MODULE 2

INFORMATION TECHNOLOGY

OUTLINES

- The components of a computer system
- The stages of IT infrastructure evolution
- The technology drivers of IT infrastructure evolution
- Contemporary computer hardware platform trends
- Computer processing, storage, input and output technology
- Types and classifications of computer systems
- Managing hardware assets
- Managing IT infrastructure and management solutions
- Operating systems
- Application software packages
- Programing languages
- Managing software assets
- Contemporary software trends
- Collaborative and social software
- Components and functions of telecommunications systems
- Communications networks
- eBusiness and eCommerce technologies
- Networking/telecommunications platforms
- Consulting and system integration services

The components of a computer system

The components of a computer is made up of the **Hardware**, **Software** and recently recognized, **People ware** or **Human ware**. The **Software** is the program or instructions that facilitate the use of the hardware for a given task; the **Hardware** is the physical components of the computer, while the **People ware** consists of the human resources that make things work in the computer department.

Hardware

Computer Hardware, in a broad sense, refers to all the physical, electrical and mechanical components of a computer system. The basic elements of the computer hardware consist of the input device, output device and the system base/unit which is commonly referred to as Central Processing Unit (CPU).

- *Input Devices:* The input devices are used in entering data and instructions into the computer system. Some of the input devices include: Punched Cards, Terminals, Optical Character Recognition (OCR) etc.
- **Output Devices:** The output devices include some of the input such as the Visual Display Units (VDU) or terminals, voice recognition, magnetic disk and hard copy terminals (printers).
- **Central Processing Unit (CPU):** The CPU otherwise called the black box of the computer performs several functions. It is the most important unit of the computer system. It controls the various activities of the computer and is responsible for coordinating other units and processing whatever data is received from the input unit. It is made up of three units, namely: Arithmetic Logic Unit, Control Unit, and Main Memory Unit/Primary Storage Unit

The components of a computer system... cont.

Software

Software is the collection of all instructions or programs written in a computer language, which the computer understands and executes. They are stored as files on disk.

There are three types of software namely**:**

    1. System Software

    2. Application Software

    3. Utilities Software

1. System Software: Also called Operating Software, it facilitates the communication of the user and the other software to achieve a task with the computer. It also makes the entire hardware component come together and function as a system. It gives access to the computer. Types of system software include:

- Personal Computer Disk Operating System (PC DOS).
- Microsoft Disk Operating System (MS/DOS).
- UNIX- Used in a multi-tasking environment e.g. networking.
- Windows Operating Software, etc.

2. Application Software: This software allows users carry out specific tasks with the computer. Types of application software include:

- Word Processing Application Software
- Electronic Spreadsheet Application Software
- Data Base Management Application Software
- Education Application Software, ,etc.

The components of a computer system... cont.

Utility Software

There are packages that work on disks and diagnose the personal computer. They are also used for detection, removal and the prevention of viruses contaminating the system. The Utility Software is designed to aid in computer system maintenance. Packages include:

- PC tools
- Norton disk doctor (NDD)
- Anti-virus tools
- Doctor SOLOMON.

Peopleware

The people that make things work in the computer department are referred to as peopleware. These include:

- The System Analyst
- The Computer Programmer
- The Computer Operator
- The Data Control Officer
- The Data Preparation Officer
- The Media Librarian etc.
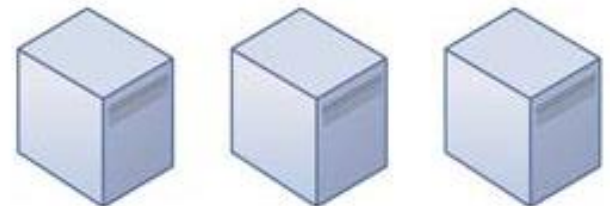
The stages of IT infrastructure evolution

The IT infrastructure in organizations today is an outgrowth of over 50 years of evolution in computing platforms. IT infrastructure is a set of physical devices and software required to operate enterprise. The set of firm-wide services include: Computing platforms providing computing services, Telecommunications services, Data management services, Application software services, Physical facilities management services, IT management, standards, education, research and development services.

Six (6) stages are identified in this evolution

Stage 1: <u>Electronic Accounting Machine Era: 1930–1950</u>

The first era of business computing used specialized machines that could sort computer cards into bins, accumulate totals, and print reports. Although the electronic accounting machine was an efficient processor of accounting tasks, the machines were large and cumbersome. Software programs were hardwired into circuit boards, and they could be changed by altering the wired connections on a patch board. There were no programmers, and a human machine operator was the operating system, controlling all system resources.

Electronic
Accounting
Machine
(1930–1950)

The stages of IT infrastructure evolution... cont.

Stage 2: <u>General-purpose Mainframe and Minicomputer Era: 1959 to present</u>

The first commercial all-electronic vacuum tube computers appeared in the early 1950s with the introduction of the UNIVAC computers and the IBM 700 Series. Not until 1959 with the introduction of the IBM 1401 and 7090 transistorized machines did widespread commercial use of mainframe computers begin in earnest. In 1965, the general-purpose commercial mainframe computer truly came into its own with the introduction of the IBM 360 series.

