E-COMMERCE, M-COMMERCE AND EMERGING TECHNOLOGIES
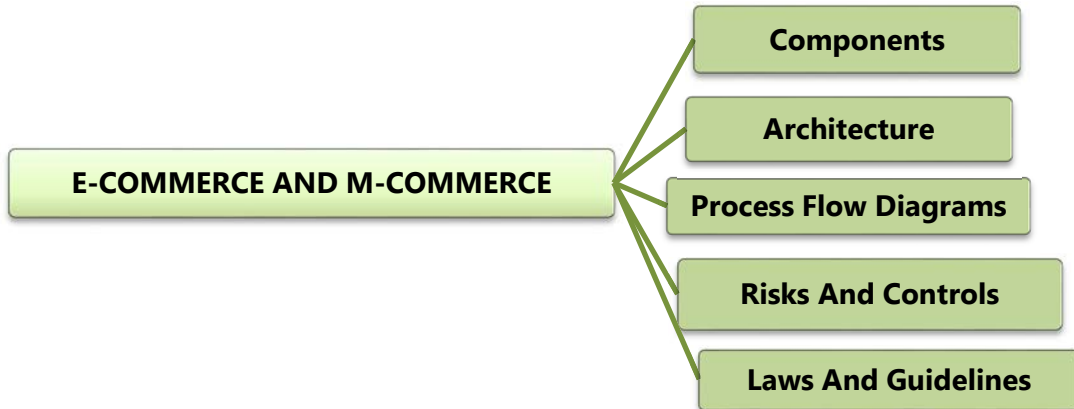
LEARNING OUTCOMES

After reading this chapter, you will be able to -

☐ Understand the meaning, components and architecture of E-commerce.

☐ Grasp the knowledge about the process flows in E-commerce transactions.

☐ Comprehend the various aspects of risks and controls in E-commerce.

☐ Recognise applicable laws and guidance governing E-Commerce.

☐ Acknowledge a basic understanding on the paradigms of various Computing Technologies like Cloud Computing, Grid Computing, Mobile Computing, Green Computing and BYOD etc.

CHAPTER OVERVIEW

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                                          ┌──────────────────────┐
                                          │     Components       │
                                          └──────────────────────┘
                                          ┌──────────────────────┐
                                          │     Architecture     │
┌─────────────────────────────┐          └──────────────────────┘
│ E-COMMERCE AND M-COMMERCE   │──────────┌──────────────────────────┐
└─────────────────────────────┘          │  Process Flow Diagrams   │
                                          └──────────────────────────┘
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                                          │  Risks And Controls  │
                                          └──────────────────────┘
                                          ┌──────────────────────┐
                                          │  Laws And Guidelines │
                                          └──────────────────────┘
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EMERGING TECHNOLOGIES	• **Virtualization** • **Grid Computing** • **Cloud Computing** • **Mobile Computing** • **Green IT** • **BYOD** • **Web 3.0** • **Artificial Intelligence** • **Machine Learning**

4.1 INTRODUCTION TO E-COMMERCE

E-Commerce: "Sale / Purchase of goods / services through electronic mode is e-commerce." This could include the use of technology in the form of Computers, Desktops, Mobile Applications, etc.

The greatest change due to technology innovations in last five years has been the way users perform their daily chores / activity of life. E-Commerce and its related technologies are unquestionably the current leading-edge business and finance delivery systems.

The explosion in the application of technologies and the delivery of these technologies in to the hands of consumers has made the vision, the dream, the fantasy of conducting business electronically, anywhere in the global community, a reality. E-commerce is no longer just a concept; it is a market force to be reckoned

with. As more and more organizations launch Internet/ World Wide Web (WWW) home pages and intranets to disseminate company/product information, and expand their customer base, countless yet unnamed companies are just beginning to investigate this alternative. These companies are realizing that business via the Internet is inevitable that they will not be able to ignore. The lure of reaching additional customers, expanding market shares, providing value-added services, advancing technological presence, and increasing corporate profits is just too valuable to disregard, and will eventually attract companies to electronic commerce like moths to a flame.

E-Commerce is the process of doing business electronically. It refers to the use of technology to enhance the processing of commercial transactions between a company, its customers and its business partners. It involves the automation of a variety of Business-To-Business (B2B) and Business-To-Consumer (B2C) transactions through reliable and secure connections.

A recent report on India's e-Commerce growth forecasts that as a result of rising internet penetration as roughly 350 million Indian citizens are already online and that number is expected to nearly double to 600 million by 2020*. This number is more than projected users in USA by that time. Above fact is an indicator that India's e-business shall be growing very fast as internet penetration increases.

4.1.1 Traditional Commerce and E-Commerce

The greatest change due to technology innovations in last five years has been the way users perform their daily chores / activity of life. An illustrative Table 4.1.1 shows how technology has entered every aspect of human life.

Table 4.1.1: Example of how Technology has entered every aspect of human life

S. No.	Activity	Then	Now
1	Wake up	Alarm clocks with snooze buttons.	Mobile alarms, multiple types. Some forcing you to solve mathematical quiz before you snooze them. Ensuring you wake up.
2	Morning chores	Make / Cook Breakfast	Multiple home delivery solutions available where you can order online.

3	Going to office	In small towns in India, there was AUTO RICKSHAW	Now even in small towns you have a mobile APP through which you can call a JUGNOO auto / bike, an OLA or UBER auto / cab.
4	Office Admin	All jobs to be done by assigned service provider. For example: Courier's need to be sent to courier agency	Now you book through online APP, the courier agency picks up POST at designated time and place.
5	Procurements of all items: Items include Electronic, Furniture, Mobiles, Grocery, Cars and Bikes etc. all items covered here.	Go shop by shop to check price and quality	Now it is possible to search all products online, buyer can compare prices and order online. Few online sellers are giving facility of delivery within 12 hours of ordering.

Above is the way consumer / customers are buying products / services. This has forced organization to change their product / service delivery channels. The previous product delivery channel which was typically defined by the Fig. 4.1.1 has moved to the new product delivery model Fig. 4.1.2.
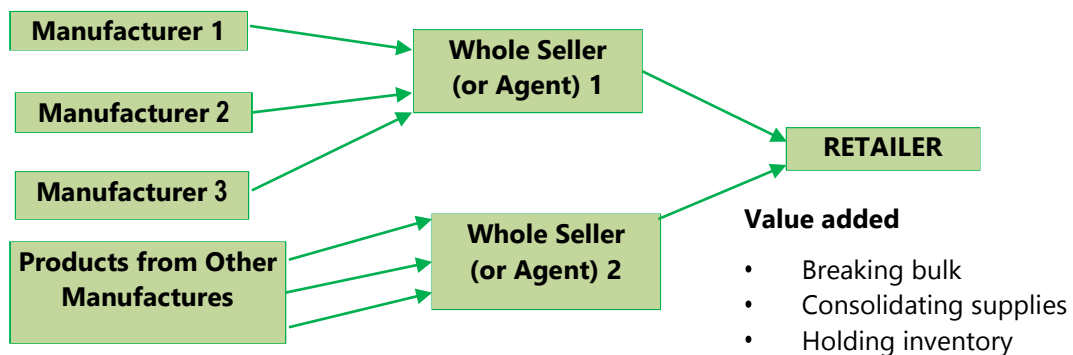
Fig. 4.1.1: Old Model

Fig. 4.1.1 illustrates the old traditional model of doing business with multiple layers before product is finally delivered to customer. Fig. 4.1.2 illustrates the new

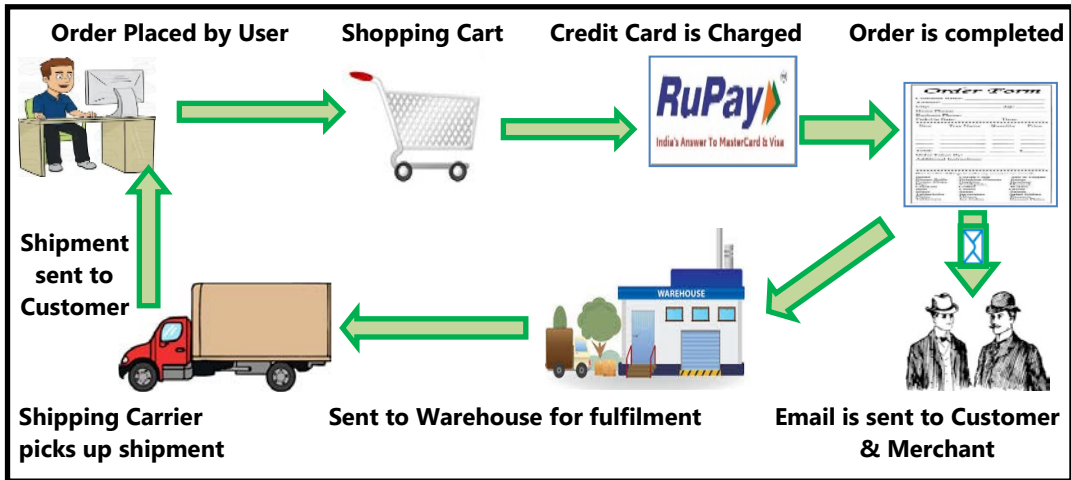business model enabled by technology. In this model the link to consumer and supplier is virtually direct.

Fig. 4.1.2: New Model of E-Commerce

4.1.2 Difference between Traditional Commerce and E-Commerce

Table 4.1.2 highlights difference between Traditional Commerce and E-Commerce.

Table 4.1.2: Traditional Commerce Vs. E-Commerce

BASE FOR COMPARISON	TRADITIONAL COMMERCE	E-COMMERCE
Definition	Traditional commerce includes all those activities which encourage exchange, in some way or the other of goods / services which are manual and non-electronic.	E-Commerce means carrying out commercial transactions or exchange of information, electronically on the internet.
Transaction Processing	Manual	Electronically

Availability for commercial transactions	For limited time. This time may be defined by law. Like special stores which may run 24 hours, but in general available for limited time.	24×7×365
Nature of purchase	Goods can be inspected physically before purchase.	Goods cannot be inspected physically before purchase.
Customer interaction	Face-to-face	Screen-to-face
Business Scope	Limited to particular area.	Worldwide reach
Information exchange	No uniform platform for exchange of information.	Provides a uniform platform for information exchange.
Resource focus	Supply side	Demand side
Marketing	One way marketing	One-to-one marketing
Payment	Cash, cheque, credit card, etc.	Credit card, fund transfer, Cash in Delivery, Payment Wallets, UPCI application etc.
Delivery of goods	Instantly	Takes time, but now e-commerce websites have created options of same day delivery, or delivery within 4 hours. This option is restricted to number of cities as of now. AMAZON has already started delivery in United States of America through drones.

Fraud	Relatively lesser as there is personal interaction between the buyer and the seller.	Lack of physical presence in markets and unclear legal issues give loopholes for frauds.
Process	Because of manual processing of business transactions; chances of clerical errors are high.	Automated processing of business transactions minimizes the clerical errors. Manufacturers can have better inventory management. As they will always know what products customers are buying. They shall be able to maintain inventory on JIT (Just in Time) basis.
Profit Impact	The cost incurred on the middlemen, overhead, inventory and limited sales reduces the profit of the organization.	By increasing sales, cutting cost and streamlining operating processes - (i) The profits margin of manufacturers is increased. (ii) Above (i) allow manufacturers to give discounts to customers. (iii) Customers get better prices.

4.1.3 Illustration of E-Commerce Transaction

STEP 1: Go to website (like www.snapdeal.com, www.flipkart.com, www.amazon.in, etc) and create your user ids (identifications). Those who have social media ids, can directly link through those ids.

OR

Go to Google Play Store in your hand-held device and download the special software needed for e-commerce transaction called as APP (Application). Once downloaded, user needs to press OPEN. The APP is installed on the handheld device. For example: OYO (Hotel Booking APP), IRCTC (Train ticket booking APP), Foodpanda (Food ordering APP) and millions of APP like this.

STEP 2: Select the type of product you wish to buy. Each such e-commerce vendor has huge display of product inventory. User needs to make sure that s/he selects the right product type.

STEP 3: From the products listed, user needs to select the correct product s/he needs to buy.

STEP 4: User makes the final choice and goes for making payment online.

STEP 5: At the time of making payment, e-commerce vendor shows all details including the product being bought and the final price of the same for review of the customer and confirmation before final payment.

STEP 6: Once user goes for online payment, the e-commerce vendor displays the payment options. Payment options can be cash on delivery, Payment by Debit/Credit Cards, etc.

STEP 7: Once the user selects the payment option, he is directed to the payment gateway where he enters the OTP or the password and the payment is made vide the Credit Card. Once the payment is made, the confirmation email / SMS are received by the user.

STEP 8: Based on the delivery terms, the product is delivered to the customer in specified time.

The first e-commerce transaction vide mobile is supposed to have been done in Norway in 1997, when a Coco-Cola vending machine were configured to respond to mobile messages received from customers. The vending machine delivered products on receiving text messages.

4.1.4 Benefits of E-Business

E-business benefits individuals, businesses, government and society at large. The major benefits from e-business are as follows:

A.   **Benefits to Customer / Individual / User**

♦   **Convenience:** Every product at the tip of individual's fingertips on internet.

♦   **Time saving:** Number of operations that can be performed both by potential buyers and sellers increase.

♦   **Various Options:** There are several options available for customers which are not only being easy to compare but are provided by different players in the market.

♦ **Easy to find reviews:** There are often reviews about a particular site or product from the previous customers which provides valuable feedback.

♦ **Coupon and Deals:** There are discount coupons and reward points available for customers to encourage online transaction.

♦ **Anytime Access:** Even midnight access to the e commerce platforms is available which brings in customer suitability.

B.   Benefits to Business / Sellers

♦ **Increased Customer Base:** Since the number of people getting online is increasing, which are creating not only new customers but also retaining the old ones.

♦ **Recurring payments made easy:** Each business has number of operations being homogeneous. Brings in uniformity of scaled operations.

♦ **Instant Transaction:** The transactions of e commerce are based on real time processes. This has made possible to crack number of deals.

♦ **Provides a dynamic market:** Since there are several players, providing a dynamic market which enhances quality and business.

♦ **Reduction in costs:**

➢ To buyers from increased competition in procurement as more suppliers are able to compete in an electronically open marketplace.

➢ To suppliers by electronically accessing on-line databases of bid opportunities, on-line abilities to submit bids, and on-line review of rewards.

➢ In overhead costs through uniformity, automation, and large-scale integration of management processes.

➢ Advertising costs.

♦ **Efficiency improvement due to:**

➢ Reduction in time to complete business transactions, particularly from delivery to payment.

➢ Reduction in errors, time, for information processing by eliminating requirements for re-entering data.

> ➢ Reduction in inventories and reduction of risk of obsolete inventories as the demand for goods and services is electronically linked through just-in-time inventory and integrated manufacturing techniques.

♦ **Creation of new markets:** This is done through the ability to easily and cheaply reach potential customers.

♦ **Easier entry into new markets:** This is especially into geographically remote markets, for enterprises regardless of size and location.

♦ **Better quality of goods:** As standardized specifications and competition have increased and improved variety of goods through expanded markets and the ability to produce customized goods.

♦ **Elimination of Time Delays:** Faster time to market as business processes are linked, thus enabling seamless processing and eliminating time delays.

