CHAP- 2

Information Systems and IT Fundamentals

EMERGING COMPUTING MODELS

Cloud Computing

Cloud Computing Environment

Public clouds

Available to general public or a large industry group. They are administrated by 3rd parties.

Key benefits

→ Widely used in deployment & management of enterprise applications.

→ Allows organisation to deliver highly scalable & reliable applications rapidly.

Private clouds

→ They are built primarily by IT departments within enterprises by using the concepts of grid & virtualization.

→ E.g. Apple i cloud.

Community clouds

→ Sharing of computing infrastructure in between organisations of same community.

→ For example: All govt. organisation within India.

Hybrid clouds

→ It is maintained by both internal & external providers.

→ Composition of two or more clouds. E.g.

→ Microsoft uses hybrid cloud.

→ Sensitive data on private cloud & general on public cloud.

CLOUD COMPUTING ARCHITECTURAL CONSIDERATIONS

Refers to the components & subcomponents that typically consist of front & back end.

Front end

The front end of the cloud computing system comprises of the client devices browsers.

Back end

Refers to some physical peripherals. The back end is cloud itself who does various activities like storage. For this some set of rules i.e. protocols followed by this server & uses middleware to allow computers on network to communicate with each other.

SERVICE MODELS OF CLOUD COMPUTING

1) Infrastructure as a service (Iaas):

Foundation of cloud services. It provides client with access to server hardware, storage & other fundamental computing resource.

It provides dynamic scaling so that if the customer needs more resources than expected. E.g. Database communication etc.

PROF.JIGNESH CHHEDA

EMAIL : Chheda.jignesh@gmail.com contact : 9819068991

2) Software as a service (Saas):

Includes a complic software offering on the cloud users can access a software application hosted by the cloud vendor on pay-per-use basis. E.g. PDF to word online.

3) Platform as a service (Paas):

Access to the basic operating software & optional services to develop & use software applications without the need to buy & manage the underlying computing infrastructure. E.g. Playstore.

4) Network as a service (Naas):

It is a category of cloud service that provides user to use network transport connecting services. E.g. VPN, in roaming Vodafone uses network services of BSNL.

5) Communication as a service (Caas):

Evolved in the same line as Saas. It is an outsourced enterprise communication solution that can be leased from a single vendor. E.g. Whatsapp, Line, We chat, Hike etc.

MOBILE COMPUTING

Use of movable computing devices in conjunction with mobile communication technologies to enable users to access the internet from anywhere.

Mobile Computing involves

Mobile communication	Mobile hardware	Mobile software
Refers to the infrastructure put in place to ensure that seamless (without any storage) & reliable communication goes on.	Mobile hardware includes mobile device components that receiver or access the service of mobility. These devices operate in full duplex.	It is the actual program on which mobile hardware runs. It is a O.S. of that appliance. Essential to operate the device.

A) Business Applications of Mobile Computing

Enables to conduct business anywhere & user can access through office or anywhere to the office work.

Some advantages:

(i) Increase in workforce productivity.
(ii) Consumer service can be improved.
(iii) Incident management can be improved.
(iv) Dynamically modify & update the offerings by enterprises. E.g. Snapdeal.
(v) Gives user to roam.

B) Mobile Computing Concerns

Major disadvantages are as follows:

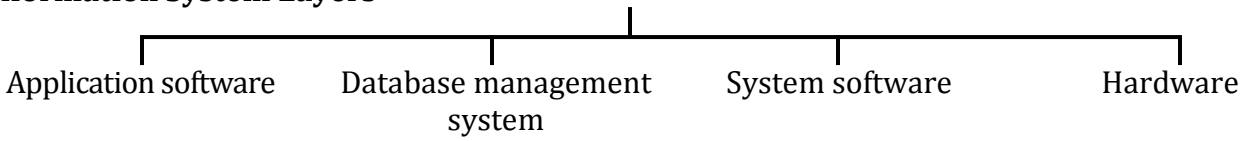
1) It has its fair share of security concerns as any other technology.
2) Dangers of misrepresentation.