Mainframe/
Minicomputer
(1959–present)
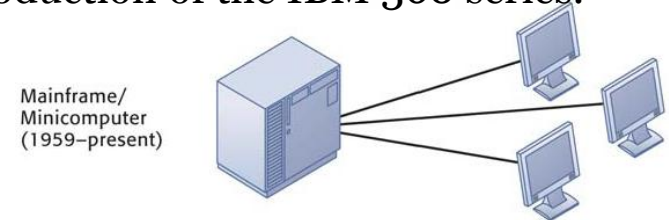
Stage 3: <u>Personal Computer Era: (1981 to present)</u>

The appearance of the IBM PC in 1981 is usually credited as the beginning of the PC era because this machine was the first to become widely adopted in American businesses. At first using the DOS operating system, a text-based command language, and later the Microsoft Windows operating system, the Wintel PC computer (Windows operating system software on a computer with an Intel microprocessor) became the standard desktop personal computer. Today, 95 percent of the world's estimated 1 billion computers use the Wintel standard.

Personal
Computer
(1981–present)

The stages of IT infrastructure evolution... cont.

Stage 4: <u>Client/server Era: 1983 to present</u>
- Desktop clients networked to servers, with processing work split between clients and servers
- Network may be two-tiered or multi-tiered (N-tiered)
- Various types of servers (network, application, Web)

In client/server computing, desktop or laptop computers called
clients are networked to server computers that provide the
client computers with a variety of services and capabilities.

Client Server
(1983–present)
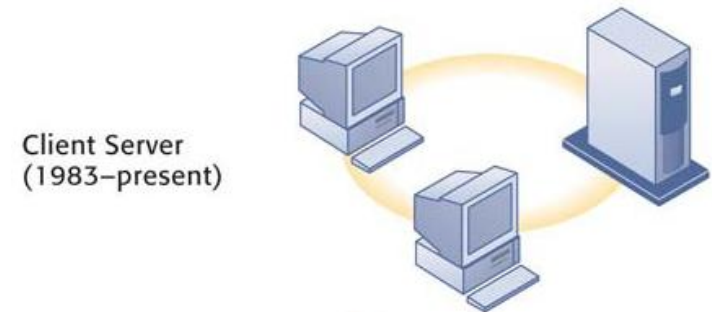
Stage 5: <u>Enterprise computing era: 1992 to present</u>

This infrastructure links different types and brands of computer hardware and smaller networks into an enterprise-wide network so that information can flow freely across the organization and between the firm and other organizations. Enterprise networks link mainframes, servers, PCs, mobile phones, and other handheld devices, and connect to public infrastructures such as the telephone system, the Internet, and public network services. It is a move toward integrating disparate networks, applications using Internet standards and enterprise applications.

Enterprise
Internet
(1992–present)

Enterprise
Server
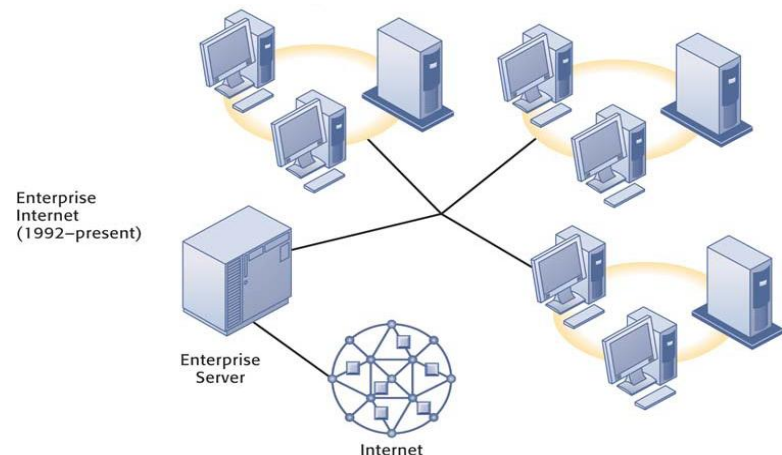
Internet

The stages of IT infrastructure evolution... cont.

Stage 6: <u>Cloud Computing: 2000 to present</u>

Cloud computing is Internet ("cloud") based development and use of computer technology ("computer"). It is a business information management style of computing in which typically real-time scalable resources are provided as a service over the Internet to users who need not have knowledge of, expertise in, or control over the technology infrastructure ("in the cloud") that supports them.