C.   Benefits to Government

♦ Instrument to fight corruption:-In line with Government's vision, e commerce provides a pivotal hand to fight corruption.

♦ Reduction in use of ecologically damaging materials through electronic coordination of activities and the movement of information rather than physical objects).

Clearly, the benefits of corporate-wide implementation of e-business are many, and this list is by no means complete. With the benefits, however, also come the risks. An organization should be cautious not to leap blindly into e-business, but rather first develop an e-business strategy, and then organize a corporate-wide team to implement that strategy.

4.1.5 E-Commerce Business Models

A Business Model can be defined as the organization of product, service and information flows, and the sources of revenues and benefits for suppliers and customers. An e-business model is the adaptation of an organization's business model to the internet economy. A Business Model is adopted by an organization as a framework to describe how it makes money on a sustainable basis and grows. A business model also enables a firm to analyze its environment more effectively and thereby exploit the potential of its markets; better understand its customers; and raise entry barriers for rivals. E-business models utilize the benefits of electronic communications to achieve the value

adding processes. Some of the e-markets are explained below in the Table 4.1.2:

Table 4.1.2: Various e-Markets

S. No.	e-Market	Description
1	e-Shops	*An e-shop is a virtual store front that sells products and services online. Orders are placed and payments made. They are convenient way of effecting direct sales to customers; allow manufacturers to bypass intermediate operators and thereby reduce costs and delivery times. Examples - www.sonicnet.com, www.wforwomen.com*
2	e-Malls	*The e-mall is defined as the retailing model of a shopping mall, a conglomeration of different shops situated in a convenient location in e-commerce.*
3	e-auctions	*Electronic auctions provide a channel of communication through which the bidding process for products and services can take place between competing buyers. Example – www.onsale.com*
4	Portals	*Portals are the channels through which websites are offered as content. The control of content can be a source of revenue for firms through charging firms for advertising or charging consumers a subscription for access.*
5	Buyer Aggregators	*The Buyer Aggregator brings together large numbers of individual buyers so that they can gain the types of savings that are usually the privilege of large volume buyers. In this, the firm collects the information about goods/service providers, make the providers their partners, and sell their services under its own brand. Example -* ***www.zomato.com***
6	Virtual Communities	*Virtual Community is a community of customers who share a common interest and use the internet to communicate with each other. Amazon.com provides websites for the exchange of information on a wide range of subjects relating to their portfolio of products and services. Virtual communities benefit from network externalities whereby the more people who*

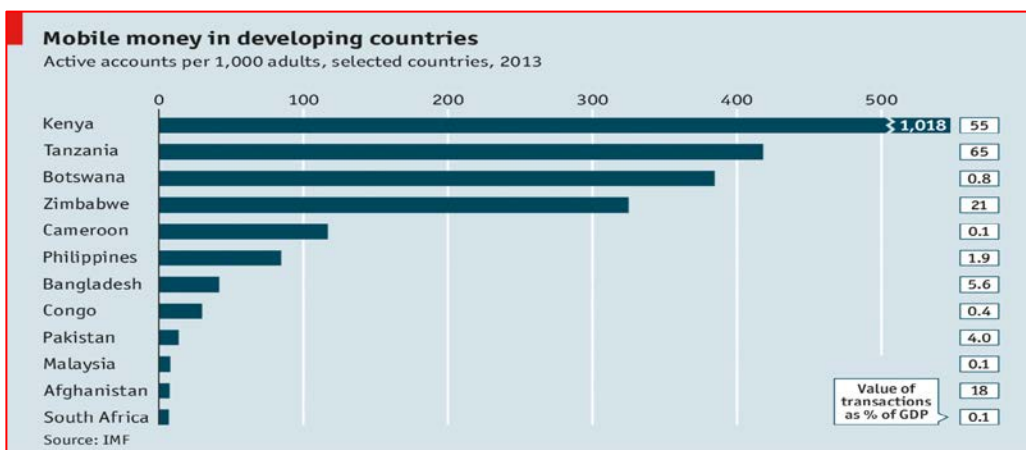|		
		join and contribute to the community, the greater the benefits that accrue, but without any additional cost to participants.
7	*e-marketing*	*e-marketing is the use of electronic communications technology such as the internet, to achieve marketing objectives. Of course, information on websites also empowers customers and helps them achieve their objectives. For example, they can compare prices of products by rival firms. The internet changes the relationship between buyers and sellers because market information is available to all parties in the transaction.*
8	*e-procurement*	*e-procurement is the management of all procurement activities via electronic means. Business models based on e-procurement seek efficiency in accessing information on suppliers, availability, price, quality and delivery times as well as cost savings by collaborating with partners to pool their buying power and secure best value deals. E-procurement infomediaries specialize in providing up-to-date and real-time information on all aspects of the supply of materials to businesses.*
9	*e-distribution*	*The e-distribution model helps distributors to achieve efficiency savings by managing large volumes of customers, automating orders, communicating with partners and facilitating value-adding services such as order tracking through each point in the supply chain. An example of a firm specializing in e-distribution is wipro.com (www.wipro.com) who use the internet to provide fully integrated e-business-enabled solutions that help to unify the information flows across all the major distribution processes including sales and marketing automation, customer service, warehouse logistics, purchasing and inventory management, and finance.*

The e-business models relating to e-business markets can be summarized as given below in the Table 4.1.3.

Table 4.1.3: Some Business Models for E-Commerce

Models	Definition	e-business markets	Examples
Business-to-Consumer (B2C)	Generally, this supports the activities within the customer chain in that it focuses on sell-side activities.	e-shops, e-malls, e-auctions, buyer aggregators, portals etc.	www.cisco.com www.amazon.com
Business-to-Business (B2B)	This supports the supply chain of organizations that involves repeat commerce between a company and its suppliers or other partners.	e-auctions, e-procurement, e-distribution, portals, e-marketing etc.	www.emall.com
Consumer-to-Consumer (C2C)	This supports the community plan surrounding the organization and can be seen as a commercial extension of community activities.	e-auctions, virtual communities etc.	www.eBay.com

4.1.6 E-Commerce Future

From 1997, E-commerce has increased in leaps and bounds. Data by The Economist magazine for 2013 as shown in Fig. 4.1.3 is a pointer that E-commerce vide mobiles is not only limited to developed world. Looking to data, developing/third world countries have adopted is faster.

Mobile money in developing countries
Active accounts per 1,000 adults, selected countries, 2013

Country	Value of transactions as % of GDP
Kenya	1,018 — 55
Tanzania	65
Botswana	0.8
Zimbabwe	21
Cameroon	0.1
Philippines	1.9
Bangladesh	5.6
Congo	0.4
Pakistan	4.0
Malaysia	0.1
Afghanistan	18
South Africa	0.1

Source: IMF

Fig. 4.1.3: E-Commerce widespread in Developing Countries*

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*Source: www.economist.com

4.2 COMPONENTS OF E-COMMERCE

Referring to the Fig, 4.2.1, E-commerce components include the following:

(i) **User:** This may be individual / organization or anybody using the e-commerce platforms. As e-commerce, has made procurement easy and simple, just on a click of button e-commerce vendors needs to ensure that their products are not delivered to wrong users. In fact, e-commerce vendors selling products like medicine / drugs need to ensure that such products are not delivered to wrong person/user.
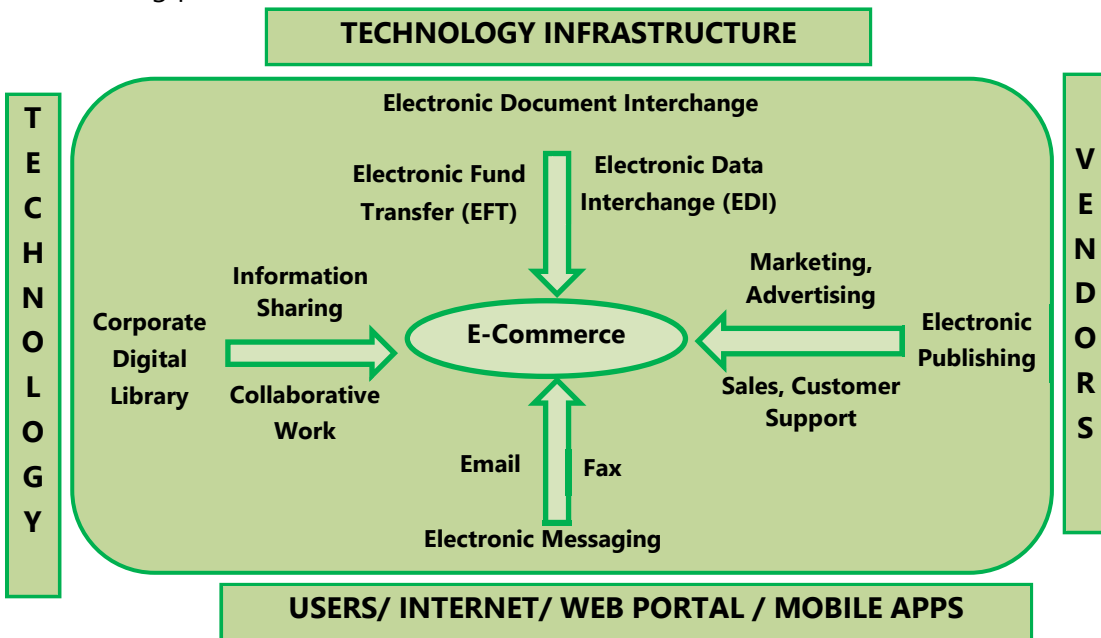
Fig. 4.2.1: Components of E - Commerce

(ii) **E-commerce Vendors:** This is the organization / entity providing the user, goods/ services asked for. For example: www.flipkart.com. E-commerce vendors further needs to ensure following for better, effective and efficient transaction.

- **Suppliers and Supply Chain Management:** These being another important component of the whole operations. For effectiveness, they need to ensure that -

    ♦ They have enough and the right goods suppliers.

    ♦ They (suppliers) are financially and operationally safe.

♦ Suppliers are able to provide real-time stock inventory.

♦ The order to deliver time is very short.

- **Warehouse operations:** When a product is bought, it is delivered from the warehouse of e-commerce vendor. This place is where online retailers pick products from the shelf, pack them as per customer's specification / pre-decided standards and prepare those products to be delivered. These operations have become very critical to the success of the whole e-commerce business. Many e-commerce companies are investing huge amounts of money in automating the whole warehouses.

- **Shipping and returns:** Shipping is supplementary and complementary to whole warehouse operations. Fast returns have become Unique Selling Preposition (USP) for many e-commerce vendors, so these vendors need very effective and efficient return processing.

- **E-Commerce catalogue and product display:** Proper display of all products being sold by vendor including product details, technical specifications, makes for a better sales conversion ratio. These help customers gauge the products/services being sold. A good catalogue makes a lot of difference to whole customer experience.

- **Marketing and loyalty programs:** Loyalty programs establish a long-term relationship with customer. The best examples can be customer loyalty programs being run by airline industry. In airline industry, customer can get good discount/ free tickets based on loyalty points accumulated. The same concept is being used by e-commerce vendors to ensure customer loyalty.

- **Showroom and offline purchase:** Few e-commerce vendors over period have realized that their products can be sold fast if customers are able to feel / touch / see those products. These vendors have opened outlets for customer experience of their products.

- **Different Ordering Methods:** These are the way customer can place his/her order, say Cash on Delivery is today most preferred method.

- **Guarantees:** The product/service guarantee associated with product/ service being sold. Money back guarantees help generate a security in customer's mind that in case of any problems, their money shall be safely returned back.

- **Privacy Policy:** Represents policy adopted by the e-commerce vendor vis-à-vis customer data/information. E-commerce website must have a privacy policy. Customers are very concerned about the information that they are

sharing. E-commerce vendors need to clearly explain them what the vendor plan to do with the various information that is collected from its customers.

- **Security:** Represents the security policy adopted by the e-commerce vendors. Vendor website needs to state that online data used to transact is safe that vendors is using appropriate security including security systems like SSL (Secure Socket Layer). This guarantees that the data provided by customer will not fall into the hand of a malicious hacker while transferring from his / her computer to the web server.

Privacy Policy and Security are also gaining importance under the Information Technology Act, 2000 (as amended 2008). The act specifically states that security of such data (the one collected by e-commerce vendor from customer) shall be responsibility of e-commerce vendor.

(iii) **Technology Infrastructure:** The computers, servers, database, mobile apps, digital libraries, data interchange enabling the e-commerce transactions.

(a)   Computers, Servers and Database

- These are the backbone for the success of the venture. Big e-commerce organization invest huge amount of money/time in creating these systems. They store the data / program used to run the whole operation of the organization.

- As cloud computing is increasingly being used, many small / mid-sized e-commerce originations have started using shared infrastructures.

(b)   Mobile Apps

Just as with the personal computer, mobile devices such as tablet computers and smart phones also have operating systems and application software. In fact, these mobile devices are in many ways just smaller versions of personal computers. A mobile app is a software application programmed to run specifically on a mobile device.

Smartphone's and tablets have become a dominant form of computing, with many more smartphones being sold than personal computers. This means that organizations will have to get smart about developing software on mobile devices in order to stay relevant. These days, most mobile devices run on one of two operating systems: Android or iOS. Android is an open-source operating system supported by Google whereas iOS is Apple's mobile operating system. There are other mobile Operating systems like BlackBerry OS, Windows Mobile, Tizen and FireFox OS.

As organizations consider making their digital presence compatible with mobile devices, they must decide whether to build a mobile app. A mobile app is an expensive proposition, and it will only run on one type of mobile device at a time. For example, if an organization creates an iPhone app, those with Android phones cannot run the application. Each app takes several thousand dollars to create, so this is not a trivial decision for many companies. One option many companies have is to create a website that is mobile-friendly. A mobile website works on all mobile devices and costs about the same as creating an app.

It includes the following:

- Mobile store front modules are an integral part of m-commerce apps, where all commodities and services are categorized and compiled in catalogs for customers to easily browse through the items on sale and get essential information about the products.

- Mobile ticketing module is an m-commerce app component that is closely linked to promotional side of commercial business and enables vendors to attract customers by distributing vouchers, coupons and tickets.

- Mobile advertising and marketing module empowers merchants to leverage m-commerce channels in order to manage its direct marketing campaigns, which are reported to be very effective especially when targeted at younger representatives of digital information consumers.

- Mobile customer support and information module is a point of reference for information about a particular retailer, its offerings and deals. The news about the company, current discounts, shop locations and other information is either pushed to users' m-commerce apps or can be found in m-commerce app itself.

- Mobile banking is inextricably linked to selling process via m-commerce apps, because no purchase can be finalized without a payment. There are various options for executing mobile payments, among which are direct mobile billing, payments via SMS, credit card payments through a familiar mobile web interface, and payments at physical POS terminals with NFC technology.

(c) **Digital Library:** A Digital Library is a special library with a focused collection of digital objects that can include text, visual material, audio material, video material, stored as electronic media formats (as opposed to print, microform, or other media), along with means for organizing, storing, and retrieving the files and media contained in the library collection. Digital libraries can vary immensely in size and scope, and can be maintained by individuals, organizations, or affiliated with established physical library buildings or institutions, or with academic institutions. The digital content may be stored locally, or accessed remotely via computer networks. An electronic library is a type of information retrieval system.

