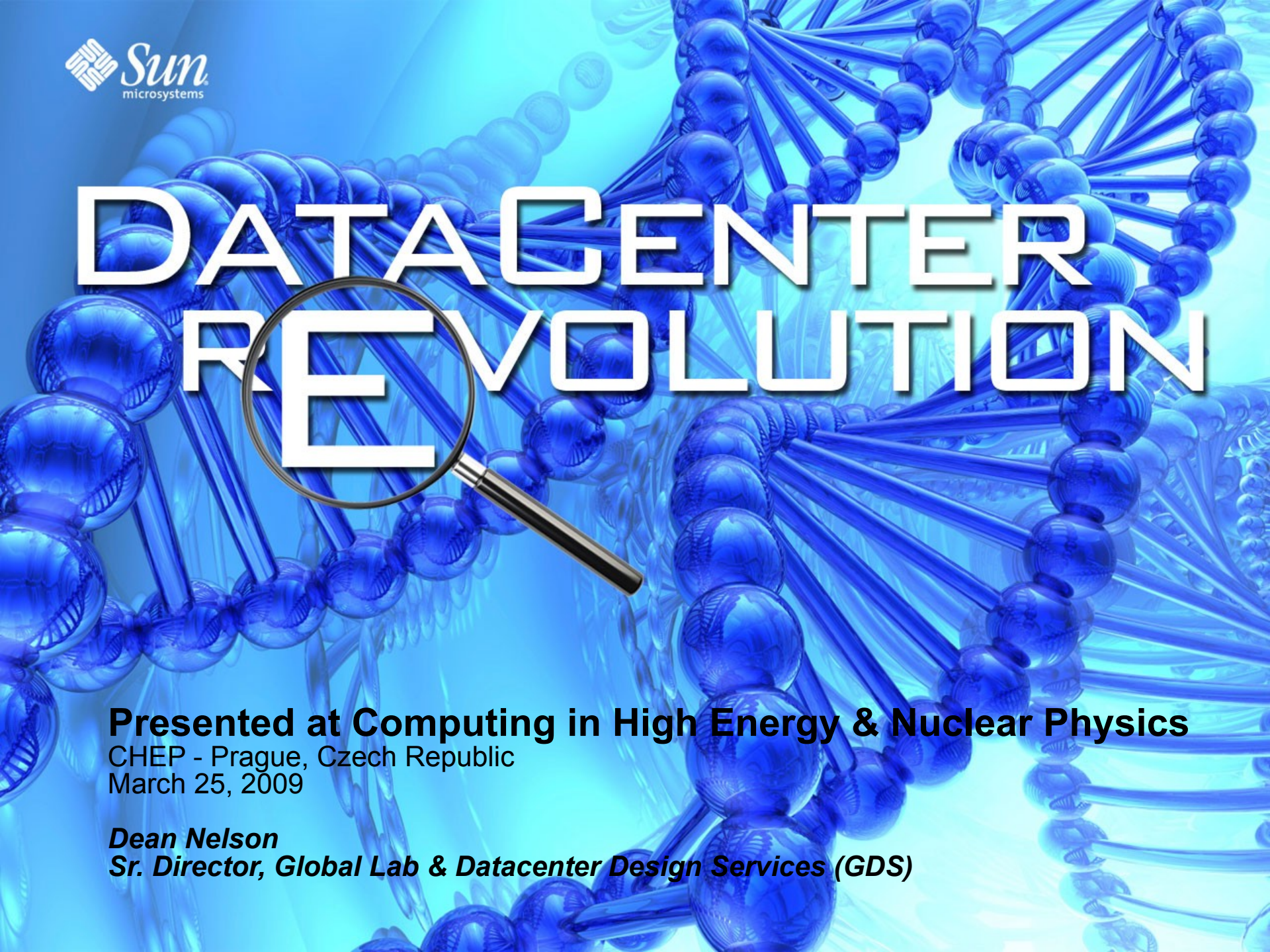


Presented at Computing in High Energy & Nuclear Physics
CHEP - Prague, Czech Republic
March 25, 2009

Dean Nelson
Sr. Director, Global Lab & Datacenter Design Services (GDS)

Density is King - Moore's Law

64 Threads in 1997
E10K

128 Threads, 16 Cores
5140

768 Cores, 28.5kW
6048

1&½ Footprint	Size	Full Rack 42
9620 Watts	Power (Systems at peak utilization)	30 kWatts (720W each)
1,800 lbs.	Weight	~2200 lbs.
~150k tpm	Performance	~300k tpm (2x per 5140)

Reality: Heterogeneous Data Centers

Industry Average is Between 4-6kw/cabinet; >20kw Skyscrapers will be Integrated; Must Deal with mixed load environment


Why is this topic important?

Unprecedented Activity

- Sun Datacenter Briefings over 17 months (07/07-2/09)
  - >675 – an average of ~8 per week
  - California = >4,000 people representing >400 customer companies have engaged in briefings and toured Santa Clara, CA, India and UK datacenters in 15 months
  - Colorado = Almost 1,000 people in less than two months
  - Challenges: Power, cooling, space, connectivity and utility costs
  - Interest: Investment Protection, Future-Proofing, Efficiency
- Investments
  - 21 of these companies spending $19B in datacenter projects in the US alone
  - Does not include Microsoft, Google, Facebook or DRT

A different perspective

A single server is responsible for about the same amount of CO2 as a typical automobile driven for a year

Server

440 Watt Server

3,942 kWh/year

5.3 Tonnes CO_2

Auto Travel

Toyota Camry

15,000 m/year

(24,000 km/year)