PROF JIGNESH CHHEDA

3) Power consumption: It rely entirely on battery power.

4) Potential health hazards (due to radiation).

Information System Layers



Application Software

Means software that causes a computer to perform useful task beyond the running of the computer itself. Software which is used for a specific purpose.

Different types of application software [CEEEMA I]

1) Application suite:

Bundle of applications. E.g. MsOffice.

2) Enterprise software:

Addresses an enterprise's needs & data flow in a huge distributed environment.

3) Enterprise infrastructure software:

Provides capabilities required to support enterprise software systems. E.g. Security software.

4) Information worker software:

Addresses individual needs required to manage & create info for individual projects within departments. E.g. Spreadsheets of excel.

5) Content access software:

Used to access contents. E.g. VLC media player, Adobe reader.

6) Educational software:

Holds contents adopted for user of students. E.g. ICAI.

7) Media development software:

Generate & print electronic media for others to consume. E.g. Video editing etc.

Advantages

Addressing user needs
Designed for specific purpose

Less threat from virus
Restrict access & can come up with means to protect their network as well.

Regular updates
Licensed application software gets regular updates.

Disadvantages

Development is costly
Costly for developers

Infection from malware
If software is used by many people then risk

DATABASE MANAGEMENT SYSTEM (DBMS)

PROF JIGNESH CHHEDA

Database: means collection of interrelated data. E.g. Students information, address book in a cell phone.

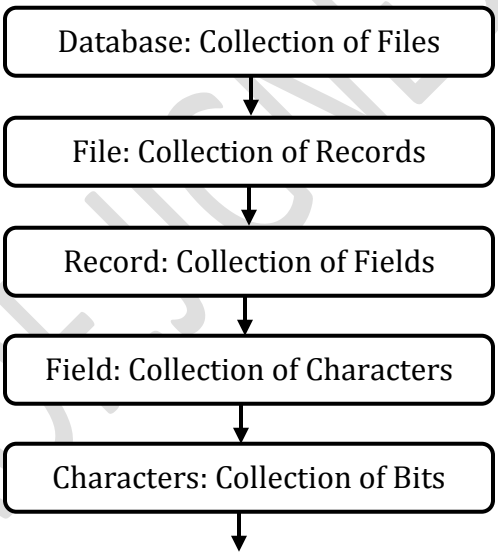
DBMS: It is an application to manage database. E.g. SQL, Oracle.For DBMS following things should be done:

1) Knowing its information needs.
2) Acquiring that information.
3) Organizing that information in meaningful way.
4) Assuring information quality.
5) Providing software tools for access into they require.

Functions of DBMS

- Adding new files to database.
- Deleting existing files from database.
- Inserting data in existing files.
- Modifying data in existing files.
- Deleting data in existing files.
- Retrieving or querying data existing files.

Database Model Hierarchy



Database Models

Hierarchical Database Structure	Network Database Structure	Relational Database Model	Object Oriented Database Model
Features: • Less flexible as relationship between records are	• It vies all records in set. • Each set is composed of an owner record & 1	• Unlike 1st 2 this model does not require explicit relationship. • A relational database	Object oriented database provides a mechanism to store complex data in different types of formats like text, image, video,

PROF. GANESH CHHEDA

fixed by structure.
- It requires flow of data identified before search.
- Ad hoc queries, difficult & time consuming.
- Day to day operational data can be processed rapidly.
- The data whose natural relation fit nicely, this structure is useful.
- Data is logically structured in tree pattern.
- It provides parent-child relationship among nodes.
- It implements 1 to 1 & 1 to many relation, many to 1 is not possible.

or more member records.
- So, all type of relations are possible to 1 to many, many to 1.
- Record to be a member of 1 or more set at 1 time i.e. a member can have more than 1 owner.
- No need to find entrance point it can be accessed from bottom also unlike hierarchical database structure. So it provides more flexibility.

