

LEVERAGING THE COMMERCIAL MARKET TO POWER THE EXASCALE DATA CENTER

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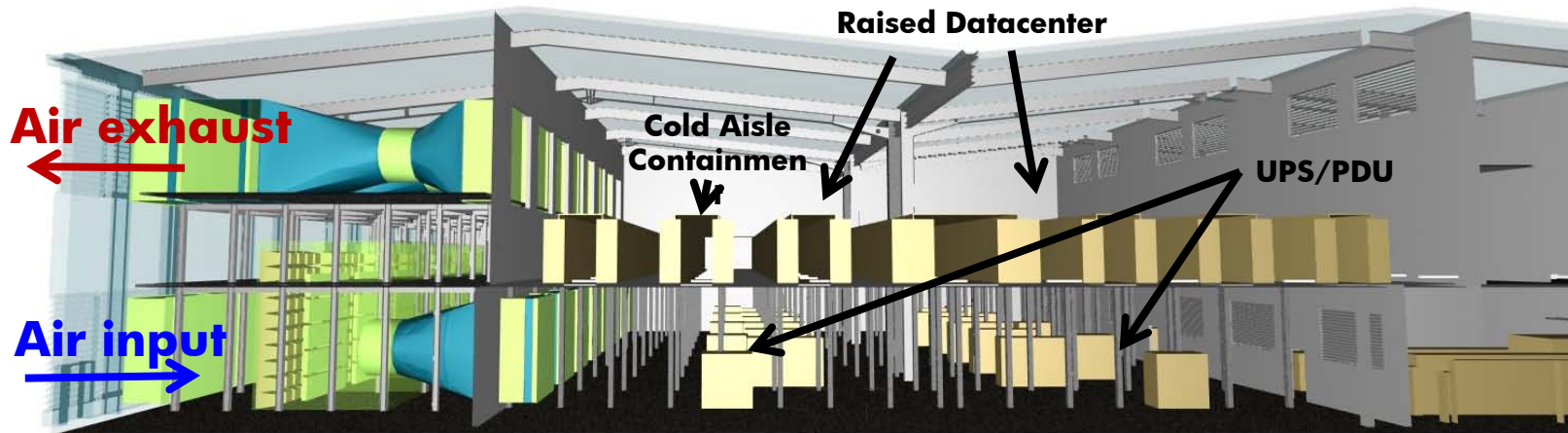
POWER & COOLING TRENDS IN THE COMMERCIAL MARKET

- Rising power/server
- Which drives IT and facility efficiency improvements
- Generally low (but rising) CPU utilization, which drives:
 - Scalable power across performance range
 - Lower idle power
 - Power capping, for precise provisioning
- Free air cooling
- Low but rising power density
- Modular facilities (containers)



FREE AIR COOLING—EARLY DEPLOYMENTS SHOWING SIGNIFICANT PROMISE

- HP Enterprise Services Datacenter, Wynyard, UK



<http://h10134.www1.hp.com/news/features/5138/>

<http://www.hp.com/hpinfo/newsroom/press/2010/100517b.html>

- “NetApp RTP Data Center is First Ever Data Center to Earn EPA's Energy Star for Superior Energy Efficiency ” July 14, 2010