5.3 Tonnes CO_2

Air Travel

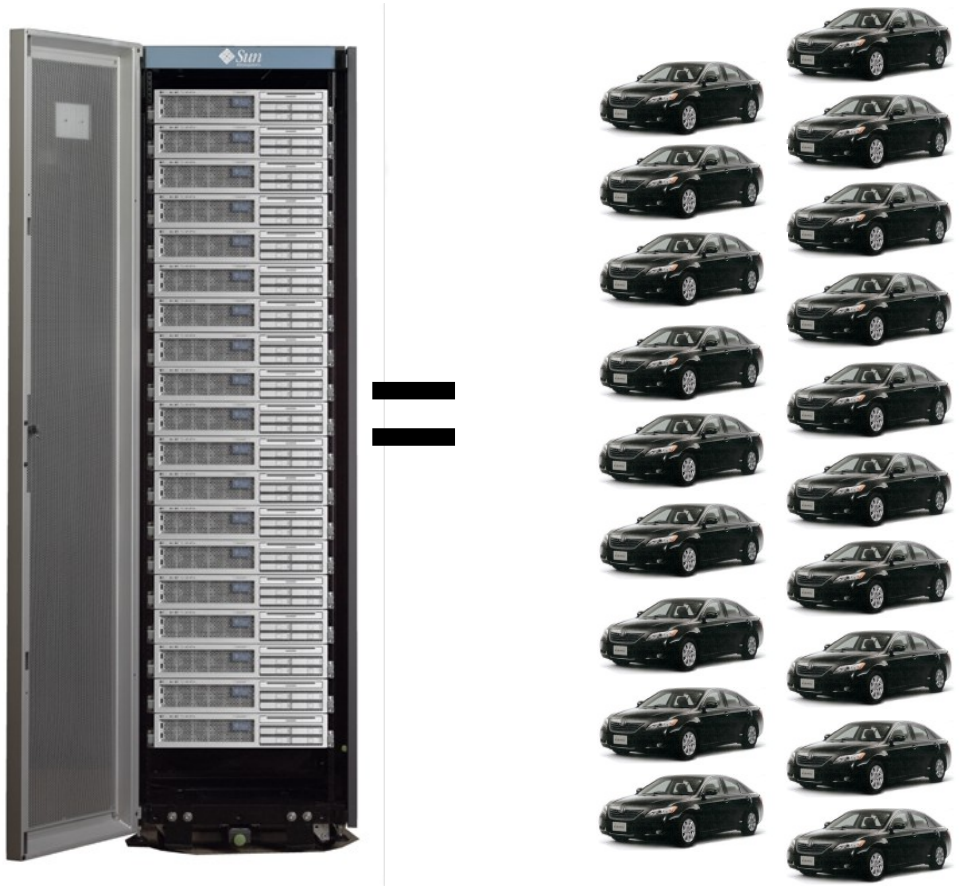
Commercial Airliner

Vancouver-Toronto (7 trips)

5.2 Tonnes CO_2

A different perspective

A single server is responsible for about the same amount of CO2 as a typical automobile driven for a year



BUT

Moore's Law Mandates Efficiency Gains

Automotive Equivalent Efficiency, 10 year period

163 MPG!

Changing Priorities & Drivers

- $15B investment ($1.2B solar project)
- First Carbon Neutral, Waste Free, Car-Free City

Investment in solar innovation will change the industry

Floating Data Centers

- Tier1-Tier3 ECO datacenters at US and international ports
- Capacity: 4000 racks and over 350 SunMDs
- 75MW of power, free cooling from ocean water
- Six months time to market, up to 40% less than traditional build