is structured into a series of 2 dimensional tables i.e. table format.
- Easy for most of people to understand.
- When we merge the data of tables or of different types/column/features should be common it them.
- **Advantages:**
- Allows manage flexibility in queries & creating reports.
- New tables can be created by merging.
- Relation in database structure is more flexible than 1st 2.
- No need of explicit relationship.
- **Disadvantages:**
- Cannot process large batch application with the speed of 1st 2.

media, etc. E.g. FB

Advantages: [UF IM PAPI]

- **Permitting data sharing:** Info can be made available to different users.
- **Minimizing data redundancy:** No need to repeat the same data over & over again.
- **Integrity can be maintained:** Data have to be at one place. E.g. Numeric field. Therefore all data in that field will be in numeric field.
- **Program & file consistency file:** Formats & programs are standardize.
- **User friendly:** Data user is able to access & manipulate data easily.
- **Improved security:** Should be there. Rules can be built to access sensitive data.
- **Achieving program/data independence:** Databases programs data are independent of each other.
- **Faster app. Development:** Becomes fast. Only the logic required to retrieve the data in the way of user needs.

Disadvantages:

- Costly & time consuming.
- Security is needed for sensitive data.

HARDWARE

Input Device

Through which we can interact with the system.

E.g. Keyboard, scanner, Barcode, stylus, touch screen, webcam, microphone etc.

PROF JIGNESH CHHEDA

Processing Device

Include computer chips that contain the central processing unit & main memory.

CPU (Central Processing Unit) (CPU or Micro processing unit) is a actual hardware that interprets & executes the program instructions & co-ordinates all other device work together.

It consists of three functional units

- **Control Unit (CU)** – Controls flow of data & instruction to & from memory & controls which tasks to execute & when
- **Arithmetic & Logical Unit (ALU)** – performs arithmetic operations such as +, -, × & logical comparision of no. like =, <, > etc.
- **Registers** (Temporary storage of CPU)
  - Accumulators can keep running total of arithmetic value
  - Address Registers Gives location of data which is stored in primary memory i.e. RAM.
  - Storage Registers temporarily store data that is being sent to or coming from the system memory
  - Misc. for general purpose

Data Storage Devices

Here programs & data are stored.

Types of memory

- **Internal memory** – Registers within CPU. Small & fast
- **Primary memory**
  - **Random**
    - Access memory (RAM)
    - Read write memory
    - Info can be readed & modified
    - Volatile – lost as power is turned off
  - **Read only memory (ROM)**
    - Non-volatile
    - Not modified
    - Used by manufacturers to store data & programs
      - Cache
      - Virtual
      - 2ndry Storage

PROF. IGNESH CHHEDA

memory Part of CPU Register, Volatile but different from register For bridging speed differences between registers & primary (data) memory	memory • Temporary • Created by OS When RAM becomes full, then in HDD. It creates a space used as RAM	• Non-volatile • Great capacity • Greater economy • Slow speed E.g. HDD, CD, DVD

Output Devices

Cathode – Ray Tube	Liquid Crystal	Laser Printer	Ink Jet Printer	Plotter	Speakers
It creates pictures by developing colours through phosphoras & electrical gun interaction.	Display used in laptop. Crystal molecules change their orientation when an electric current flows through it.	Printer that form images using electro static process like photo copier works.	Makes images by forcing ink drops let through nozzles.	Printer uses computer directed pens for creating high quality image. E.g. ECG.	Gives audio output.

SYSTEM SOFTWARE

Software = Set of instruction to control hardware.

System software is computer that is designed to operate the computer hardware and to give & maintain a platform for running application software.

An Operating System (OS) is a sent of computer programs that manages computer hardware resources & acts as an interface with computer application prams.

System software support hardware & manage it.

Q. A variety of activities are executed by OS which includes

1) Performing hardware functions: Like input from keyboard, retrieve data from disk etc.

2) User interfaces:

DOS (OS) → Command user interface

Windows → Graphic User Interface

Command user interface = Text command to execute command

GUI = Uses icons & menus

PROF. IGNESH CHHEDA

3) **Memory Management:** OS decides how memory is allocated for different application is decided.