- Refers to a model of computing where firms and individuals obtain computing power and software applications over the Internet or other network

- Fastest growing form of computing.
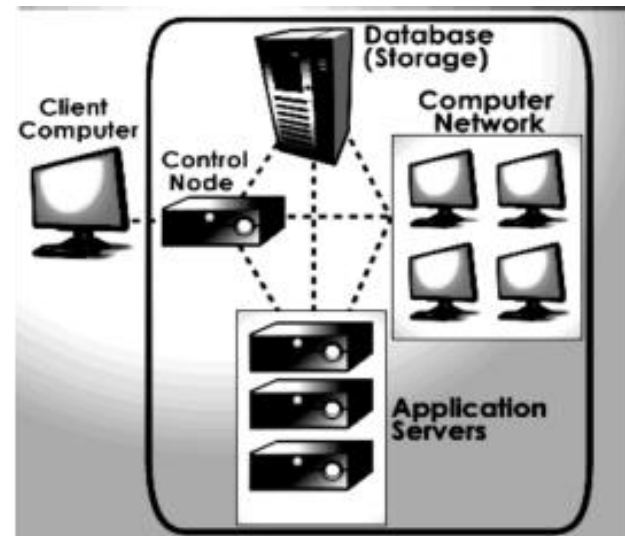
The Technology Drivers of IT infrastructure Evolution

<u>Moore's Law and Micro-processing power</u>

- Computing power doubles every 18 months
- Nanotechnology:
  - Shrinks size of transistors to size comparable to size of a virus

<u>Law of Mass Digital Storage</u>

The amount of data being stored each year doubles

<u>Metcalfe's Law and network economics</u>

- Value or power of a network grows exponentially as a function of the number of network members
- As network members increase, more people want to use it (demand for network access increases)

<u>Declining communication costs and the Internet</u>

- An estimated 1.5 billion people worldwide have Internet access
- As communication costs fall toward a very small number and approach 0, utilization of communication and computing facilities explodes

<u>Standards and network effects</u>

- Technology standards:
  - Specifications that establish the compatibility of products and the ability to communicate in a network
  - Unleash powerful economies of scale and result in price declines as manufacturers focus on the products built to a single standard

The technology drivers of IT infrastructure evolution... cont.

IT Infrastructure has 7 main components: Computer hardware platforms, Operating system platforms, Enterprise software applications, Data management and storage, Networking/telecommunications, platforms; Internet platforms, and Consulting system integration services.

1. Computer hardware platforms
- *Client machines:* Desktop PCs, mobile devices – PDAs, laptops
- *Servers:* Blade servers: ultrathin computers stored in racks
- *Mainframes:* IBM mainframe equivalent to thousands of blade servers
- *Top chip producers*: AMD, Intel, IBM
- *Top firms*: IBM, HP, Dell, Sun Microsystems

2. Operating system platforms
- *Operating systems:*
- Server level: 75% run Windows; 25% run Unix or Linux.
- Client level: 90% run Microsoft Windows (XP, 2000, CE, etc.); Handheld device OS's (Android, iPhone OS), Cloud computing OS's (Google's Chrome OS)

3. Enterprise software applications
- *Enterprise application providers:* SAP and Oracle – Middleware providers: BEA

4. Data management and storage
- *Database software:* IBM (DB2), Oracle, Microsoft (SQL Server), Sybase (Adaptive Server Enterprise), MySQL
- *Physical data storage:* EMC Corp (large-scale systems), Seagate, Maxtor, Western Digital
- *Storage area networks (SANs):* Connect multiple storage devices on dedicated network

The technology drivers of IT infrastructure evolution… cont.

5. Networking/telecommunications platforms

– *Telecommunication services:* • Telecommunications, cable, telephone company charges for voice lines and Internet access. • AT&T, Verizon

– *Network operating systems:* • Windows Server, Novell, Linux, Unix

– *Network hardware providers:* • Cisco, Alcatel-Lucent, Nortel, Juniper Networks

6. Internet platforms

– Hardware, software, management services to support company Web sites, (including Web hosting services) intranets, extranets

– *Internet hardware server market*: Dell,

HP/Compaq, IBM

– *Web development tools/suites*: Microsoft (FrontPage, .NET) IBM (WebSphere) Sun (Java), independent software developers: Adobe, RealMedia

7. Consulting and system integration services

– Even large firms do not have resources for a full range of support for new, complex infrastructure

– Software integration: ensuring new infrastructure works with legacy systems

– Legacy systems: older TPS created for mainframes that would be too costly to replace or redesign

– Accenture, IBM Global Services, EDS, Infosys, Wipro

Contemporary Computer Hardware Platform Trends

We will look at eight hardware trends:

1. The emerging mobile digital platform

– Cell phones, smartphones (BlackBerry, iPhone) • Have assumed data transmission, Web surfing, e-mail and IM duties

– Netbooks: • Small, low-cost lightweight notebooks optimized for wireless communication and core computing tasks

– Tablets (iPad)

– Networked e-readers (Kindle)

2. Grid computing

– Connects geographically remote computers into a single network to combine processing power and create virtual supercomputer

– Provides cost savings, speed, agility

3. Virtualization

– Allows single physical resource to act as multiple resources (i.e., run multiple instances of OS)

– Reduces hardware and power expenditures

– Facilitates hardware centralization

4. Cloud computing

– On-demand (utility) computing services obtained over network • Infrastructure as a service • Platform as a service • Software as a service