- At the end of a dock instead of the end of a street

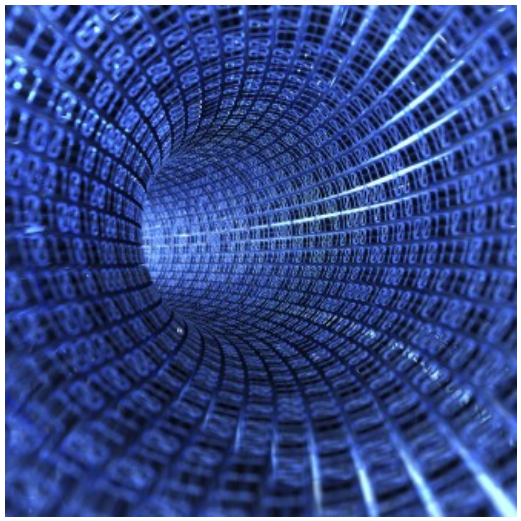

Strategy

A New Age

Industrial Age

Global Production

Global Consumption



Information Age

All Things Connected

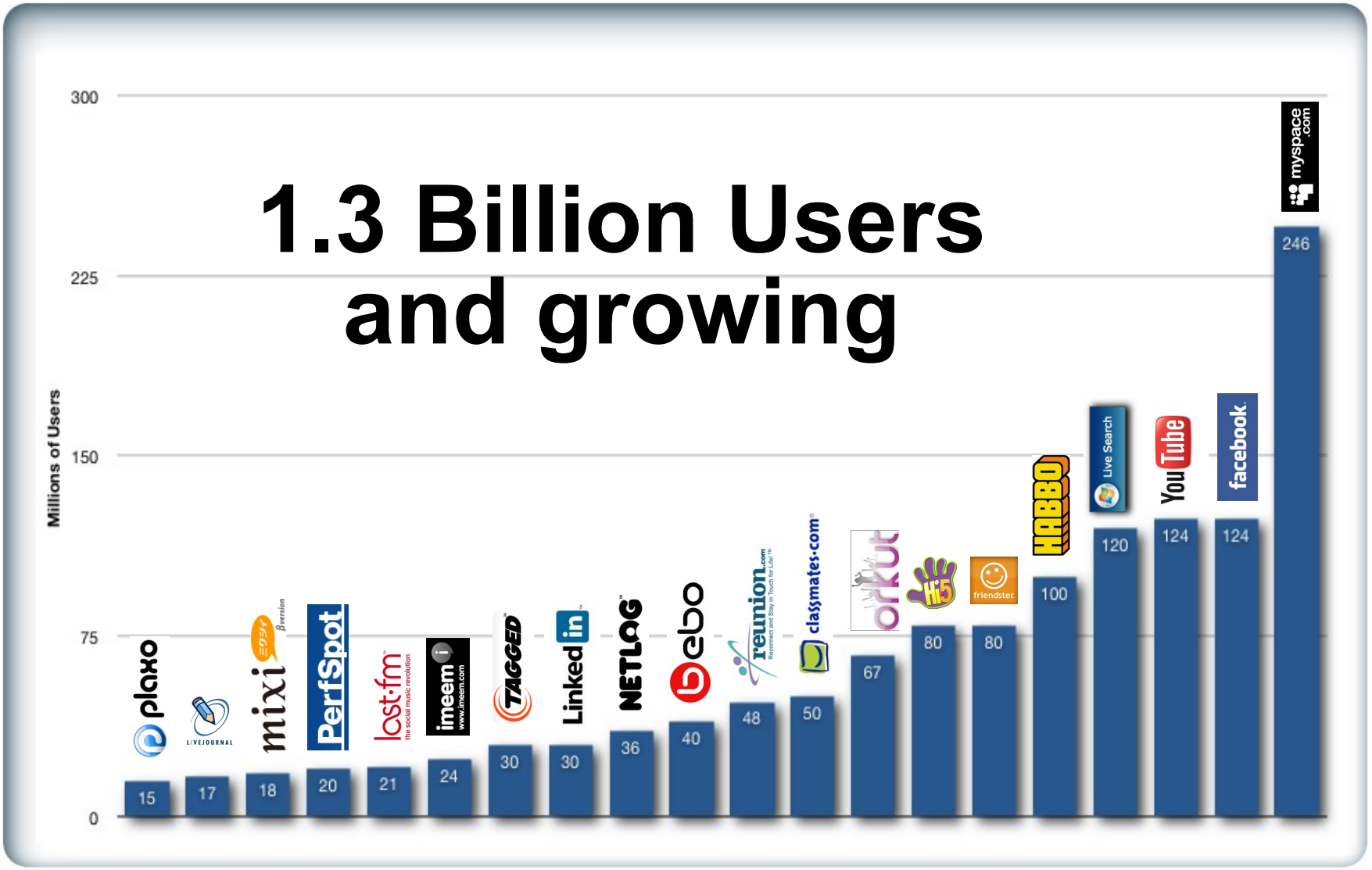
Data Storm Building

Participation Age

Unprecedented Contribution

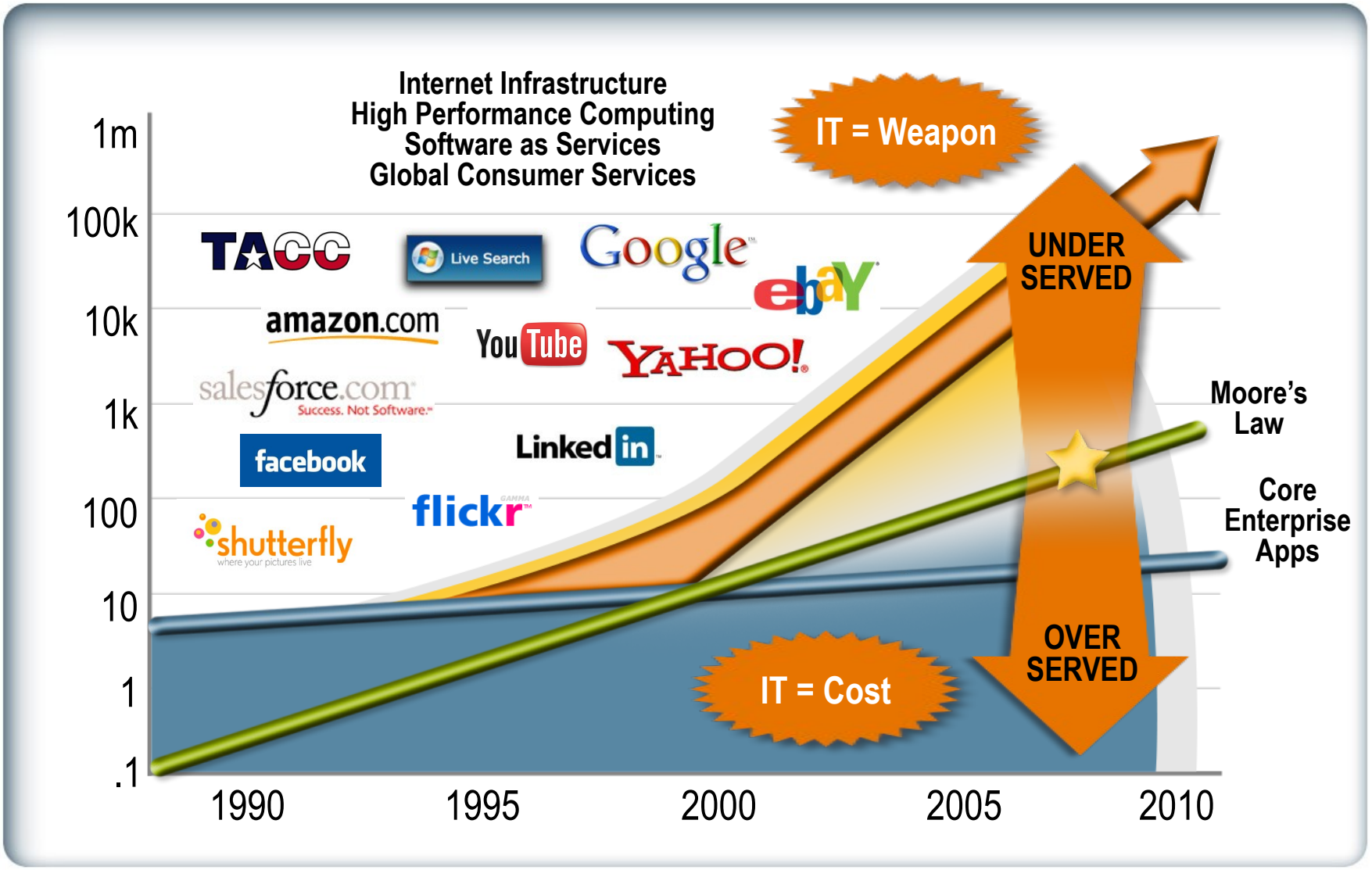
Unprecedented Consumption

Top 20 Social Networks



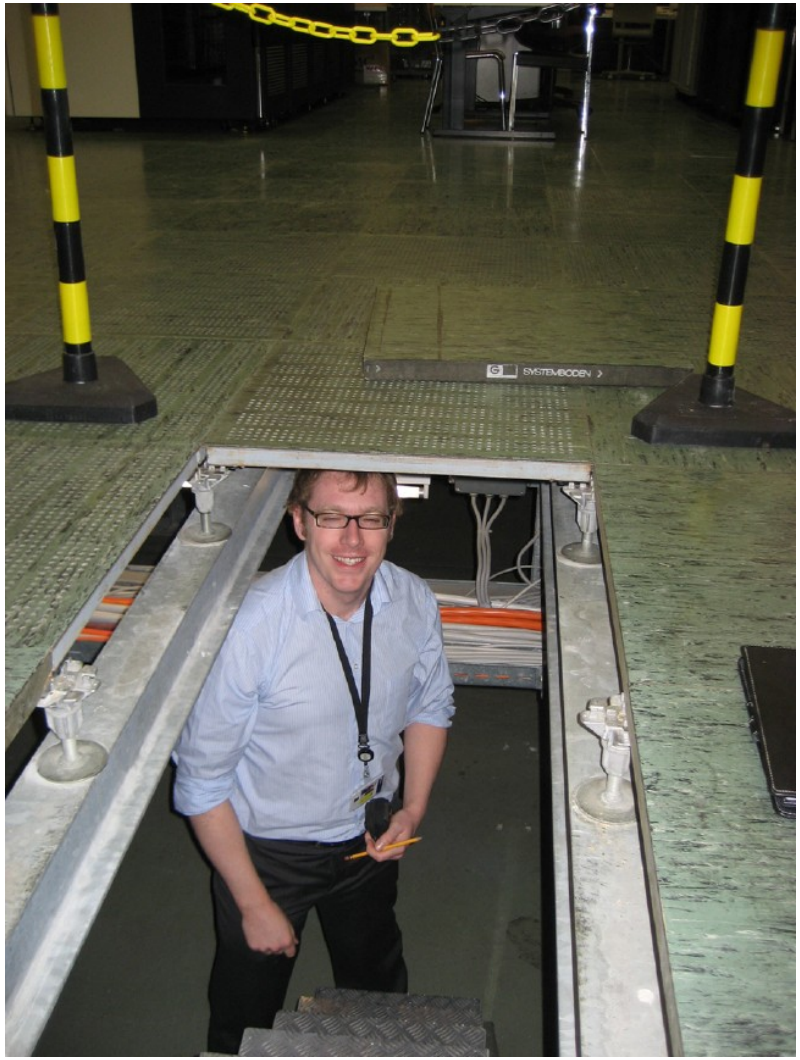
Source: http://en.wikipedia.org/wiki/List_of_social_networking_websites (as of 11/10/2008)