(d) **Data Interchange:** Data Interchange is an electronic communication of data. For ensuring the correctness of data interchange between multiple players in e-commerce, business specific protocols are being used. There are defined standards to ensure seamless / exact communication in e-commerce.

(iv) **Internet/Network:** This is the key to success of e-commerce transactions.

- This is the critical enabler for e-commerce. Internet connectivity is important for any e-commerce transactions to go through. Net connectivity in present days can be through traditional as well as new technology.

- The faster net connectivity leads to better e-commerce. Many mobile companies in India have launched 4G services.

- The success of e-commerce trade depends upon the internet capability of organization. At a global level, it is linked to the countries capability to create a high-speed network. The latest communication technologies like 4G, 5G have already made in-roads in India.

(v) **Web portal:** This shall provide the interface through which an individual/organization shall perform e-commerce transactions.

- Web Portal is the application through which user interacts with the e-commerce vendor. The front end through which user interacts for an e-commerce transaction. These web portals can be accessed through desktops/laptops/PDA/hand-held computing devices/mobiles and now through smart TVs also.

- The simplicity and clarity of content on web portal is directly linked to customer experience of buying a product online. E-commerce vendors put a lot of money and effort in this aspect.

(vi) Payment Gateway: The payment mode through which customers shall make payments. Payment gateway represents the way e-commerce / m-commerce vendors collects their payments. The payment gateway is another critical component of e-commerce set up. These are the last and most critical part of e-commerce transactions. These assures seller of receipt of payment from buyer of goods/services from e-commerce vendors. Presently numerous methods of payments by buyers to sellers are being used, including Credit / Debit Card Payments, Online bank payments, Vendors own payment wallet, Third Party Payment wallets, like SBI BUDDY or PAYTM, Cash on Delivery (COD) and Unified Payments Interface (UPI).

4.3 ARCHITECTURE OF NETWORKED SYSTEMS

Architecture is a term to define the style of design and method of construction, used generally for buildings and other physical structures. In e-commerce, it denotes the way network architectures are build.

E-commerce runs through network-connected systems. Networked systems can have two types of architecture namely;

(i) Two tier, and

(ii) Three tier.

4.3.1 Two Tier Client Server

In a **Two-tier network**, client (user) sends request to Server and the Server responds to the request by fetching the data from it. The Two-tier architecture is divided into two tiers- **Presentation Tier** and **Database Tier** as shown in the Fig. 4.3.1.

(i) Presentation Tier (Client Application/Client Tier): This is the interface that allows user to interact with the e-commerce / m-commerce vendor. User can login to an e-commerce vendor through this tier. This application also connects to database tier and displays the various products / prices to customers.

(ii) Database Tier (Data Tier): The product data / price data / customer data and other related data are kept here. User has not access to data / information

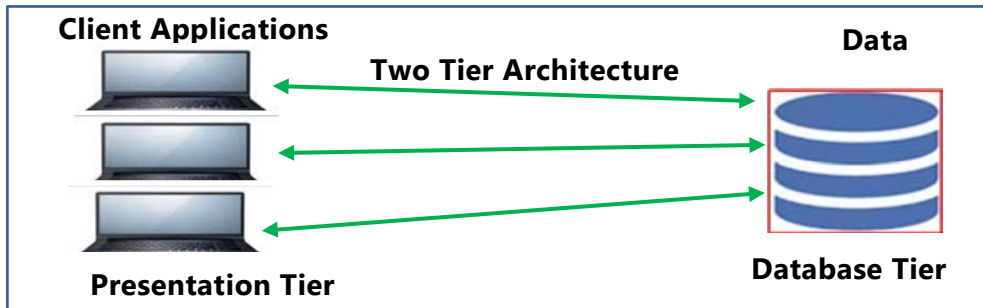at this level but he/she can display all data / information stored here through application tier.

Client Applications

Two Tier Architecture

Data

Presentation Tier

Database Tier

Fig. 4.3.1: Two Tier Client Server Architecture

The **Advantages of Two-Tier Systems** are as follows:

- The system performance is higher because business logic and database are physically close.

- Since processing is shared between the client and server, more users could interact with system.

- By having simple structure, it is easy to setup and maintain entire system smoothly.

The **Disadvantages of Two-Tier Systems** are as follows:

- Performance deteriorates if number of users' increases.

- There is restricted flexibility and choice of DBMS, since data language used in server is proprietary to each vendor.

4.3.2 Three Tier Client Server

Three - Tier architecture is a software design pattern and well-established software architecture. Its three tiers are the **Presentation Tier**, **Application Tier** and **Data Tier**. Three-tier architecture is a client-server architecture in which the functional process logic, data access, computer data storage and user interface are developed and maintained as independent modules on separate platforms. The three-tier architecture is shown in Fig. 4.3.2 and explained below:

(i) **Presentation Tier:** Occupies the top level and displays information related to services available on a website. This tier communicates with other tiers by sending results to the browser and other tiers in the network.

(ii) **Application Tier:** Also, called the **Middle Tier**, **Logic Tier**, **Business Logic** or **Logic Tier**; this tier is pulled from the Presentation tier. It controls application

functionality by performing detailed processing. In computer software, business logic or domain logic is the part of the program that encodes the real-world business rules that determine how data can be created, displayed, stored and changed.
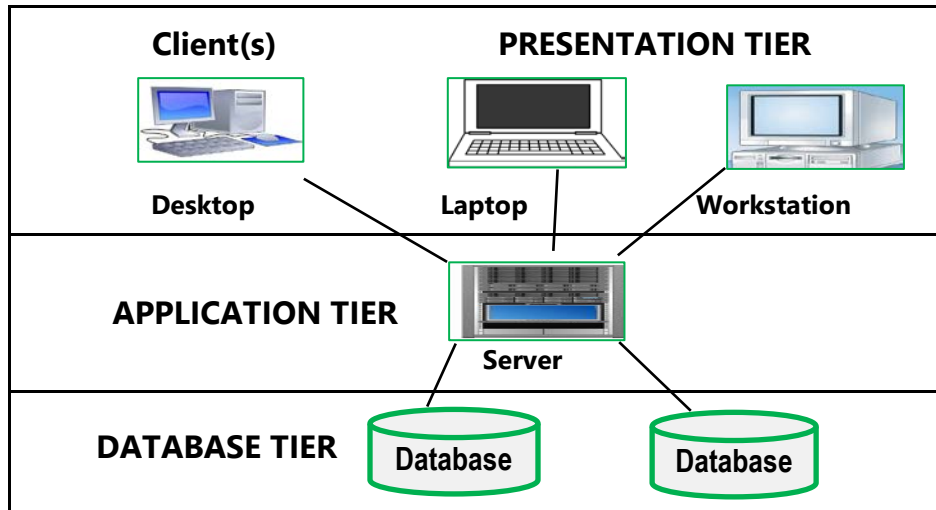

Fig. 4.3.2: Three-Tier Client Server Architecture

(iii) Database Tier: This tier houses the database servers where information is stored and retrieved. Data in this tier is kept independent of application servers or business logic. The Data Tier includes the data persistence mechanisms (database servers, file shares, etc.) and the data access layer that encapsulates the persistence mechanisms and exposes the data. The data access layer should provide an Application Programming Interface (API) to the application tier that exposes methods of managing the stored data without exposing or creating dependencies on the data storage mechanisms. Avoiding dependencies on the storage mechanisms allows for updates or changes without the application tier clients being affected by or even aware of the change. To conclude, in Three Tier Architecture three layers like Client, Server and Database are involved. In this, the Client sends a request to Server, where the Server sends the request to Database for data, based on that request the Database sends back the data to Server and from Server the data is forwarded to Client.

The following are the **Advantages of Three-Tier Systems**:

♦ **Clear separation of user-interface-control and data presentation from application-logic:** Through this separation more clients can have access to a wide variety of server applications. The two main advantages for client-

applications are quicker development through the reuse of pre-built business-logic components and a shorter test phase.

♦ **Dynamic load balancing:** If bottlenecks in terms of performance occur, the server process can be moved to other servers at runtime.

♦ **Change management:** It is easy and faster to exchange a component on the server than to furnish numerous PCs with new program versions.

The **Disadvantages of Three-Tier Systems** are as follows:

♦ It creates an increased need for network traffic management, server load balancing, and fault tolerance.

♦ Current tools are relatively immature and are more complex.

♦ Maintenance tools are currently inadequate for maintaining server libraries. This is a potential obstacle for simplifying maintenance and promoting code reuse throughout the organization.

4.3.3 Which Architecture is used?

In two tier architectures, application performance will be degraded upon increasing the users and it is cost in-effective whereas a three-tier architecture provides High performance, lightweight persistent objects, flexibility, maintainability, reusability and scalability, performance, high degree of flexibility in deployment, better Re-use, improved data integrity, improved security wherein client does not have direct access to database, easy to maintain and application performance is good. Apart from the usual advantages of modular software with well-defined interfaces, the three-tier architecture is intended to allow any of the three tiers to be upgraded or replaced independently in response to changes in requirements or technology.

All e-commerce applications follow the three-tier network architecture.

4.3.4 E-Commerce Architecture Vide Internet

Fig. 4.3.3 depicts the E-commerce architecture vide Internet and Table 4.3.1 elaborates the functioning of each layer.

Table 4.3.1: Description of each Layer as per Fig. 4.3.3

S. No.	Layer	Includes	Purpose
1	Client/ User Interface	Web Server, Web Browser and Internet. For example: In example (Fig. 4.3.3) where user buys a mobile phone	This layer helps the e-commerce customer connect to e-commerce merchant.

		from an e-commerce merchant it includes - User, Web Browser (Internet Explorer/Chrome) & Web Server	
2	Application Layer	Application Server and Back End Server. For example - In the same example, it includes: - E-merchant - Reseller - Logistics partner	Through these application's customer logs to merchant systems. This layer allows customer to check the products available on merchant's website.
3	Database Layer	The information store house, where all data relating to products and price is kept.	This layer is accessible to user through application layer.
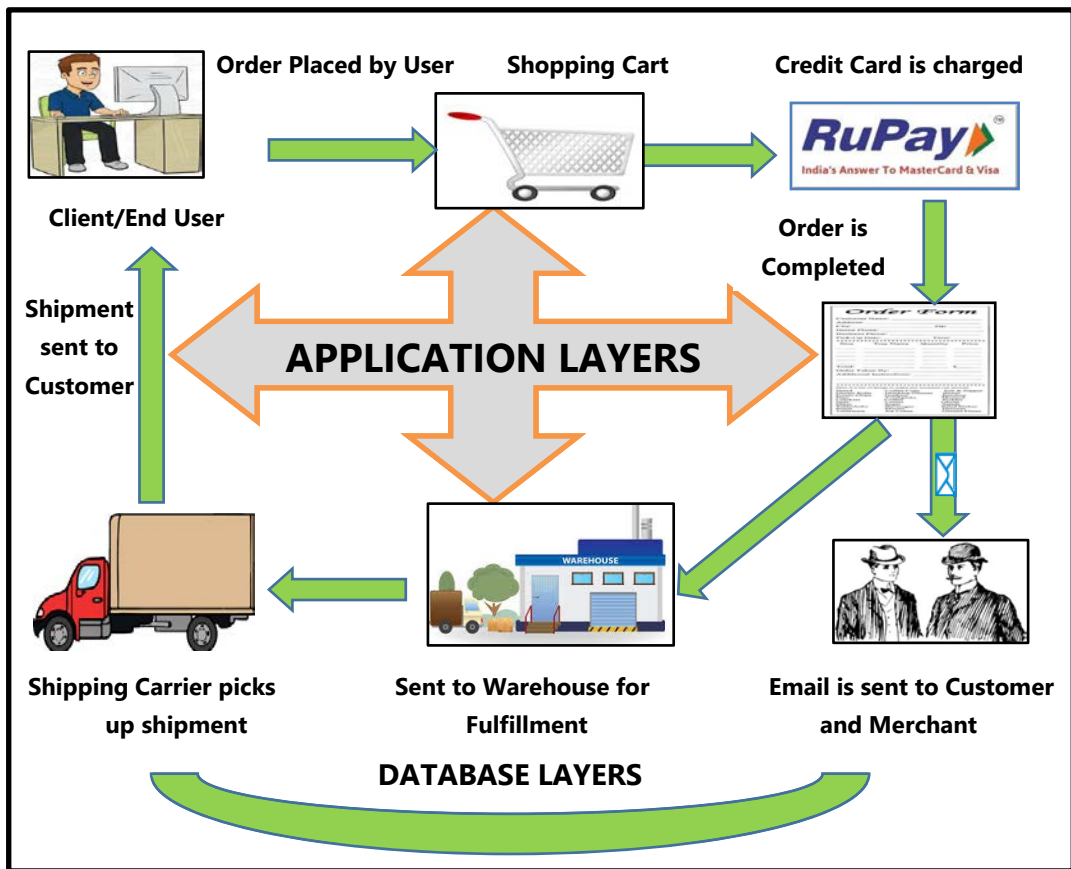
Fig. 4.3.3: E-commerce Vide Internet

4.3.5 E-Commerce Architecture Vide Mobile Apps

M-Commerce (Mobile Commerce): M-commerce (mobile commerce) is the buying and selling of goods and services through wireless handheld devices such as cellular telephone and Personal Digital Assistants (PDAs). M-commerce enables users to access the Internet without needing to find a place to plug in. Refer Fig. 4.3.4 for E-Commerce vide Mobile Apps.
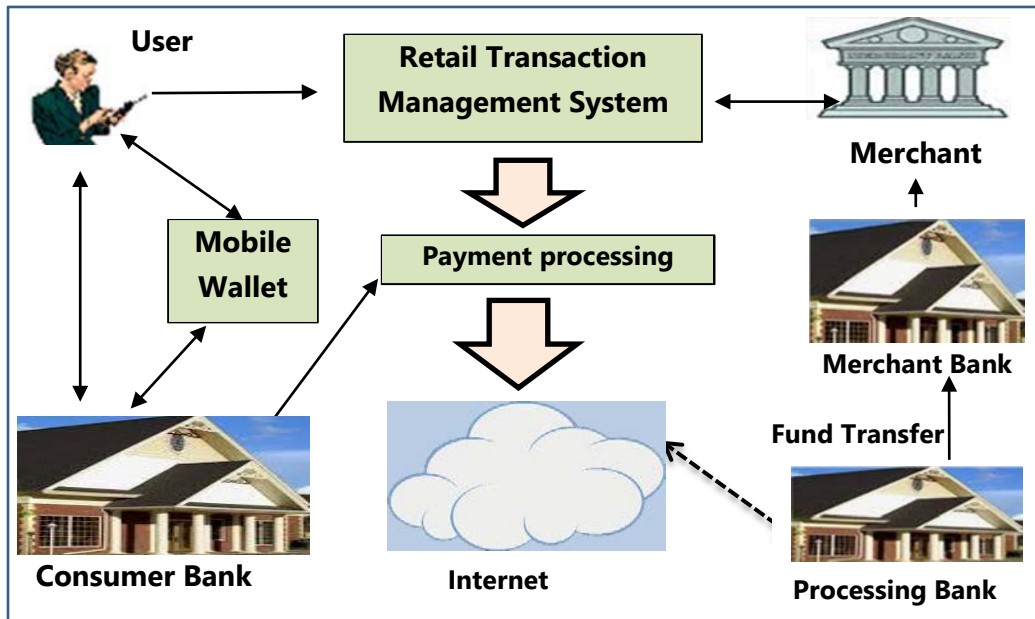

Fig. 4.3.4: E- commerce Vide Mobile Apps

The key growth in the mobile e-Commerce sector in recent years has been in through so-called Apps. Apps, short for Mobile Applications, are small piece of software developed specifically for the operating systems of handheld devices such as mobile phones, PDAs and Tablet computers. Mobile Apps can come preloaded on handheld devices or can be downloaded by users from the app stores over the Internet.

