Management of Information Systems

BME VIK TMIT

Software Engineering, BSc

Management of Information Systems

4. Servers, Desktops

PART I

SERVERS

Elements of the Infrastructure

- User terminals
  - Desktop Computer
  - Personal Computer
  - PDA, smartphone, etc.
- Server
- Network (operational and maintenance)
- Storage

- The user terminals, the servers, and their network are complex, computer systems, constituting several units: Information systems

Typical Product Families

- Most typically a computer vendor has 3 different product families:
  - home,
  - business,
  - server

HOME PRODUCT FAMILY

- Characteristics of a home product family:
  - absolute cheapest starting price
  - expensive upgrades, accessories
  - characteristics are given in general terms
    - e.g.: video resolution rather than video card type
  - suppliers are changed frequently, so the are not „two same”
  - flexible „game features”: joystick, high performance graphic, audio

Business Product Family

- Characteristics of a business product family:
  - Minimizing the whole „life-cost” (more expensive start price, but longer lifetime)
  - Less frequent changes:
    - Expensive to store spare parts to a lot of (sub)types
    - Expensive to train the support/sales personal

SERVER PRODUCT FAMILY

- Characteristics of a server product family:
  - Different architecture (to have „longer life”: lot of free capacity, easy-to-upgrade, easy-to-expand)
  - Minimal cost comparing to performance
  - Easy to maintain, robust, minimal service/repairing time
  - Location of connection/control equipment/buttons: goal to be easy-to-maintain/expand, not to save space
  - Reliability is the key design option

Hardware Characteristics of Servers

- More internal space for (future) extensions: for cards, CPU-s, drives, etc.
- More CPU performance: more CPUs or one very fast and powerful CPU (but frequently I/O bound!)
- High performance I/O: typically servers perform much more I/O activities than the clients (prop. to # of clients)
  - Fast I/O subsystem,
  - Fast internal buses,
  - Fast network interfaces,
  - RAID technology
- More upgrade options
  - designed for growth – easy to add/replace CPU, memory...
- Rack mountable design
- No side-access needs (connectors only at front and back)

SERVERS - DEFINITION

- ***Server:*** in computer science & information systems terminology a server is a (typically heavy duty) computer or software that provides
  - the access and usage of the stored or provided ***data*** for other devices,
  - usage of its ***hardware resources*** (e.g. printer, backup storages, processors)
  - access to different ***services***.

Server Appliances

- A Server Appliance is a device that is suitable for one, dedicated service
- E.g.:
  - File server
  - Web-server
  - (E-)mail server
  - DNS server

Classification of Servers

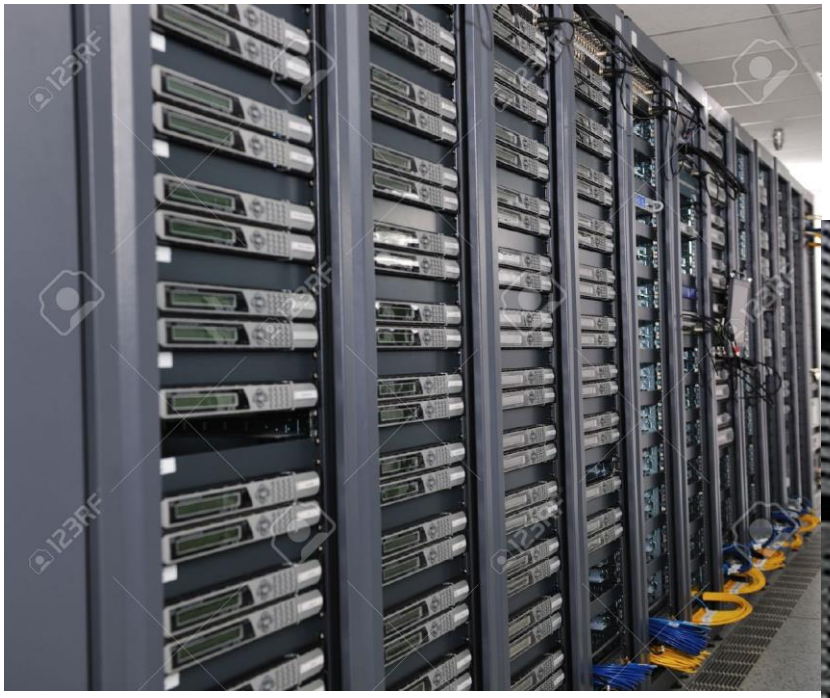
- According to functionality, e.g.
  - Web-servers,
  - FTP-servers,
  - Database-servers
- According to the served area, e.g.
  - Internet servers,
  - Intranet servers;
- According to power, capacity

SERVERS

Server Racks

- Rackmount servers
  - RU (rack unit) or U
    - 1.75 inch high
    - 19 (or 23) inches wide
  - Servers typically 2U or 4U
    - For virtualization the larger performance required -> larger space
  - Full-rack (Full-wide) / Half-rack (Half-wide) servers