– Cloud can be public or private

– Allows companies to minimize IT investments

– Drawbacks: Concerns of security, reliability

5. Green computing

– Practices and technologies for manufacturing, using, disposing of computing and networking hardware

6. Autonomic computing

– Industry-wide effort to develop systems that can configure, heal themselves when broken, and protect themselves from outside intruders

– Similar to self-updating antivirus software; Apple and Microsoft both use automatic updates

7. High performance, power-saving processors

– Multi-core processors

Types And Classifications of Computer Systems

Computer can be classified according to:

1. Devices
2. Sizes/Classes and Classification
3. Purposes
4. Generations
5. Processors

1. Classification according to Devices

There are three types of computer by their devices namely:

a) *Analogue Computer:* An Analogue computer is a computer that measures physical or continuous variables. They are used for weather forecasting, metrological surveys. launching space satellite. remote sensing operations by surveyors.

b) *Digital Computer:* A digital computer is a computer that counts in discrete or numerical variable i.e. counting from 0-1, 0-9, infinity or "infinitesimal".

Digital computers are used for business and commercial data processing applications such as: Preparation of sales report/analysis, Preparation of payroll report/analysis, Preparation of stock control and inventory, Preparation of labor variable analysis, For statistical Projections, For monitoring laboratory experiments.

c) *Hybrid Computers:* This combines the features of analogue and digital computers. It can count in a discrete or numerical variable and as well measure in a continuous variable.

2. Classification according to Sizes

There are three types of computer according to their sizes;

a) Mainframe Computers: This is the highest mainframe type of computer by size. Other categories of mainframe include super mainframe computer or monster computer which is higher than the normal mainframe.

b) Minicomputers: This is a scaled down mainframe computer, though it is smaller than mainframe computer. Categories of minicomputers include midi &maxi.

c) Microcomputers: This is the smallest type of computer according to size. A microcomputer has a small computer microprocessor as the Central Processing Unit. A microprocessor is a miniature CPU found on microcomputers. It is made up of silicon chips or semi-conductor memory or micro-miniaturization (micro-chips). Types are the Tower Computer, Mini Tower Computer, Desktop Computer and Laptop Computer, etc.

3. Classification according to Purpose

a) General Purpose Computer: A general purpose computer is a computer that is designed to solve a wide range of problems such as science, technology, education, business, government etc.

b) Special Purpose Computer: A special purpose computer is a computer that is designed to solve special problems or job. It can be called a dedicated computer.

Types and Classifications of Computer Systems... cont.

4. Classification according to Generations
There are five (5) generations of computers as at date. They are:-
1st Generation Computer
2nd Generation Computer
3rd Generation Computer
4th Generation Computer
5th Generation Computer

5. Classification according to Processors
Computer types classified according to their processor type come in the following categories:
8086 series
8088 series
XT's
AT's
80286 (286 processors)
80386 (386 processors)
80486 (486 processors)
80586 (586 processors)

Characteristics of Computers
Computers have the following characteristics:
1. *Flexibility:* Computers are used for variety of purposes
2. *Speed:* Computers process transactions at a high level of speed
3. *Accuracy:* Once the input into the system is correct, computers produce accurate results and output
4. *Reliability:* Computers are reliable
5. *Time Saving:* Computers processes transactions very fast and thereby saves time

Managing IT Infrastructure and Management solutions

Dealing with platform and infrastructure change
– As firms shrink or grow, IT needs to be flexible and scalable
– Scalability: • Ability to expand to serve larger numbers of users
– For mobile computing and cloud computing
  • New policies and procedures for managing these new platforms
  • Contractual agreements with firms running clouds and distributing software required

Management and governance
– Who controls IT infrastructure?
– How should IT department be organized?
  • Centralized – Central IT department makes decisions
  • Decentralized – Business unit IT departments make own decisions
– How are costs allocated between divisions, departments?

Making wise infrastructure investments
– **Amount to spend on IT is complex question**
  • Rent vs. buy, outsourcing
– **Total cost of ownership (TCO) model**
  • Analyzes direct and indirect costs
  • Hardware, software account for only about 20% of TCO
  • Other costs: Installation, training, support, maintenance, infrastructure, downtime, space and energy
  • TCO can be reduced through use of cloud services, greater centralization and standardization of hardware and software resources.

