



# Projected Trends In Data Center Applications, Size & Efficiency

**Dennis Symanski – Senior Project Manager**

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Berkeley, CA

# What are some of the trends that are making data center loads “grow”?

- **Facebook** had 1 billion users in AUG2012, all sharing photos & details on what they're eating for lunch

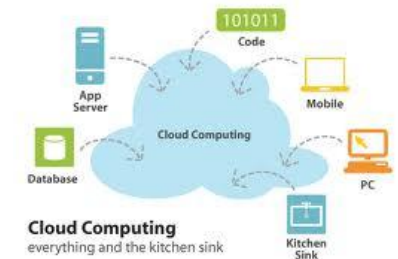


- **Apple**

- 300,000 iPad Apps/800,000 iPhone Apps
- \$1Billion, 500,000 sq ft data center to sell Apps, iTunes
- Many of those Apps need “**other**” data centers to run



- **Cloud Computing** (Data Center services are being offered without having to build & operate your own data center)



- 1.9 Billion **emailers** sent 107 Trillion emails in 2010



# What are some of the trends that are making data center loads “grow”?

- **Electronic Medical Records**

- More people/Living Longer/More Tests



- **Smart Grid**

- 10’s of millions of Smart Meters
- Utilities’ data centers collecting petabytes of data



- **Gaming**

- Sony PlayStation Network >77 million users



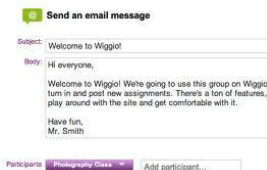
- **Google/YouTube & Apple**

- France Telecom in negotiations with Apple & Google
- Mobile-data traffic growing by 5% “every week”



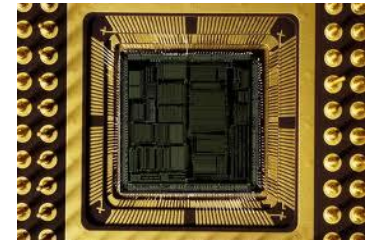
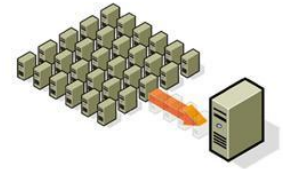
# How fast will data “grow”?

- Think about our own use of data
- In the 90’s, our emails were just short **text** messages.....a few kilo-bytes
- Then in the 00’s, we sent “attachments” like **photos** and power point slides.....a few mega-bytes
- Now in the 10’s, we’re streaming 2 hour HD **movies** from Netflix.....a few giga-bytes
- Each of those is an increase of a “thousand” every 10 years!
- **Data Centers are using ~93 Billion kWh/year**



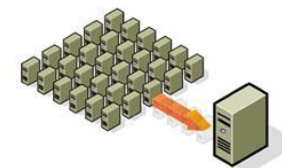
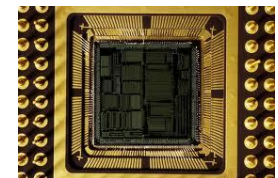
# Technologies that can reduce data center loads

- **Server Virtualization** (Multiple applications on a single server to remove many servers)
- **More Energy Efficient CPUs** (Multi-core CPUs can automatically shut off individual cores if not needed at that time)
- **More Energy Efficient Power Supplies** (80PLUS & Energy Star programs)
- **More Energy Efficient UPSs** (Historically very inefficient)