Table 4.3.2: Description of Fig. 4.3.4

S. No.	Layer	Includes	Purpose
1	Client / User Interface	Mobile Web Browser and Internet. For example: In example discussed above where user	This layer helps the e-commerce customer connect to e-commerce merchant.

		buys a mobile phone from e-commerce merchant; it includes: - Mobile App (Application) - User	
2	Application Layer	Application Server and back end server. For example: In the same example, it includes - E-merchant - Reseller - Logistics partner - Payment Gateway	Through these application's customer logs to merchant systems. This layer allows customer to check the products available on merchant's website.
3	Database Layer	The information store house, where all data relating to products, price it kept.	This layer is accessible to user through application layer.

4.4 WORK FLOW DIAGRAM FOR E-COMMERCE
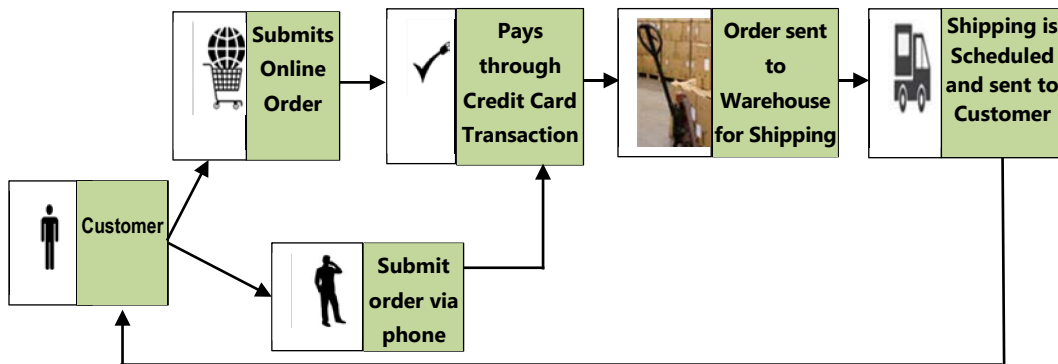
Fig. 4.4.1: E-Commerce Workflow Diagram*

Refer Fig. 4.4.1 for E-Commerce Work Flow and Table 4.4.1 for its description.

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* source: www.juanribon.com

Table 4.4.1: Description of E-Commerce Work Flow Diagram

S. No.	Step	Activities
1	Customers login	Few e-commerce merchants may allow same transactions to be done through phone, but the basic information flow is e-mode.
2	Product / Service Selection	Customer selects products / services from available options.
3	Customer Places Order	Order is placed for selected product / service by customer. This step leads to next important activity PAYMENT GATEWAY.
4	Payment Gateway	Here customer makes a selection of the payment method. In case payment methods is other than cash on delivery(COD), the merchant gets the update from payment gateway about payment realisation from customer. In case of COD, e-commerce vendor may do an additional check to validate customer.
5	Dispatch and Shipping Process	This process may be executed at two different ends. First if product / service inventory is managed by e-commerce vendor, then dispatch shall be initiated at merchant warehouse. Second, many e-commerce merchants allow third party vendors to sale through merchant websites. For example: FLIPKART states that it has more than 1 lac registered third party vendors on its website.
6	Delivery Tracking	Another key element denoting success of e-commerce business is timely delivery. Merchants keep a track of this. All merchants have provided their delivery staff with hand held devices, where the product / service delivery to customers are immediately updated.
7	COD tracking	In case products are sold on COD payment mode, merchants need to have additional check on matching delivery with payments.

Numerous services are of the nature which does not have a separate delivery need, for example booking a train ticket through irctc.co.in. In this case, there is no separate delivery of service, tickets booking updates are generated as soon as payments are received by irctc.co.in payment gateways.

4.5 RISKS AND CONTROLS RELATED TO E-COMMERCE

4.5.1 Risks in an e-Business Environment

Risk is possibility of loss. The same may be result of intentional or un-intentional action by individuals. Risks associated with e-commerce transactions are high compared to general internet activities. These include the following:

(i) **Privacy and Security:** There are often issues of security and privacy due to lack of personalized digital access and knowledge.

(ii) **Quality issues:** There are quality issues raised by customers as the original product differs from the one that was ordered.

(iii) **Delay in goods and Hidden Costs:** When goods are ordered from another country, there are hidden costs enforced by Companies.

(iv) **Needs Access to internet and lack of personal touch:** The e-commerce requires an internet connection which is extra expensive and lacks personal touch.

(v) **Security and credit card issues:** There is cloning possible of credit cards and debit cards which poses a security threat.

(vi) **Infrastructure:** There is a greater need of not only digital infrastructure but also network expansion of roads and railways which remains a substantial challenge in developing countries.

(vii) **Problem of anonymity:** There is need to identify and authenticate users in the virtual global market where anyone can sell to or buy from anyone, anything from anywhere.

(viii) **Repudiation of contract:** There is possibility that the electronic transaction in the form of contract, sale order or purchase by the trading partner or customer maybe denied.

(ix) **Lack of authenticity of transactions:** The electronic documents that are produced during an e-Commerce transaction may not be authentic and reliable.

(x) **Data Loss or theft or duplication:** The data transmitted over the Internet may be lost, duplicated, tampered with or replayed.

(xi) **Attack from hackers:** Web servers used for e-Commerce maybe vulnerable to hackers.

(xii) **Denial of Service:** Service to customers may be denied due to non-availability of system as it may be affected by viruses, e-mail bombs and floods.

(xiii) **Non-recognition of electronic transactions:** e-Commerce transactions, as electronic records and digital signatures may not be recognized as evidence in courts of law.

(xiv) **Lack of audit trails:** Audit trails in e-Commerce system may be lacking and the logs may be incomplete, too voluminous or easily tampered with.

(xv) **Problem of piracy:** Intellectual property may not be adequately protected when such property is transacted through e-Commerce.

4.5.2 Control in an e-Business Environment

Internal Control, as defined in accounting and auditing, is a process for assuring achievement of an organization's objectives in operational effectiveness and efficiency, reliable financial reporting, and compliance with laws, regulations and policies. For example:

- Company may have a policy to force employees to change their passwords every 30 days.

- A CA firm may not allow office staff access to social sites during office hours.

In an e-business environment, controls are necessary for all persons in the chain, including-

A. **Users:** This is important to ensure that the genuine user is using the e-commerce/ m-commerce platform. There is risk if user accounts are hacked and hackers buy products / services.

B. **Sellers / Buyers / Merchants:** These people need to proper framework in place to ensure success of business. Many e-commerce businesses have lost huge amount of money as they did not have proper controls put in place. These include controls on:

   a. Product catalogues

   b. Price catalogues

   c. Discounts and promotional schemes

   d. Product returns

e. Accounting for cash received through Cash on Delivery mode of sales.

C. Government: Governments across the world and in India have few critical concerns vis-à-vis electronic transactions, namely:

a. Tax accounting of all products / services sold.

b. All products / services sold are legal. There have been instances where narcotics drugs have found to be sold and bought through electronic means.

D. Network Service Providers: They need to ensure availability and security of network. Any downtime of network can be disastrous for business.

E. Technology Service Providers: These include all other service provider other than network service provider, for example, cloud computing back-ends, applications back-ends and like. They are also prone to risk of availability and security.

F. Logistics Service Providers: Success or failure of any e-commerce / m-commerce venture finally lies here. Logistics service providers are the ones who are finally responsible for timely product deliveries.

G. Payment Gateways: E-commerce vendors' business shall run only when their payment gateways are efficient, effective and foolproof.

Each participant needs to put in place controls in an e-commerce environment. Any lack of exercising controls by anyone can bring the risk to whole chain. All participants as discussed above need to trained and educated for proper controls. Each participant needs to put in place policies, practices and procedures in place to protect from e-commerce / m-commerce related risks. These will include the following:

1. Educating the participant about the nature of risks.

Every participant needs to be educated / sensitized towards risk associated with such transactions. Organizations need to put in place infrastructure / policy guidelines for the same. These policies may include the following:

- Frequency and nature of education programs.

- The participants for such program.

For example: All bank in India, allowing on line payments put ads on their websites "Dos and Don'ts for online payments." The more informed your organization is, the easier it will be to combat online threats and to carry out risk mitigating measures.

2. **Communication of organizational policies to its customers.**

   To avoid customer dissatisfaction and disputes, it is necessary to make the following information clear throughout your website:

   - **Privacy Policies:** These should be available through links on any website.

   - **Information security:** Create a page that educates customers about any security practices and controls.

   - **Shipping and billing policies:** These should be clear, comprehensive and available through a link on the home page during online purchase.

   - **Refund policies:** Establish and display a clear, concise statement of a customer's refund and credit policy.

3. **Ensure Compliance with Industry Body Standards.**

   All e-Commerce organizations are required to be complying with and adhere to the rules outlined by the law of land. In India Reserve Bank of India, has been releasing these standards from time to time.

4. **Protect your e-Commerce business from intrusion.**

   a. **Viruses:** Check your website daily for viruses, the presence of which can result in the loss of valuable data.

   b. **Hackers:** Use software packages to carry out regular assessments of how vulnerable your website is to hackers.

   c. **Passwords:** Ensure employees change these regularly and that passwords set by former employees of your organization are defunct.

   d. **Regular software updates:** Your site should always be up to date with the newest versions of security software. If you fail to do this, you leave your website vulnerable to attack.

   e. **Sensitive data:** Consider encrypting financial information and other confidential data (using encryption software). Hackers or third parties will not be able to access encrypted data without a key. This is particularly relevant for any e-Commerce sites that use a shopping cart system.

   f. Know the details of your payment service provider contract.

4.5.3 Case Studies

Case 1: Return of Mobile

A person in Hyderabad was caught for returning mobiles with defective parts.

Modus operandi:

- He used to buy new mobile online from India's largest m-commerce vendor.

- Return them with complaint that mobile purchased is defective.

- He used to replace the new mobiles internal components with defective components.

- He kept on doing this for two years before being caught.

What control lapse lead to above fraud?

- Entities poor policy documentation regarding accepting mobile returns as defective.

- Within the organization there must have been a person putting a red mark when the same person was returning mobiles as defective. This reflects poor audit mechanism.

Case 2: Purchase fake/inferior products online.

Certain websites allow anybody to sell products on, which creates a market for fake and bootleg products. It is important to check the history of the seller and read all the details to ensure the product is the brand name product you originally intended to buy. A good rule of thumb is that if it's too good to be true, it usually is. Designer headphones, purses and watches will always cost around retail price online.

4.5.4 Cyber Security Risk Considerations

The business and technological environment in which the entities operate are rapidly changing on account of the E-Commerce platforms on which most of them now operate. Therefore, it is imperative for the consideration of Cyber Security Risks in the audit procedures.

Risk Assessment is always a very important part and parcel of the audit procedures. One of the most important aspects to be kept in mind during the risk assessment process is giving due consideration to the changing risks in the entity and its environment due to the ever-evolving technology landscape which can have a potential impact on the financial statements. There could be cyber security risks with **Direct** as well as **Indirect** impact.

♦ A **Direct Financial Impact** could be if the Application at the Company's Retailers which contains financial information has weak passwords at all Open Systems Interconnection (OSI) layers resulting in harming the integrity of data.

♦ An **Indirect Operational Impact** could be if the sensitive customer information in the form of Bank Account Numbers Recipes of Patented products, etc. could be breached which would result in legal and regulatory actions on the Company on account of breach of confidential information.

(Standard on Auditing) SA 315 recognizes that IT poses specific risks to an entity's Internal Control in the form of the following:

♦ Reliance on systems or programs that are inaccurately processing data, processing inaccurate data, or both.

♦ Unauthorized access to data that may result in destruction of data or improper changes to data, including the recording of unauthorized or non-existent transactions, or inaccurate recording of transactions. Particular risks may arise where multiple users access a common database.

♦ The possibility of IT personnel gaining access privileges beyond those necessary to perform their assigned duties thereby breaking down segregation of duties.

♦ Unauthorized changes to data in master files.

♦ Unauthorized changes to systems or programs.

♦ Failure to make necessary changes to systems or programs.

♦ Inappropriate manual intervention.

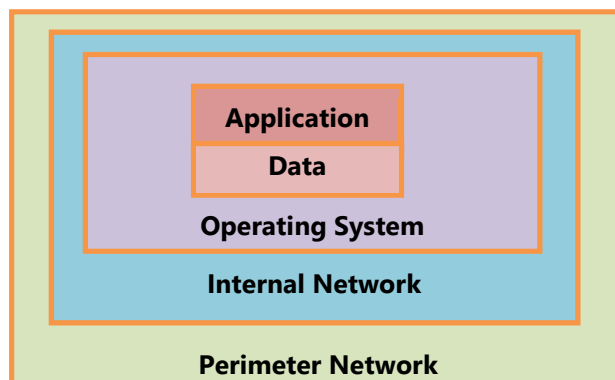♦ Potential loss of data or inability to access data as required.

Fig. 4.5.1: Levels through which Cyber breach can occur

Referring to the Fig. 4.5.1, it is interesting to note that cyber breach incidents usually occur through the Perimeter and Internal Network and then go on to the Application and Database which store the financial information. Illustrations of the considerations as controls addressing key cyber security risks are as under:

(i)   A Network Diagram detailing server, databases, hubs, routers, internal and external network, etc.

(ii)   List of the Digital Assets used by the Company and the IT Managers responsible for the protection for those digital assets along with the physical location of those assets.

(iii) Policy and Procedure document of the criticality of the Digital Assets, the use of those digital assets, any direct impact on the financial statements of the company, access restrictions to those assets.

(iv)   Any incidents of cyber security breach which occurred and the actions taken and controls built in to avoid them from occurring again.

(v)   Annual review by the CIO, based on the Company's digital assets and the IT Environment in which it operates assessing which are the most critical cyber security risks and designing controls to address the same.

(vi)   Are the IT managers responsible for the safeguarding of the assets from cyber-attacks, adequately skilled and trained to perform the functions.

(vii) The Entity should have a IT Security Policy circulated to all Employees detailing the procedures to be adhered to when accessing IT systems/ resources like password security, restricted use of internet, etc.

(viii) Periodical review of access rights to all IT resources to ensure that the access to the users is commensurate with their functional roles and responsibilities.

(ix)   Adequate approvals exist before the access is granted to any IT resources.

(x)   Timely employee awareness campaigns focusing on methods of intrusion which can be stopped based on individual actions.

(xi)   Use of firewalls by the Company to allow internet activity in accordance with the rules defined.

