 racks, each containing 12 PDU outlets, 14 racks having 74 nodes, 2 racks having 72 nodes, for a total of 1180 nodes which is > 1/8 of the compute nodes
- InfiniBand switches
  - 18 islands and hence 18 IFB racks (10 PDU outlets; the system total of 180 IFB PDU outlets)
  - The average power for one PDU is measured and then multiply by 180 to get the value for the entire system.

❑ Level 3

- SUM(Measurement points 1) – NSR1

Level 1, 2, 3 measurements at LRZ

Performance: 2.582 PetaFlops (Green500)	
Level	Full run
Level1 (> 1kW)	2,449.290KW
Efficiency (MFlops per Watt)	1054
Level2 (> 10kW)	2,602.214kW
Efficiency (MFlops per Watt)	992
Level2 (> 1/8 machine)	2,639.915kW
Efficiency (MFlops per Watt)	978
Level3	2,766.352kW
Efficiency (MFlops per Watt)	933

Observations

- **Level 1 possible without node level measurement capabilities (1/16 system)**
- **Level 2 node level measurement capability a must have (1/8 system)**
  - Estimate rest of used system components (networking, cooling etc.)
- **Level 3 easiest for us**
  - subtract 2 values
  - Needs to be planed

Conclusion

Next time you make changes to your data center,
think about measurement capability improvements !