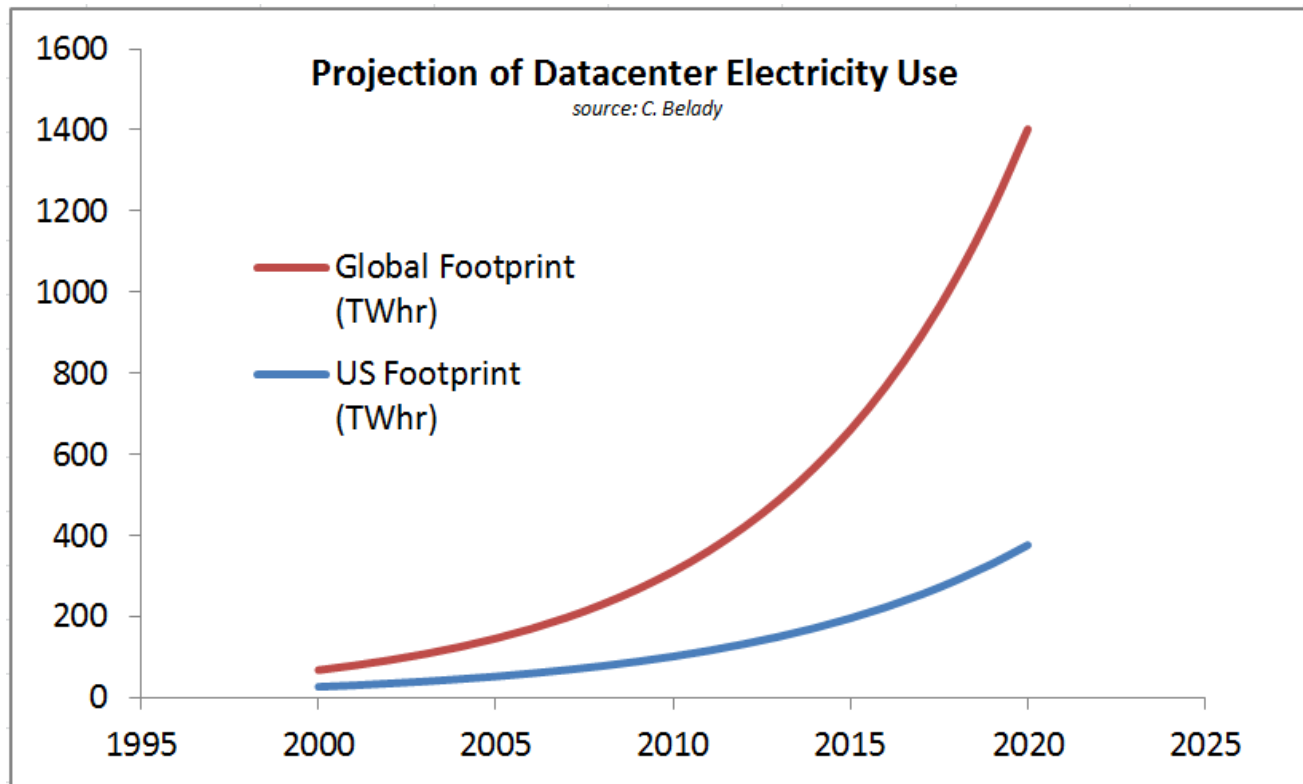
# Which “Trends” Will Dominate in the Future?

- ↑ The use of electronic devices & services using data centers will continue to increase
- ↑ The price of electricity is cheap compared to the cost of businesses failing
- → The 80PLUS & Energy Star programs are reaching the point of diminishing returns?
- ↓ More efficient CPUs & chips are needed (think of battery life for “mobile” devices)
- ↓ Virtualization software will continue to evolve and grow (many servers still at single digit utilization)



# What will 2020 Data Center Energy Usage Look Like?


**Microsoft** is predicting: **a continued “doubling” of energy usage every 5 years through 2020**



— PROJECTING ANNUAL NEW DATACENTER CONSTRUCTION MARKET SIZE – March 2011

— By Christian L. Belady, P.E. Microsoft

# What will 2020 Data Center Energy Usage Look Like?

-  is predicting:
  - Cloud Computing will replace many of the older, smaller, less efficient Data Centers, but once done, “they” will grow at the same doubling every 5 year rate.....**if not faster!**
  - Competition between the BIG players in Data Centers (Amazon, Apple, eBay, Facebook, Google, Microsoft, etc) will increase the size, number and power of their data centers
    - **Their own Data Center energy usage will double in “less” than 5 years**



# What will 2020 Data Center Energy Usage Look Like?



- [amazon.com](https://www.amazon.com) got burned by



- 23MAY2011 99 ¢ release of album
- Buy the album & get 20GB Cloud storage
- Buyers waited up to 10 hours to download the album
- Amazon apologized using “twitter”
- **Amazon will only accelerate the growth of their already HUGE data centers**

# What will 2020 Data Center Energy Usage Look Like?



- **Delta Products Corp**

- The largest power supply manufacturer in the world for TVs, Electric Vehicles, Servers and Storage Arrays
- Their data center equipment customers (including Cisco, Dell, EMC, Fujitsu, HP, IBM, Oracle and others) have been increasing their projected volume of power supply purchases
  - **They see evidence that this trend will continue**

# What will 2020 Data Center Energy Usage Look Like?

- **KC Mares** – Megawatt Consulting
  - Designed most of Yahoo's worldwide data centers
  - Consultant on many of the largest commercial data centers built in the US and around the world
  - Has worked on the design of Data Centers with a projected PUE of 1.08
- **He is predicting that by 2020, energy usage for Data Centers will be 3X to 5X what it is today!**