<http://www.netapp.com/us/company/news/news-rel-20100714.html>

– Pros

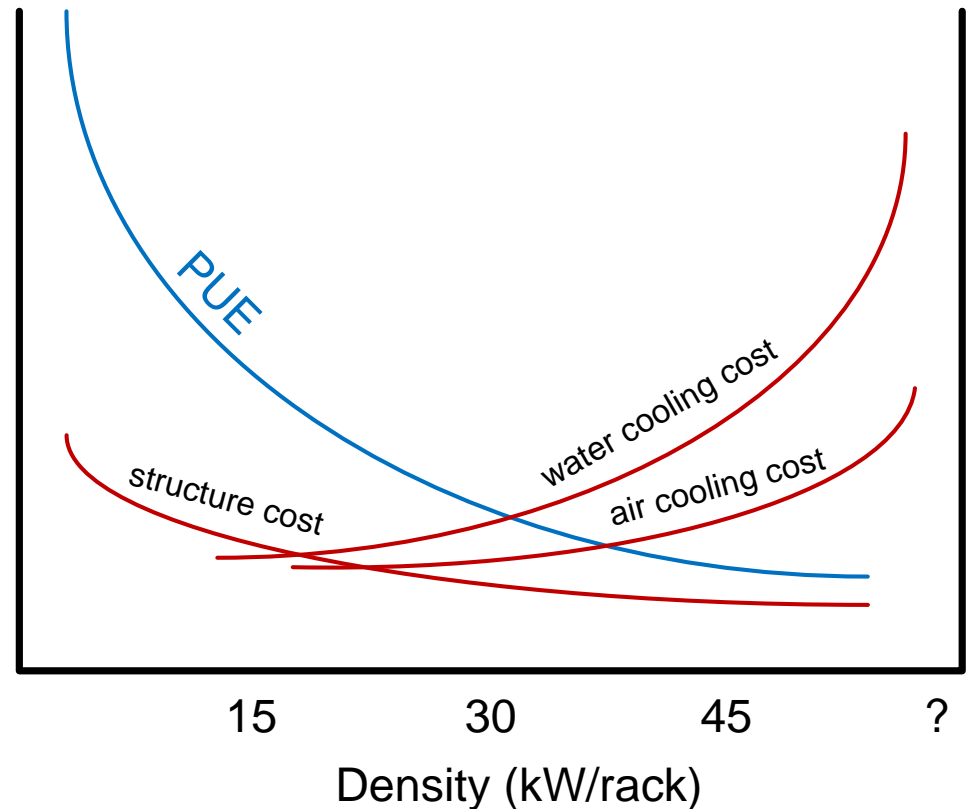
- Super low cooling cost
- Lowest potential capital

– Cons

- Harder to reuse waste heat
- Environmental catastrophe vulnerability
- Theoretical max rack power 30-40kW?

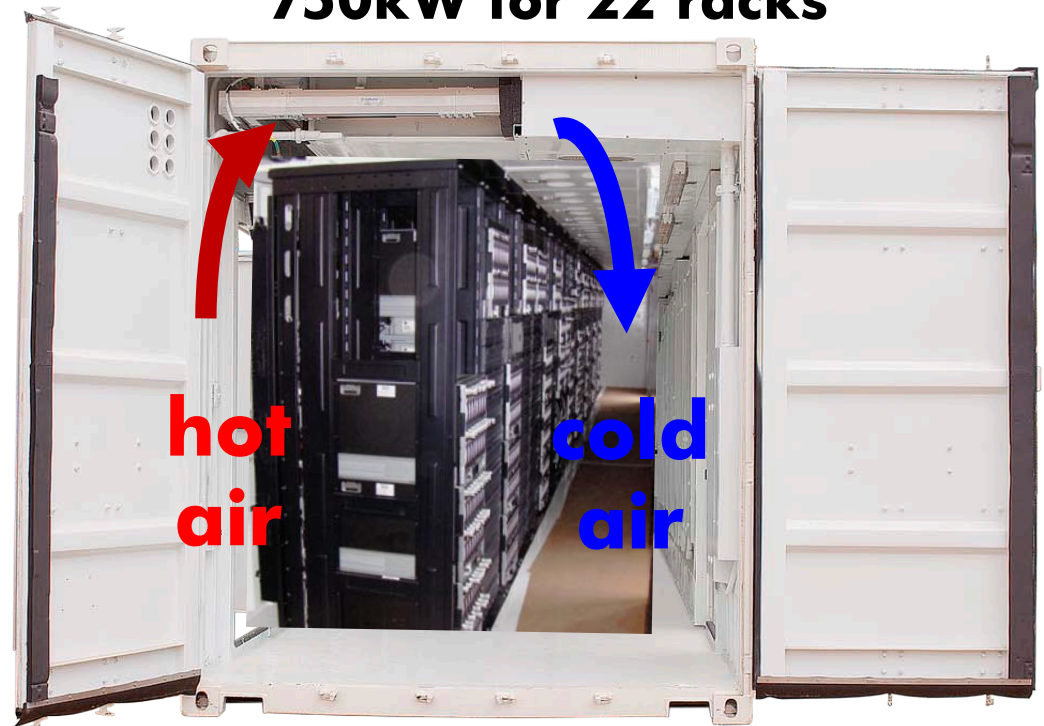
LOW (5-15KW) BUT RISING (20-30KW) RACK POWER DENSITY