1U, 2U, 4U SERVERS

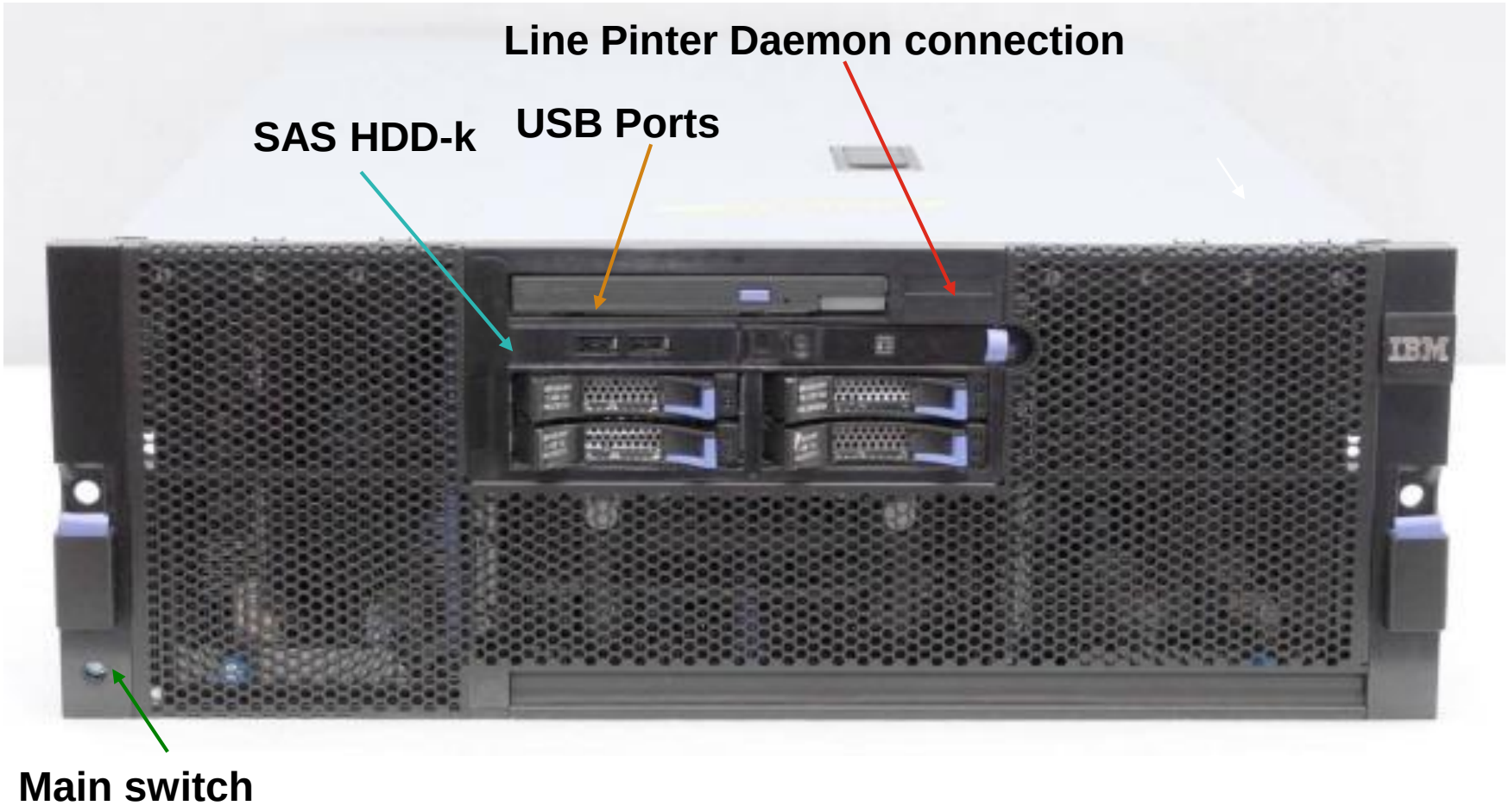


Server rack front

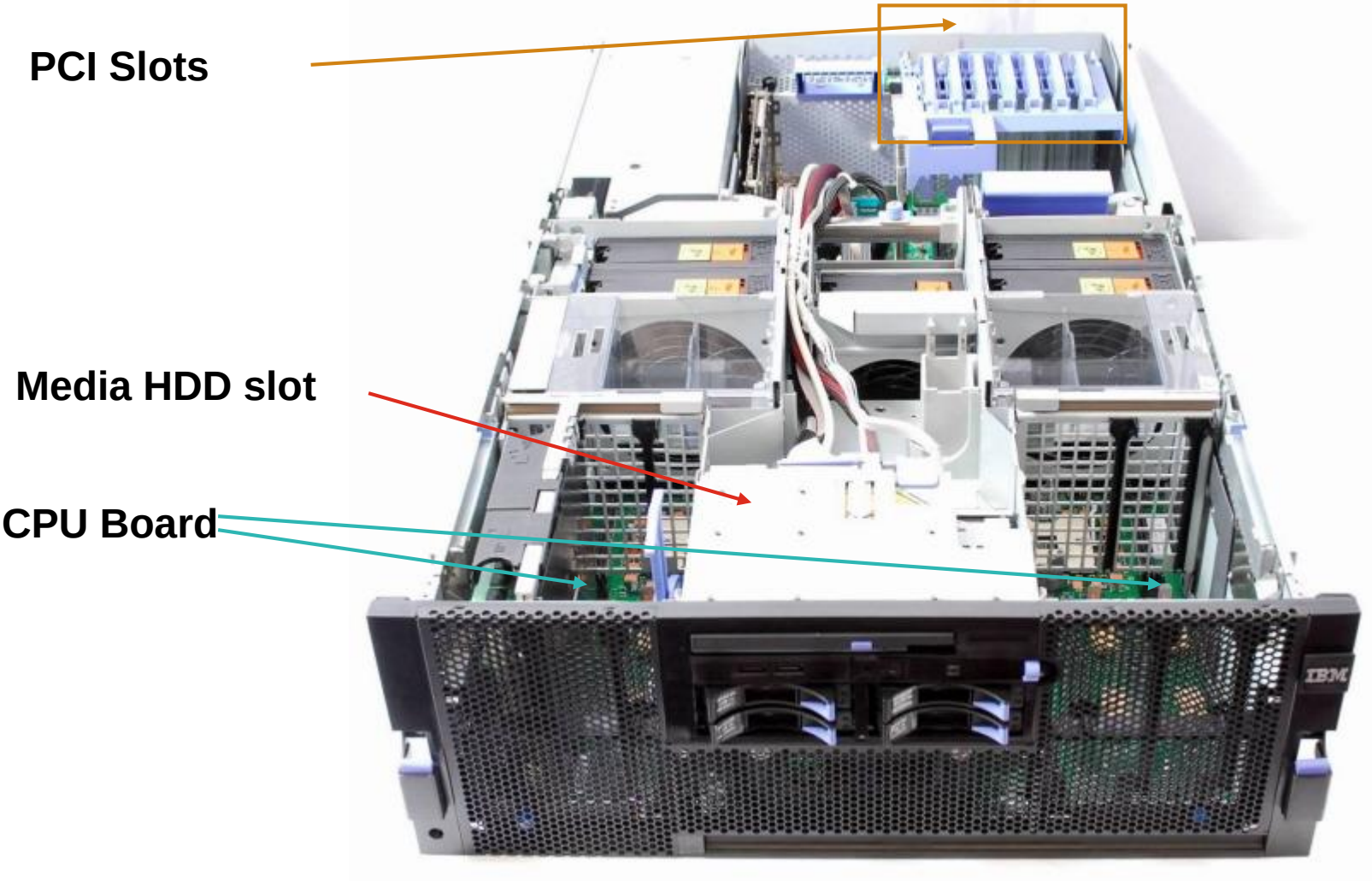
Server rack back

User terminal

FRONT PANEL


Line Pinter Daemon connection
SAS HDD-k
USB Ports
Main switch

INTERNAL VIEW

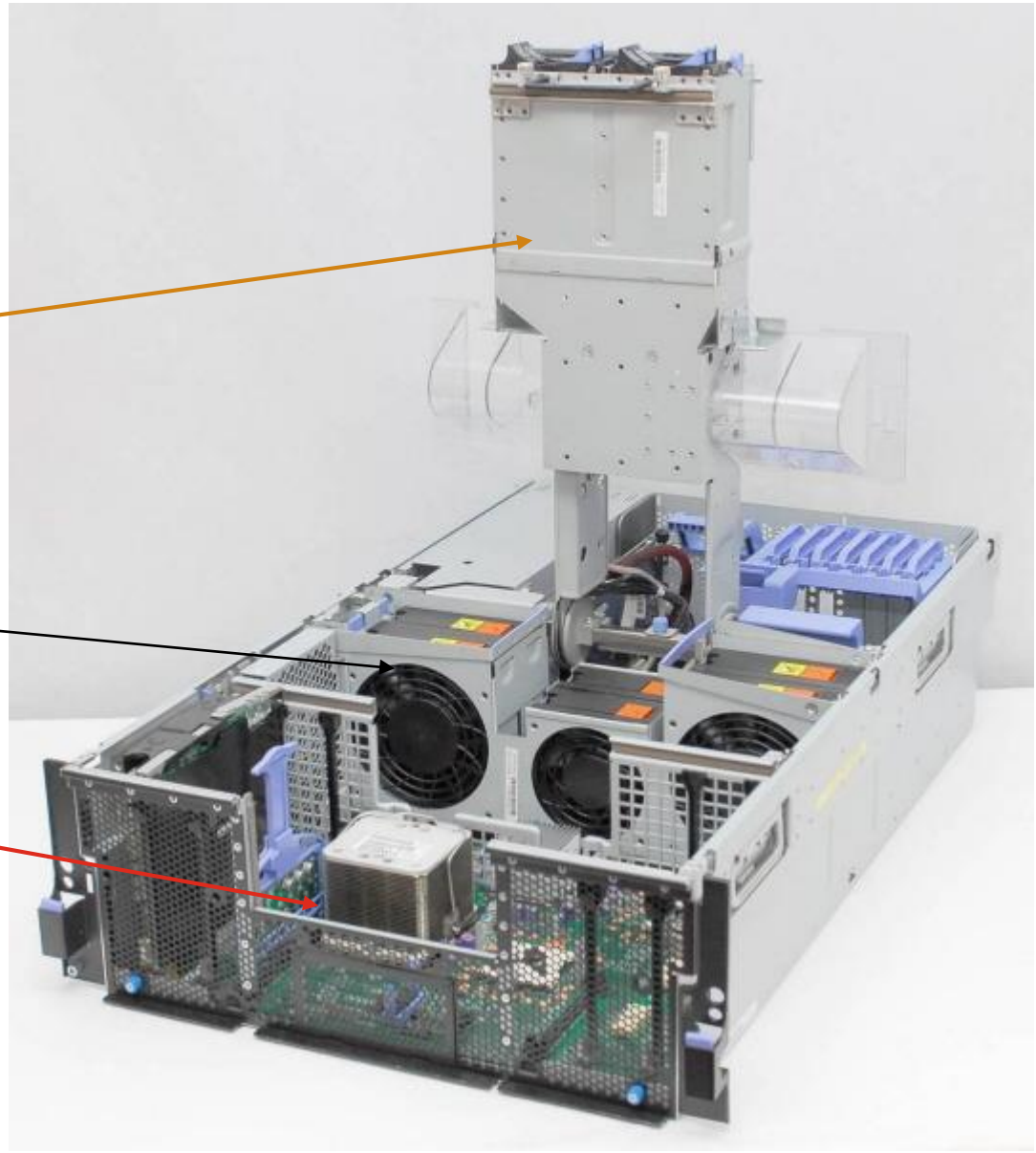


Centerfold media HDD slot

Media HDD slot
- **4 - 2.5” HS SAS HDD**
- **Front panel USB slots**

Fans

CPU card

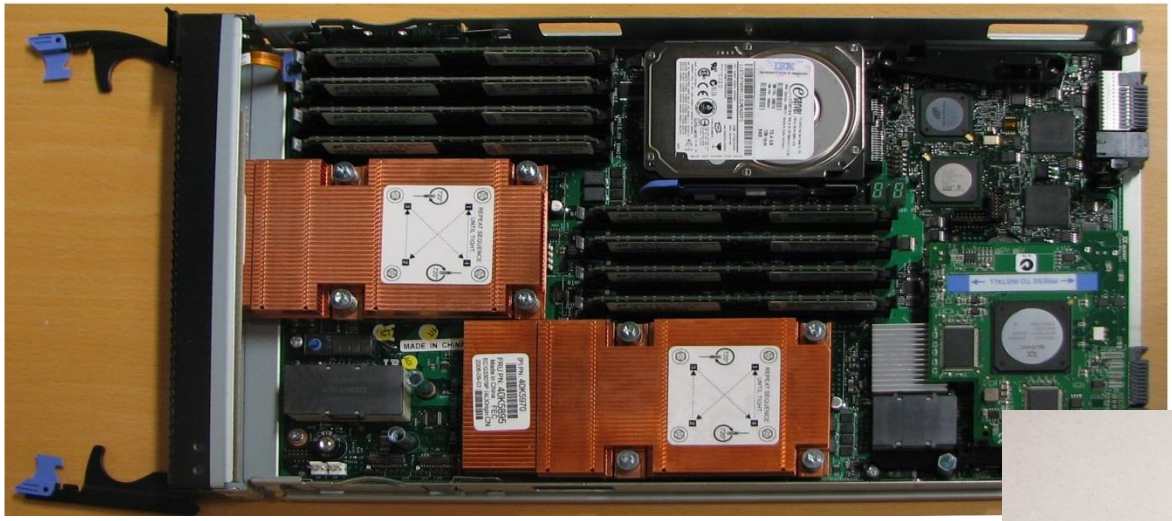


MEMORY CARD

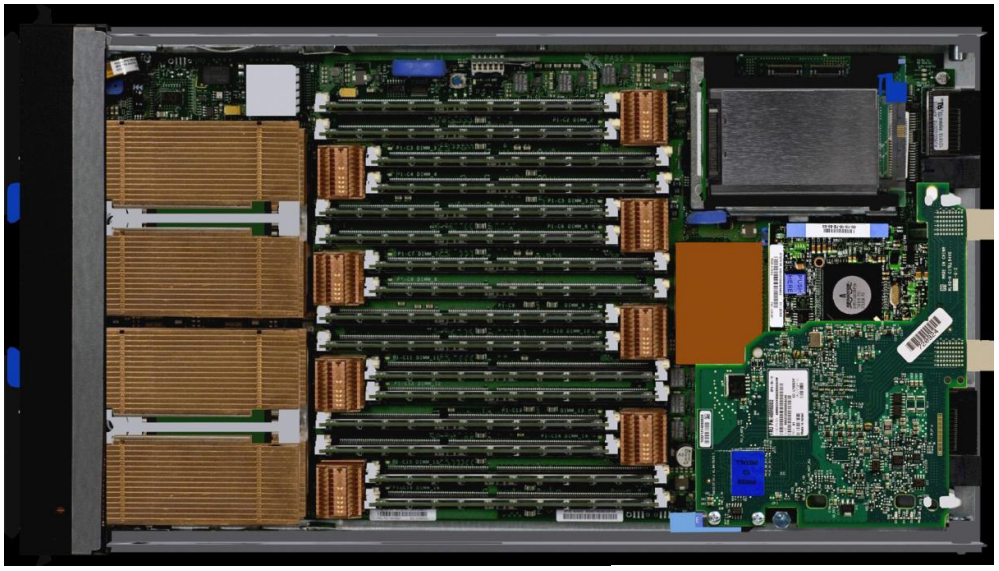
BLADE SERVERS

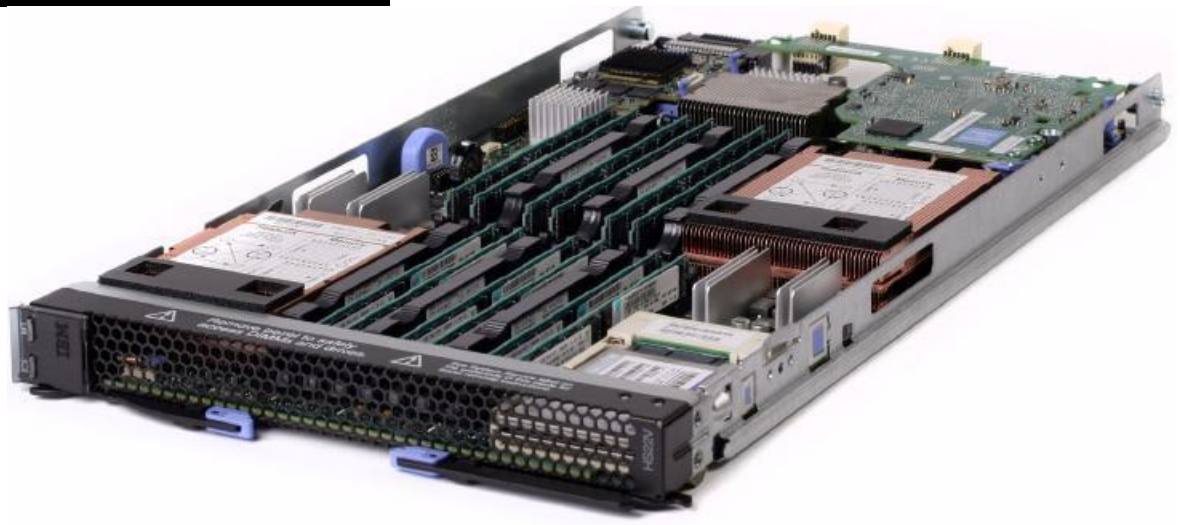
- Stripped-down computer
- Optimized to consume a minimal amount of power
- Use the space in a data center as efficiently as possible