# Who could have predicted twitter.....more “growth”!

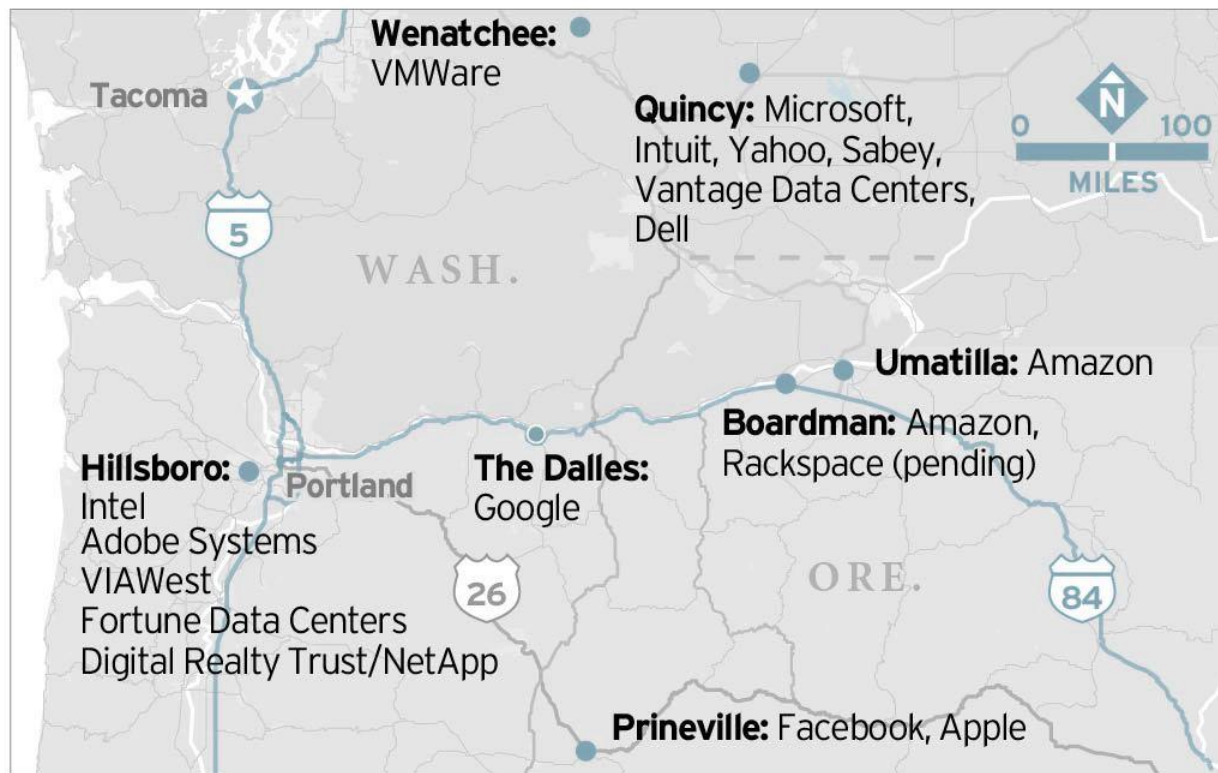


- *#tweets*
- **3 years, 2 months and 1 day.** The time it took from the first Tweet to the billionth Tweet.
- **1 week.** The time it now takes for users to send a billion Tweets.
- **50 million.** The average number of Tweets people sent per day, in Feb2010.
- **140 million.** The average number of Tweets people sent per day, in Feb2011.
- **177 million.** Tweets sent on March 11, 2011.
- **456.** Tweets per second (TPS) when Michael Jackson died on June 25, 2009 (a record at that time).
- **6,939.** Current TPS record, set 4 seconds after midnight in Japan on New Year's Day.
- **24.1 million** Tweets during the 2013 Super Bowl.
  
- *#accounts*
- **572,000.** Number of new accounts created on March 12, 2011.
- **460,000.** Average number of new accounts per day over the last month.
- **182%.** Increase in number of mobile users over the past year
  
- #presidents/dictators de-throned with the help of twitter
- **3.** Tunisia & Egypt & Libya

**What new future applications will catch on fire and increase data center loading??**

# Are all of these data centers in Silicon Valley?!?

## Some large Northwest data centers



MARK GRAVES/THE OREGONIAN

Some of these data centers are over 500,000 sq ft, \$1B and 10's of megawatts

# Data Center Type and Server Population

0.7% of data centers (Enterprise & Mid-tier)  
contain 43% of all servers

(Amazon/Apple/Facebook/Google/Visa/Yahoo)