- PUE and building structural costs go down with increasing rack power density
 - At some point, IT-hardware cooling costs rise significantly with density
 - Free air cooling should always be cheaper (both capital and operating) than water cooling
 - We don't yet know the ultimate limit of air cooling or cost burden of high-density water cooling
- When will the solution cost less if spread out?**



MODULAR FACILITIES—HP POD

750kW for 22 racks



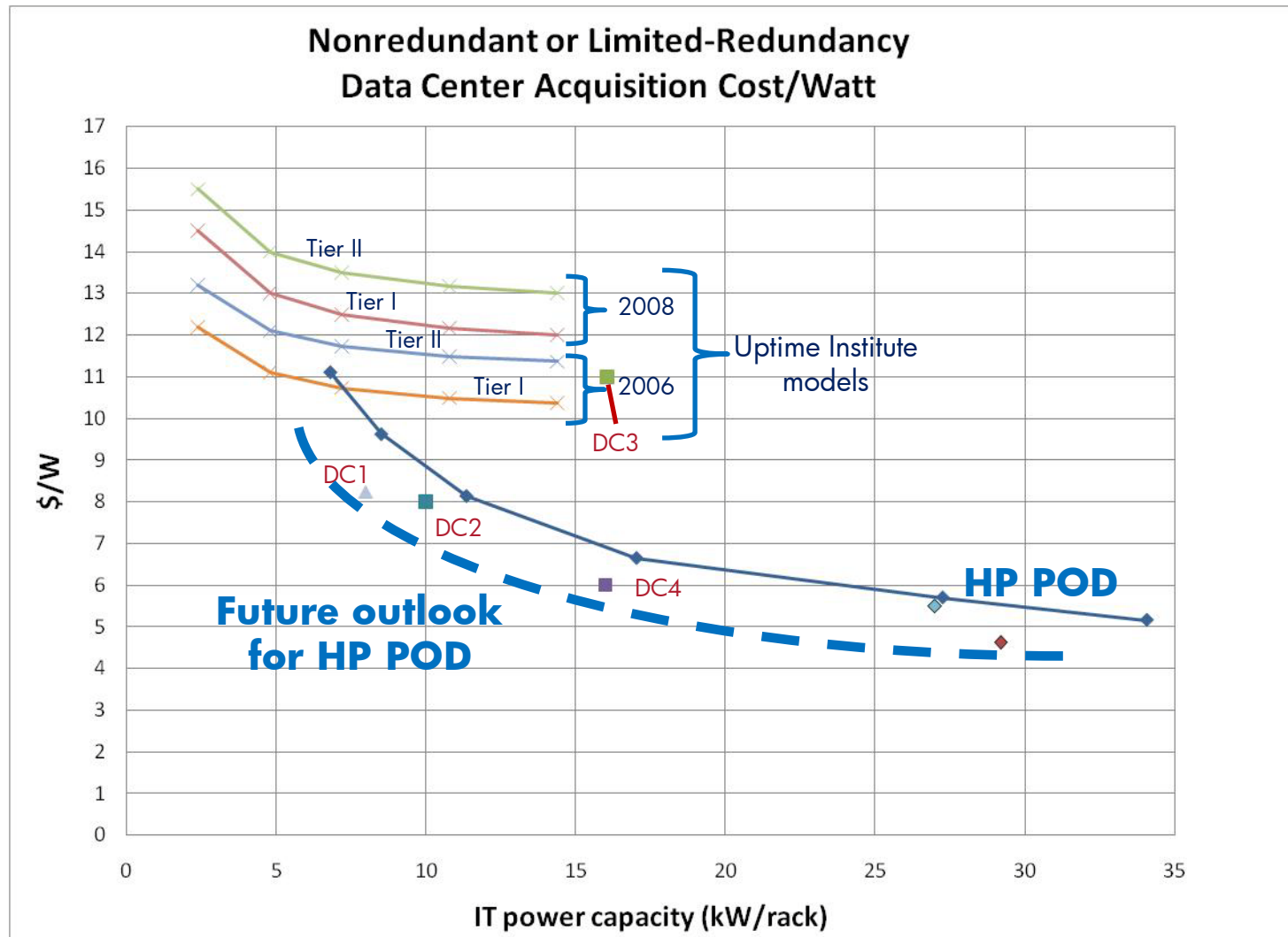
– Pros

- Low acquisition cost
- Pay as you grow
- 6wk PO to ship, empty or full of IT
- Max efficiency as technology advances
