

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

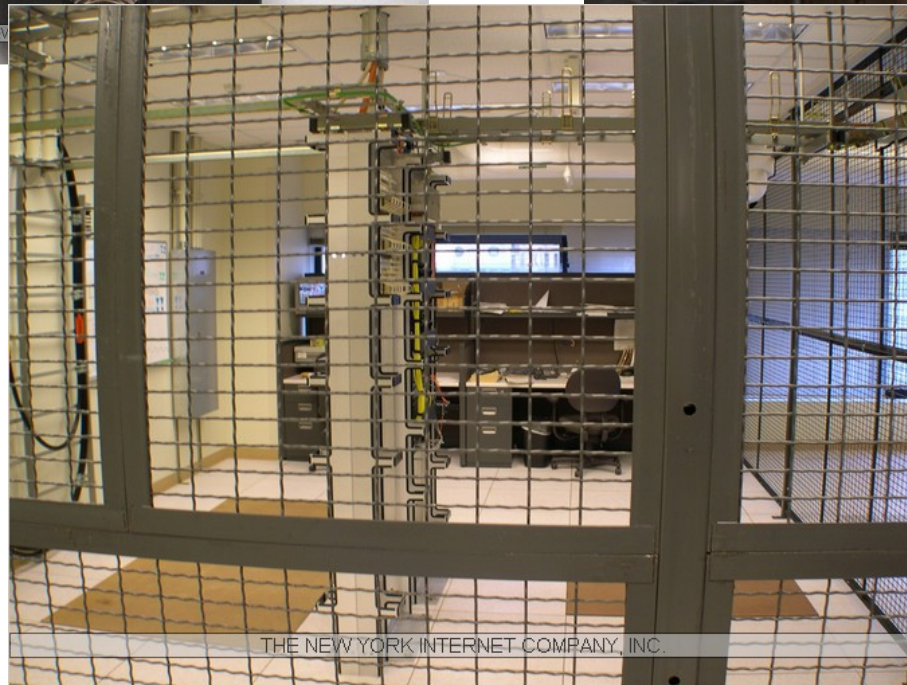
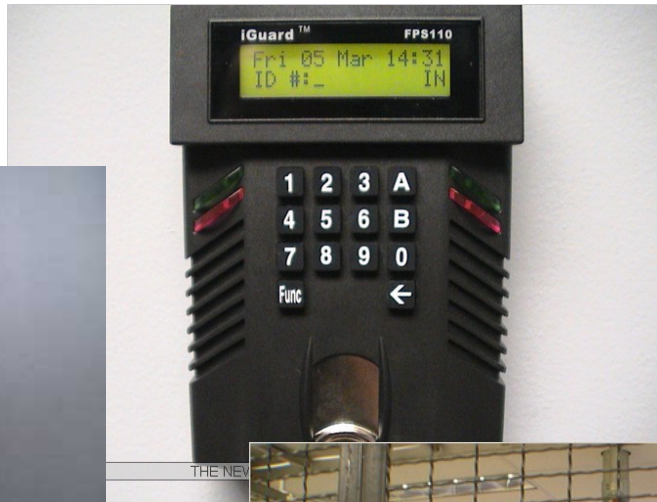
Data Center Needs