The Shift


Internet Infrastructure
High Performance Computing
Software as Services
Global Consumer Services
IT = Weapon
1m
100k
10k
1k
100
10
1
.1
TACC
Live Search
Google
ebay
amazon.com
YouTube
YAHOO!
salesforce.com
Success. Not Software.
facebook
LinkedIn
flickr
shutterfly
where your pictures live
UNDER SERVED
Moore's Law
Core Enterprise Apps
OVER SERVED
IT = Cost
1990
1995
2000
2005
2010


Innovate

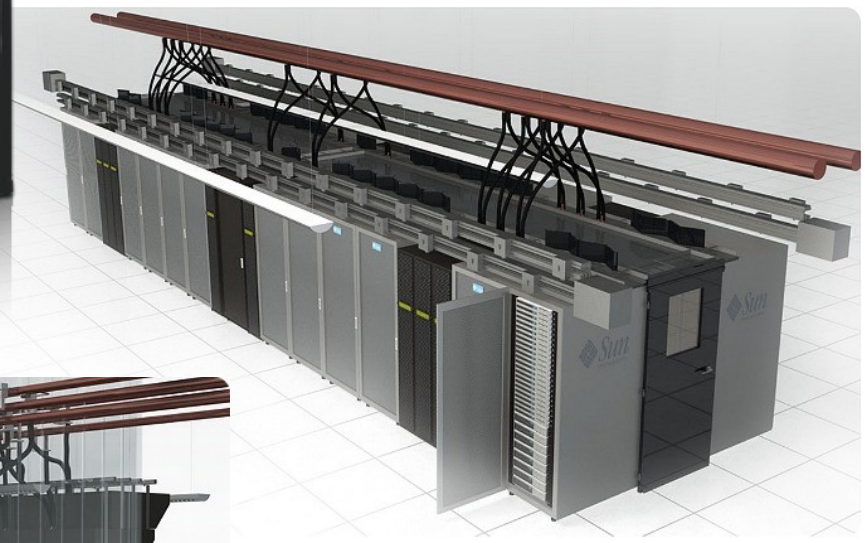
A moment of silence...



- Raised Floors Are Dead
  - > No longer required
  - > Go against physics
  - > Increasingly cumbersome
  - > Expensive
- Next Generation equipment requires a new way of thinking...

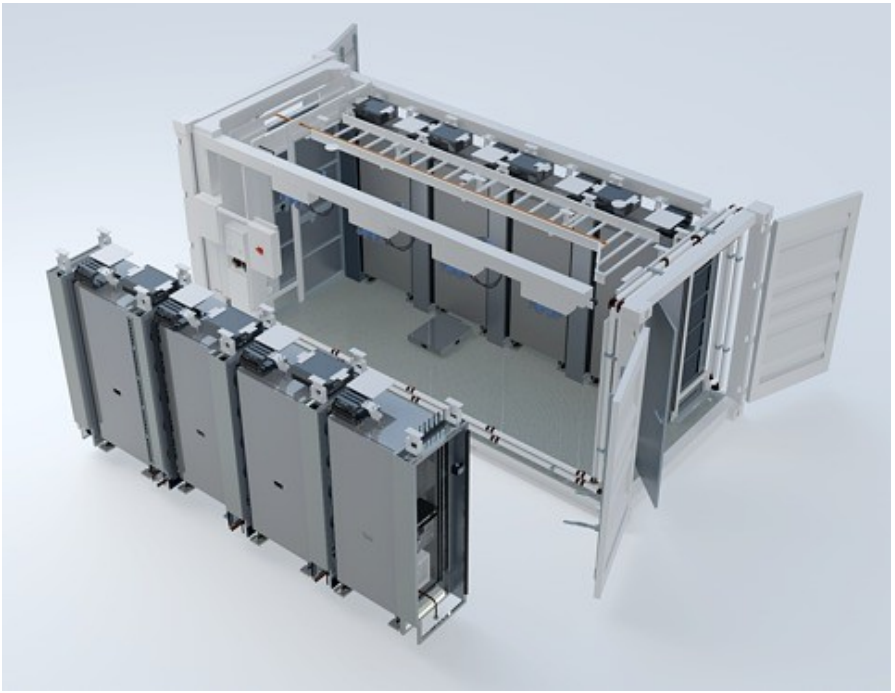
Pod Architecture

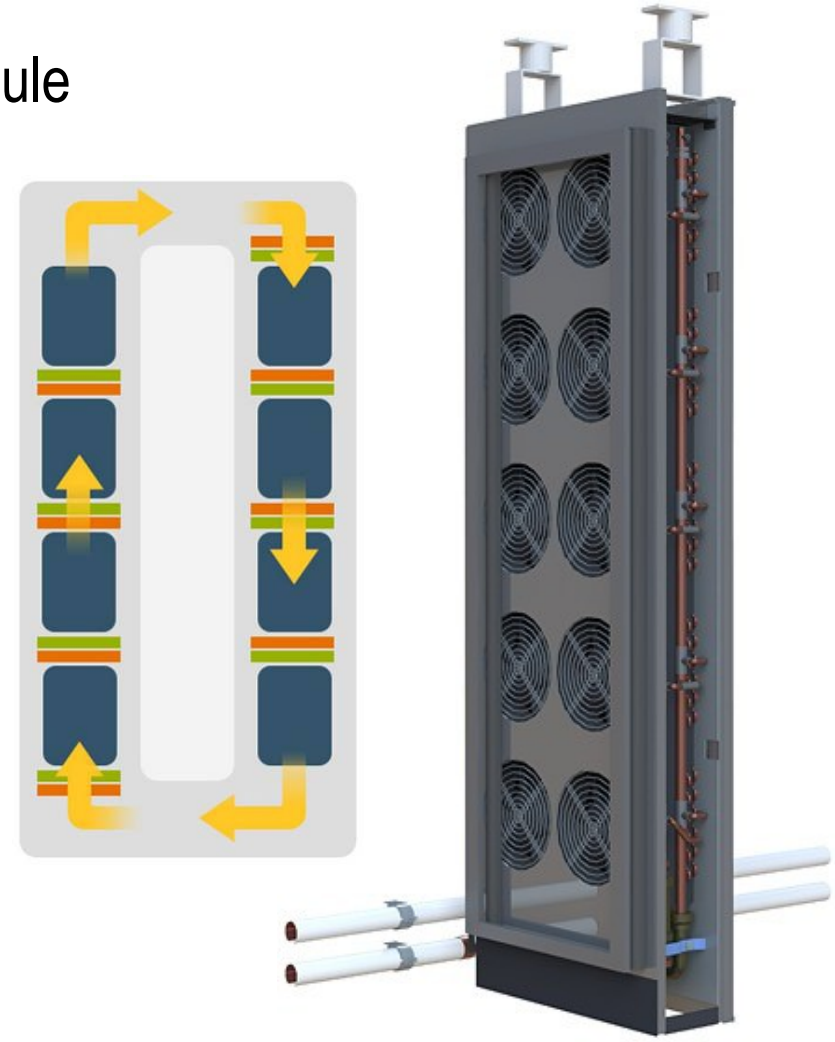
Modular Data Center Building Blocks
Container and/or Brick & Mortar



