

# Data Center Trends Q&A

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# Agenda

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- ◆ Nomenclature
- ◆ What is a standard DC?
- ◆ Survey Early Results
- ◆ Summary

# Nomenclature

## ◆ W/sq.ft (Multiple definitions)

- Total Computer Room Power Density
  - ◆ Total Power-In / Raised floor footprint
  - ◆ Power-In includes all power creation & HVAC equipment
  - ◆ Good for comparing DC to DC overall capabilities
- Rack Power Density
  - ◆ Rack power-in / Rack total footprint (rack + req'd floor space)
  - ◆ Does not account for power-in/heat-out equipment
  - ◆ Primary method used for this discussion

## ◆ kW/rack

- Allows for comparing equipment hosting capability
- Drives a specific space usage due to heat removal requirements
- Often calculated via entire DC capabilities
- Can be augmented by spot cooling technologies/BKM's

# Nomenclature cont.

## ◆ kW/rack (Assuming 9"w x 24"d x 40uh rack)

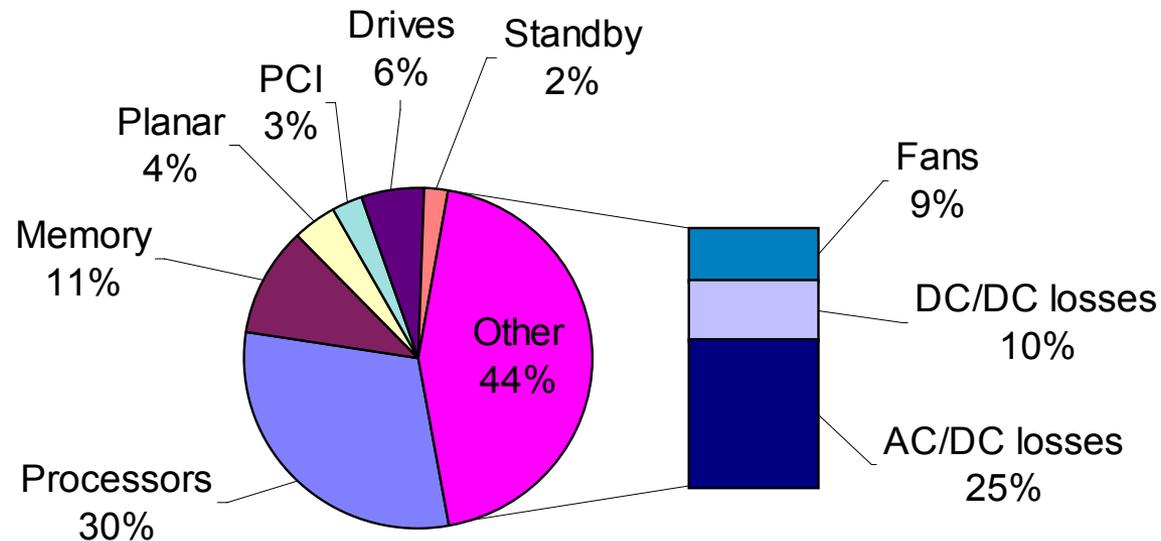
- Total footprint driven by CEC + airflow + service
  - ◆ 65 W/sq.ft. -> ~ 20 sq.ft./rack
  - ◆ 90 W/sq.ft. -> ~ 30 sq.ft./rack
  - ◆ 150 W/sq.ft. -> ~45 sq.ft./rack
  - ◆ 250 W/sq.ft. -> ~60 sq.ft./rack
- Wide variance in values impacted by
  - ◆ Raised floor height and under-floor airflow characteristics
  - ◆ Floor tile technology (Perf vs. open slots)
  - ◆ Lack of adequate ceiling height/airflow severely degrades
  - ◆ CRAC vs. central-plant vs. Hood technologies
  - ◆ Spot cooling solutions

# What is a standard DC?

- ◆ In past, avg DC  $\leq$  65W/sq.ft. or 3-4 kW/rack
  - 200W/sq.ft was then a special case
- ◆ Today, avg DC 90-150W/sq.ft. or 5-8 kW/rack
  - Special cases of up to 500W/sq.ft. w/ air cooling
    - ◆ 28kW/rack with specialized cooling infrastructure
    - ◆ \$/sq.ft. construction costs can exceeds fab costs
    - ◆ Only a couple in the world....
    - ◆ Highly dense systems can also create floor load impacts!
- ◆ Is there a natural economic breakpoint
  - Hot/cold aisle clearly work to 200W/sq.ft., What Limit?
  - Spot cooling technologies can add significant cost and space utilization issues

# Where's all that power going?

- ◆ 50% of DC power-in utilized before CEC
  - Includes power distribution and cooling
- ◆ Approx. 50% power never reaches Proc/chipset



Example 2u system: Your power may vary

# Early Survey Results

- ◆ Not statistically relevant yet...but interesting
- ◆ Typical wide range
  - 65-300W/sq.ft. or 3.8-17kW/rack capability
  - Majority  $\leq$  200W/sq.ft.
- ◆ Growing thermal knowledge in-house
  - Wide range of tools from calculator to sophisticated thermal dynamics modeling – little consistency
- ◆ Growing interaction between traditional IT and operations/facilities for planning purposes
  - Majority Short term realistic planning  $\leq$  2years

# Early Survey Results cont.

- Limited spot cooling deployed today
  - ◆ And top range was within the typical  $\leq 200\text{W/sq.ft.}$
  - ◆ No evidence of exotic cooling...and some resistance to H<sub>2</sub>O
- Limited calculating economies of scale
  - ◆ New dense modular systems likely to impact
- Growing trend towards dense modular systems
  - ◆ 1-2u selling in volume ... for servers anyway 😊
  - ◆ Blade sales beginning to ramp – but your not sure why
    - Often due to IT benefits of sharing infrastructure switches, buy as you need with easy retrofit, cost per MIP
- Hot/Cool Aisles in place in most responses
  - ◆ Future technologies investigations required if top end changes

# Summary

- CFRT respondents fairly representative of average
  - ◆ No top end HDDC in response mix
    - Drug research, Financial modeling, Processor Design
    - Their paving the way towards future HE DC
- Good mix – can learn from each other!
  - ◆ DC mix clearly within today's air-cooling technology
  - ◆ Spot cooling & exotic not yet required
  - ◆ Continue to share BKM's as you exceed your prior limits!
- We considering plans to gain larger sample size
  - ◆ Appreciate pointers to other studies for DC capability trends
  - ◆ We'll share results as we gain respondents