- Max flexibility. Segregate apps and customize support, e.g., Tier levels, w/ or w/o UPS, etc.
- Ultimate future-proofing

– Cons

- Network diameter issues
- Unknown support for non-standard IT gear (not 19" rack, air cooled)

HP POD—BREAK-THRU COST MODEL “FROM DIRT TO DATACENTER”



KEY TAKE-AWAYS FOR LEVERAGING THE COMMERCIAL MARKET

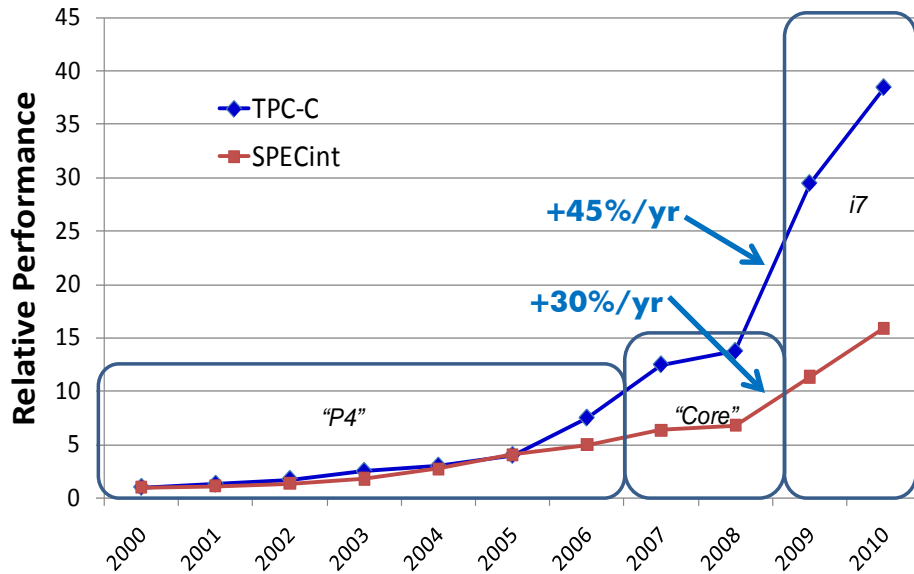
- Air is free. **Why not use it?**
- Commercial products will be optimized for low density. **What keeps you from spreading out?**
- Modular facilities maximize flexibility and minimize cost. **Can you afford not to use them?**
- Site selection can drive many other decisions. **Why does your data center have to be where it is?**