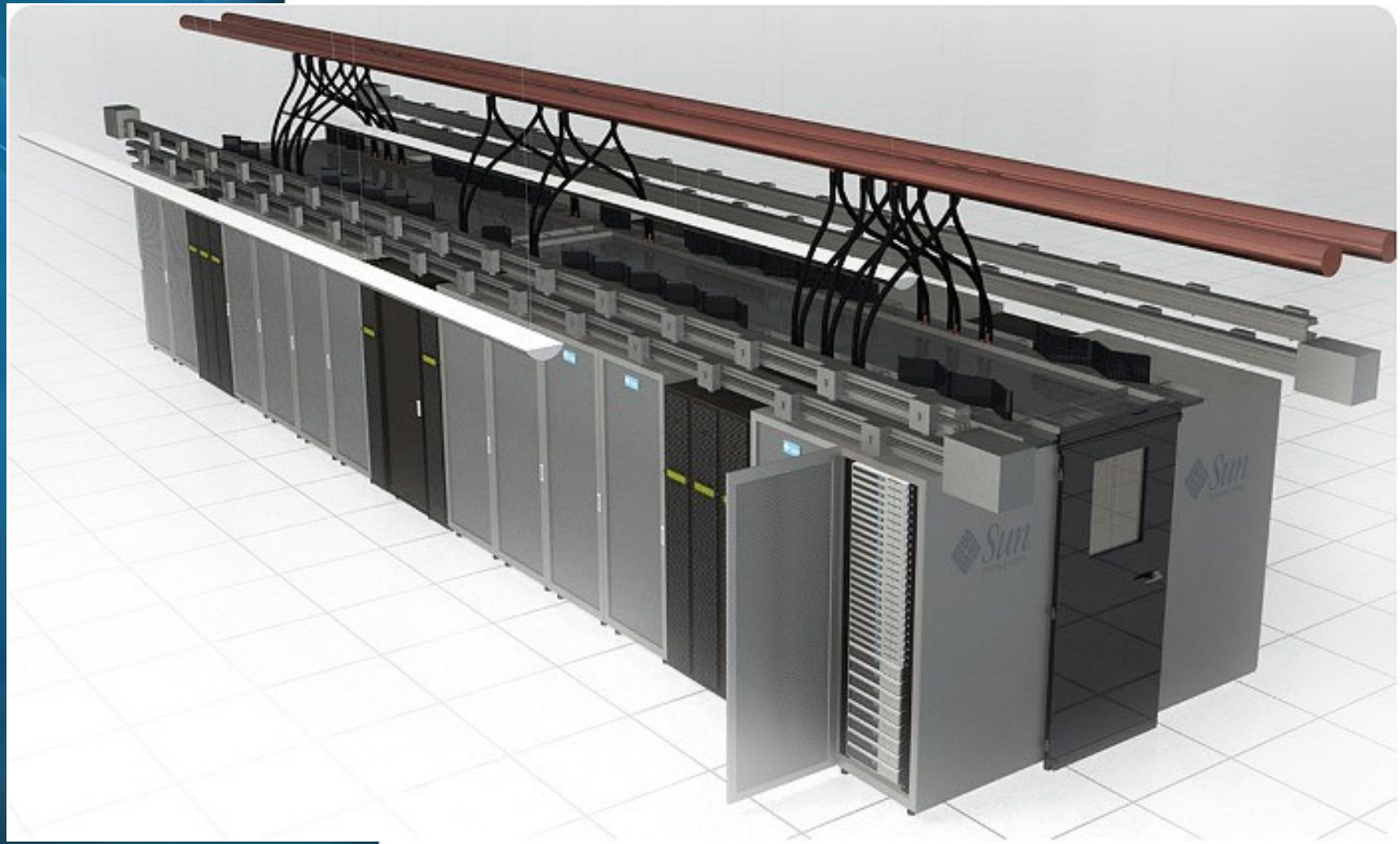
Cooling in Sun Modular Datacenter

- Integrated cooling modules
- Circular airflow, 5 cooling zones per module
- Variable-speed fans on a per-fan basis
- Handles densities up to 25 kW/rack





Sun Pod Architecture



Sun Pod Architecture

Closeup: Power Distribution

Modular overhead, hot-pluggable busway with conductors to handle multiple voltages and phases

- Requires no floor space or cooling
  - Transformers moved outside the datacenter
- Snap-in cans with short whips
  - Non-disruptive
  - Reduced copper consumption
  - No in-place abandonment
  - Significant time reduction – from months to minutes


Act

History: Sun's Internal Challenge

- Facilities is Sun's second largest expense
  - > Real estate, utility, tax, and support costs
- 20+ years of organic growth
  - > New products, reorgs, acquisitions
  - > Lack of design standards and control of implementations for global technical infrastructure
  - > Duplication and inefficiencies
- Multi-billion dollar IT/R&D technical infrastructure portfolio
  - > 860k ft^2 (80k m^2) of Eng and IT space globally (reduced from 1.4M ft^2 - 130k m^2)
  - > 1,068 individual rooms (reduced from 1,685)
  - > IT space = 17% of the portfolio (143k ft^2 / 13k m^2 – 275 rooms)
  - > Engineering/Services = 83% of the portfolio (718k ft^2 / 67k m^2 – 793 rooms)

Global Consolidation

China, India, UK, Czech Republic, Norway

- $250M investment
- 41% global datacenter space compression
  - > 1.44M ft^2 to 858k ft^2
- Scalable/Future Proof
  - > 9MW to 21MW (CA)
  - > 7MW to 10MW (CO)
- Largest Liebert/APC installs
- 15 Buildings to 2
- 152 Datacenters to 14
- $1.2M Utility Rebates $250k Innovation Award
- Enabled company pace
- Reduced opex 30% (CA)

Colorado DC Consolidation

- Largest, most complex & costly consolidation in Sun's history
- 66% Datacenter compression
  - > 496k ft^2 to 126k ft^2
- Scalable/Future Proof
  - > 7MW to 10MW
- First & Largest Liebert XD dynamic cooling install
- Water treatment saves 600k gallons/year, eliminates chemicals
- Waterside economizer, free cooling > 1/3 of year.
- Compressed 165k ft^2 raised floor to <700 ft^2 ($4M Cost Avoidance)
- Flywheel UPS, eliminates batteries.
- Chillers 32% more efficient at avg load than ASHRAE std
- 2 ACE Awards
- Removed 1M kWh per month
- Removed 5% of global carbon


Share

Power Usage Effectiveness (PUE)

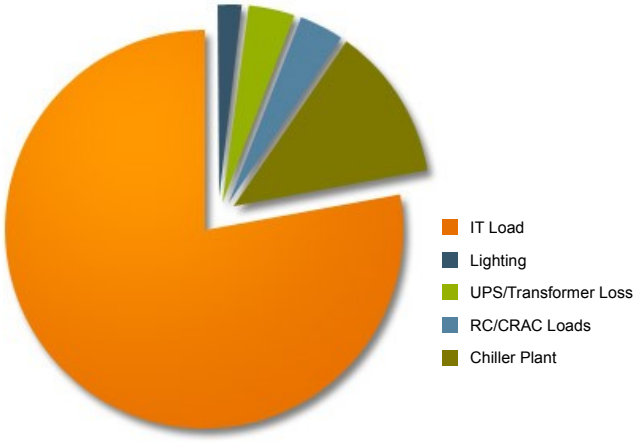
SCA11-1500 Data Center Efficiency Benchmark