Managing IT Infrastructure and Management solutions... cont

Competitive forces model for IT infrastructure investment

1. Market demand for firm's services

2. Firm's business strategy

3. Firm's IT strategy, infrastructure, and cost

4. Information technology assessment

5. Competitor firm services

6. Competitor firm IT infrastructure investments
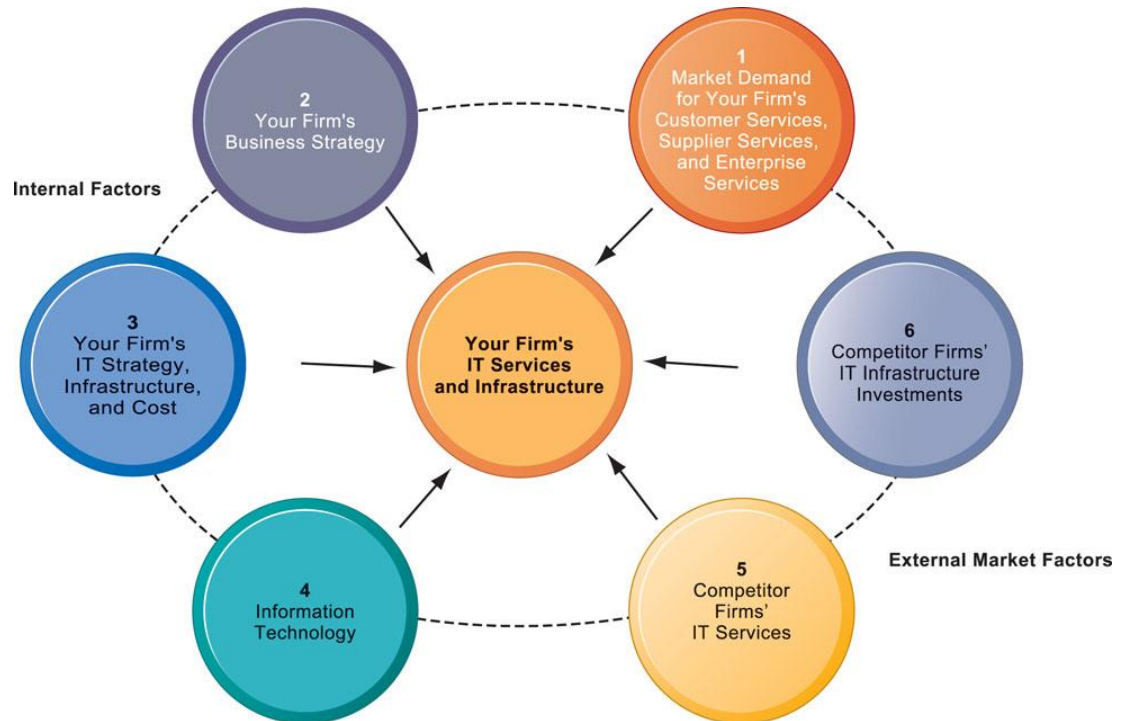
Operating Systems

Operating system is the first piece of software to be installed on your computer. It is preinstalled on a new computer .

Types/Examples of Operating Systems

Types and examples of operating systems include:

i.   Control Program for Microprocessor **(CP/M)**.

ii.   Personal Computer Disk Operating System **(PC DOS)**.

iii. Microsoft Disk Operating System**(MS/DOS)**.

iv.   Digital Research Disk Operating system **(DRDOS)**.

v.   **UNIX**- used in a multi-tasking environment e.g. networking.

vi.   **XENIX** – used in a multi-tasking environment e.g. networking.

vii. **Windows** Operating Software of various versions. **Windows** can be described as a graphical/pictorial operating system that facilities the running or execution of more than one application program at a time. Windows comes in various versions. Such as Windows 3.11, Windows for workgroup and Windows 95, Windows 98, Windows 2000, Windows XP, Vista etc.

viii. **Linux**- refers to the family of UNIX-like computer operating systems using the Linux kernel. Linux can be installed on varieties of computer hardware, ranging from mobile phones, tablet computers, and video games consoles, to mainframes and supercomputers. Linux is a leading server operating system, and runs the 10 fastest supercomputers in the world.

Operating Systems... cont

Functions of Operating Systems

1. Operating systems perform the following key functions:
2. Processor management, that is, the assignment of processor to different tasks being performed by the computer system.
3. Memory Management, that is, allocation of main memory and other storage areas to the system programs as well as user programs and data.
4. Input/output management, that is, co-ordination and assignment of the different output and input device while one or more programs are being executed.
5. File management, that is, the storage of file of various storage devices to another. It also allows all files to be easily changed and modified through the use of text editors or some other file manipulation routines.
6. Establishment and enforcement of a priority system. That is, it determines and maintains the order in which jobs are to be executed in the computer system.
7. Automatic transition from one job to another as directed by special control statements.
8. Interpretation of commands and instructions.
9. Coordination and assignment of compilers, assemblers, utility programs, and other software to the various user of the computer system.
10. Facilities easy communication between the computer system and the computer operator (human). It also establishes data integrity and security.

Programming Languages

A **programming language** is an artificial language, which is intentionally created to inform the computer on what to do in a step by step manner. It is designed to express computations that can be performed by a machine, particularly a computer. Programming languages can be used to create programs that control the behavior of a machine, **algorithms**, or as a mode of human communication.

The **development of programming languages** follows a trend referred to as generations or levels. Each of the generation is a step closer to the languages used by human beings. The generations used in describing the development of programming languages are:

a) Machine language
b) Assembly language
c) Procedural language
d) Non procedural languages
e) Natural languages

a) Machine language is a first generation language. It is also known as the computer language. It consists of binary numbers- 0s and 1s- that directly correspond to the computer's electrical states.

b) Assembly language is a second generation language. It is the first programming language to break programmers' dependence on machine language. In assembly language, each program statement corresponds to an instruction that the microprocessor can carry out. The assembly language, just like the machine language, is procedure dependent and closely tied to the hardware inside the system unit. The second generation language uses mnemonics- base 10 (decimal) numbers as well as brief abbreviations for program instructions.

