System Administration

Topics

1. Servers vs Desktops
2. Server Hardware
3. Different Approaches to Servers

How are Servers different?

- 1000s of clients depend on server.
- Requires high reliability.
- Requires tighter security.
- Often expected to last longer.
- Investment amortized over many clients, longer lifetime.

Vendor Product Lines

Home
- Cheapest purchase price.
- Components change regularly based on cost.

Business
- Focuses on Total Cost of Ownership (TCO).
- Slower hardware changes, longer lifetime.

Server
- Lowest cost per performance metric (nfs, web)
- Easy to service rack-mountable chassis.
- Higher quality (MIL-SPEC) components.

Server Hardware

- More internal space.
- More CPU/Memory.
  - More / high-end CPUs.
  - More / faster memory.
- High performance I/O.
  - PCIe vs PCI
  - SCSI/FC-AL vs. IDE
- Rack mounted.
- Redundancy
  - RAID
  - Hot-swap, hot-spares

Rack Mounting

Efficient space utilization.
- Simple, rectangular shape measured in [illegible].
- Repair and upgrade while mounted in rack.
- No side access required.

Requirements
- Cooling through back, not sides.
- Drives in front, cables in back.
- Remote management (serial console, hardware sensors, VM MUI)

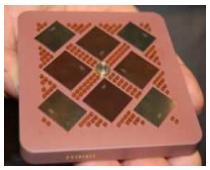
Server Memory

Servers need more RAM than desktops.
- x86 supports up to 64GB with PAE.
- x86-64 supports 1 PB (1024 TB)

Servers need faster RAM than desktops.
- Higher memory speeds.
- Multiple DIMMs accessed in parallel.
- Larger CPU caches.

Server CPUs

Enterprise Processors
- Intel Xeon (x86)
- AMD Opteron (x86)
- Itanium 2
- Sun UltraSPARC T2+
  - 4, 6, or 8 cores.
  - Each with 4 threads.
- IBM POWER 6+
  - dual-core 5.0 GHz
  - Each with 2 threads.



POWER 5 MCM with 4 dual-core HT CPUs + 4 36MB L3 cache chips.

Xeon vs Pentium/Core

- Xeon based on Pentium/Core with changes that vary by CPU:
  - Supports more CPUs
  - Faster/larger CPU caches
  - Faster/larger RAM support
  - Better hyperthreading

System Buses

Servers need high I/O throughput.
- Fast peripherals: SCSI-3, Gigabit ethernet
- Often use multiple and/or faster buses.

PCI
- Desktop: 32-bit 33 MHz, 133 MB/s
- Server: 64-bit 66 MHz, 533 MB/s

PCI-X (backward compatible)
- v1.0: 64-bit 133 MHz, 1.06 GB/s
- v2.0: 64-bit 533 MHz, 4.3 GB/s

PCI Express (PCIe)
- Serial architecture, v3.0 up to 16 GB/s

Hardware Redundancy

Disks are most likely component to fail.
- Use RAID for disk redundancy.
- Cover in detail in Disks lecture.

Power supplies second most likely to fail.
- Use redundant power supplies.
- Many servers need 2 power supplies normally.
- Need 3 power supplies for redundancy.
- Use separate power cord and UPS for each power supply.

Full and n+1 Redundancy

n+1 Redundancy: One component can fail, but the system is still functional.
- Ex: RAID 5, dual NICs with failover

Full Redundancy: Two complete sets of hardware configured with failover mechanism.
- Manual: SA switches to 2nd system when notices failure.
- Automatic: The second system monitors the first and switches over automatically on failure.
- Load-sharing: Both systems serve users, sharing load, but each has capacity to handle entire load on its own. When one fails, other automatically handles entire load.

Hot-swap Components

Hot-swap components
- Components can be replaced while running.
- Need n+1 redundancy for this to be useful.
- Don't need to schedule a downtime.

Issues
- Which parts are hot-swappable?
- May require a few seconds to reconfigure.
- Be sure components are hot-swap, not hot-plug.

Hot Plug and Hot Spare

Hot Plug
- Electrically safe to replace component.
- Part may not be recognized until next reboot.
- Requires downtime, unlike hot swap.

Hot Spare
- Spare component already plugged into system.
- System automatically uses hot spare when disk/CPU board etc. fails.
- Provides n+2 redundancy.

Separate Administrative Network

Reliability
- Allows access to machines even when network is down.

Performance
- Backups require so much bandwidth that they're often done over their own network.

Security
- Network security monitoring data and logs sent across network should be secured.

Maintenance Contracts

- All machines eventually break.
- Vendors offer variety of maint contracts.
- **Non-critical**: Next-day or 2-day contract.
- **Clusters**: If you have many similar hosts (CPU or web farm), then on-site spares may be cheaper than maintenance contract.
- **Controlled Model**: Use small # of machine types for all servers, so you can afford a spares kit.
- **Critical Host**: Same-day response or on-site spares.
- **Highly Critical**: On-site technician + dup machine.

Data Protection

- Avoid desktop backups by storing data on servers. Easy on UNIX, harder on Windows.
- Use RAID for server hardware failures.
  - Mirror root disk, higher RAID levels for data.
  - Some servers use 16GB Flash drives for root disk.
  - Doesn't protect against software mistakes.
- Server backups
  - Use specialized admin network to keep load off main network.
  - Use specialized tape jukeboxes to fully automate backups of large data servers (DBs, fileservers).

Keep Servers in Data Center

Data center necessary for server reliability.
- Power (enough power, UPS)
- Climate control (temperature, humidity)
- Fire protection
- High-speed network
- Physical security

Server OS

Need greater reliability, security than desktop.
- Remove unnecessary OS components.
- Configure for best security & performance.

Install and config specialized server software.
- Server software: web, db, nfs, dns, ldap, etc.
- May need monitoring software too.
- Configuration: disk space, networking

Server OS install should be automated too.

Remote Administration

Servers must be accessible remotely.
- Allows SA to fix problems quickly at 3am.
- Allows SA to work outside machine room.

Remote Administration
- Serial console and concentrator (UNIX)
- Networked KVM (Windows)
- Remote power control.
- Important to secure remote admin facilities.

Server Appliances

Dedicated hardware + software
- Fileserver (NetApp, Auspex)
- Print servers
- Routers

Advantages
- Performance
- Reliability
- Easy to setup
- Extra capabilities

Disadvantages
- Cost

Many Inexpensive Workstations

Why buy svr hardware?
- Buy two cheap rack-mount PCs + failover software.
- Works if two PCs cheaper than server.
- Google's approach with ~450,000 servers.

Blade Servers

- High-density servers on a board.
  - CPU
  - Memory
  - Disk
- Each blade lives in a blade chassis.

Blade Chassis

- Blade chassis provides power, network, remote.
- Typically hot-swappable, hot-spare.
- Racks can only support 1 svr/RU.
- Blades are higher density, but also require more power and cooling.

Key Points

Servers vs desktops
- Requirements and hardware differences.

Redundancy
- Full vs n+k redundancy.
- Hot plug vs hot spare.

Services
- Requirements: service, server, customer, operational.
- Machine independence and open architectures.

Performance
- Latency vs. throughput.