4) **Task Management:** Facilitate a user to work with more than one application at a time i.e. multi-asking.

5) **Networking Capability:** OS can provide systems with features & capabilities to help connect computer networks. E.g. Window so excellent capability to connect to internet.

6) **Logical access security:** OS provide logical security by establishing a procedure for identification & authentication using a user ID & password.

7) File management keeps a track of where each file is stored & who can access it.

NETWORK LINKS

Computer network is a collection of computers & other hardware interconnected by communication channels that allow sharing of resources & information.

Computer in a computer in a computer network is called a Node.

Networks could be of 2 types

Connection oriented networks	Connectionless networks
Connection is first established & then data is exchanged. E.g. Circuit switch.	No prior connection before data exchanges. E.g. Packet switching.

Each of these networks are modeled to address the following basic issues:

Routing	Bandwidth	Resilience	Conflict contention
Decides the how to communicate the data from source to destination in a network	Data carrying capacity	Ability of network to recover from any kind of error	Conflict for some common resource. E.g. Bus topology • Single cable • More users → Traffic

Important benefits of computer network [DR RUC]

Distributed nature of information	Resource sharing	Computational power	Reliability	User communication
Data which are scattered over different departments or geographic locations will be consolidated using network.	Data could be stored at a central location & can be shared across different systems. Even resource sharing could be in terms of sharing peripherals like printers which are normally by many systems.	Computational power is a process in which processing is distributed amongst server & client.	Data is stored at server then no problem due to failure of Node. E.g. One ATM fails then other can be operated.	Allow users to communicate using e-mail etc.

PROF. JIGNESH CHHEDA

PEOPLE : USERS

Most important element in most computer based information system.

E.g. Management, Auditors, Employee etc.

It includes all people who manage, run, program & maintain the system.

INFORMATION SYSTEM LIFE CYCLE

Also know as System Development Life Cycle (S DLC)

It is a set of activities which guides to develop system.

SDLC PHASES

PHASE I: SYSTEM INVESTIGATION

Examines that "What is the problem & it worth solving"?

Feasibility study

Technical feasibility: Does the technology exists to implement the proposed system.

Economic feasibility: System should be cost effective.

Legal feasibility: Is there any conflict between system Y proposed system. E.g. RBI, SEBI, IRDA etc.

Operational feasibility: Current work practices & procedure feasible for new system or not.

Schedule feasibility: Desired team frame to implement.

PHASE II: SYSTEM ANALYSIS

Examines that "What must the info system do to solve the problem"?

It involves gathering details about the current system & will involve:

Interviewing staff:

At different levels from end users to senior management.

Examine current business:

Current order documents, computer system procedures, report used by management.

Sending out questionnaires:

For draw out clear answers.

Observation of current procedures:

Study different department & procedures could be more efficient or detect drawbacks.

The systems drawbacks:

The systems analyst will:

- Examine data & info flows.
- What the proposed system will actually do.
- Analyze cost & & benefits.
- Outline system implementation options.
- Consider possible hardware configurations.
- Make recommendations.

PROF JIGNESH CHHEDA

PHASE III: SYSTEM DESIGNING

Examines that "How will the info system do what it must do to obtain the solution to the problem"?

It specifies the technical aspects in terms of:

Hardware platform: Computer, input, storage etc.

Software: Programming language, package & database.

Outputs & inputs: layouts, screen, icons.

User interface: How users will interact with computer system.

Modular design: Each program should be independent of each other.

Test plan: Develop test data.

Conversion plan: How the new system is to be implemented.

Documentation: Includes systems & operations documentation.

PHASE IV: SYSTEM IMPLEMENTATION

Examines that "How will the solution be put into effect"?