  - Server density can be ~6 times higher
- How can it be achieved?
  - Only the core components
    - CPU, memory, integrated NW controller
    - Optionally Fiber Channel Host Bus Adaptor (HBA)
  - Rest --???

BLADE SERVERS

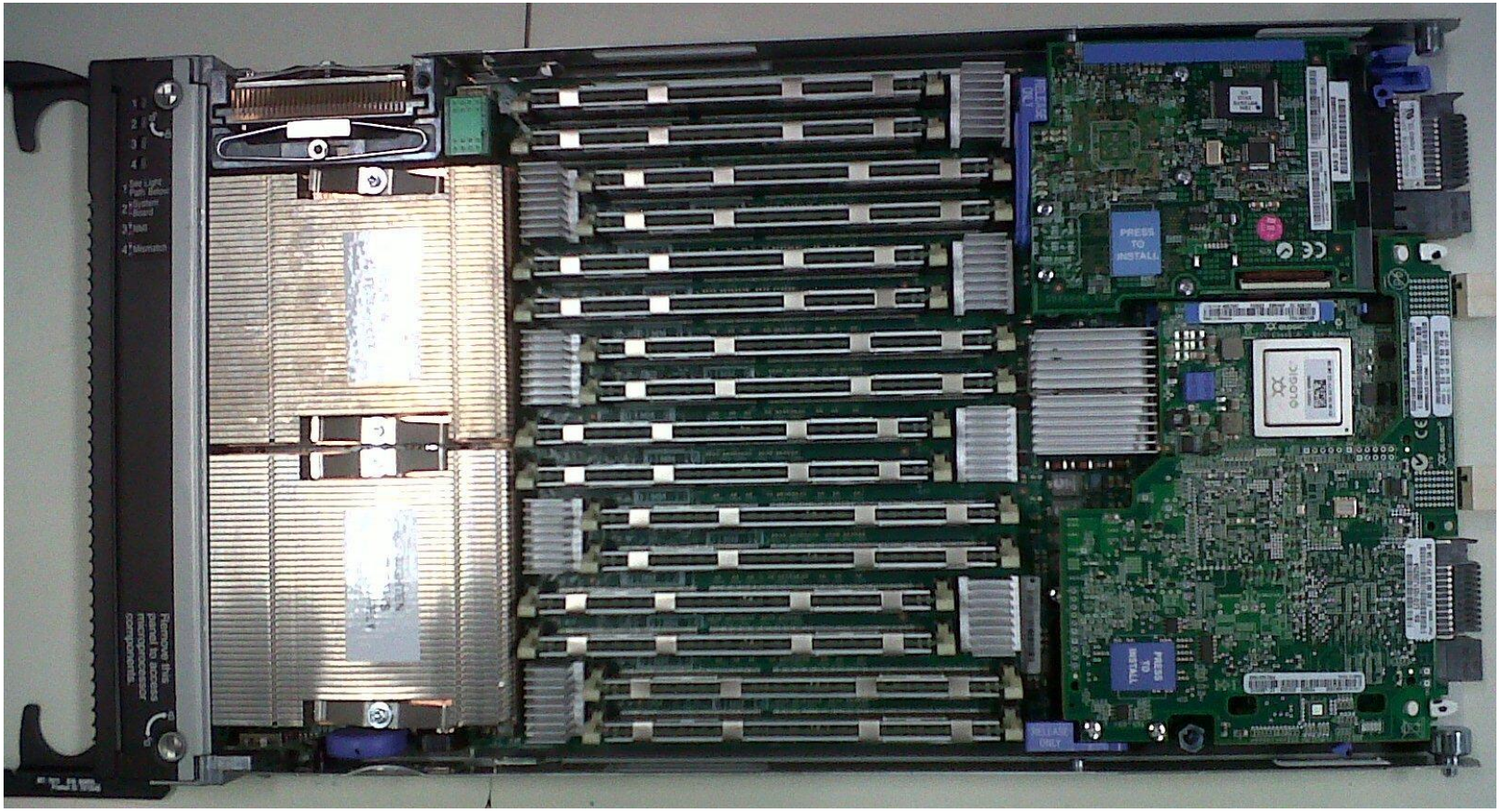


BLADE SERVERS





BLADE SERVER

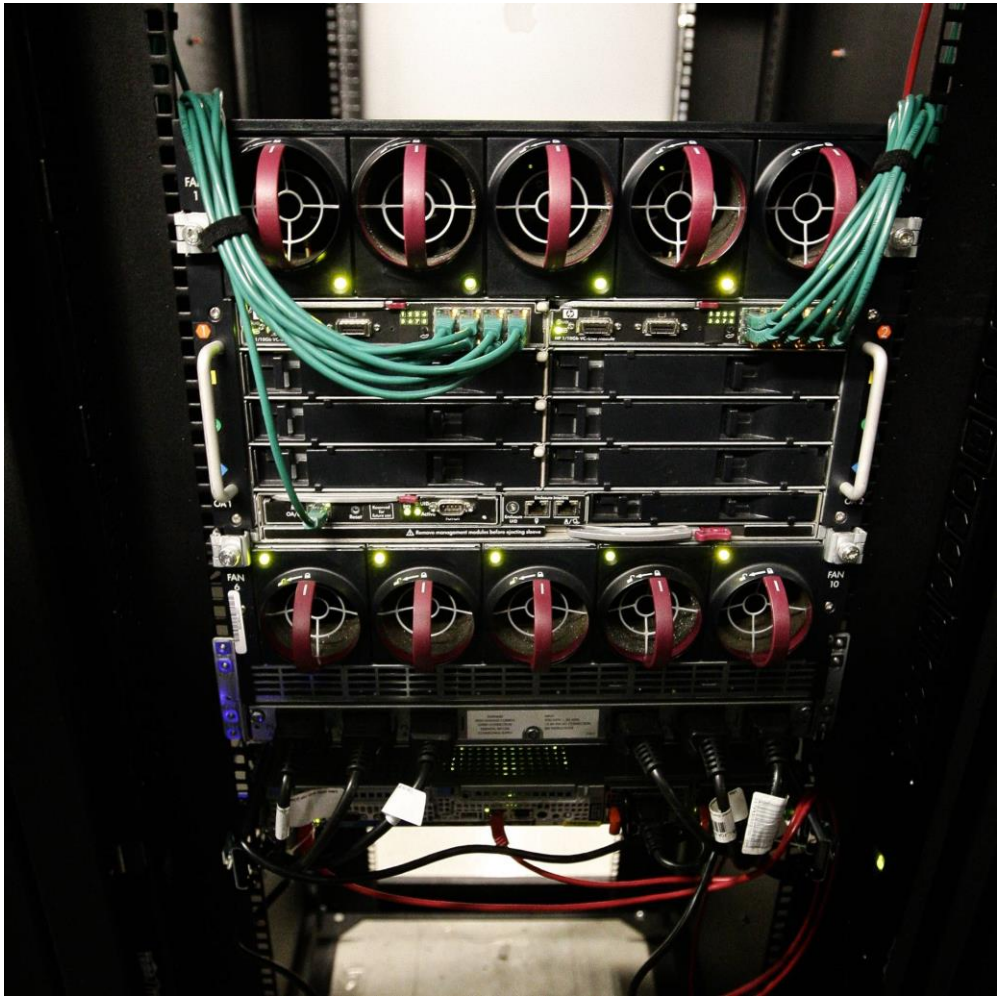


Blade Chassis

- Blade server cannot be used on its own
  - -> blade chassis
- Consolidation of
  - Power supply
    - But: more power cables
  - Cooling
  - Disks (in blades no or even just a few -> SAN)
    - Bootable from SAN
  - Network connectivity
  - User interface ports
    - Keyboard, video, mouse, DVD