(xii) Any baseline security configurations established by the Company under any security standards which are periodically reviewed.

(xiii) All remote access logins are configured for two factor' authentications like - using of username, password, pin, token, etc.

(xiv) Any vulnerability scans or penetration testing performed by the Company and any findings noted.

(xv) Are the backups scheduled properly and timely checked by restoration of data?

The above procedures are even to be considered for the assets not owned by the Company but where the Company is utilizing services from another service provider like the Server maintenance and security is outsourced to an outsourced service provider.

4.6 GUIDELINES AND LAWS GOVERNING E-COMMERCE

4.6.1 Guidelines for E-Commerce

All entity going for e-commerce / m-commerce business needs to create clear policy guidelines for the following:

1. **Billing:** The issues are -

    a. Format of bill

    b. The details to be shared in bills.

    c. Applicable GST.

2. **Product guarantee / warranty:** Proper display of product guarantee / warranty online as well as documents sent along with the products.

3. **Shipping:** The shipping time, frequency of shipping, the packing at time of shipping, all these needs to be put in policy documents. This will ensure products are properly packed and timely shipped.

4. **Delivery:** Policy needs to be defined for:

    a. Which mode of delivery to be chosen? Say through courier / third party had delivery / own staff hand delivery

    b. When deliveries to be made? Say time of day.

    c. Where deliveries to be made? Say buyer's office / home or through dedicated delivery shops. Many e-commerce companies in India have started creating delivery shops in metro cities. These delivery centers are in big residential townships. The buyer shall take delivery of products from these centers.

5.   **Return:** Policy for return of goods need to be put in place defining:

   a.   Which goods to be accepted in return? Food products would generally not be accepted.

   b.   The number of days within which returns can be accepted.

   c.   The process of verifying the authenticity of products received back.

   d.   The time within which buyer shall be paid his/her amount back for goods returned.

6.   **Payment:** Policy guidelines need to be created for the following payment related issues:

   a.   Mode of payment.

   b.   For which products, specific payment mode shall be there. Organization restricts cash on delivery for few consumable products.

4.6.2 Commercial Laws Governing E-Commerce

All e-commerce transactions are commercial business transactions. All these transactions are covered under multiple laws, including commercial laws. Following commercial laws are applicable to e-commerce and m-commerce transactions.

♦   **Income Tax Act, 1961:** Income Tax Act, has detailed provisions regarding taxation of income in India. In respect of e-commerce / m-commerce transactions, the issue of deciding place of origin transaction for tax purpose is critical.

♦   **Companies Act, 2013:** Companies Act, 2013, regulates the corporate sector. The law defines all regulatory aspects for companies in India. Most of the merchants in e-commerce / m-commerce business are companies, both private and public.

♦   **Foreign Trade (Development and Regulation) Act, 1992:** An Act to provide for the development and regulation of foreign trade by facilitating imports into, augmenting exports from, India and for matters connected therewith or incidental thereto. Amazon has recently allowed Indian citizens to purchase from its global stores. All these shall be regulated through above law.

♦   **The Factories Act, 1948:** Act to regulate working conditions of workers. The act extends to place of storage as well as transportation. Most of the merchants in e-commerce / m-commerce business need to comply with provisions of the act.

♦ **The Custom Act, 1962:** The act that defines import / export of goods / services from India and provides for levy of appropriate customs duty. India being a signatory to General Agreement on Trade and Tariff (GATT) under World Trade Organization, cannot levy any custom duty that GATT non-compliant. This one law is subject to debate across the world. For example: An Indian company downloads software being sold by a foreign company whether the same shall be chargeable to duty of import.

♦ **The Goods and Services Tax (GST) Law:** This Law requires each applicable business, including e-commerce/ m-commerce, to upload each sales and purchase invoice on one central IT infrastructure, mandating reconciliations of transactions between business, triggering of tax credits on payments of GST, facilitating filling of e-returns, etc.

♦ **Indian Contract Act,1872:** The Act defines constituents of a valid contract. In case of e-commerce / m-commerce business, it becomes important to define these constituents.

♦ **The Competition Act, 2002:** Law to regulate practices that may have adverse effect on competition in India. Competition Commission have been vigilant to ensure that e-commerce / m-commerce merchants do not engage in predatory practices.

♦ **Foreign Exchange Management Act (FEMA 1999):** The law to regulate foreign direct investments, flow of foreign exchange in India. The law has important implications for e-commerce / m-commerce business. With a view to promote foreign investment, as per regulations framed under Foreign Exchange Management Act, (FEMA) 1999, FDI up to 100% under the automatic route is permitted in companies engaged in e-commerce provided that such companies would engage in Business to Business (B2B) e-commerce. Foreign investment in Business to Customer (B2C) e-commerce activities has been opened in a calibrated manner and an entity is permitted to undertake retail trading through e-commerce under the following circumstances:

  (i) A manufacturer is permitted to sell its products manufactured in India through e-commerce retail.

  (ii) A single brand retail trading entity operating through brick and mortar stores, is permitted to undertake retail trading through e-commerce.

  (iii) An Indian manufacturer is permitted to sell its own single brand products through e-commerce retail. Indian manufacturer would be the

investee company, which is the owner of the Indian brand and which manufactures in India, in terms of value, at least 70% of its products in house, and sources, at most 30% from Indian manufacturers.

♦ **Consumer Protection Act, 1986:** The law to protect consumer rights has been source of most of litigations for transaction done through e-commerce and m-commerce.

All laws above have same nature of applicability as in a normal commercial transaction. The fact that transactions are done electronically gives rise to issues which are unique in nature. Few of issues have been put to rest by court decisions but new issues crop up every day. An illustrative list of such issues is discussed in the Table 4.6.1.

Table 4.6.1: Illustrative List of Issues during an Online Transaction

S. No.	Event	Legal questions out of event
1	Product ordered by **'A'** delivered to **'B'**. (For example: a DEO). **'A'** had made payment online.	1. What if **'B'** accepts the products and starts using? 2. **'A'** had ordered the product to gift to spouse on his/her birthday. What of the mental agony caused? 3. The product is a medicine necessary of treatment of **'A's** dependent parents. In case of any complication to **'A's** parent due to delayed delivery who bears the additional medical costs? Above is only an illustrative list. Imagine numerous possible combinations based on fact of in-correct delivery.
2	Service ordered by **'A'** not provided by online vendor. For example: **'A'** courier company does not collect an important document.	1. Who bears the loss that may be incurred by **'A'**?
3	**'A'** auction website sales in-advertently sales products which cannot be sold at all, or sale of those	1. What is the legal liability if seller of products? 2. What is legal liability of buyers of such products?

	products is illegal. For example: Guns/ Narcotics Drugs.	3. What is the legal liability of auction web-site?
4	**'A'** downloads a software from a server in USA. **'A'** is in state of MP and then he sells the software to a person in Mumbai or Sells the same to another person in Singapore.	1. Whether such a download is import? 2. If **'A'** re-exports can s/he claim benefits under customs?

4.6.3 Special Laws governing E-Commerce

E-commerce are covered under few other laws as these transactions are done electronically.

- Information Technology Act, 2000 (As amended 2008)

- Reserve Bank of India, 1932.

I.   Information Technology Act, 2000

This law governs all internet activities in India. The law is applicable to all online transactions in India, and provides for penalties, prosecution for non-compliances. The important issues dealt in by the law includes:

- Legality of products / services being offered online.

- Data Protection

- Protecting Your Customer's Privacy Online

- Online Advertising Compliance

- Compliance with Information Technology Act, provisions.

II.   Reserve Bank of India, 1932

Reserve Bank of India (RBI), from time to time frames guidelines to be followed by e-commerce / m-commerce merchants allowing online payments through various modes. The merchant needs to comply with these guidelines. For example:

- The conversion of all Credit / Debit cards to be made CHIP based.

- An OTP / PIN for all transactions done on point of sale machines through debit / credit cards.

- The compliance with capital adequacy norms for payments wallet like SBI BUDDY/ PAYTM etc.

Case 1: Delivering soap instead of mobile phone.

The police in Mumbai have registered a case of cheating against online shopping portal for delivering a bar of soap to a customer who had ordered a Samsung Galaxy Note 4. Mr. A, a resident of Walkeshwar, was excited to receive the parcel, but was shocked to find a bar of Nirma soap instead. Mr. A, who works at a leading global IT firm, decided to register the complaint after the company initially said his complaint was not genuine.

"I had ordered a Samsung Galaxy Note 4 on May 25 and the product was delivered on May 30. I had opted for cash-on-delivery and paid ₹ 29,900 to the delivery boy," Mr. A informed.

Minutes later, he opened the box and saw it contained a bar of soap in place of the smartphone. "The box contained a soap bar and an Android phone charger. I telephoned the deliveryman immediately. He was 10 minutes away from my home but said I would have to call Flipkart's customer care number to lodge a complaint".

He called the customer care but was shocked when he was told his complaint was not genuine. He reported the matter to the Malabar Hill police and lodged a complaint, after which a first-information report under Section 420 (cheating and dishonestly inducing delivery of property) of the Indian Penal Code was registered.

"My experience with online retailer has been disgusting. I received Nirma soap instead of a smartphone. Over the next few days I called them several times to inquire about the issue but received neither the cell phone nor my money. They initially denied me a refund or replacement, claiming that my complaint was not genuine. This was very annoying, so I filed a complaint with the police and on various customer complaint websites, after which they refunded my money on Tuesday," Mr. A said.

"We will begin our investigation by taking the statement of the delivery boy, after which we will look into other aspects of the case," police sub-inspector said.

For its part, online retailer said in written statement: "The company observes a zero-tolerance policy on incidents that impact customer trust. We are conducting an internal investigation into this case and are putting all efforts to find out the real facts of this incident. Meanwhile, as a responsible marketplace, the money has been refunded to the customer in good faith."

Case 2: Online Retailer not being paid by companies putting ads on online retailer's portal.

India's top online retailer filed first such case in the Delhi High Court against a US-based computer data storage company WD for allegedly not paying more than ₹ 1 crore for placing advertisements on the retailer's website.

4.7 DIGITAL PAYMENTS

Digital Payment is a way of payment which is made through digital modes. In digital payments, payer and payee both use digital modes to send and receive money. It is also called electronic payment. No hard cash is involved in the digital payments. All the transactions in digital payments are completed online. It is an instant and convenient way to make payments.

New digital payment platforms such as UPI and IMPS are becoming increasingly popular. Using these new platforms, banks have been scaling rapidly. Every Bank is impacted by new digital disruptions, so new banking services and ways should be adapted to use various digital channels to interact and provide services to customers. To reach out to customers at their convenience, banks are aggressively going digital. For millennials, banking is all about convenience – a seamless user interface akin to that of games or app. They value transparency and minimal processes. Convenience can be delivered through mobile apps and digital banking, the latter is provided by relationship managers, who need to be proficient in products and process knowledge. A high level of adaptability is a must for banking sector in this highly digital and tech-savvy age, where banking transactions can happen even on a mobile or tablet with a few clicks.

4.7.1 Different Types of Digital Payments

From traditional digital payment methods, India is moving towards newer methods of digital payments.

I.   **New Methods of Digital Payment**

   (i)   UPI Apps: Unified Payment Interface (UPI) and retail payment banks are changing the very face of banking in terms of moving most of banking to digital platforms using mobiles and apps. UPI is a system that powers multiple bank accounts (of participating banks), several banking services features like fund transfer, and merchant payments in a single mobile application. UPI or unified payment interface is a payment mode which is used to make fund transfers through the mobile app. User can transfer funds between two accounts using UPI apps. User must register

for mobile banking to use UPI apps. Currently, this service is only available for android phone users. User need to download a UPI app and create a VPA or UPI ID. There are too many good UPI apps available such as BHIM, SBI UPI app, HDFC UPI app, iMobile, PhonePe app etc. as shown in the Fig. 4.7.1.

Fig. 4.7.1: UPI Apps

(ii) **Immediate Payment Service (IMPS):** It is an instant interbank electronic fund transfer service through mobile phones. It is also being extended through other channels such as ATM, Internet Banking etc.

(iii) **Mobile Apps: BHIM (Bharat Interface for Money)** is a Mobile App developed by National Payments Corporation of India (NPCI) based on UPI (Unified Payment Interface). It facilitates e-payments directly through banks and supports all Indian banks which use that platform. It is built on the Immediate Payment Service infrastructure and allows the user to instantly transfer money between the bank accounts of any two parties. BHIM works on all mobile devices and enables users to send or receive money to other UPI payment addresses by scanning QR code or using account number with Indian Financial Systems Code (IFSC) code or MMID (Mobile Money Identifier) Code for users who do not have a UPI-based bank account.

(iv) **Mobile Wallets:** It is defined as virtual wallets that stores payment card information on a mobile device. Mobile Wallets provide a convenient way for a user to make-in-store payments and can be used that merchants listed with the mobile wallet service providers. There are mobile wallets like Paytm, Freecharge, Buddy, Mobikwik etc. Some of these are owned by banks and some are owned by private companies.

(v) **Aadhar Enabled Payment Service(AEPS):** Government of India, is planning to launch this in near future. AEPS is an Aadhaar based digital payment mode. Customer needs only his or her Aadhaar number to pay to any merchant. AEPS allows bank to bank transactions. It means the money you pay will be deducted from your account and credited to the payee's account directly. Customers will need to link their AADHAR numbers to their bank accounts. APES once launched can be used at POS terminals also.

(vi) Unstructured Supplementary Service Data(USSD): A revolutionary idea, where to make payments through mobiles there is neither need for internet nor any smart phone. USSD banking or *99# Banking is a mobile banking based digital payment mode. User does not need to have a smartphone or internet connection to use USSD banking. S/he can easily use it with any normal feature phone. USSD banking is as easy as checking of mobile balance. S/he can use this service for many financial and non-financial operations such as checking balance, sending money, changing Mobile Banking Personal Identification number (MPIN) and getting Mobile Money Identifier (MMID).

II. Traditional Methods of Digital Payment

(i) E-Wallet: E-wallet or mobile wallet is the digital version of physical wallet with more functionality. User can keep his / her money in an E-wallet and use it when needed. Use the E-wallets to recharge phone, pay at various places and send money to friends. If user's have a smartphone and a stable internet connection, they can use E-wallets to make payments. These E-Wallets also give additional cashback offers. Some of the most used E-wallets are State bank buddy, ICICI Pockets, Freecharge, Paytm etc. as shown in the Fig. 4.7.2.

Fig. 4.7.2: E-Wallets

(ii) Cards: Cards are provided by banks to their account holders. These have been the most used digital payment modes till now. Various types of cards are as follows:

o **Credit Cards:** A small plastic card issued by a bank, or issuer etc., allowing the holder to purchase goods or services on credit. In this mode of payment, the buyer's cash flow is not immediately impacted. User of the card makes payment to card issuer at end of billing cycle which is generally a monthly cycle. Credit Card issuer charge customers per transactions / 5% of transaction as transaction fees.

o **Debits Cards:** A small plastic card issued by a bank. Allowing the holder to purchase goods or services on credit. In this mode of payment, the buyer's cash flow is immediately

affected that as soon as payment is authorized buyers account is debited.

(iii) **Net Banking:** In this mode, the customers log to his / her bank account and makes payments. All public sectors, large private sector banks allow net banking facilities to their customers.