Q & A

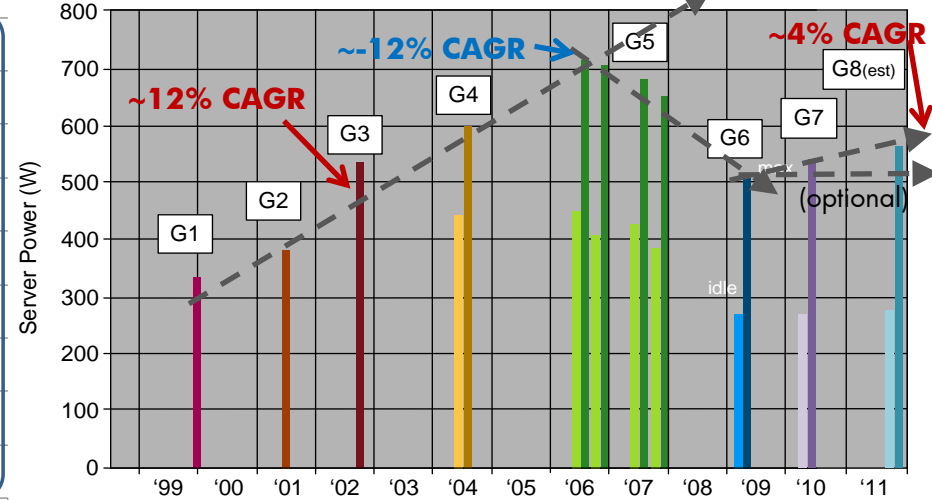


PERFORMANCE AND POWER TRENDS

Two-Socket x86 Servers Historical Performance



DL380 "Large Configuration" Power by Generations



CPU performance rising 30-45%/yr

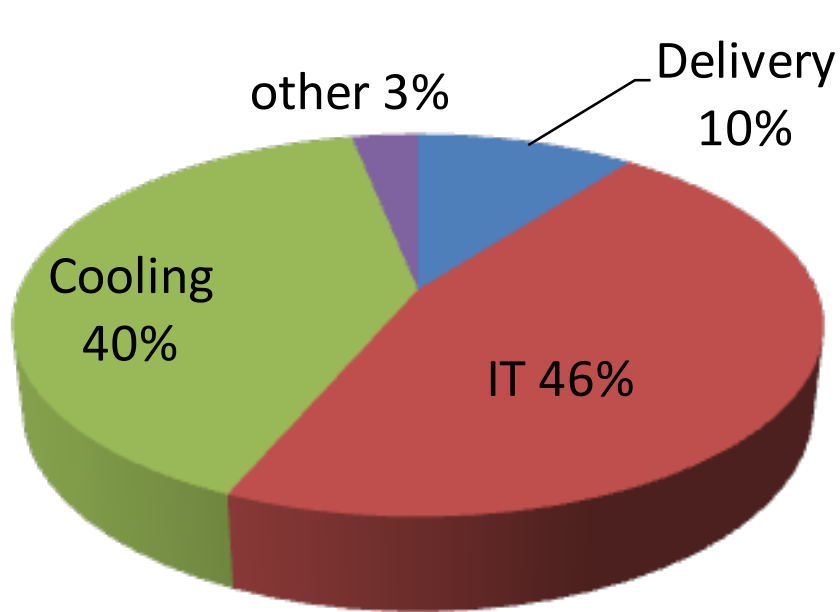
10x performance increase in 3 yrs requires $10/1.3^3=4.7x$ more servers

Power/server bumpy ride

- ~+12%/yr before 2006
- ~-12%/yr 2006-2009
- ~+4-7%/yr future

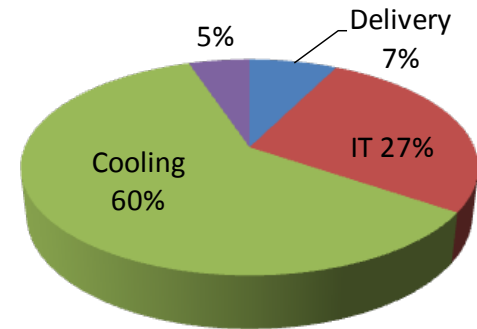
4.7x more servers in 3 yrs could consume $4.7*1.07^3=5.6x$ more aggregate IT power

TYPICAL POWER & COOLING EFFICIENCY

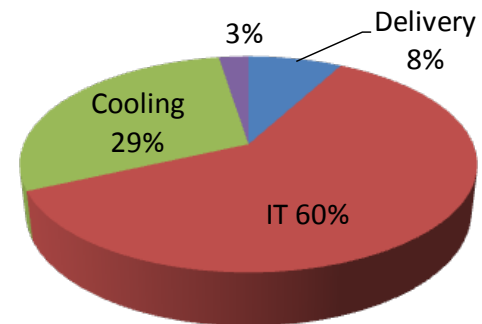


Median Datacenter, PUE=2.17

(state-of-the-art HP POD PUE=1.1-1.3 depending on local weather)



"Worst" Datacenter, PUE=3.70



"Best" Datacenter, PUE=1.66

Improving PUE from 2.0 to 1.2, 5.6x more IT power and would still require $5.6/2.0*1.2=3.3x$ more total datacenter power

Source: HP Critical Facilities Energy Audit Services, 39 datacenters, 2008-2009