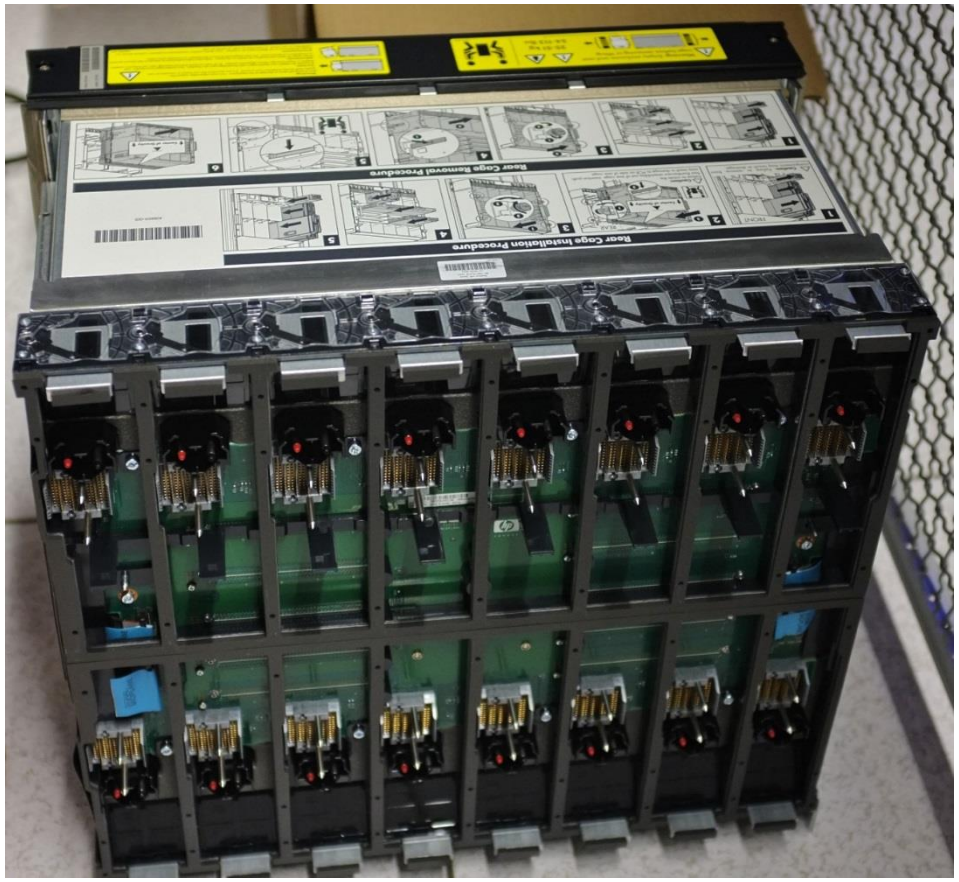
Blade Server Chassis – front

Blade Server Chassis – rear



Blade Server Chassis – empty

BLADE SERVER CHASSIS – MIDPLANE



- Redundant interconnections among blades
- Switch
- Media IF
- Management (load sharing)
- Redundant power distribution

Blade Server

Half-wide and full-wide blades

BLADE SERVER – TERMINOLOGY

- Server blade
  - One server
- Blade server
  - Synonym of Server blade
  - Chassis with server blades
    - Blade (Server) System

Blade Servers

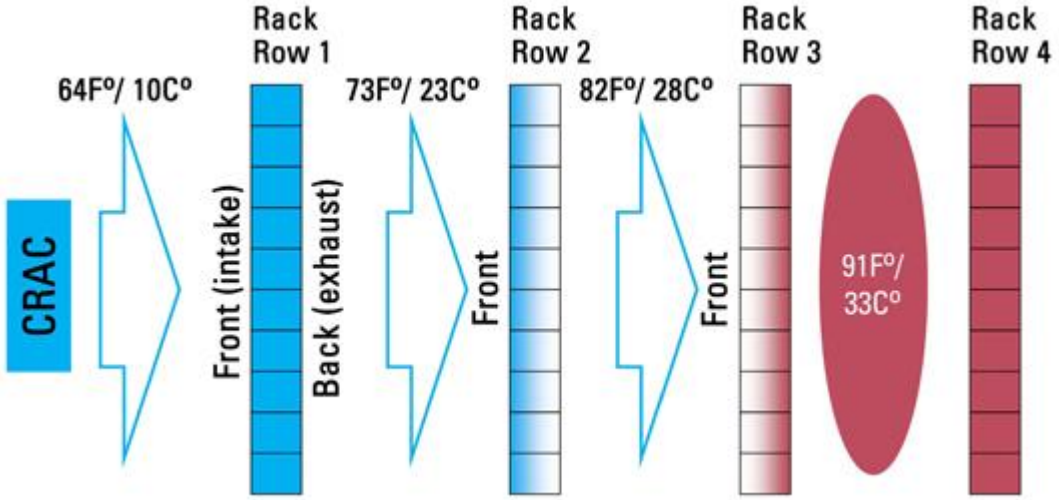
- Why to use them?
  - Smaller space (~ 1/6 – 1/10)
    - Smaller room
    - Fewer racks
    - Shorter cables (up to 85% reduction)
  - Smaller power consumption (25-50%)
    - -> Reduced cooling costs
    - But…
  - Large computation power
  - High processor/core density

Blade Servers

- But…
  - Price
    - A blade server is cheaper, but the chassis is expensive
    - It worths if it is full (14-16 or more…)
      - Not good for small companies
    - Chassis is not standardized
      - Only one company
      - Or even only one type (!)

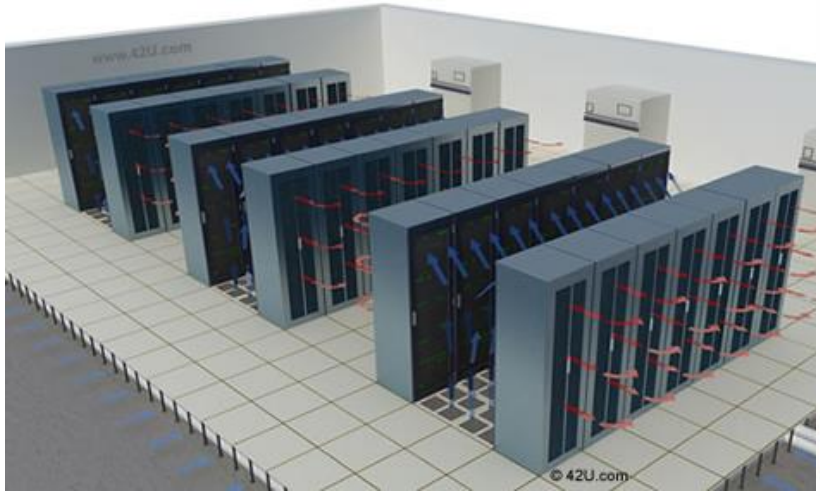
BLADE SERVERS

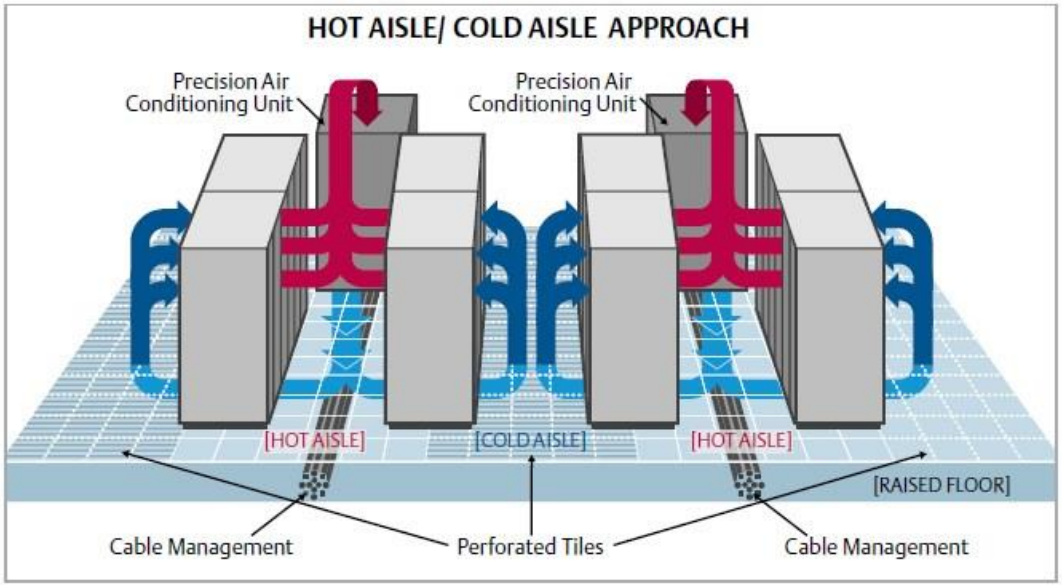
– Cooling
  - Though less power (heat), but power/heat density is high
  - More efficient, special cooling system
  - Traditional case:



HOT AISLE/COLD AISLE LAYOUT

- Fronts of the server(rack)s face each other
- Raising the floor ~50cm





Hot Aisle/Cold Aisle Layout

BLADE SERVERS

- Memory
  - Smaller than in ‘regular’ servers, but in nowaday’s models acceptable
  - But not extendable, because of lack of space
- Disks
  - Typically no or very limited disk space
    - 1-2 disks
    - For the operating system, not to store (large amount of) data
  - Disk/Storage modules in chassis
    - Consumes (lot of) space
    - Often it is still not enough
    - SAN – Fibre Channel cards
    - Typically do not support hot-swappable disks
  - When is it a big problem???