Programming Languages… cont

c) High Level or Procedural languages are third generation languages. These languages were developed as a result of the difficulties in writing code in machine and assembly languages. The aim of developing these languages is to make programming languages more user friendly, modular, and reusable. Third generation languages are classified as high level languages. High level languages eliminate the need for programmers to understand the intimate details of how the hardware, specifically the processor, handles data. The programmer can write an instruction using familiar English words such as EDIT, PRINT, or SAVE. Third generation languages instructions focuses on software engineering.

d) Non procedural languages are fourth generation languages. Whereas procedural languages provide detailed instructions that are designed to carry out a specific action, for example printing information in a chart format; non procedural languages are not tied down to step by step procedures that force the programmer to consider the procedure that must be followed to obtain the desired result.

d) Natural languages would eventually be the ultimate non procedural language. This is the fifth generation languages. This is everyday language that people speak. Computers would be easier to use if they could understand natural language, whether the input is spoken or typed.

Contemporary Software Trends

There are four major themes in contemporary software platform evolution:

1. Linux and open source software
2. Software for the Web: Java and Ajax
3. Web services
4. Service-oriented architecture
5. Software outsourcing and cloud services

1) Linux and open source software

- _Open-source_ software: Produced by community of programmers, free and modifiable by user. Open source software is by definition not restricted to any specific operating system or hardware technology, although most open source software is currently based on a Linux or Unix operating system.
- _Linux:_ Perhaps the most well known open source software is Linux, an operating system
- related to Unix. Linux applications are embedded in cell phones, smartphones, netbooks, and consumer electronics. Linux is available in free versions downloadable from the Internet or in low-cost commercial versions that include tools and support from vendors such as Red Hat.

2) Software for the Web: Java and Ajax

Java platform has migrated into cellular phones, smartphones, automobiles, music players, game machines, and finally, into set-top cable television systems serving interactive content and pay-per-view services.

Ajax: Asynchronous JavaScript and XML. Allows client and server to exchange small pieces of data without requiring the page to be reloaded

Contemporary Software Trends… cont

3) Web services

Web services refer to a set of loosely coupled software components that exchange information with each other using universal Web communication standards and languages.

Software components that exchange information using Web standards and languages:

– XML: Extensible Markup Language
  • More powerful and flexible than HTML
  • Tagging allows computers to process data automatically
– SOAP: Simple Object Access Protocol
  • Rules for structuring messages enabling applications to pass data and instructions
– WSDL: Web Services Description Language
  • Framework for describing Web service and capabilities
– UDDI: Universal Description, Discovery, and Integration
  • Directory for locating Web services

4) SOA: Service-oriented architecture

This is a set of self-contained services that communicate with each other to create a working software application. Software developers reuse these services in other combinations to assemble other applications as needed.

Example: an "invoice service" to serve whole firm for calculating and sending printed invoices.

Dollar Rent A Car uses Web services to link online booking system with Southwest Airlines' Website

5) Software outsourcing and cloud services

There are three external sources for software:

A. *Software packages and enterprise software:* A software package is a prewritten commercially available set of software programs that eliminates the need for a firm to write its own software programs for certain functions, such as payroll processing or order handling.

B. *Software outsourcing (domestic or offshore)*

Domestic:: Primarily for middleware, integration services, software support

Offshore: Primarily for lower level maintenance, data entry, call centers, although outsourcing for new-program development is increasing

C. *Cloud-based software services*

Software as a service (SaaS)

• Accessed with Web browser over Internet

• Ranges from free or low-cost services for individuals to business and enterprise software

• Users pay on subscription or per-transaction, e.g. Salesforce.com

• Service Level Agreements (SLAs): formal agreement between customers and their service providers.

– *Mashups:* • Combinations of two or more online applications, such as combining mapping software (Google Maps) with local content.

– *Apps:* • Small pieces of software that run on the Internet, on your computer, or on your cell phone and are generally delivered over the Internet. Most of these apps are for the iPhone, Android, and BlackBerry operating system platforms.

eBusiness and eCommerce Technologies

E-Commerce

E-commerce is the process of doing business electronically. It is commerce accelerated and enhanced by Information Technology networks. E-commerce is a composite of technologies, processes and business strategies that foster the instant exchange of information within and between organizations. It is a range of applications that extend the core business activities of the enterprise into a virtual electronic community that is shared with customers, suppliers, business partners, employees, and prospects.

▫ *e-Commerce Relationships:*

Business-to-Business (B2B) – is used to refer to companies whose customers are other businesses

Business-to-Consumer (B2C) – is the e-Commerce where the company's customers are individuals who buy or transact business directly with it.

Business-to-Government (B2G) – is government departments setting up their website to directly reach the common citizen.