- 573 kW less support power compared to industry PUE target (2)*
- 36% More efficient than the industry PUE target and almost 50% better that industry PUE average (2.5)*
- $400,000 Annual opex savings compared to typical data center ($0.08/kWh)

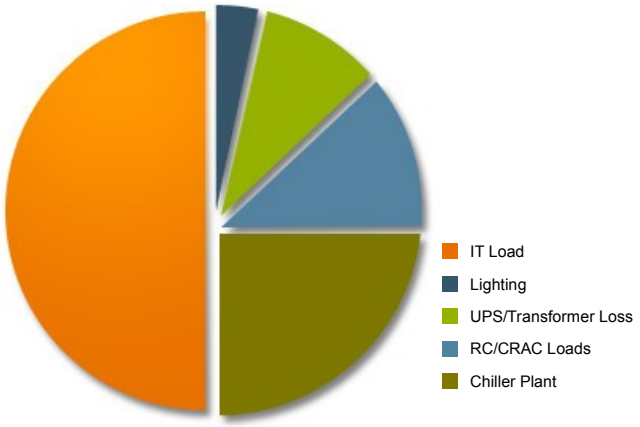
SCA11-1500 Software Datacenter PUE		
Load	**kW**	**% of Total Load**
IT Load	798	78.02%
Chiller Plant	126	12.28%
RC/CRAC Loads	39	3.84%
UPS/Transformer Loss	39	3.86%
Lighting	20	2.00%
Total Load	1023	
Total Support Loads	225	
PUE	**1.28**	
DciE	**78%**	

Target Datacenter PUE		
Load	**kW**	**% of Total Load***
IT Load	798	50.00%
Chiller Plant	399	25.00%
RC/CRAC Loads	192	12.00%
UPS/Transformer Loss	160	10.00%
Lighting	48	3.00%
Total Load	1596	
Total Support Loads	798	
PUE	**2.00**	
DciE	**50%**	

SCA11-1500 Power Use



Typical Data Center



* Industry average & target from uptime institute: http://www.datacenterknowledge.com/archives/2008/Jan/22/case_study_ups_green_data_center.html

Best Practices = Competitive Weapon

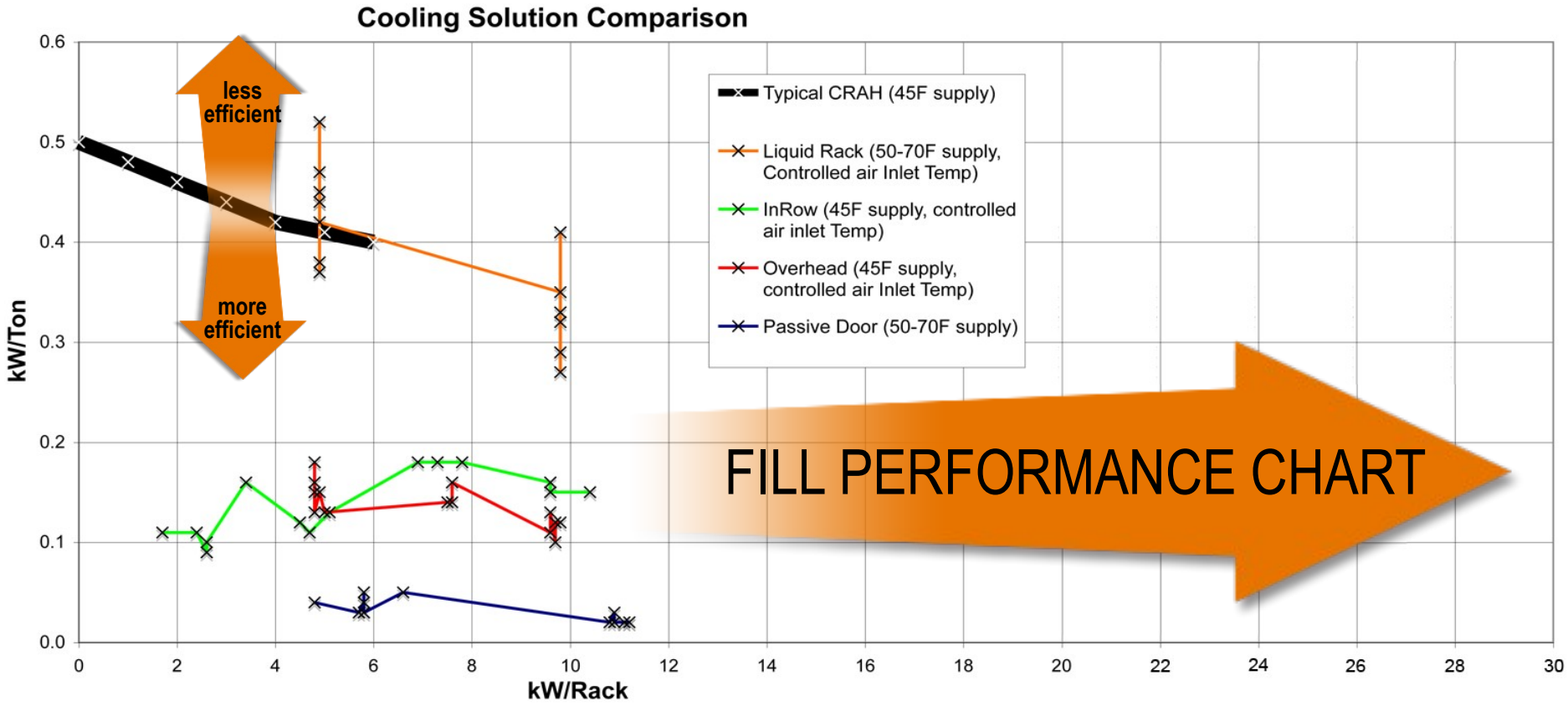
- Align Facilities, IT & Engineering
  - Partnering nets significant short term & long term savings
    http://www.sun.com/aboutsun/environment/docs/aligning_business_organizations.pdf
- Hardware Replacement
  - Apply new hardware solutions and extend the life of your DC
    http://www.sun.com/aboutsun/environment/docs/creating_energy_efficient_dchw_consolidation.pdf
- Simplify Datacenter design with the POD concept
  - Power: Modular, Scalable, Smart http://www.sun.com/aboutsun/environment/docs/powering_energy_efficientdc.pdf
  - Cooling: Adaptable, Scalable, Smart http://www.sun.com/aboutsun/environment/docs/cooling_energy_effiicientdc.pdf
  - Cabling: Distributed vs Centralized http://www.sun.com/aboutsun/environment/docs/connecting_energy_efficientdc.pdf
  - Measurement: Power to control http://www.sun.com/aboutsun/environment/docs/accurately_measure_dcpower.pdf
- Data Center Tour Videos
  - California: http://www.sun.com/aboutsun/environment/media/datacenter_tour.xml
  - Colorado: http://www.sun.com/featured-articles/2009-0126/feature/index.jsp

