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: 64-80F
  - Ambient temperature (in room) is usually 40+ degrees lower than inside of computer
  - When chips reach ~120F, they may not work correctly; at ~160F, they break (some CPUs can operate up to ~200F)
- 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?
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

Illustration of proposed Facebook data center in Sweden.
Power in Data Centers

APCC integrated power, cooling, management
Data Center Space
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 to transport

- Now called SGI....
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