E-Business Enabling Software

* Supply Chain Management (SCM): is the supply chain software which are tools or modules used in executing supply chain transactions, managing supplier relationships and controlling associated business processes. It integrates supply and demand management within and across companies automating the process of planning and management of all activates involved ion sourcing, procurement, conversion, and logistics management activities. It addresses the following problems: Distribution Network Configuration; Distribution Strategy.

* Customer Relationship Management (CRM): consists of the processes a company uses to track and organize its contacts with its current and prospective customers. It is used to support these processes; information about customers and customer interactions can be entered, stored and accessed by employees in different company departments. It involves the use of technology in attracting new and profitable customers, while forming tighter bonds with existing ones.

CRM includes: Front office operations (face-to-face meetings, phone calls, e-mails etc); Back office operations (billing, maintenance, planning, marketing, finance etc.); Business relationships (interaction with other companies and partners e.g. suppliers, vendors etc); Analysis (market share, number and types of customers, revenue etc).

* Sales Force Automation (SFA): are information systems used in marketing and management that help automate some sales and sales force management functions. It is often called CRM systems. It automatically records all the stages in a sales process. SFA includes the following sub-systems:

Contact Management System (tracks all contact made with a given customer, the purpose of contact, any follow-up etc.)

Sales Leading Tracking System (lists potential customers through paid phone lists, or customers of related products)

Sales Forecasting

Order Management

Product knowledge

eBusiness and eCommerce Technologies... cont

* Human Resources Management (HRM): Also called HR Information System, HR Technology, or HR Modules refers to the systems and processes that combine both human resources management (HRM) and IT. It consists of the following:

Payroll module (taxes, time, attendance)

Work time

Benefits administration module

HR management module (covers aspects from application to retirement)

Online recruiting (use of applicant tracking system (ATS)).

* Asset Management: Is an integrated software solution that works with all departments that are involved in the procurement, deployment, management and expense reporting of IT assets. Assets include all elements of software and hardware that are found in the business environment.

* Software Asset Management – applies to business practices to software management; software licence management, configuration management; compliance to regulatory and legal restrictions.

* Hardware Asset Management – entails the management of the physical components of computers and computer networks, form acquisitions through disposal.

Networking/Telecommunications platforms

Computer Networking, Types and Configuration

Computer network consists of two or more computers that are linked in order to share resources such as printers and CD-ROMs, exchange files, or allow electronic communications. It may also be defined as a collection of resources among themselves. The computers on a network may be linked through cables, telephone lines, radio waves, satellites, or infrared light beams.

Types of Computer Networks

One way to categorize the different types of computer network designs is by their scope or scale. For historical reasons, the networking industry refers to nearly every type of design as some kind of area network. Common examples of area network types are Personal area network (PAN), Local area network (LAN), Metropolitan area network (MAN), Campus area network (CAN), Storage Area network (SAN) and Wide area network (WAN).

The computer networks which are designed for personal use are known as **PAN** or personal area networks. A PAN network is typically on an area of 20 to 30 feet. When we need the facility of network to be used on a really small commercial area or in small computer labs, we prefer LAN.

LANs are capable of higher data transfer within small geographical area. LAN usually operates at a speed of Giga Bit.

CAN is larger network than LAN. CAN is usually established in university campus to establish a connection among different computer labs, library, registration office and different academic units.

MAN is usually a middle way to LAN and WAN. It is established by the various interconnections between WAN and LAN. Man is spread over an area of around 5 to almost 50 km. MAN has many applications , it is most commonly used in banks, online reservation systems and in many military based services. If we make a complex network of many LANs we will end up making a wide area network. Wide area network is commonly known as internet. The applications and availability of internet can be now seen in every building of commercial or other nature.

SAN is a network which is created by attaching storage devices such as disk arrays and tapes to a common server so that the storage devices appear to be confined to operating system is known as storage area network

Others are **DAN** - Desk Area Network, and **WLAN** - Wireless Local Area Network (a LAN based on Wi-Fi wireless network technology)

All of the above mentioned network connections can be established using wireless or wired communication. Computer networks are of many uses. First and the foremost advantage are the file and data sharing. Other than that the other purposes that it serves are increased storage of data, more data sharing and cost efficiency.

Network Topology

The topology of a network is the geometric representation of all links and nodes of a network. It refers to the configuration of cables, computers, and other peripherals, that is, the structure, consisting of transmission links and processing nodes, that provides communications connectivity in a network. A link is the physical transmission path that transfers data from one device to another. A node is a network device (computer on the network). Network topologies may be either physical or logical, in the case of a LAN. Physical topology is about the physical design of a network like the location and devices while Logical topology refers to the method of how data is transferred in a network (how information is passed between workstations). Network topology is planned by the configuration of connections between the physical and /or logical nodes which is determined by the graphical mapping based on graph theory. The graph theory describes specific features of a network topology like physical interconnections, signal types, distances between nodes, network diameter for size, etc.

Network topology is of several types which include Mesh, Star, Tree, Bus, Ring topologies.