It involves following steps:

- Coding & testing of the system.
- Acquisition of hardware & software.
- Either installation of new system or modification of old system involves following major activities:
  - Installing the new hardware.
  - Training the users.
  - Conversion of master files. E.g. Tally 7.2 → Conversion (migration) → Tally 9.0
- In conversion there are following major activities:
  - **Direct change over:** Totally stop old & implement new system.
  - **Parallel conversion:** Old system continues with new system for few weeks (expensive)
  - **Phased conversion:** Broken down into individual modules which can be implement at different times.
  - **Pilot Conversion:** Apply new system in different branch/office in different times.

PHASE V: SYSTEM MAINTENANCE & REVIEW

This phase evaluates results of solution & modifies the system to meet the changing need.

Maintenance definition: Set of activities which will keep the system into working condition.

Post implementation review would be done to address:

- Programming amendments
- Adjustment of clerical procedures
- Modification of reports &
- Request for new programs

System maintenance could be with following different objectives:

Perfective maintenance: While the system runs satisfactorily.

Adaptive maintenance: Adapt to changing needs within a company.

Corrective maintenance: If error occurs then it must be corrected.

PROF. JIGNESH CHHEDA

RECENT TECHNOLOGIES/DEVICES

1) Bluetooth:

1) Standard for exchanging data over short distance max upto 50 meters.
2) We can send pictures, videos, exchange business cards & also transfer files to our PC.
3) Both data & voice transmission can be sent & received.
4) Bluetooth is really like a very low power radio signal.
5) Bluetooth signals are secure from the moment they are sent.

E.g. Keyboard & mouse, printer, cell phones & headsets

2) Wi-Fi:

1) Popular wireless networking technology that uses radio waves to provide wireless high speed internet & network connections.
2) Wi-Fi networks have limited range. A typical wireless access point might have a range of 32 meters.
3) Wi-Fi is a "Wireless Local Area Networks" (WLAN) products that are based on the "Institute of Electrical & Electronics Engineers" (IEEF) 802.11 standards.
4) Less secure than wired connections.
5) Many corporations also provide wireless networks to their off-site & telecommunicating workers to use at home or in remote offices.

3) Laptop: Notebook

1) Is a small, portable computer & small enough that it can sit on a lap.
2) Small & light enough that it could be used while sitting in our lap.
3) Typically weightless than 3 kg.
4) Use flat panel technologies. E.g. LCD displays.
5) Almost equivalent to PC having same CPUs etc.

4) Tablet Computer or Tablet:

A tablet computer or simply tablet is 1 general purpose computer continued in a single panel.

Features of Tablets:

i) Input Method: Solely on a touch interface.
ii) Size: Roughly of a small pad of paper & a weight that is less than 1 kg.
iii) Battery life: Low power requirement of hardware component.
iv) Storage capacity: 16 & 64 GB of storage.
v) Performance: Suited for tasks like email, web browsing etc. small activities hot for heavy activities.
vi) Software: 2 major tablet platforms are Android and I OS amongst.
vii) Wireless: Most of them have Wi-Fi, Bluetooth & mobile connectivity.

5) Smartphone:

- Have advanced computing capability connectivity than a featured phone.
- Combination of the traditional PDA & cell phone.
- Allows e-mail & install apps etc. in one device.
- Modern smart phones also include high resolution.

Web-browsers etc.

- High speed data access is provided by Wi-Fi & mobile broadband.

PRAJUGNESH CHEDA

6) Touchpad:

1) A touchpad is a pointing device featuring a tacit sensor.
2) Touchpads operate in one of several ways including capacitive sensing & conduct an sensing.
3) Used in mouse of laptop, Blackberry phones.
4) Used due to vary in size, requires less space to operate.
5) Capacitance-based touch pads will not sense the tip of a pencil or other similar implement.

7) i-Pad:

1) The i-pad runs a version of iOS.
2) iOS is designed for finger based use & has none of the tiny features which required a styles on earlier tablets.
3) iOS uses less power & so gives mere battery life than itel devices used by windows tablets.