ADVANTAGES

- More computation power on less space
- Management
  - Failover/load balancing
    - designed for this
  - Self-diagnosis – replace
- Easy set-up
  - Just plug-in into the chassis
  - Power, network, cabling – solved in chassis
    - Not to connect each server separately to power, net (Ethernet, SAN, management NW), display, keyboard, mouse

DISADVANTAGES

- Special climate control
- Costs
  - Server + chassis
    - Not well scalable
  - Special initial configuration, special training, special administration
  - Not compatible, vendor-specific solutions
    - Vendor lock
- Devaluation
  - Cannot be upgraded
  - Not standardised, not compatible new server with old chassis

WHAT CAN THEY BE USED FOR?

- Tasks for high computing but less storage requirements
  - E-mail, web servers
  - SSL encrypting of Web communication
  - Infrastructure applications such as DNS
  - Streaming audio and video content
  - Database control
  - Virtualization, virtual machines – memory!!!
  - Distributed computing
- Server clusters
  - See later in Data Centers chapter

HOMOGENEOUS / HETEROGENEOUS SYSTEMS

- Servers can be
  - Homogeneous (from same vendor/from same type, family)
  - Heterogeneous (from more, different vendors/from different product families).
- Advantages of homogeneous systems:
  - Easier education
  - Easier maintenance
  - Easier repairing (one set of spares)
- Advantages of heterogeneous systems :
  - Can not stuck when something happens (bankrupt) to the vendor
  - Most appropriate equipment can be chosen to all tasks
  - Competition between vendors result in smaller price

Reliability of Servers

- More users depend on them – reliability is the key
- Small repairing time
  - Different architecture – „longer life”
  - Free capacity
  - Duplications
- Maintenance agreement
- Disk backup
- Location in a safe place (data center)

Location of Servers

- Must be protected against
  - Damage by disaster
  - Electromagnetic influence
  - Damage caused by human
- Must be located in a safe place
  - UPS – Uninterruptible Power Supply
  - HVAC - heating, ventilating and air conditioning
  - Fire protection
  - Physical protection (physical harm, unauthorized access)

UNINTERRUPTIBLE POWER SUPPLY (UPS)

- Fire alarm sensor

FIRE-EXTINGUISHER

Fire-safe door

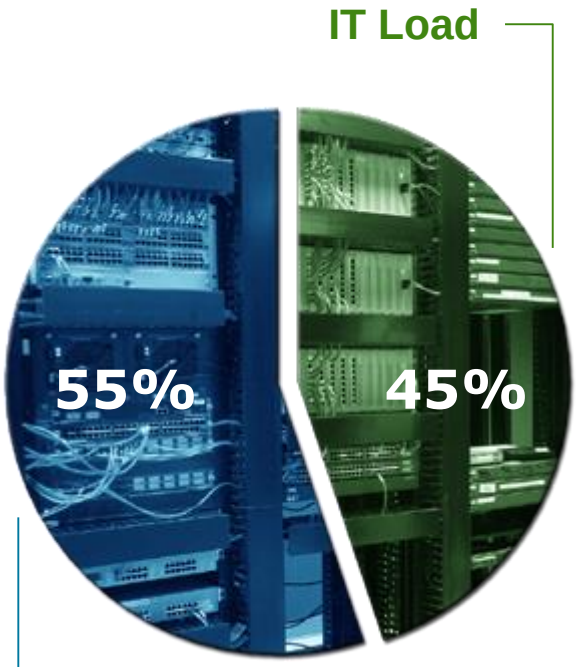
Air Conditioning is essential ☺

Power Supply of a Typical Data Center

- How large part of the energy do you think is used for useful CPU calculations?

Power Supply of a Typical Data Center

Data Centre

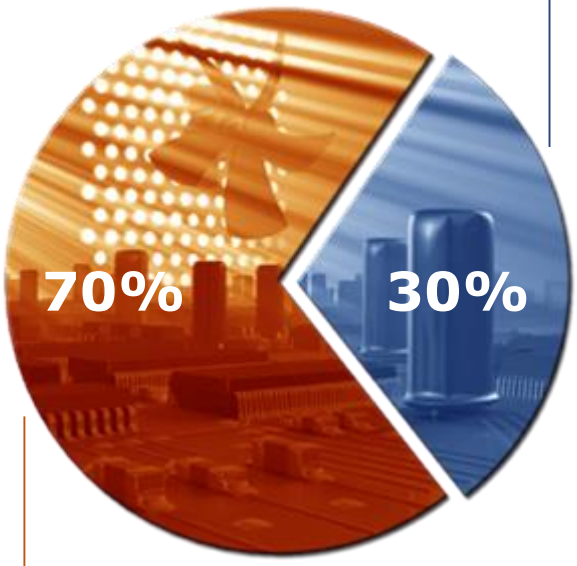


Data source: *Creating Energy-Efficient Data Centres, , U.S. Department of Energy , Data Centre Facilities and Engineering Conference , May 18, 2007*