Mesh Topology: This network topology is generally too costly and complex for practical networks since each represented number of node must have ports (n-1) to have a connection in the mesh. It is used with a small number of nodes interconnected. In a mesh topology, every node has a devoted link to every other node which requires *n (n–1)/2* links to connect *n* nodes. The link is a point-to-point link.

Star Topology: A star topology is designed with each node (file server, workstations, and peripherals) connected directly to a central network hub or concentrator. Data on a star network topology passes through the hub or concentrator before continuing to its destination. The hub manages and controls all functions of the network. It rebroadcasts all transmissions received from any peripheral node to all peripheral nodes on the network. A node sends data to another node through the central hub, which then relays the data to the target node. All peripheral nodes may thus communicate with all others by transmitting to, and receiving from, the central node only.

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Tree Topology: A tree topology (also called hierarchical topology) combines the features of star and bus topologies. It is the connection of a central node (root node) to multiple star topologies in such a way that not every node is directly connected to a central hub. It is a symmetrical connection. Tree topologies allow for the expansion of an existing network, and enable organizations to configure a network to meet their needs. It consists of groups of star-configured workstations connected to a linear bus backbone cable.

Bus Topology: In a bus topology, there is a main run of cable with a terminator at each end. All nodes (fileserver, peripherals, and workstations) are connected to the linear cable. A shared medium connects all nodes in the network. This shared medium may be a single wire or radio frequency. LANs use this type of topology, where each system is connected to a single cable. It is cheap to set up compared to other topologies since it uses a single wire, but it is difficult to manage and the entire network shuts down if there is a break in the main cable.

Ring Topology: The ring topology is set up according to its name in a circular form through which data travels around in one direction in the ring. The signal travels around the ring and each system repeats the process keeping the signal strong. This topology provides an innate and natural reliability for a signal travels from a source around the ring to the target and back to the origin. A ring is not a flexible topology.

Network Devices

Network devices are the several computer network hardware components and architecture needed to perform data-processing and communication such as hubs, modems, switches, routers, etc.

***Hubs*:** This device connects all the computers in a network to allow transfer of data packets. It enables the sharing of data between all the devices that is connected to it. Hubs are sometimes referred to as repeater hub; it duplicates the data packets received through a port and shares it to all ports in the networks.

***Modems*:** **MODEM** is an acronym for Modulator-Demodulator. This device receives digital signals and converts them into analogue signals over the network and it also receives analogue signals and convert back to digital signals, for it is capable of knowing the difference between zero (0) and one (1). It modulates the signals into frequencies suitable for transmission and demodulates them at the receiving end. It is commonly used to link a telephone to a computer system for communication purposes.

***Switches*:** A switch is a more sophisticated type of hub. It is a small network device that joins computers together in multiple within one Local Area Network. A network switch is quite identical to a hub but a switch is more efficient than a hub. As against a hub, a switch does keep track of which computer is connected to each port.

***Routers*:** a router translates information from one network to another; it is similar to a super intelligent bridge. Routers select the best path to route a message, based on the destination address and origin. The router can direct traffic to prevent head-on-collisions, and is smart enough to know when to direct traffic along back roads and shortcuts.

***Network Interface Card (NIC)*:** the network interface card (NIC), also called network adapter or a LAN adapter provides the physical connection between the network and the computer workstation. NICs are a major factor in determining the speed and performance of a network. Most NICs are internal, with the fitting into an expansion slot like an RJ45 or BNC socket and a few LED indicators to show the activity of the network inside the computer. Ethernet cards and Token ring cards are the most common network interface connections.

Benefits of Networking

- Sharing of resources – A network of computers gives the benefit of sharing resources between computers e.g. peripherals like printers, scanners, fax machines, modems etc.

- Speed – Networks provide a very rapid method for sharing and transferring files. Without a network, files are shared by copying them to a removable storage device, and then are transferred to other computers.

- Security – Files and programs on a network can be well secured using several security measures like password, encryption etc., to restrict access to unauthorised users.

- Ease of communication – The presence of a network provides the hardware necessary to install an e-mail system which aids personal and professional communications and it facilitates the dissemination of information within an organization.

- Centralized software management – All of the software needed can be installed on one computer (file server) which is then shared by other workstations instead of spending time and energy installing updates and tracking files on stand-alone computers throughout the organization.

Review Questions

1. Define IT infrastructure and describe its components.
2. Identify and describe the stages and technology drivers of IT infrastructure evolution.
3. Assess contemporary computer hardware platform trends.
4. Should all firms move toward green computing? Why or why not?
5. What are the challenges of managing IT infrastructure and management solutions?
6. Why is selecting computer hardware and software for the organization an important management decision? What management, organization, and technology issues should be considered when selecting computer hardware and software?
7. Should organizations use software service providers for all their software needs? Why or why not? What management, organization, and technology factors should be considered when making this decision?
8. What are the advantages and disadvantages of cloud computing?
9. Distinguish between e-commerce and e-business.
10. Highlight the benefits of Networking

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