Sun Blueprints

- First Chapter - Modularity Released June 10, 2008
- Second Chapter - Electrical Released March 10, 2009
- Total of nine chapters to be released over the next 12 months
- Download: http://sun.com/blueprints

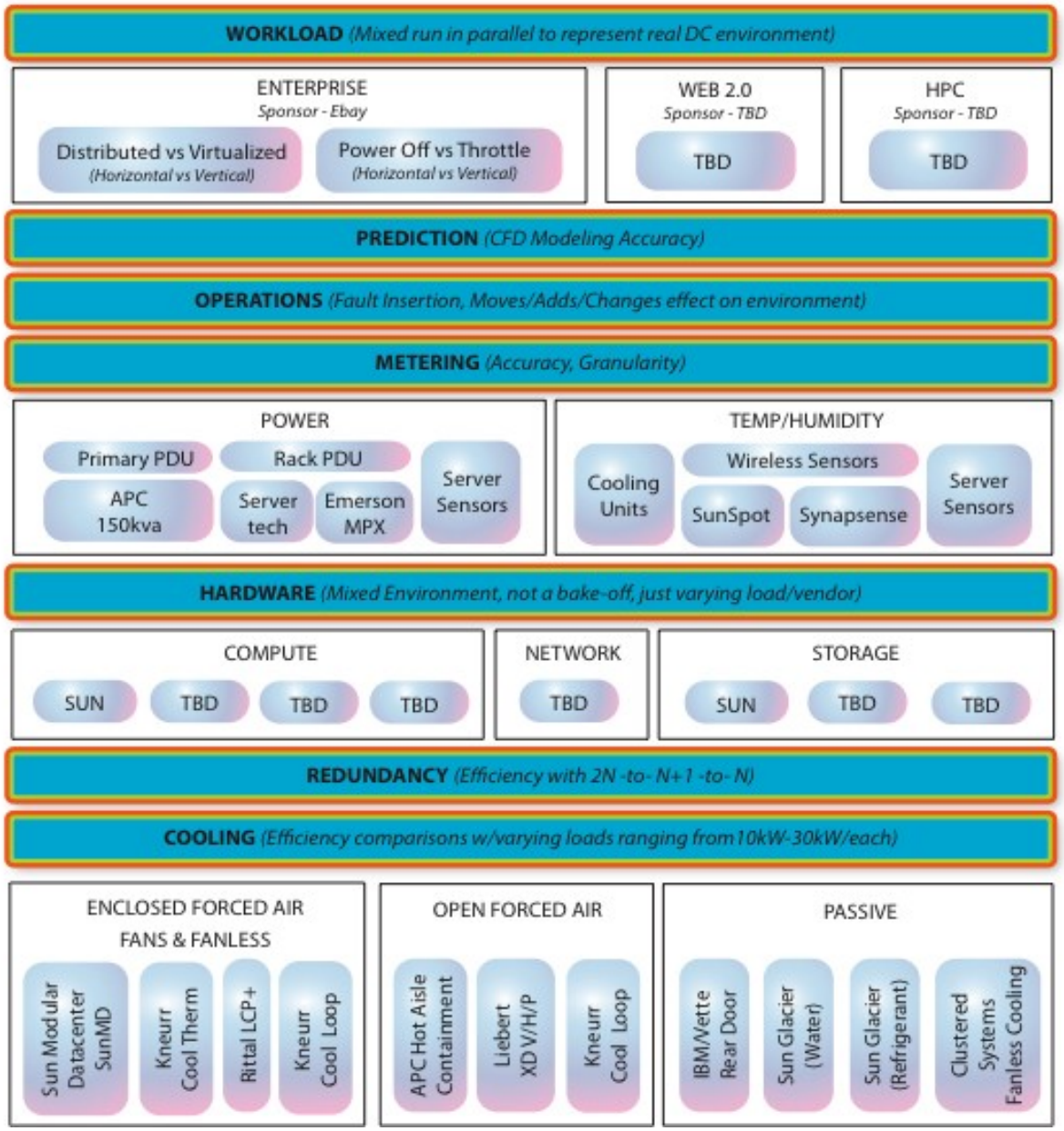
Participate & Contribute

CO2 - Chill-Off 2



CHILL-OFF 2 STACK

Contact: dean.nelson@sun.com - Updates: http://blogs.sun.com/geekism



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TESTING SUPPORT

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REVIEWERS

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Silicon Valley Leadership Group · DATA CENTER Pulse · Berkeley Lab

Chill Off 2 Close Up...

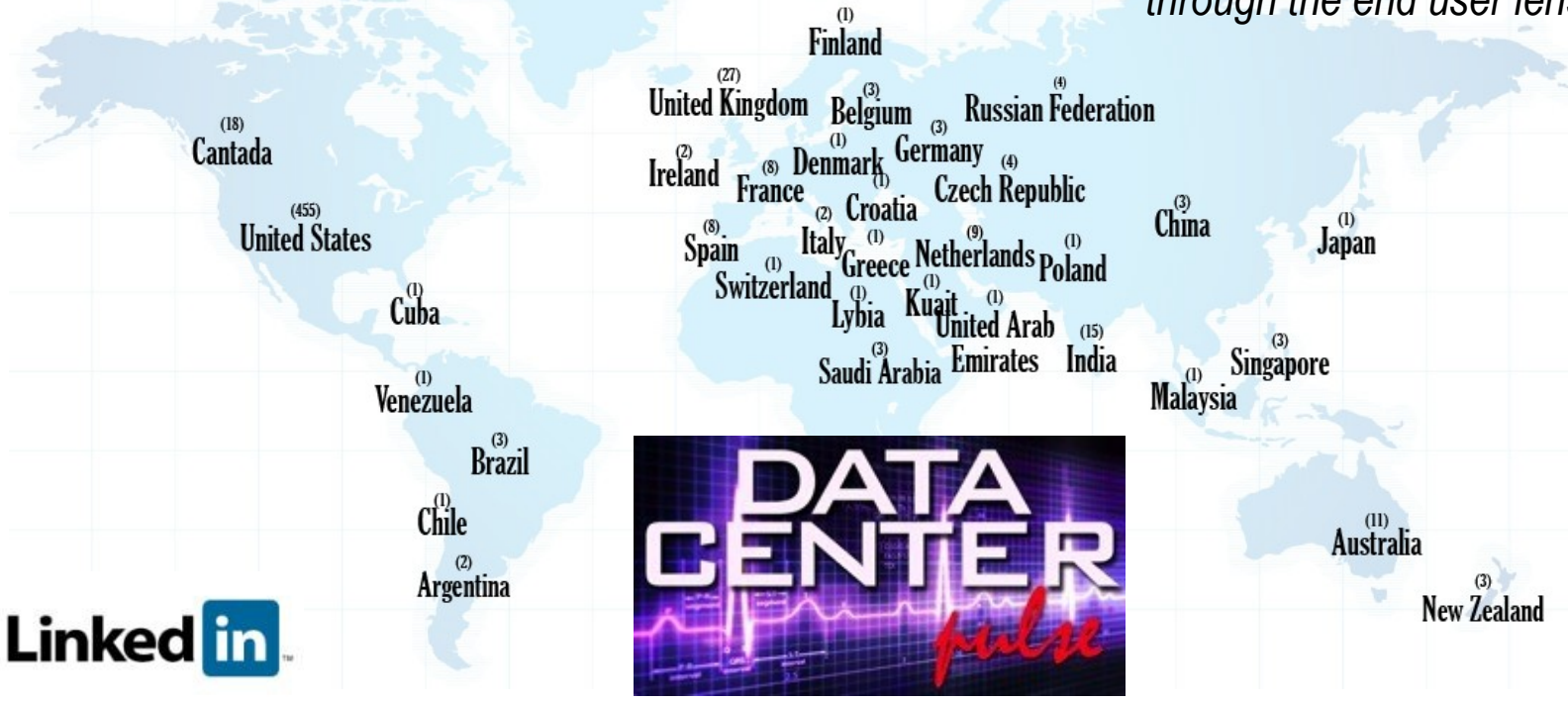
Ultra-efficient no-fan, high-density servers that plug into the pod infrastructure