4.7.2 Advantages of Digital Payments

(i) **Easy and convenient:** Digital payments are easy and convenient. Person do not need to take loads of cash with themselves.

(ii) **Pay or send money from anywhere:** With digital payment modes, one can pay from anywhere anytime.

(iii) **Discounts from taxes:** Government has announced many discounts to encourage digital payments. User get 0.75% discounts on fuels and 10% discount on insurance premiums of government insurers.

(iv) **Written record:** User often forgets to note down his / her spending, or even if nothing is done it takes a lot of time. These are automatically recorded in passbook or inside E-Wallet app. This helps to maintain record, track spending and budget planning.

(v) **Less Risk:** Digital payments have less risk if used wisely. If user losses mobile phone or debit/credit card or Aadhar card, no need to worry a lot. No one can use anyone else's money without MPIN, PIN or fingerprint in the case of Aadhar. It is advised that user should get card blocked, if lost.

4.7.3 Drawbacks of Digital Payments

Every coin has two sides so as the digital payments. Despite many advantages, digital payments have a few drawbacks also.

(i) **Difficult for a Non-technical person:** As most of the digital payment modes are based on mobile phone, the internet and cards. These modes are somewhat difficult for non-technical persons such as farmers, workers etc.

(ii) **The risk of data theft:** There is a big risk of data theft associated with the digital payment. Hackers can hack the servers of the bank or the E-Wallet a customer is using and easily get his/her personal information. They can use this information to steal money from the customer's account.

(iii) **Overspending:** One keeps limited cash in his/her physical wallet and hence thinks twice before buying anything. But if digital payment modes are

used, one has an access to all his/her money that can result in overspending.

4.8 COMPUTING TECHNOLOGIES

Recently, emerging technologies are seen to be having enormous potential to meet the global challenges. One of the high-potential technologies is informatics. It is expected to revolutionize the value-additions to the huge information component, which is growing exponentially. Technological innovations in the field of storage, mining and services may be the key to address emerging challenges. Though several other advance technologies include synthetic biology, Nano-scale design, systems biology, wireless networks, Information and Communications Technology (ICT) enhanced educational systems etc.; ICT appears to be spearheading all such developments at one or the other levels. To add some flavor to address the challenges, some of the technologies, which have recently emerged and are being rapidly adapted include cloud, grid, mobile, and green computing.

4.8.1 Virtualization

In computing, **Virtualization** means to create a virtual version of a device or resource, such as a server, storage device, network or even an operating system where the framework divides the resource into one or more execution environments. Virtualization refers to technologies designed to provide a layer of abstraction between computer hardware systems and the software running on them. By providing a logical view of computing resources, rather than a physical view; virtualization allows its' users to manipulate their systems' operating systems into thinking that a group of servers is a single pool of computing resources and conversely, allows its users to run multiple operating systems simultaneously on a single machine.

I. Concept of Virtualization

The core concept of Virtualization lies in Partitioning, which divides a single physical server into multiple logical servers. Once the physical server is divided, each logical server can run an operating system and applications independently. For example - Partitioning of a hard drive is considered virtualization because one drive is partitioned in a way to create two separate hard drives. Devices, applications and human users are able to interact with the virtual resource as if it were a real single logical resource.

II.   Application Areas of Virtualization

♦   **Server Consolidation:** Virtual machines are used to consolidate many physical servers into fewer servers, which in turn host virtual machines. Each physical server is reflected as a virtual machine "guest" residing on a virtual machine host system. This is also known as "Physical-to-Virtual" or 'P2V' transformation.

♦   **Disaster Recovery:** Virtual machines can be used as "hot standby" environments for physical production servers. This changes the classical "backup-and-restore" philosophy, by providing backup images that can "boot" into live virtual machines, capable of taking over workload for a production server experiencing an outage.

♦   **Testing and Training:** Virtualization can give root access to a virtual machine. This can be very useful such as in kernel development and operating system courses.

♦   **Portable Applications:** Portable applications are needed when running an application from a removable drive, without installing it on the system's main disk drive. Virtualization can be used to encapsulate the application with a redirection layer that stores temporary files, windows registry entries and other state information in the application's installation directory and not within the system's permanent file system.

♦   **Portable Workspaces:** Recent technologies have used virtualization to create portable workspaces on devices like iPods and USB memory sticks.

III.   Common Types of Virtualization

♦   **Hardware Virtualization:** Hardware Virtualization or Platform Virtualization refers to the creation of a virtual machine that acts like a real computer with an operating system. Software executed on these virtual machines is separated from the underlying hardware resources. For example, a computer that is running Microsoft Windows may host a virtual machine that looks like a computer with the Linux operating system; based software that can be run on the virtual machine.

The basic idea of Hardware virtualization is to consolidate many small physical servers into one large physical server so that the processor can be used more effectively. The software that creates a virtual machine on the host hardware is called a hypervisor or Virtual Machine Manager. The hypervisor controls the processor, memory and other components

by allowing several different operating systems to run on the same machine without the need for a source code. The operating system running on the machine will appear to have its own processor, memory and other components.

♦ **Network Virtualization: Network Virtualization** is a method of combining the available resources in a network by splitting up the available bandwidth into channels, each of which is independent from the others, and each of which can be assigned (or reassigned) to a particular server or device in real time. This allows a large physical network to be provisioned into multiple smaller logical networks and conversely allows multiple physical LANs to be combined into a larger logical network. This behavior allows administrators to improve network traffic control, enterprise and security. Network virtualization involves platform virtualization, often combined with resource virtualization.

Various equipment and software vendors offer network virtualization by combining any of the Network hardware such as switches and Network Interface Cards (NICs); Network elements such as firewalls and load balancers; Networks such as virtual LANs (VLANs); Network storage devices; Network machine-to-machine elements such as telecommunications devices; Network mobile elements such as laptop computers, tablet computers, smart phones and Network media such as Ethernet and Fiber Channel. Network virtualization is intended to optimize network speed, reliability, flexibility, scalability, and security.

♦ **Storage Virtualization: Storage Virtualization** is the apparent pooling of data from multiple storage devices, even different types of storage devices, into what appears to be a single device that is managed from a central console. Storage virtualization helps the storage administrator perform the tasks of backup, archiving, and recovery more easily and in less time by disguising the actual complexity of a Storage Area Network (SAN). Administrators can implement virtualization with software applications or by using hardware and software hybrid appliances. The servers connected to the storage system aren't aware of where the data really is. Storage virtualization is sometimes described as "abstracting the logical storage from the physical storage.

4.8.2 Grid Computing

The computing resources in most of the organizations are underutilized but are necessary for certain operations. The idea of Grid computing is to make use of such non-utilized computing power by the needy organizations, and thereby the Return on Investment (RoI) on computing investments can be increased.

Grid Computing is a computer network in which each computer's resources are shared with every other computer in the system. It is a distributed architecture of large numbers of computers connected to solve a complex problem. In the grid computing model, servers or personal computers run independent tasks and are loosely linked by the Internet or low-speed networks. A typical Grid Model is shown in Fig. 4.8.1.

It is a special kind of distributed computing. In distributed computing, different computers within the same network share one or more resources. In the ideal grid computing system, every resource is shared, turning a computer network into a powerful supercomputer. With the right user interface, accessing a grid computing system would look no different than accessing a local machine's resources. Every authorized computer would have access to enormous processing power and storage capacity.
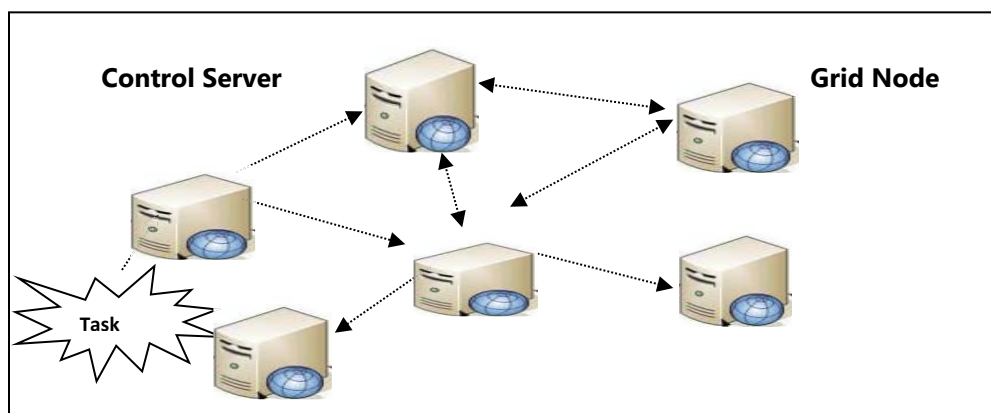

Fig. 4.8.1: Grid Computing Scenario

I.   **Benefits of Grid Computing**

♦   **Making use of Underutilized Resources:** In most organizations, there are large amounts of underutilized computing resources including even the server machines. Grid computing provides a framework for exploiting these underutilized resources and thus has the possibility of substantially increasing the efficiency of resource usage. Grid computing (more specifically, a data grid) can be used to aggregate this

unused storage into a much larger virtual data store, possibly configured to achieve improved performance and reliability over that of any single machine.

♦ **Resource Balancing:** For applications that are grid-enabled, the grid can offer a resource balancing effect by scheduling grid jobs on machines with low utilization. This feature of grid computing handles occasional peak loads of activity in parts of a larger organization. An unexpected peak can be routed to relatively idle machines in the grid; and if the grid is already fully utilized, the lowest priority work being performed on the grid can be temporarily suspended or even cancelled and performed again later to make room for the higher priority work.

♦ **Parallel CPU Capacity:** The potential for usage of massive parallel CPU capacity is one of the most common visions and attractive features of a grid. A CPU-intensive grid application can be thought of as many smaller sub-jobs, each executing on a different machine in the grid. To the extent that these sub-jobs do not need to communicate with each other, the more scalable the application becomes. A perfectly scalable application will, for example, finish in one tenth of the time if it uses ten times the number of processors.

♦ **Virtual resources and virtual organizations for collaboration:** Grid computing provides an environment for collaboration among a wider audience. The users of the grid can be organized dynamically into several virtual organizations, each with different policy requirements. These virtual organizations can share their resources such as data, specialized devices, software, services, licenses, and so on, collectively as a larger grid. The grid can help in enforcing security rules among them and implement policies, which can resolve priorities for both resources and users.

♦ **Access to additional resources:** In addition to CPU and storage resources, a grid can provide access to other resources as well. For example, if a user needs to increase their total bandwidth to the Internet to implement a data mining search engine, the work can be split among grid machines that have independent connections to the Internet. In this way, total searching capability is multiplied, since each machine has a separate connection to the Internet.

♦ **Reliability:** High-end conventional computing systems use expensive hardware to increase reliability. The machines also use duplicate

processors in such a way that when they fail, one can be replaced without turning the other off. Power supplies and cooling systems are duplicated. The systems are operated on special power sources that can start generators if utility power is interrupted. All of this builds a reliable system, but at a great cost, due to the duplication of expensive components.

♦ **Management:** The goal to virtualize the resources on the grid and more uniformly handle heterogeneous systems create new opportunities to better manage a larger, more distributed IT infrastructure. The grid offers management of priorities among different projects. Aggregating utilization data over a larger set of projects can enhance an organization's ability to project future upgrade needs. When maintenance is required, grid work can be rerouted to other machines without crippling the projects involved.

II. Types of Resources

A grid is a collection of machines, sometimes referred to as nodes, resources, members, donors, clients, hosts and many other such terms. They all contribute any combination of resources to the grid as a whole. Some resources may be used by all users of the grid, while others may have specific restrictions.

♦ **Computation:** The most common resource is Computing Cycles provided by the processors of the machines on the grid where processors can vary in speed, architecture, software platform, and other associated factors such as memory, storage, and connectivity. There are three primary ways to exploit the computation resources of a grid.

    o   To run an existing application on an available machine on the grid rather than locally;

    o   To use an application designed to split its work in such a way that the separate parts can execute in parallel on different processors; and

    o   To run an application, that needs to be executed many times, on many different machines in the grid.

♦ **Storage:** The second most common resource used in a grid is Data Storage. A grid providing an integrated view of data storage is sometimes called a Data Grid. Each machine on the grid usually provides some quantity of storage for grid use, even if temporary. Storage can be memory attached to the processor or it can be

secondary storage, using hard disk drives or other permanent storage media. More advanced file systems on a grid can automatically duplicate sets of data, to provide redundancy for increased reliability and increased performance.

♦ **Communications:** Communications within the grid are important for sending jobs and their required data to points within the grid. The bandwidth available for such communications can often be a critical resource that can limit utilization of the grid. Redundant communication paths are sometimes needed to better handle potential network failures and excessive data traffic. In some cases, higher speed networks must be provided to meet the demands of jobs transferring larger amounts of data.

♦ **Software and Licenses:** The grid may have software installed that may be too expensive to install on every grid machine. Some software licensing arrangements permit the software to be installed on all of the machines of a grid but may limit the number of installations that can be simultaneously used at any given instant. License management software keeps track of how many concurrent copies of the software are being used and prevents more than that number from executing at any given time.

♦ **Special equipment, capacities, architectures, and policies:** Platforms on the grid will often have different architectures, operating systems, devices, capacities, and equipment. Each of these items represents a different kind of resource that the grid can use as criteria for assigning jobs to machines. For example, some machines may be designated to only be used for medical research. These would be identified as having a medical research attribute and the scheduler could be configured to only assign jobs that require machines of the medical research resource.

III. Application Areas of Grid Computing

♦ Civil engineers collaborate to design, execute, & analyze shake table experiments.

♦ An insurance company mines data from partner hospitals for fraud detection.

♦ An application service provider offloads excess load to a compute cycle provider.

- ♦ An enterprise configures internal & external resources to support e-Business workload.

- ♦ Large-scale science and engineering are done through the interaction of people, heterogeneous computing resources, information systems and instruments, all of which are geographically and organizationally dispersed.

IV. Grid Computing Security

To develop security architecture, following constraints are taken from the characteristics of grid environment and application.

- ♦ **Single Sign-on:** A user should authenticate once and they should be able to acquire resources, use them, and release them and to communicate internally without any further authentication.

- ♦ **Protection of Credentials:** User passwords, private keys, etc. should be protected.

- ♦ **Interoperability with local security solutions:** Access to local resources should have local security policy at a local level. Despite of modifying every local resource there is an inter-domain security server for providing security to local resource.

- ♦ **Exportability:** The code should be exportable i.e. they cannot use a large amount of encryption at a time. There should be a minimum communication at a time.

- ♦ **Support for secure group communication:** In a communication, there are number of processes which coordinate their activities. This coordination must be secure and for this there is no such security policy.

- ♦ **Support for multiple implementations:** There should be a security policy which should provide security to multiple sources based on public and private key cryptography.