Power Supply of a Typical Data Center

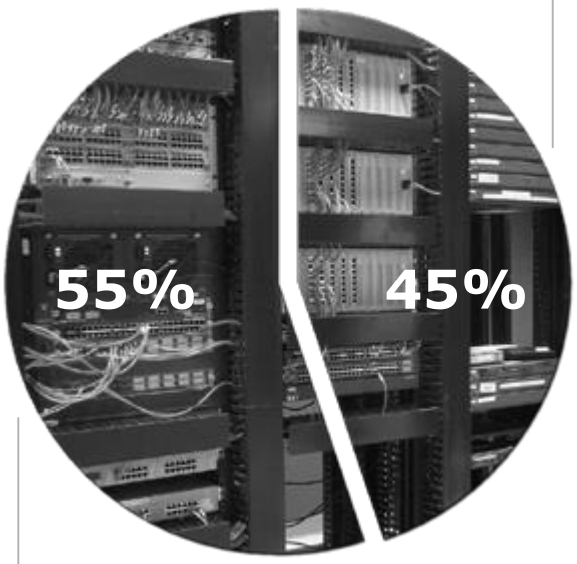
Data Centre

Server hardware

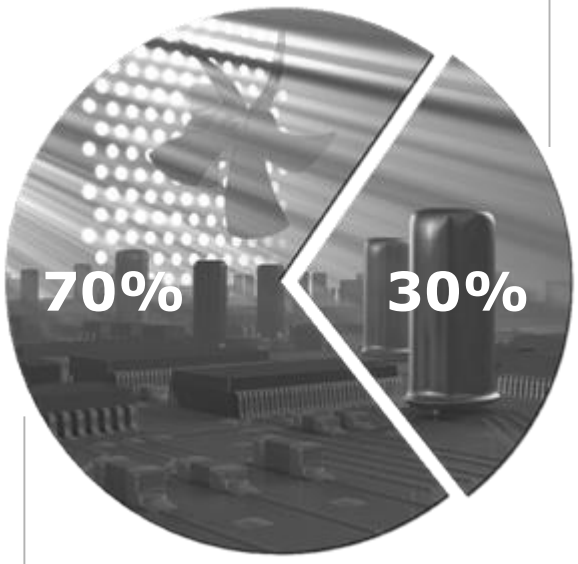


Power Supply of a Typical Data Center

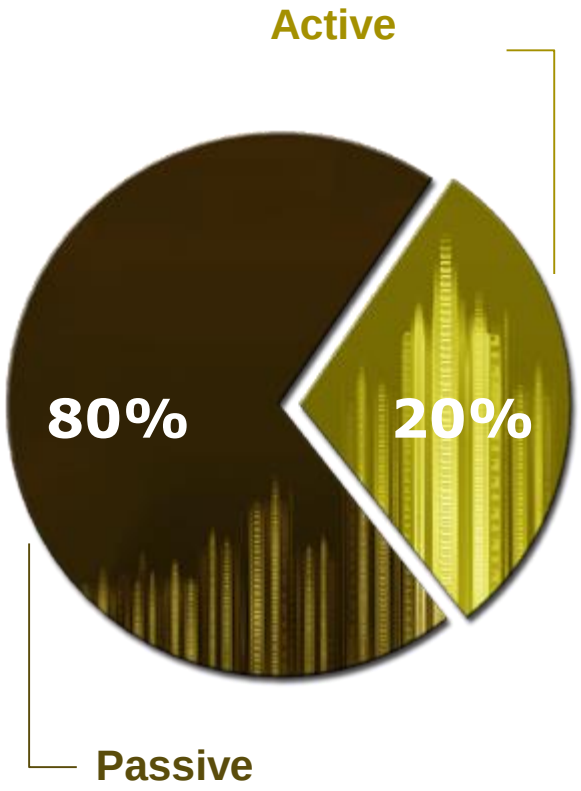
Data Centre



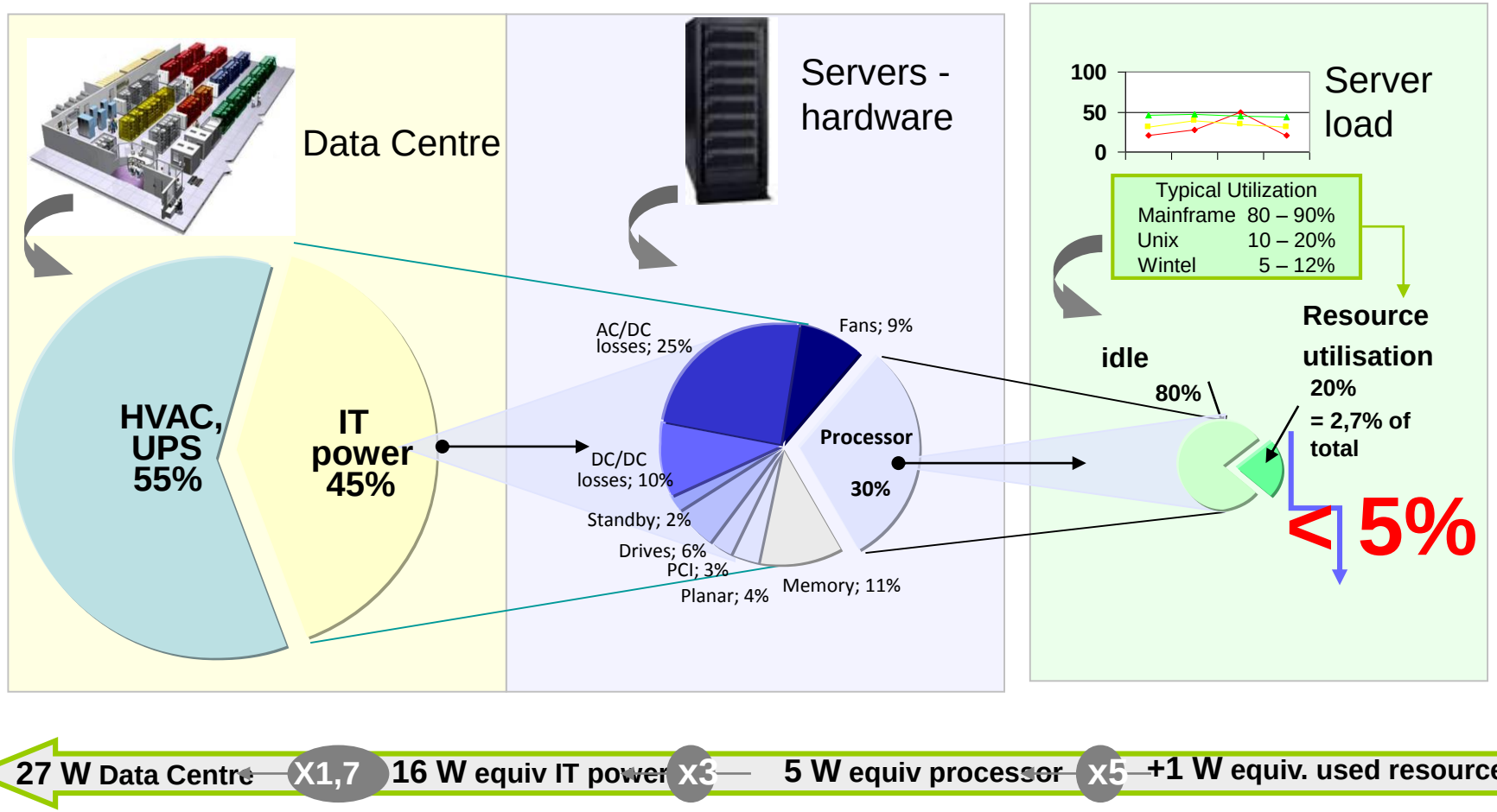
Server hardware



Server loads



Real View of the Power Consumption of a Data Center



Data Centers

- Own site
- Data centrer, server hotels
- Server service
- Outsourcing
  - Advantages
    - More economic, specific competence
  - Disadvantage
    - Vulnerability
- Later in details

Final Location of Servers

- Recommendable to locate the servers into final place *before* operating system, etc. is installed
- To the contrary :
  - machine remains in a labor for a certain period, where no UPS, HVAC, not safe – this itself may cause outage in service,
  - no protection, if the machine is in the lab, additional programs can be installed on them (even unauthorized persons)
  - while it is moved to its final place FOR SURE out-of-service!

DATA BACKUP

- Theory:
  - Data stored on clients are not backed up. So it is advisable to users to store their data on server – that is backed up. So no need to backup the local data
- But:
  - especially in certain operating systems (Windows) a lot of personal settings, configuration files, downloaded programs are stored locally

DATA BACKUP

- Data stored on servers are backed up
  - In case of failure to restore the data (to a not too old state)
  - Archivation
- Later on discussed in full details

Operating Systems

- The operating systems of the servers and desktops can be
  - Different
    - E.g.: in a case of a web-server the operating system of the server and the client may be different, only the communication protocol must be the same
  - Same (exactly, or same operating system with different settings)
    - UNIX CPU server

Special Administrative Network

- Servers need to be maintained remotely – later in details
- Advisable to maintain a special, administrative network for back-ups and monitoring
- Back-ups require to carry very high amount of data over the network – highly reduce the bandwidth for users
- The special, administrative network: simpler, more fault-tolerant elements
- Unaffected by the outages of the „regular” network
  - Monitoring system less likely product false errors when there is a network problem
  - A tool for the system administrators to reach the machines during such outages

Remote Administration Access

- In old days: Separate keyboard + monitor to every server
- Now: console server
- Advantage:
  - Save space
  - All the tasks can be done remotely
  - Not in the air-conditioned/protected data centre
- Remotely controlled power supplies

REDUNDANCY

- Disk storage redundancy (RAID) - later
- Redundancy of components
- Redundant power supply
- Hot-swap components

Full and n+1 Redundancy

- n+1 redundancy: one of any particular component can fail, yet the system is still functional.
- Full redundancy: two complete sets of hardware are set up, and some kind of „fail-over” is configured
  - Switch over: manual or automatic
  - One system works – other idle till failure
  - Load sharing – both systems work with half of the total load, but both have enough capacity to cope with the whole load.
- In case of n>2: n+1 redundancy is cheaper than full
- Often not the whole system is n+1 redundant, only the main parts

Hot-swap Components

- Normally: parts can be removed and replaced only when the system is powered off
- Hot-swap: ability to remove and replace a component while the system is running
  - but often the replacement can be performed at the next scheduled maintenance period
  - risk of double failure

Hot-swap Problems

- Which parts are not hot-swappable?
- How and how long is service interrupted when the parts are hot-swapped?
- Some network devices have hot-swappable IF cards, but the CPU is not
- How long can the system operate – or only with degraded capacity?
  - e.g.: hot-swapped disk, while data content build on the new
- The device is hot-swappable, but when a new unit added – reset...
- So hot-swap parts do not makes outages disappear for sure, they just reduces the (risk of) outage

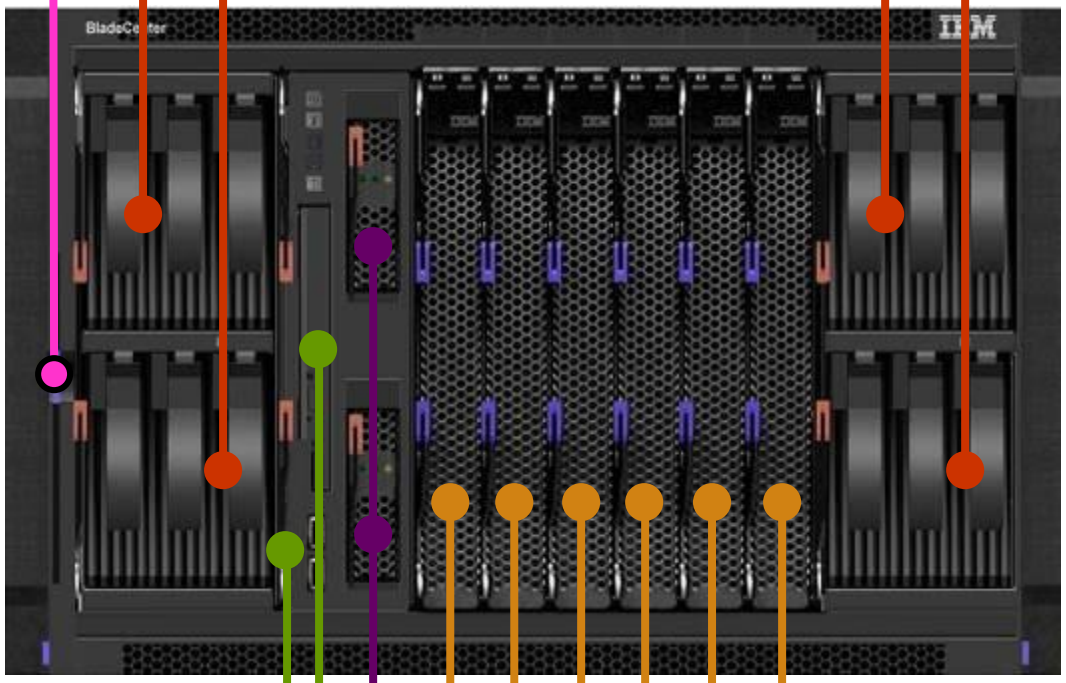
Examples for Redundancy

- Reliability
  - Disks
  - Redundant power supply
  - Redundant cooling
  - All I/O connections redundant
  - Doubled switching modules
  - Redundant buses, disk connectors
  - Doubled management modules
- Availability
  - Management system monitors the components
  - Predictive Failure Analysis
  - Error logs