8) Ipod:

1) Portable media players designed & marketed by Apple Inc.
2) Firstly released on 23rd October, 2001.
3) Its most recent redesigns were announced on Sept. 12, 2012.
4) There are four current versions of ipod

Ultra compact ipod shuffle	The compact ipod nano	The touch screen ipod touch	Hardrive based ipod classic

5) ipod can serve as external data storage device.
6) Memory ranging from 2 GB for the ipod shuffle to 160 GB the ipod classic.

9) Ultra-Mobile PC (UMPC)

1) An ultra-mobile PC is a small from factor version of pen computer.
2) Microsoft dropped the licensing requirement that tablet. PCs must support proximity sensing of the stylus, which Microsoft termed “hovering”.
3) These are operated like tablet PC’s using a touch screen or a stylus & can also have a physical keyboard.
4) No clear boundary between sub-note books & ultra-mobile PCs.

10) Android:

1) It is a lenux based operating system.
2) Android OS is used in phones of Samsung, HTC, Sony etc.
3) Android devices come in all shapes & sizes.
4) Android is open source i.e. no requirement of legal licence.

PROF. JIGNESH CHHEDA

IT INTRODUCTION

→ IT enables business enterprises to differentiate their products.

→ Enterprises these days are equipped with e-mail, video conferencing equipment & internal chat too which provide an efficient way to communicate & conduct business.

Uses Voice Over Internet Protocol (VOIP), Whats app, Team viewer, etc.

→ Most enterprises store digital versions of documents on clouds.

→ So they are able to store tremendous data economically & for immediate access.

→ It also provides security to enterprises like Firewall, authentication, password etc.

AUDITING IN IT ENVIRONMENT

→ Auditing in a computerised environment would depend on the scope & objective of audit.

→ Audit broadly would involve the process of evaluating & reporting the adequacy of system controls, efficiency etc.

The Audit objectives:

1) Existence of assets, liabilities etc.
2) Authorisation: Events have occurred in accordance with management's intent.
3) Valuation: Accounting values should be fairly presented.
4) Cut-off: Is transaction is recorded in the proper accounting period.
5) Compliance: Compliance with governmental laws & regulations.
6) Operational: Activity is performed economically efficient & effectively.
7) Assisting management in implementing internal control & recommendations.
8) Determining whether efficient use is made of the organisation's computer resources.

DIFFERENCES IN AUDIT PROCEDURES ARE GIVEN

1) Study technical aspects:

Gather evidential matter relating to technical aspects of system. The focus is to begin from the peripheral controls to application's controls.

2) Use unique techniques:

Audit in a computerized environment would require application of unique techniques to these efforts. The auditor must understand the procedures for testing & evaluating computer controls.

3) Audit software usage: E.g. CAAT

These procedures include the use of generalized audit software to survey the contents of data files etc.

IMPACT OF IT ON RISKS & CONTROLS

→ Ready access to terminals which may related to crimes like hacking the data etc.

→ Online processing of data may result in guessing passwords by hackers.

→ If no appropriate controls are set then there might be fear of loss of data, data theft.

→ Failure of serve etc.

To avoid this contingencies should be anticipated & planning done to handle them.

PROF JIGNESH CHHEDA

4 MAJOR AREAS IN WHICH CONTROLS HAVE BEEN AFFECTED

1) Source of data transactions may be centralized.
2) Data librarian may become charge for data.
3) Use methods like segregation of duties, transfer of responsibilities.
4) Decline of accountability traditional functions responsibilities & boundaries have been eliminated or are hidden by new methods.

AUDITORS CONCERN

1) New criteria in evaluating control weakness in computerized info systems.
2) Tailor testing techniques.
3) Use computers to perform some portions of audit examination.

BUSINESS PROCESS AUTOMATION

Steps involved in any BPA are as follows:

Step 1: Define why we plan to implement BPA?

Step 2: Understand the rules/regulation under which it needs to comply with?

Step 3: Document the process, we wish to automate.

Step 4: Define the objectives/goals to be achieved by implementing BPA.

Step 5: Engage the business process consultant.

Step 6: Calculate ROI for project.

Step 7: Development of BPA.

Step 8: Testing the BPA.