4.8.3 Cloud Computing

To understand Cloud Computing, we first must understand what the cloud is. **"The Cloud"** refers to applications, services, and data storage on the Internet. These service providers rely on giant server farms and massive storage devices that are connected via Internet protocols. Cloud Computing is the use of these services by individuals and organizations. You probably already use cloud computing in some forms. For example, if you access your e-mail via your web browser, you are using a form of cloud computing. If you use Google Drive's applications, you are using cloud computing. While these are free versions of cloud computing, there is big business in providing applications and data storage over the web. Salesforce is a

good example of cloud computing as their entire suite of CRM applications are offered via the cloud. Cloud Computing is not limited to web applications; it can also be used for services such as phone or video streaming. The best example of Cloud Computing is Google Apps where any application can be accessed using a browser and it can be deployed on thousands of computers through the Internet.

Cloud Computing, simply means the use of computing resources as a service through networks, typically the Internet. The Internet is commonly visualized as clouds; hence the term "cloud computing" for computation done through the Internet. With Cloud Computing, users can access database resources via the Internet from anywhere, for as long as they need, without worrying about any maintenance or management of actual resources. Besides these, databases in cloud may be highly dynamic and scalable. In fact, it is a very independent platform in terms of computing.

Cloud Computing is both, a combination of software and hardware based computing resources delivered as a networked service. This model of IT enabled services enables anytime access to a shared pool of applications and resources. These applications and resources can be accessed using a simple front-end interface such as a Web browser, and thus enabling users to access the resources from any client device including notebooks, desktops and mobile devices.

Cloud Computing provides the facility to access shared resources and common infrastructure offering services on demand over the network to perform operations that meet changing business needs (shown in Fig. 4.8.2). The location of physical resources and devices being accessed are typically not known to the end user. It also provides facilities for users to develop, deploy and manage their applications 'on the cloud', which entails virtualization of resources that maintains and manages itself.
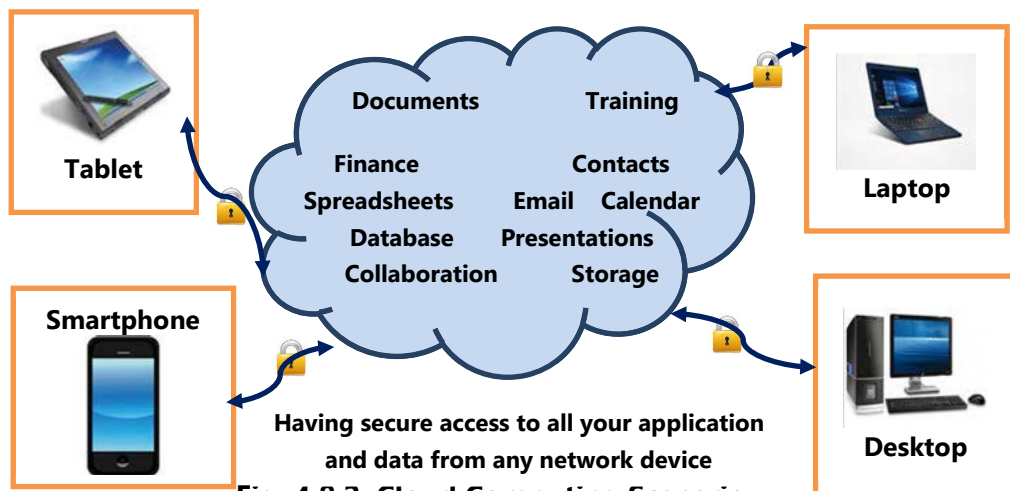

Tablet

Smartphone

Documents   Training

Finance   Contacts

Spreadsheets   Email   Calendar

Database   Presentations

Collaboration   Storage

Laptop

Desktop

Having secure access to all your application and data from any network device

Fig. 4.8.2: Cloud Computing Scenario

With cloud computing, companies can scale up to massive capacities in an instant without having to invest in new infrastructure, train new personnel or license new software. Cloud computing is of benefit to small and medium-sized business systems, who wish to completely outsource their data-center infrastructure; or large companies, who wish to get peak load capacity without incurring the higher cost of building larger data centers internally. In both the instances, service consumers use **'what they need on the Internet'** and **'pay only for what they use'**.

The service consumer may no longer be required to pay for a PC, use an application from the PC, or purchase a specific software version that's configured for smart phones, PDAs, and other devices. The consumers may not own the infrastructure, software, or platform in the cloud based schemes, leading to lower up-fronts, capital, and operating expenses. End users may not need to care about how servers and networks are maintained in the cloud, and can access multiple servers anywhere on the globe without knowing 'which ones and where they are located'.

I.   Characteristics of Cloud Computing

The following is a list of characteristics of a cloud-computing environment. Not all characteristics may be present in a specific cloud solution. However, some of the key characteristics are given as follows:

♦   **Elasticity and Scalability:** Cloud computing gives us the ability to expand and reduce resources according to the specific service requirement. For example, we may need a large number of server resources for the duration of a specific task. We can then release these server resources after we complete our task.

♦   **Pay-per-Use:** We pay for cloud services only when we use them, either for the short term (for example, for CPU time) or for a longer duration (for example, for cloud-based storage or vault services).

♦   **On-demand:** Because we invoke cloud services only when we need them, they are not permanent parts of the IT infrastructure. This is a significant advantage for cloud use as opposed to internal IT services. With cloud services, there is no need to have dedicated resources waiting to be used, as is the case with internal services.

♦   **Resiliency:** The resiliency of a cloud service offering can completely isolate the failure of server and storage resources from cloud users. Work is migrated to a different physical resource in the cloud with or without user awareness and intervention.

♦ **Multi Tenancy:** Public cloud service providers often can host the cloud services for multiple users within the same infrastructure. Server and storage isolation may be physical or virtual depending upon the specific user requirements.

♦ **Workload Movement:** This characteristic is related to resiliency and cost considerations. Here, cloud-computing providers can migrate workloads across servers both inside the data center and across data centers (even in a different geographic area). This migration might be necessitated by cost (less expensive to run a workload in a data center in another country based on time of day or power requirements) or efficiency considerations (for example, network bandwidth). A third reason could be regulatory considerations for certain types of workloads.

II.   Advantages of Cloud Computing

♦ **Achieve economies of scale:** Volume output or productivity can be increased even with fewer systems and thereby reduce the cost per unit of a project or product.

♦ **Reduce spending on technology infrastructure:** Data and information can be accessed with minimal upfront spending in a pay-as-you-go approach, which is based on demand.

♦ **Globalize the workforce:** People worldwide can access the cloud with Internet connection.

♦ **Streamline business processes:** Getting more work done in less time with less resources are possible.

♦ **Reduce capital costs:** Not required to spend huge money on hardware, software, or licensing fees.

♦ **Pervasive accessibility:** Data and applications can be accesses anytime, anywhere, using any smart computing device, making our life so much easier.

♦ **Monitor projects more effectively:** It is feasible to confine within budgetary allocations and can be ahead of completion cycle times.

♦ **Less personnel training is needed:** It takes fewer people to do more work on a cloud, with a minimal learning curve on hardware and software issues.

♦ **Minimize maintenance and licensing software:** As there is no too much of non-premise computing resources, maintenance becomes simple and updates and renewals of software systems rely on the cloud vendor or provider.

♦ **Improved flexibility:** It is possible to make fast changes in our work environment without serious issues at stake.

III. Drawbacks of Cloud Computing

♦ If Internet connection is lost, the link to the cloud and thereby to the data and applications is lost.

♦ Security is a major concern as entire working with data and applications depend on other cloud vendors or providers.

♦ Although Cloud computing supports scalability (ie. quickly scaling up and down computing resources depending on the need), it does not permit the control on these resources as these are not owned by the user or customer.

♦ Depending on the cloud vendor or provide, customers may have to face restrictions on the availability of applications, operating systems and infrastructure options.

♦ Interoperability (ability of two or more applications that are required to support a business need to work together by sharing data and other business-related resources) is an issue wherein all the applications may not reside with a single cloud vendor and two vendors may have applications that do not cooperate with each other.

IV. Cloud Computing Environment

The Cloud Computing environment can consist of multiple types of clouds based on their deployment and usage. Such typical Cloud computing environments, catering to special requirements, are briefly described as follows (given in Fig. 4.8.3).

(A) Private Cloud: This cloud computing environment resides within the boundaries of an organization and is used exclusively for the organization's benefits. These are also called **Internal Clouds** or Corporate Clouds. Private Clouds can either be private to the organization and managed by the single organization **(On-Premise Private Cloud)** or can be managed by third party **(Outsourced Private Cloud)**. They are built primarily by IT departments within enterprises, who seek to optimize utilization of infrastructure resources

within the enterprise by provisioning the infrastructure with applications using the concepts of grid and virtualization.
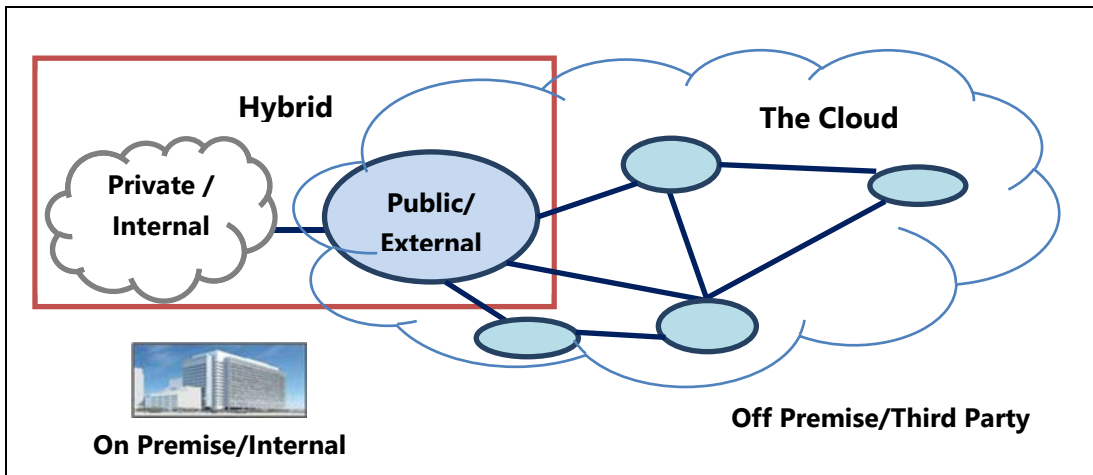

Fig. 4.8.3: Cloud Deployment Models

Characteristics of Private Cloud

♦   **Secure:** The private cloud is secure as it is deployed and managed by the organization itself, and hence there is least chance of data being leaked out of the cloud.

♦   **Central Control:** As usually the private cloud is managed by the organization itself, there is no need for the organization to rely on anybody and its controlled by the organization itself.

♦   **Weak Service Level Agreements (SLAs):** SLAs play a very important role in any cloud service deployment model as they are defined as agreements between the user and the service provider in private cloud. In private cloud, either Formal SLAs do not exist or are weak as it is between the organization and user of the same organization. Thus, high availability and good service may or may not be available.

Advantages of Private Cloud

♦   It improves average server utilization; allow usage of low-cost servers and hardware while providing higher efficiencies; thus, reducing the costs that a greater number of servers would otherwise entail.

♦   It provides a high level of security and privacy to the user.

♦   It is small and controlled and maintained by the organization.

Moreover, one major **limitation of Private Cloud** is that IT teams in the organization may have to invest in buying, building and managing the clouds independently. Budget is a constraint in private clouds and they also have loose SLAs.

(B)   **Public Cloud:** The public cloud is the cloud infrastructure that is provisioned for open use by the general public. It may be owned, managed, and operated by a business, academic, or government organizations, or some combination of them. Typically, public clouds are administrated by third parties or vendors over the Internet, and the services are offered on pay-per-use basis. These are also called Provider Clouds. Public cloud consists of users from all over the world wherein a user can simply purchase resources on an hourly basis and work with the resources which are available in the cloud provider's premises.

Characteristics of Public Cloud

♦   **Highly Scalable:** The resources in the public cloud are large in number and the service providers make sure that all requests are granted. Hence public clouds are scalable.

♦   **Affordable:** The cloud is offered to the public on a pay-as-you-go basis; hence the user has to pay only for what he or she is using (using on a per-hour basis). And this does not involve any cost related to the deployment.

♦   **Less Secure:** Since it is offered by a third party and they have full control over the cloud, the public cloud is less secure out of all the other deployment models.

♦   **Highly Available:** It is highly available because anybody from any part of the world can access the public cloud with proper permission, and this is not possible in other models as geographical or other access restrictions might be there.

♦   **Stringent SLAs:** As the service provider's business reputation and customer strength are totally dependent on the cloud services, they follow the SLAs strictly and violations are avoided.

Advantages of Public Cloud

♦   It is widely used in the development, deployment and management of enterprise applications, at affordable costs.

♦ It allows the organizations to deliver highly scalable and reliable applications rapidly and at more affordable costs.

♦ There is no need for establishing infrastructure for setting up and maintaining the cloud.

♦ Strict SLAs are followed.

♦ There is no limit for the number of users.

Moreover, one of the **limitation of Public cloud** is security assurance and thereby building trust among the clients is far from desired but slowly liable to happen. Further, privacy and organizational autonomy are not possible.

(C) **Hybrid Cloud:** This is a combination of both at least one private (internal) and at least one public (external) cloud computing environments - usually, consisting of infrastructure, platforms and applications. The usual method of using the hybrid cloud is to have a private cloud initially, and then for additional resources, the public cloud is used. The hybrid cloud can be regarded as a private cloud extended to the public cloud and aims at utilizing the power of the public cloud by retaining the properties of the private cloud. It is typically offered in either of two ways. A vendor has a private cloud and forms a partnership with a public cloud provider or a public cloud provider forms a partnership/franchise with a vendor that provides private cloud platforms. Fig. 4.8.4 depicts Hybrid Cloud.
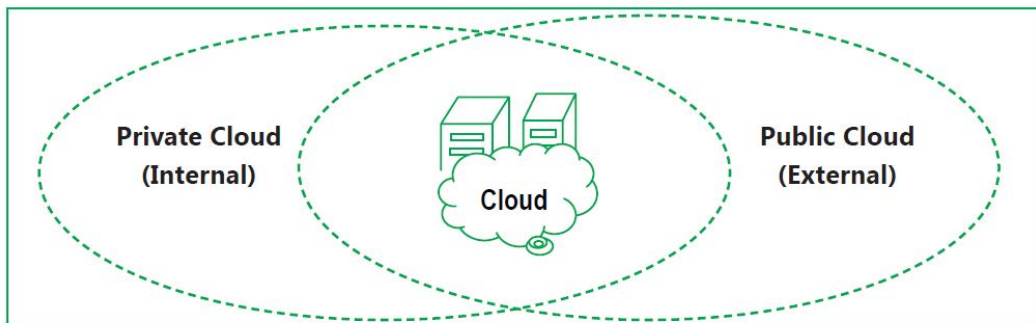

Fig. 4.8.4: Hybrid Cloud

Characteristics of Hybrid Cloud

♦ **Scalable:** The hybrid cloud has the property of public cloud with a private cloud environment and as the public cloud is scalable; the hybrid cloud with the help of its public counterpart is also scalable.

♦ **Partially Secure:** The private cloud is considered as secured and public cloud has high risk of security breach. The hybrid cloud thus cannot be fully termed as secure but as partially secure.

♦ **Stringent SLAs:** Overall the SLAs are more stringent than the private cloud and might be as per the public cloud service providers.

♦ **Complex Cloud Management:** Cloud management is complex as it involves more than one type of deployment models and the number of users is high.