- 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

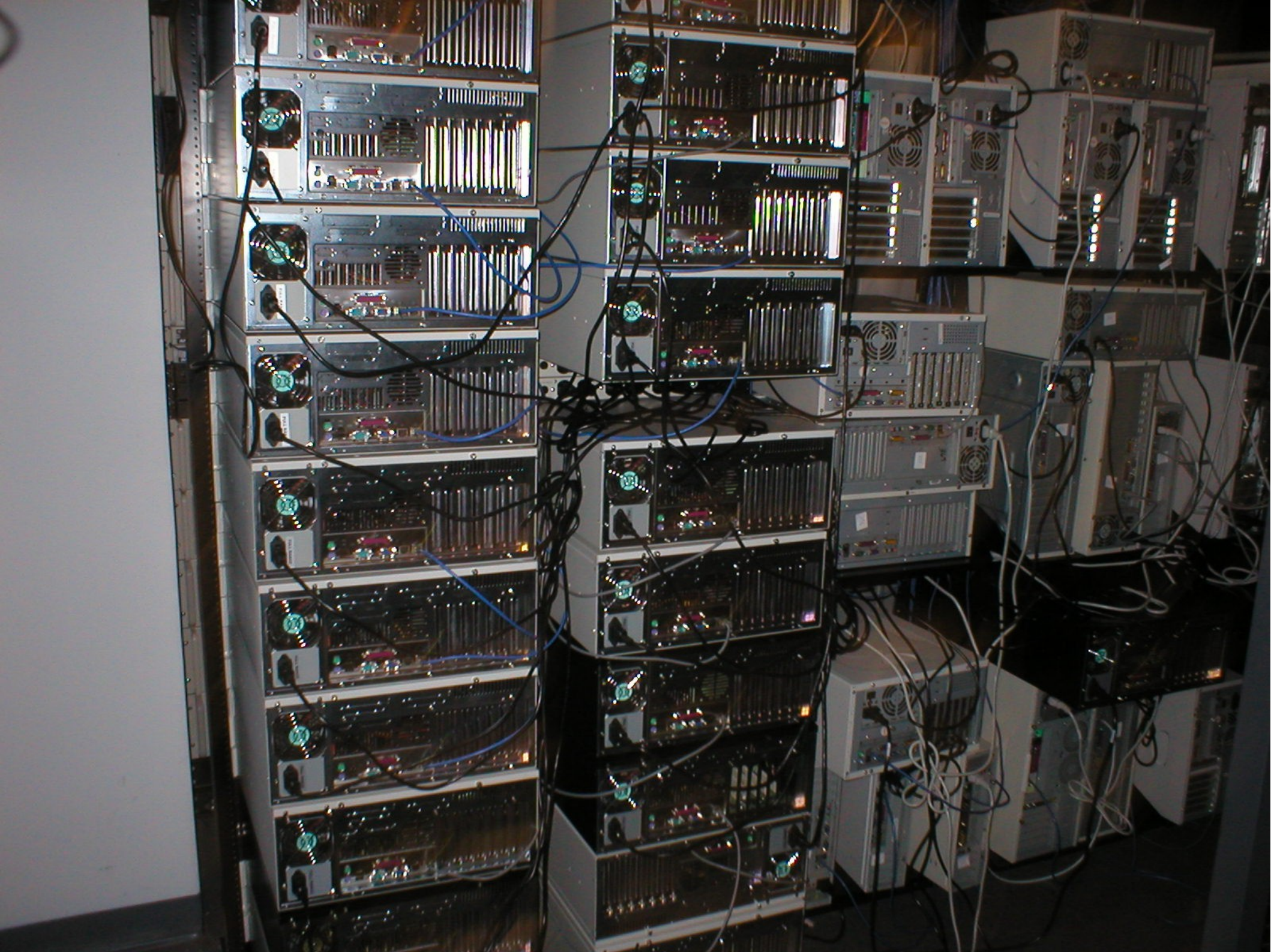


Facebook data center in Sweden.

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

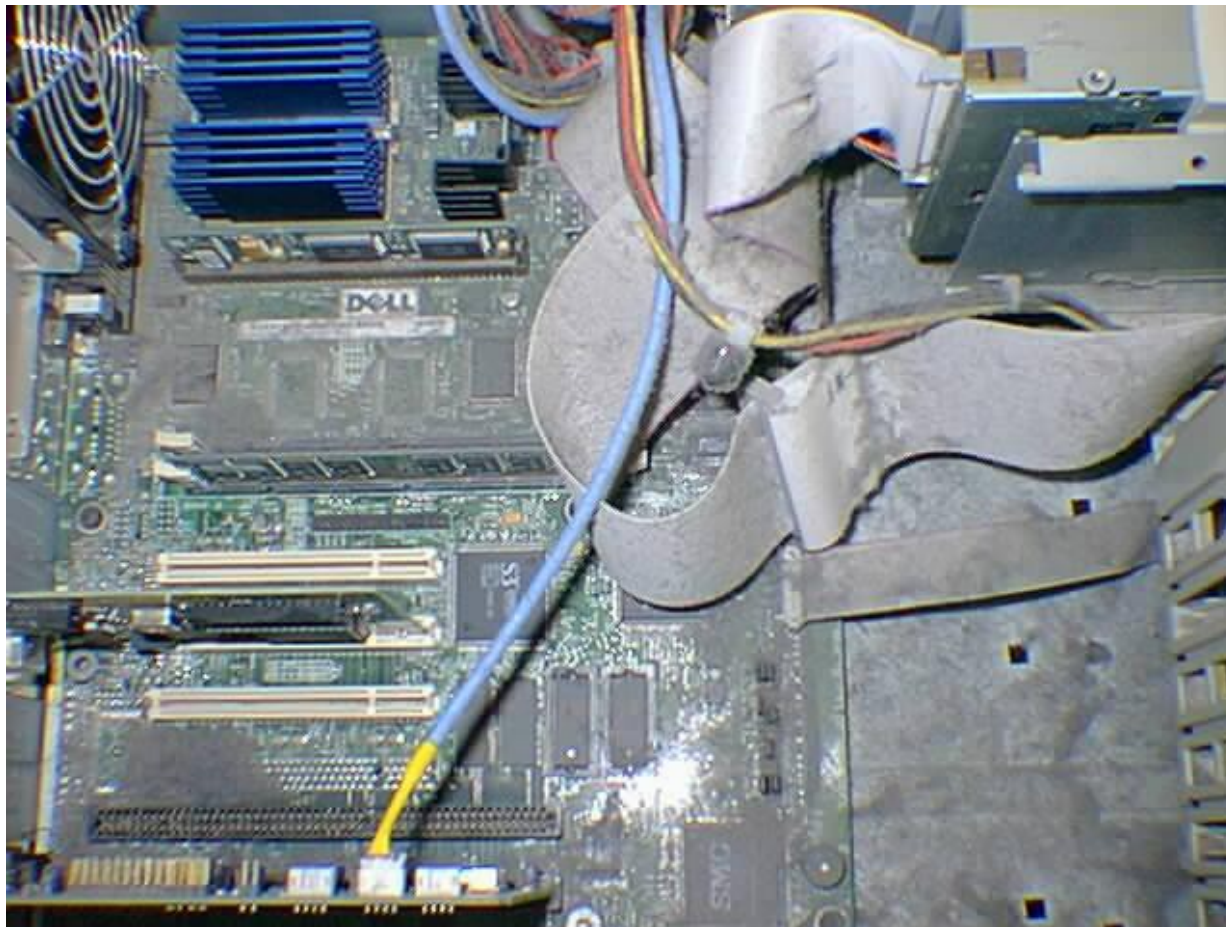
Preventive Maintenance

- 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