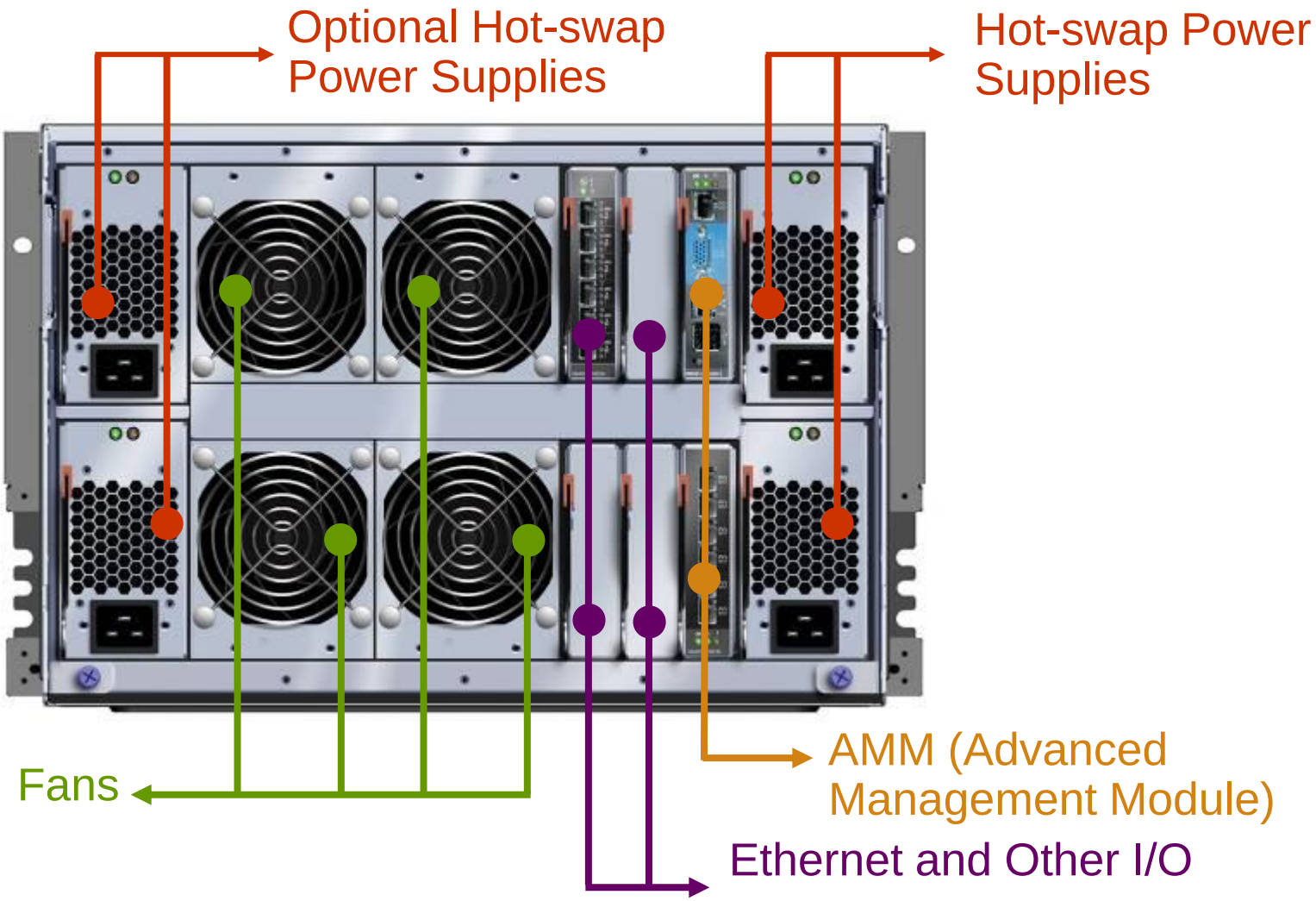
Redundant Power Supply

- Power Supply: after HDDs the next most failure-prone component
- Does not simply mean that 2 such devices
  - Means that the system can be operational if one power supply is not functioning (n+1 redundancy)
- Each power supply should have more separate power cords
  - Loose connection
  - Relocation is possible
  - Reliability: each cord from different power supply

SERVER FRONT



SERVER BACK


Optional Hot-swap Power Supplies
Hot-swap Power Supplies
Fans
AMM (Advanced Management Module)
Ethernet and Other I/O

Maintenance Contracts

- When purchasing a server, must also be considered how repairs will be handled
- Vendors tend to have a variety of maintenance contract options
  - 4 hours,
  - 12 hours,
  - 1 day response contract,
  - Only provision of spare parts that is replaced when spare parts get used

MAINTENANCE CONTRACTS - EXAMPLES

- Low/medium critical host: 1-2 day response time or no special contract at all
- Large groups of similar hosts: typically spare kits and the repairs can be done by local staff
- Controlled model selection: Goal to have just two different models
- Critical host: too expensive to have fully stocked spare kits. Stock only spares for parts that commonly fail (disk, power supply – interchangeable typically) + same day response maintenance contract
- Large variety of models from same vendor:
  - Very large number of hosts: on-site technician
  - Medium size: spares kits on the spot + technician nearby
  - Direct access to spare kits on an emergency basis
- Highly critical host: on-site technician + duplicate machine ready to be swapped into place (typically as expensive as a redundant server, but better option for non-technical companies)

Stocking Spares – Service Contract

- Trade off between stocking spares (1) – service contract (2)
  - (1) Too expensive for a small site
  - (2) Typically includes diagnostic services even if over the phone
- Sometimes the easiest way to diagnose – swap in spare parts until the problem goes away. But its local management (training technicians, stocking spares) can be complicated, if
  - Small, medium site companies
  - Non-technical companies
  - Wide variety of models used

Conclude a Maintenance Contract

- Sometimes it is discovered that a critical host is not on the service contract at a critical time
- To prevent a host being missed from a maintenance contract:
  - Good inventory program
  - Have the person responsible for purchasing machines to be the person responsible for maintenance contracts
  - Maintenance contracts also for the (~ 1 year) warranty period with „zero dollar charge”

PART II

PERSONAL TERMINALS
HOME PROCESSING

DESKTOPS

- Desktop
  - Definition, characteristics
- Desktop management
  - Tasks of ~

Desktops / Personal computers

- Desktop
- Personal Computer (PC)
- Newer solutions
  - Docks (laptop)
  - Personal Digital Assistants (PDA)
  - Smartphone
- ***Personal terminals***, Personal machines

PDA

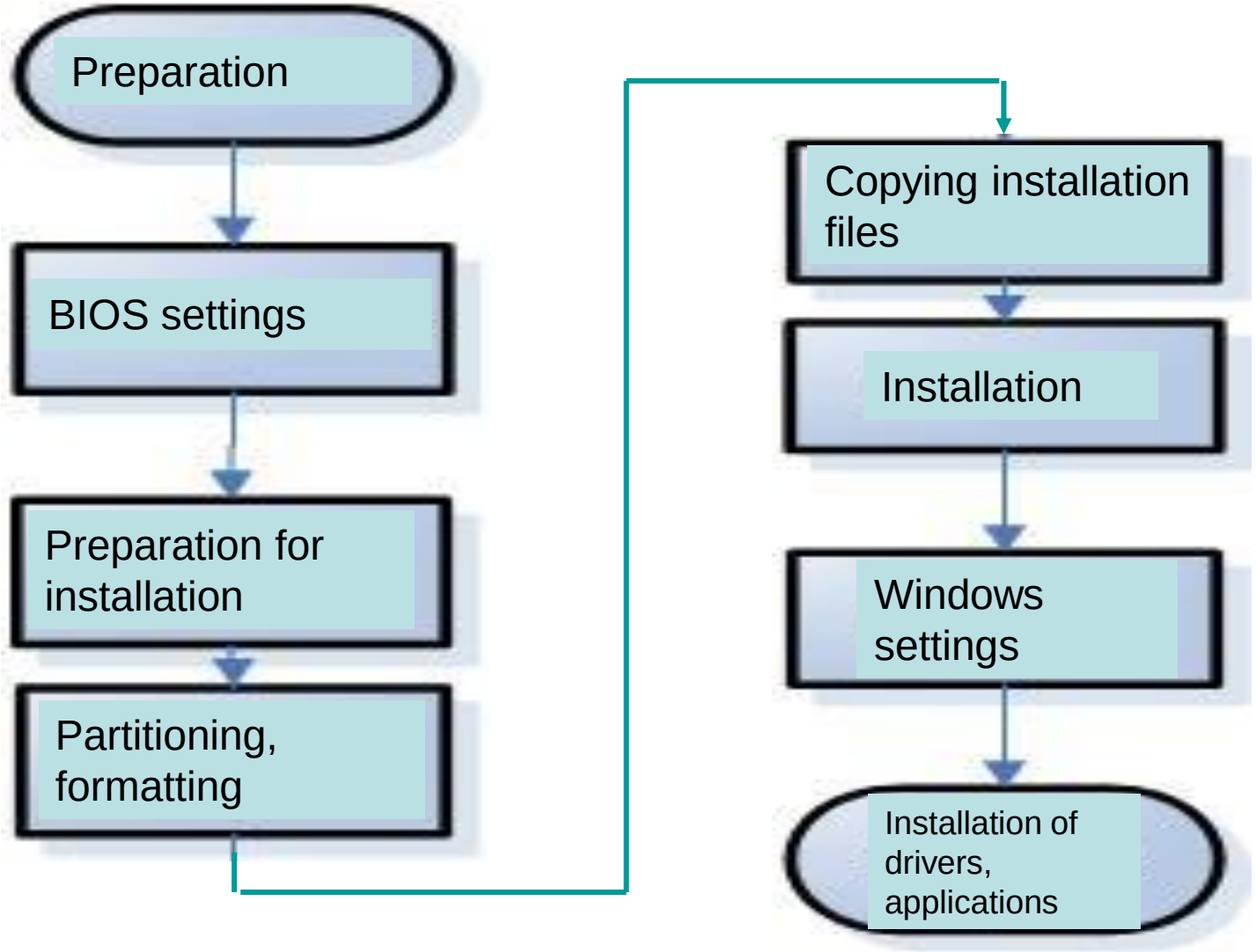
First PDA (AT&T EO440) 1993

SMARTPHONE

TABLET


SONY
Google
Guest Mode
Apps & Widgets
10:35
Friday, August 31
Socialife
Sony Select
WALKMAN
Album
Movies
Reader by Sony
Browser
Email
Camera
Remote control
Maps
Play Store
10:35

