

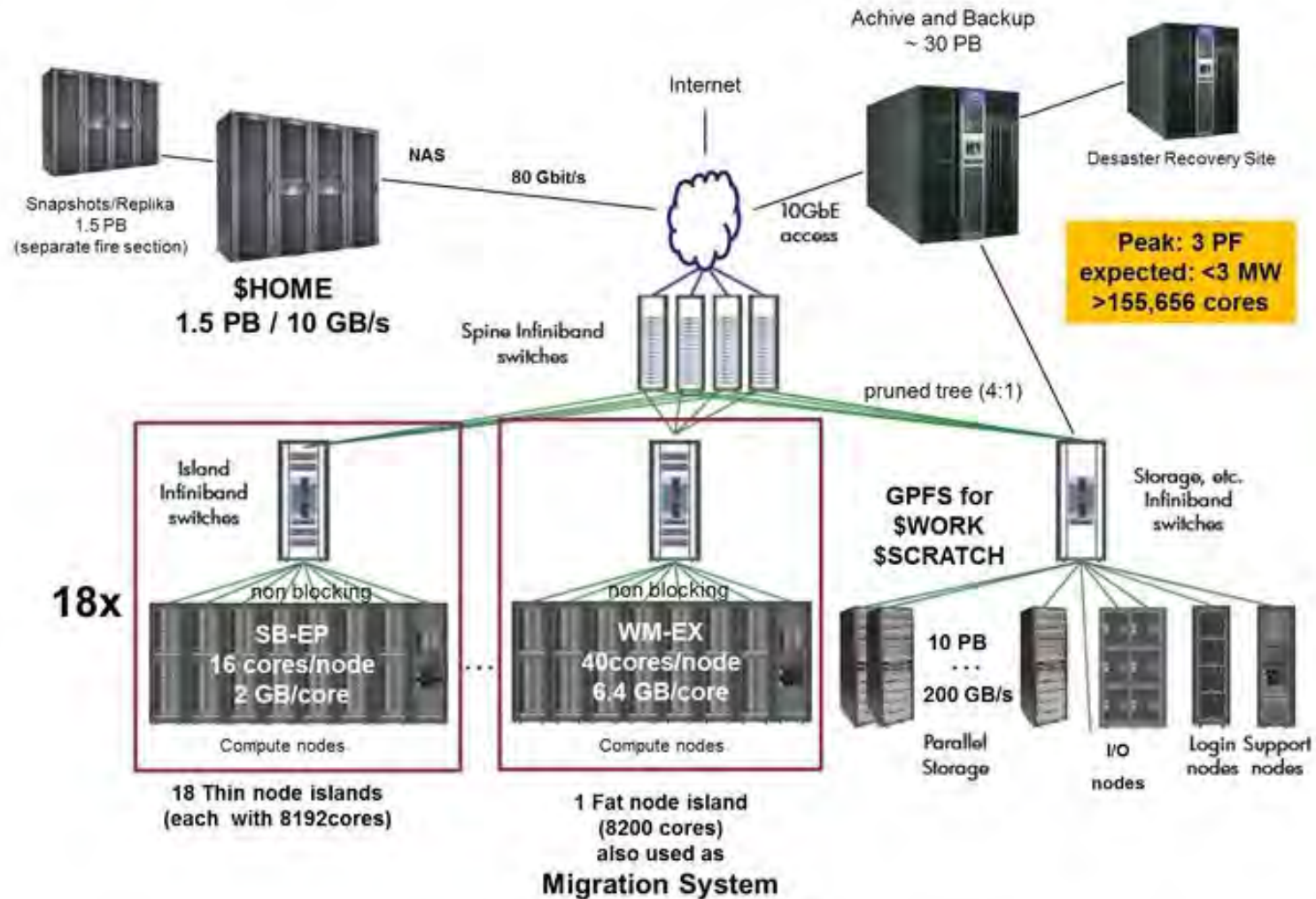


# **Experience In Power Measurements for Green500 Submission BADW-LRZ**

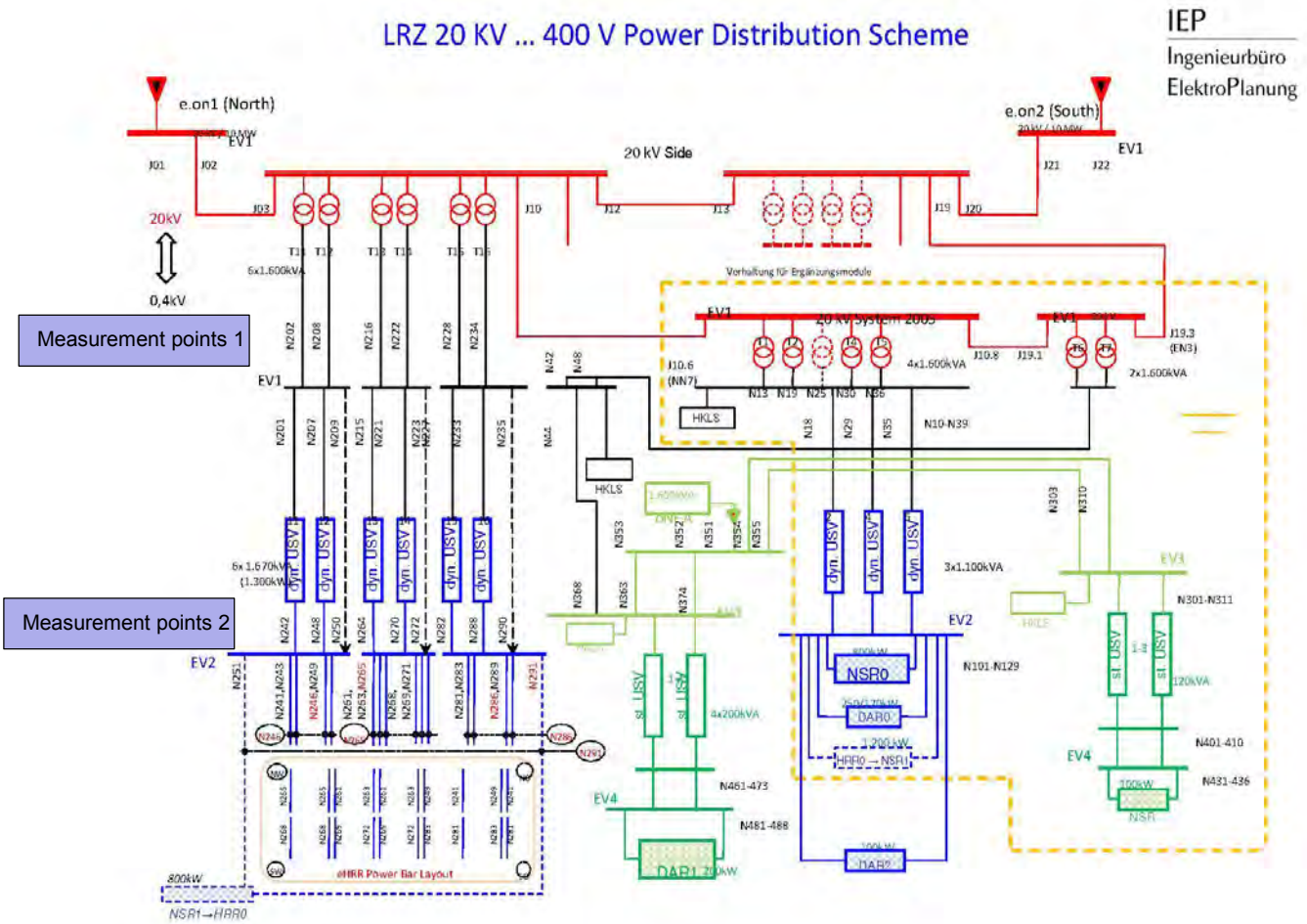
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# BADW-LRZ SuperMUC Setup



# 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

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## Level 1

- One PDU outlet with 8 nodes

## Level 2

- 1 rack (>10kW)
- $\geq 1/8$  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
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# Level 1, 2, 3 measurements at LRZ



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



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- 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
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## Conclusion

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

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