CSE 265: System and Network Administration

- Data Centers
  - Desirable features
  - Planning
- Hardware Maintenance

Facebook Oregon Data Center (2012)
Desirable features of a data center
Desirable features of a data center

- Air conditioning, humidity control
- Access to building-wide reliable (uninterruptable) power supply and raw power
- Elimination of single points of failure (e.g., network cable)
- Provision of hot standby equipment
- Hot-swappable parts
  - Hard drives, power supplies, UPS batteries
- Protection from natural disasters like fire and floods
  - Server room should be its own 'fire cell'
Desirable features of a data center

- Faraday cage for important computing equipment
  - Protect from electromagnetic leaks
  - Protect from electromagnetic pulses
- No carpet or linoleum that generates static electricity
- Well organized – equipment marked, tagged, and mapped
- Secure – both the facility (also inconspicuous), and individual spaces when multiple organizations use same facility
- Easy access to cabling
Data Center Needs

- **Temperature**: 64-80°F
  - Ambient temperature (in room) is usually 40+ degrees lower than inside of computer
  - When chips reach ~120°F, they may not work correctly; at ~160°F, they break (some CPUs can operate up to ~200°F)
- **Humidity**: 30-55%
  - Too high – condensation, short circuits
  - Too low – static electricity, jamming of printers, etc.
- **Security** (theft, vandalism, disaster)
- **Space for equipment, people** (to work on equipment)
Data Center Planning

• What are your present and future needs?
  - We would like to exhaust all resources at the same time
• Security requirements
• Fire/other hazard protection
• How much Heating and Air Conditioning?
• How much raw power? Back-up power?
• How much space?
Security in Data Centers
Fire Hazard Protection

- Useful to have early smoke detection so that failing equipment can be turned off before a fire starts
Earthquake Protection? - not here
HVAC for Data Centers

- Need to account for
  - Roof, walls, and windows (HVAC engineer)
  - Electronic gear (power consumption)
  - Light fixtures
  - Operators (people)
  - Humidity control

- Useful conversions:
  - 3.412 BTUH/watt
  - 300 BTUH/human
  - 12,000 BTUH/ton
Example HVAC Calculation

- 25 servers * 450W/server * 3.412 BTUH/watt = 38,385 BTUH
- 6 lights * 160W/light * 3.412 BTUH/W = 3,276 BTUH
- 4 humans * 300 BTUH / human = 1,200 BTUH
- 20,000 BTUH for roof, walls, and windows (given by HVAC engineer)
- Total is 62,861 BTUH * 1 ton/12,000 BTUH * 1.5 = 7.86 tons of cooling
Air Cooling is Possible

Facebook data center in Sweden.
Power in Data Centers

It's a big deal – sometimes difficult to get enough power in a machine room, and the power to individual machines should be remotely controllable (e.g., to power cycle from afar).

APCC integrated power, cooling, management
Data Center Space

Rarely do you get to see a data center like this (empty). Note the grates in the floor for cool air. The bulky refrigerator-sized units along the walls are probably air conditioners.
Dense Usage

- Large enough enterprises may find it useful to do mass-customization
- Note wheels on racks, no cases, pre-configured in this older Google data center
- Efficient - systems face inward
- Safe – racks secured together
- Organized – cabling tidy
Buy a pre-built data center
Easy transport by truck or ship

- [Rackable is now called SGI...]

Introducing ICE Cube™
The world’s most efficient modular data center
Or buy many...

From Microsoft's Chicago data center
Large scale

- Most Google's data centers are composed of standard 1AAA shipping containers packed with 1,160 servers each, with many containers in each data center. [cnet, 2009]
Maintenance of Systems

- Keep a log book of failures and replacements
- Shop around for good warranties
- Keep spare replacement systems
- Consider maintenance contracts
  - For equipment too expensive for holding spares
  - 4-48 hour response times; often function like an extended warranty
Preventive Maintenance

- Vacuum insides of computers in bad locations (lots of dust, carpets)
Preventive Maintenance

- Clean filters/vents regularly
Preventive Maintenance

- Avoid static electricity
  - Be grounded when handling electronics
- Periodically check servers for failed fan and power supplies
- Add temperature monitors (internal and external) and water sensors under raised floors
- Attach additional fans if noise is not an issue