Breaking our own warranty. We are experimenting with this type of configuration in the chill off now...

Data Center End User Community

- 788 members, 481 Companies, 39 Countries, 59 Industries
- http://datacenterpulse.org

An exclusive group of global datacenter owners, operators and users influencing the datacenter industry through the end user lens.



* Membership stats as of 1:39am 03/25/2009.

Open, Global, Focused

- Formed Sept/2008
- First Global Summit Held in CA, February 2008
  - > Un-conference, topics defined and driven by members
  - > In-person & On-line
  - > Selected Topics: Top 10, Metrics, Certification, Cloud, Industry Alignment, Fanless Servers, Power
- Access
  - > Website: http://www.datacenterpulse.org
  - > YouTube: http://www.youtube.com/user/datacenterpulse
- Join the Group through LinkedIn
  - > Owner/Operators http://www.linkedin.com/groups?gid=841187
  - > Industry http://www.linkedin.com/groups?gid=1315947

The Top 10 (Feb/2009)

1) Align Industry Organizations
2) Data Center Certification Standard
3) Standard Data Center Stack
4) Update or Dump Tier Levels
5) More Products with Modularity
6) Simple Top Level Efficiency Metric
7) End to End IT/Facilities Measurement
8) Standard Conductive Cooling Interface
9) 480V/277V Power Supplies
10) Independent Data Center Repository

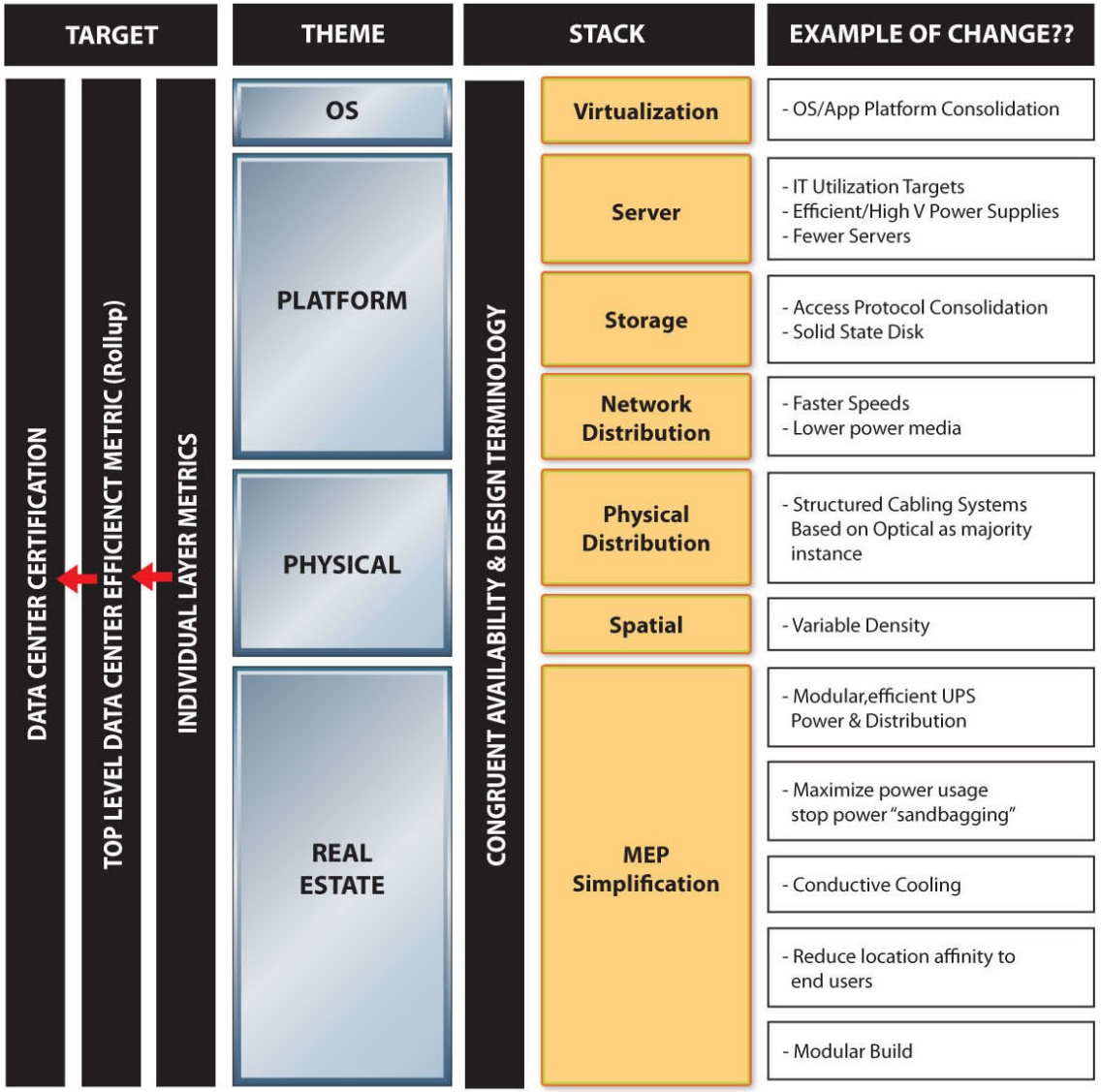
Draft: Standard Data Center Stack

DATA CENTER pulse

DATA CENTER STACK PROPOSAL

DRAFT 1.0

FEBRUARY 18, 2009



Dean Nelson
Sr. Director of Global Lab & Datacenter Design Services (GDS)
dean.nelson@sun.com
http://blogs.sun.com/geekism