OVERVIEW


Preparation
BIOS settings
Preparation for installation
Partitioning, formatting
Copying installation files
Installation
Windows settings
Installation of drivers, applications

INSTALLATION

- Regional and language options
- Type in the user name/enterprise name
- Product identification key (25 char)
- Computer name
- Administrator password
- Date, time, time zone
- Network settings
- Workgroup
- Display resolution detection

Installation of Drivers, Programs

1. To be able to use the hardware – drivers must be installed
   - Provided by the manufacturers of the functional units
   - Most important: voice, video, network cards
2. For protection:
   - Anti-virus
   - Anti-spyware
   - Firewall

- What is a firewall?
  - In computer technology: Hardware and/or software protection against unauthorized electronic access to a networked computer system

Installation of Drivers, Programs

✓ After installing anti-virus, anti-spyware and firewall:

1. Internet connection may be established
   - Why only now?
2. Upgrade protection software and operating system
   - Update menu point
   - Start: Windows Update
   - Takes a time...
3. Network settings
   - IP address
   - Subnet mask
   - Gateway
   - DNS Server address, etc.
4. Install user programs

Installation of Desktops in an Enterprise Environment

- Imagine the previous process on several hundred machines...
  - Slow
  - Error prone
- On the top of all that:
  - Different user groups
  - Different programs
  - Different ***user profiles***
- Automation needed…

DESKTOPS – OPERATION SYSTEMS

- Mainly: Pre-installed operation system
  - Problem: cannot know *exactly* what is installed…
  - Typically: machines are purchased continuously, not all at a time
  - What to do if a machine must be replaced promptly?
  - Purchase if the organisation is enlarged/re-organized
- Result: non-homogenous desktop and operation system set – source of errors!
- Not sure, if we can reach a homogenous desktop set if ***we*** install the machines

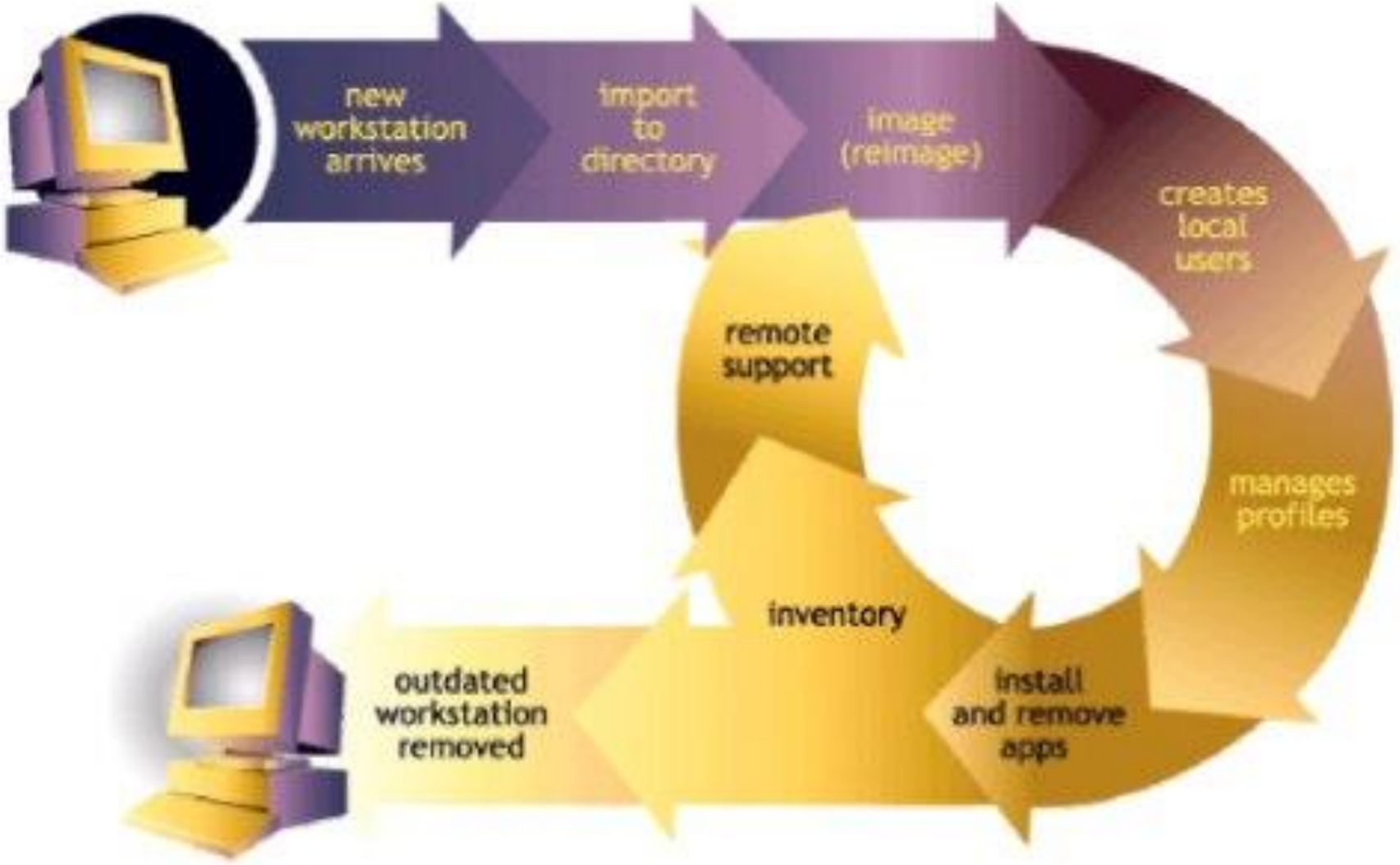
MANAGEMENT - AUTOMATION

- Advisable to automate not only the installation process, but also the management
- Attach to network
  - IP address, protocols, rights
- Access to services
  - printing, e-mailing, Internet access, etc.
- Other tasks
  - Mailbox management; virus, spam, spyware protection; access to remote storage, database

Tasks of Desktop Management

- The management of the desktops covers several issues:
  - installation and upgrade of the operation systems and applications,
  - their back-up and archivation,
  - develop and maintain a universal user interface that is used all around the company,
  - inventory of machines
- Requirement:
  - Do it with as little human's interaction as it can
  - Automation as much as possible
    - more economical
    - reduces the harms caused by human's fault.
- This whole process is called as ***Desktop Management***.

LIFE CYCLE OF A PC, TYPICAL ACTIVITIES TO MANAGE



Desktop Management Services

- Creating a system image, automatic installation
- Personalized software installation, automatic application supervision, measurement of software usage (statistics)
- Policy-based desktop supervision
- Remote supervision
- Full hardware and software inventory

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Creating a system image, & automatic installation

- Installation of new operating systems and applications on every/selected (connected or standby) computers of the company
  - from image-file
  - distribution of sample installation

- Assignments between „Application-objects” and desktops
  - Upgrades only in one place („Application-object”) and the users can see the new version immediately

Creating a system image, & automatic installation

- „Wake On LAN”-functionality
- Automatic distribution of applications
  - to more users at same time
  - probably in a personalized form
  - condition-based
  - system image distribution before system (re)start
  - automatized online application distribution function
    - during installation desktop can be used
  - Layered Agents
    - From a central site to other sites
    - Other sites to local desktops

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PERSONALIZED SOFTWARE INSTALLATION

- Tasks of personalized software installation:
  - Which applications can be accessed by user
  - Outlook of the desktop (background, screensaver, etc.)
  - Who can have an access to the PC and with which rights
  - Which printers can be used
  - To whom to turn in case of a problem

Application Supervision Functions

- System images stored in a central database
  - (Automatic) Self correcting applications
    - Unintentionally deleted, damaged files, settings
- Desktop assignment functions
  - Who from where can have an access to which application
- Application removal function

Measurement of Software Usage

- Software measurement functions
  - E.g.: Distributed applications
    - if # of licenses reached – new user cannot start it
- Reports on
  - distribution
  - usage

  of applications

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POLICY-BASED DESKTOP SUPERVISION

- Policies
  - determined of the (access) rights of users/user groups on company level
    - what can be configured
    - what can be loaded, installed
    - which SW-applications can be run
    - desktop settings
    - which network resources can be used
  - rights assigned to persons not to machines
  - stored in a central database
    - in case of modification automatically distributed to all concerned machines

POLICY-BASED DESKTOP SUPERVISION

- Policies – on different operating systems
- Display of „in force” policies
- Policy-package assignment
  - to which users/machines assigned
- Preview of „policy-package migration”
  - Shows the effect before started to be used
- Unification of data bases of different sites

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REMOTE SUPERVISION

- Faults can be prevented, fixed
  - users are not bothered with technical questions
  - pressing „help request” – e-mail to SA with the description of the error
- Remotely controllable machines
  - if entitled
- SA can control the system from anywhere (via Internet)

Functions of Remote Supervision

- Remote file transfer, program execution, diagnostics
- Locking/unlocking of mouse/keyboard during remote control
- Switch off display remotely
  - not to see specific remote control operations
- A „Wake on LAN” – a switched-off desktop can be switched on
- Access rights can be assigned
  - by user, by groups, by departments, by sites, by desktops – according to policies
  - Restrictions even for SAs

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FULL HARDWARE AND SOFTWARE INVENTORY

- Hardware inventory
- Software inventory
  - „built-in” list
  - program items/settings can be added
- Data stored in an SQL database
- Predefined / „Own” reports
  - upgrades
  - expiration of licenses
  - Path of programs-files (removal!)

TASKS OF DESKTOP INVENTORY

- Company level inventory – collection and unification of databases of sites
  - backup, automatic logging, reporting
- Collection of inventory data can be timed and automatically executed (on basis of policies)
- Mobile systems can suspend the inventory data collection when they switched off from network and resume when reconnected
- Custom Inventory - custom.ini file stored on desktop
  - describes specific information about desktop (location, user, price, inventory number, etc.)
- Collection of version numbers, paths of applications. Can be used for
  - upgrades
  - removal