BPA APPLICATION TIES UP THE FOLLOWING ACTIVITIES

1) **Integration:** It means connecting 2 applications & exchange of data between them.
2) **Orchestration:** Bringing scattered data together at one place i.e. gather data from different places/branches at one place.
3) **Automation:** Integration & orchestration should be done automatically.

To achieve the automation, we would need IT infrastructure, hardware & software to manage the same.

Process which are involved in a typical business enterprise

Database access & changes	File replication & data backup	System & event log monitoring	Job scheduling	Application integration	File transfers	Printing
It provides data access via a ODBC connections, data updates etc.	Automatic backup.	It reviews & analyzes the event log & critical system & create multistep corrective action such as restarting a server service.	Manage scheduled & unscheduled tasks fight now automatically.	It means collecting 2 apps & exchanges data between them.		Simply print job.

PROF. JIGNESH CHHEDA

COMPUTING

Definition:

Computing includes designing & building hardware & software systems for a wide range of purposes. Processing, structuring & managing various kinds of information, doing scientific studies using computers, making computer system behave intelligently, creating & using communications & entertainment media, finding & gathering info & so on.

5 SUB-DISCIPLINES OF THE COMPUTING FIELD

Computer Science	Computer Engineering	Information System	Information Technology	Software Engineering
It is a systematic study of the feasibility, structure, expression & mechanization of the methodical processes for storage, communication, accessing info etc.	Combination of electrical engineering & computer science. Computer engineers are involved in many hardware & software i.e. processors.	Same as Ch. 4	Medium for transforming data from one place/device to another place/device. E.g. Computers, e-commerce, network etc.	The design development, operation & maintenance of software.

COMPUTING TECHNOLOGIES

1) Server:

Server is a computer which provides specific services like database access communication etc. to client computer.

Different types of servers

File server	Print server	Network server	Database server	Application server	Web server	Mail server
Stores & manages files	Manages one or more printers	Manages network traffic	System that processes database queries	3 tier architecture where app. is stored	Means a server which stores website .org, .com = domain name URL =	Moves & stores mails over corporate network

2) Popular computing architecture:

Programs is not embedded in the hardware platform. Program's code is stored & manipulated in the computer memory just like data, becoming what is known as 'Software'.

(i) Instruction Set Architecture:

It is the abstract model of computing system that is seen by a machine language programmer that is, how the computer understands.

PROF. JIGNESH CHHEDA

Classification of instruction sets (2 types)

Complex Instruction Set Computer
CISC

- CPU is collection electronic circuit which are activated by micro code.
- Many features so easy to develop.
- Uses variable length designed to finish task in minimum possible instructions.

Reduced Instruction Set Computer
RISC

- CPU is collection of EC but they perform on their own.
- Less features hard to develop.
- Uses fixed length.
- RISC process or finishes task in more instructing than CISC.

Variable length instructions

- Used on CISC machines.

Advantages:

- Use exactly the amt. of space it requires.
- Reduce the amt. of memory space.

Fixed length instructions

- Used on RISC machines.
- Each instruction has the same length & occupies same amt. of space.
- Memory space is wasted.

Advantages:

- Makes the job of fetching & decoding instructions easier & more efficient.

(ii) Micro architecture:

It means how various parts on motherboard will interact operate with each other. E.g. RAM etc.

(iii) System design:

- System interconnects - Computer buses & switches: Computer bus that transfers data between components inside a computer or between computers that covers all related hardware component.
- Memory controller & hierarchies: Manages flow of data going to & from main memory.
- CPU off load mechanisms - Direct Memory Access (DMA): Features of modern computer allows certain hardware independently of CPU. E.g. Downloading, copying from one drive to another drive.
- Issues – multiprocessing, virutualisation, software features etc.
- Multi processing use of 2 or more CPU's within a single computer system to allocate task between them.
- Hardware virutualisation or platform virtualization: Creation of a virtual MIC that acts like a real computer within an OS.

----****----

PROF JIGNESH CHHEDA