They are already efficient data centers

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99.3% of data centers (more than 2.5 million of  
them) contain 57% of all servers

Hospitals

Hotels

Universities

Utilities

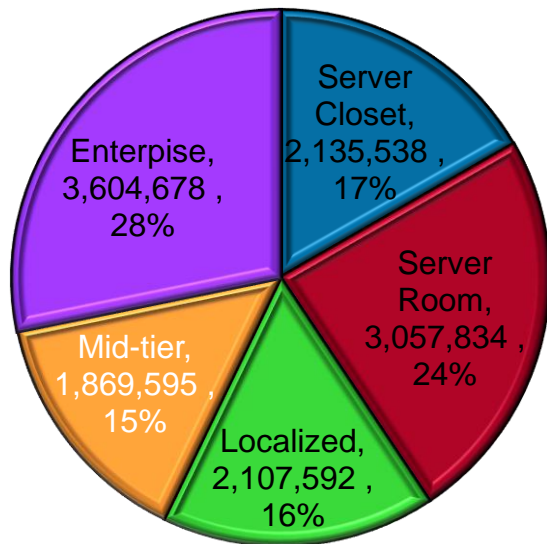
Banks

City Halls

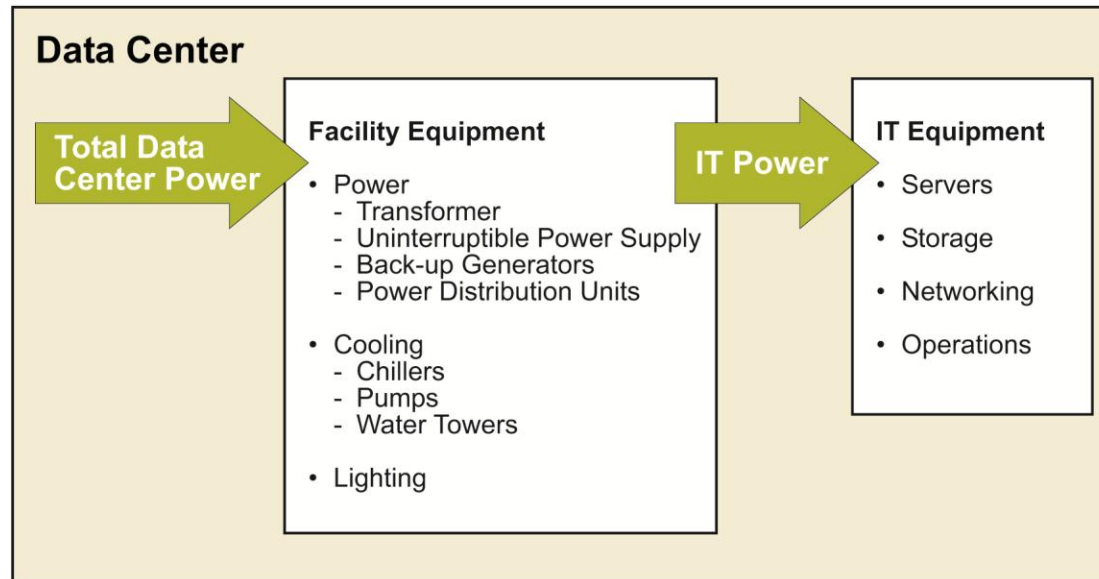
Chain Stores

These data centers operators struggle with  
heat/space/power problems and need help

Number of Servers by Data Center Type



# How Is Data Center Efficiency Measured?



- Power Usage Effectiveness (PUE)
- $PUE = \text{Total Data Center Power} / \text{IT Power}$
- The Closer The PUE Is To 1.00, The More Efficient The Data Center Is

# New York Times & WNYC/NPR & U.S. Congress

23SEP2012 Sunday New York Times

[http://www.nytimes.com/2012/09/23/technology/data-centers-waste-vast-amounts-of-energy-belying-industry-image.html?pagewanted=all&\\_r=0](http://www.nytimes.com/2012/09/23/technology/data-centers-waste-vast-amounts-of-energy-belying-industry-image.html?pagewanted=all&_r=0)

27SEP2012 U.S. Congress letter to the Dept of Energy & the EPA

<http://democrats.energycommerce.house.gov/sites/default/files/documents/Chu.Jackson.DataCenterEnergyEfficiency.2012.9.27.pdf>

05OCT2012 live interview by Leonard Lopate on WNYC/NPR

<http://www.wnyc.org/shows/lopate/2012/oct/05/please-explain-cloud-computing-and-data-barns/>



# Together...Shaping the Future of Electricity