The **Advantages of Hybrid Cloud** include the following:

♦ It is highly scalable and gives the power of both private and public clouds.

♦ It provides better security than the public cloud.

The **limitation of Hybrid Cloud** is that the security features are not as good as the private cloud and complex to manage.

(D) **Community Cloud:** The community cloud is the cloud infrastructure that is provisioned for exclusive use by a specific community of consumers from organizations that have shared concerns (eg. mission security requirements, policy, and compliance considerations). It may be owned, managed, and operated by one or more of the organizations in the community, a third party or some combination of them, and it may exist on or off premises. In this, a private cloud is shared between several organizations. Fig. 4.8.5 depicts Community Cloud. This model is suitable for organizations that cannot afford a private cloud and cannot rely on the public cloud either.

Characteristics of Community Cloud

♦ **Collaborative and Distributive Maintenance:** In this, no single company has full control over the whole cloud. This is usually distributive and hence better cooperation provides better results.

♦ **Partially Secure:** This refers to the property of the community cloud where few organizations share the cloud, so there is a possibility that the data can be leaked from one organization to another, though it is safe from the external world.

♦ **Cost Effective:** As the complete cloud if being shared by several organizations or community, not only the responsibility gets shared; the community cloud becomes cost effective too.
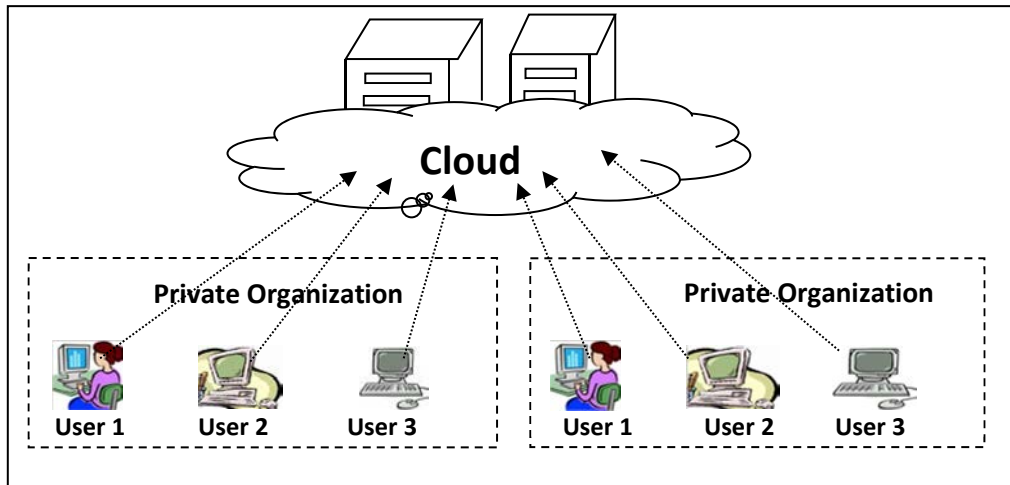
Fig. 4.8.5: Community Cloud

Advantages of Community Cloud

♦   It allows establishing a low-cost private cloud.

♦   It allows collaborative work on the cloud.

♦   It allows sharing of responsibilities among the organizations.

♦   It has better security than the public cloud.

The **limitation of the Community Cloud** is that the autonomy of the organization is lost and some of the security features are not as good as the private cloud. It is not suitable in the cases where there is no collaboration.

V.   Cloud Computing Service Models

Cloud computing is a model that enables the end users to access the shared pool of resources such as compute, network, storage, database and application as an on-demand service without the need to buy or own it. The services are provided and managed by the service provider, reducing the management effort from the end user side. The essential characteristics of the cloud include on-demand, self-service, broad network access, resource pooling, rapid elasticity, and measured service. The National Institute of Standards and Technology (NIST) defines three basic service models - Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS). These are pictorially presented in Fig. 4.8.6.

(A) **Infrastructure as a Service (IaaS): IaaS**, a hardware-level service, provides computing resources such as processing power, memory, storage, and networks for cloud users to run their application on-demand. This allows users to maximize the utilization of computing capacities without having to own and manage their own resources. The end-users or IT architects will use the infrastructure resources in the form of Virtual machines (VMs) and design virtual infrastructure, network load balancers etc., based on their needs. The IT architects need not maintain the physical servers as it is maintained by the service providers. Examples of IaaS providers include Amazon Web Services (AWS), Google Compute Engine, OpenStack and Eucalyptus.
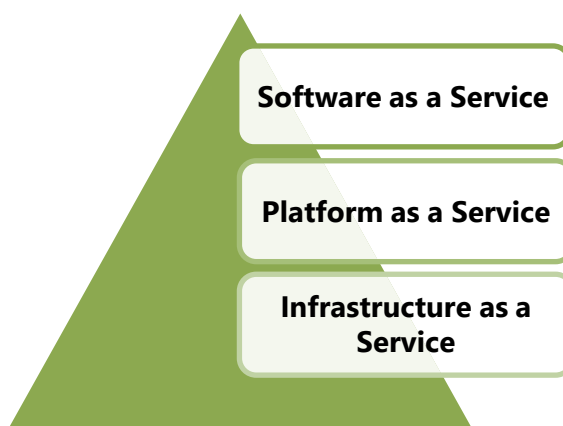

Fig. 4.8.6: Cloud Computing Basic Service Models

(i) **Characteristics of IaaS**

♦ **Web access to the resources:** The IaaS model enables the IT users to access infrastructure resources over the Internet. When accessing a huge computing power, the IT user need not get physical access to the servers.

♦ **Centralized Management:** The resources distributed across different parts are controlled from any management console that ensures effective resource management and effective resource utilization.

♦ **Elasticity and Dynamic Scaling:** Depending on the load, IaaS services can provide the resources and elastic services where the usage of resources can be increased or decreased according to the requirements.

♦ **Shared infrastructure:** IaaS follows a one-to-many delivery model and allows multiple IT users to share the same physical infrastructure and thus ensure high resource utilization.

♦ **Metered Services:** IaaS allows the IT users to rent the computing resources instead of buying it. The services consumed by the IT user will be measured, and the users will be charged by the IaaS providers based on the amount of usage.

(ii) Different instances of IaaS (as discussed in the Table 4.8.1)

Table 4.8.1: Instances of IaaS

Instance	Description
Network as a Service (NaaS)	• Provides users with needed data communication capacity to accommodate bursts in data traffic during data-intensive activities such as video conferencing or large file downloads. • It is an ability given to the end-users to access virtual network services that are provided by the service provider over the Internet on a per-per-use basis. • Allows network architects to create virtual networks; virtual network interface cards (NICs), virtual routers, virtual switches, and other networking components. • Allows the network architect to deploy custom routing protocols and enables the design of efficient in-network services, such as data aggregation, stream processing, and caching. NaaS providers operate using three common service models: Virtual Private Network (VPN), Bandwidth on Demand (BoD) and Mobile Virtual Network (MVN).
Storage as a Service (STaaS)	• Provides storage infrastructure on a subscription basis to users who want a low-cost and convenient way to store data, synchronize data across multiple devices, manage off-site backups, mitigate risks of disaster recovery, and preserve records for the long-term. • It is an ability given to the end users to store the data on the storage services provided by the service provider. • STaaS allows the end users to access the files at any time from any place. STaaS provider provides the virtual storage that is abstracted from the physical storage of any cloud data center.
Database as a Service (DBaaS)	• Provides users with seamless mechanisms to create, store, and access databases at a host site on demand. • It is an ability given to the end users to access the database service without the need to install and maintain it on the pay-per-use basis.

	• The end users can access the database services through any Application Programming Interfaces (APIs) or Web User Interfaces provided by the service provider.
Backend as a Service (BaaS)	• Provides web and mobile app developers a way to connect their applications to backend cloud storage with added services such as user management, push notifications, social network services integration using custom software development kits and application programming interfaces.
Desktop as a Service (DTaaS)	• Provides ability to the end users to use desktop virtualization without buying and managing their own infrastructure. • It is a pay-per-use cloud service delivery model in which the service provider manages the back-end responsibilities of data storage, backup, security and upgrades. • The end-users are responsible for securing for managing their own desktop images, applications, and security. These services are simple to deploy, are highly secure, and produce better experience on almost all devices.

(B) **Platform as a Service (PaaS): PaaS** provides the users the ability to develop and deploy an application on the development platform provided by the service provider. In traditional application development, the application will be developed locally and will be hosted in the central location. In stand-alone application development, the application will be developed by traditional development platforms result in licensing - based software, whereas PaaS changes the application development from local machine to online. For example - Google App Engine, Windows Azure Compute etc.

Typical PaaS providers may provide programming languages, application frameworks, databases, and testing tools apart from some build tools, deployment tools and software load balancers as a service in some cases.

(C) **Software as a Service (SaaS): SaaS** provides ability to the end users to access an application over the Internet that is hosted and managed by the service provider. Thus, the end users are exempted from managing or controlling an application the development platform, and the underlying infrastructure. SaaS changes the way the software is delivered to the customers. SaaS provides users to access large variety of applications over internets that are hosted on service provider's infrastructure. For example, one can make his/her own word document in Google docs online, s/he can edit a photo

online on pixlr.com so s/he need not install the photo editing software on his/her system - thus Google is provisioning software as a service. Different instances of SaaS are discussed in the Table 4.8.2.

Table 4.8.2: Instances of SaaS

Instance	Description
Testing as a Service (TaaS)	Provides users with software testing capabilities such as generation of test data, generation of test cases, execution of test cases and test result evaluation on a pay-per-use basis.
API as a Service (APIaaS)	Allows users to explore functionality of Web services such as Google Maps, Payroll processing, and credit card processing services etc.
Email as a Service (EaaS)	Provides users with an integrated system of emailing, office automation, records management, migration, and integration services with archiving, spam blocking, malware protection, and compliance features.

(D)   Other Cloud Service Models (Table 4.8.3)

Table 4.8.3: Other Cloud Service Models

Instance	Description
Communication as a Service (CaaS)	• It is an outsourced enterprise communication solution that can be leased from a single vender. The CaaS vendor is responsible for all hardware and software management and offers guaranteed Quality of Service (QoS). It allows businesses to selectively deploy communication devices and modes on a pay-as-you-go, as-needed basis. • This approach eliminates the large capital investments. Examples are: Voice over IP (VoIP), Instant Messaging (IM), Collaboration and Videoconferencing application using fixed and mobile devices.
Data as a Service (DaaS)	• Provides data on demand to a diverse set of users, systems or application. The data may include text, images, sounds, and videos. • Data encryption and operating system authentication are commonly provided for security. DaaS users have access

	to high-quality data in a centralized place and pay by volume or data type, as needed.
	• However, as the data is owned by the providers, users can only perform read operations on the data. DaaS is highly used in geography data services and financial data services.
Security as a Service (SECaaS)	• It is an ability given to the end user to access the security service provided by the service provider on a pay-per-use basis.
	• It is a new approach to security in which cloud security is moved into the cloud itself whereby cloud service users will be protected from within the cloud using a unified approach to threats.
Identity as a Service (IDaaS)	• It is an ability given to the end users; typically, an organization or enterprise; to access the authentication infrastructure that is built, hosted, managed and provided by the third party service provider.
	• Generally, IDaaS includes directory services, authentication services, risk and event monitoring, single sign-on services, and identity and profile management.

4.8.4 Mobile Computing

Mobile Computing refers to the technology that allows transmission of data via a computer without having to be connected to a fixed physical link. Mobile voice communication is widely established throughout the world and has had a very rapid increase in the number of subscribers to the various cellular networks over the last few years. An extension of this technology is the ability to send and receive data across these cellular networks. This is the fundamental principle of mobile computing. Mobile data communication has become a very important and rapidly evolving technology as it allows users to transmit data from remote locations to other remote or fixed locations. This proves to be the solution of the biggest problem of business people on the move i.e. mobility. A primitive scenario of mobile computing in practice is given in the Fig. 4.8.7.
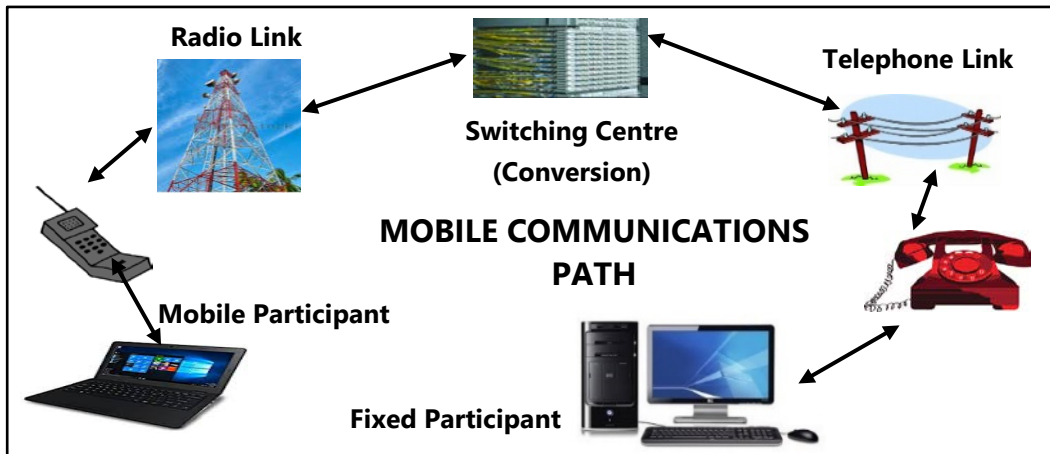
Fig. 4.8.7: Mobile Computing

I. Components of Mobile Computing

The key components of Mobile Computing are as follows:

♦ **Mobile Communication:** This refers to the infrastructure put in place to ensure that seamless and reliable communication goes on. This would include communication properties, protocols, data formats and concrete technologies.

♦ **Mobile Hardware:** Mobile Hardware includes mobile devices or device components that receive or access the service of mobility. They would range from Portable laptops, Smart Phones, Tablet PCs, and Personal Digital Assistants (PDA) that use an existing and established network to operate on. At the back end, there are various servers like Application Servers, Database Servers and Servers with wireless support, WAP gateway, a Communications Server and/or MCSS (Mobile Communications Server Switch) or a wireless gateway embedded in wireless carrier's network. The characteristics of mobile computing hardware are defined by the size and form factor, weight, microprocessor, primary storage, secondary storage, screen size and type, means of input, means of output, battery life, communications capabilities, expandability and durability of the device.

♦ **Mobile Software:** Mobile Software is the actual programme that runs on the mobile hardware and deals with the characteristics and requirements of mobile applications. It is the operating system of that appliance and is the essential component that makes the mobile device operates. Mobile applications popularly called Apps are being

developed by organizations for use by customers but these apps could represent risks, in terms of flow of data as well as personal identification risks, introduction of malware and access to personal information of mobile owner.

II. Working of Mobile Computing

♦   The user enters or access data using the application on hand-held computing device.

♦   Using one of several connecting technologies, the new data are transmitted from hand-held to site's information system where files are updated and the new data are accessible to other system user.

♦   Now both systems (hand-held and site's computer) have the same information and are in sync.

♦   The process work the same way starting from the other direction.

The process is similar to the way a worker's desktop PC access the organization's applications, except that user's device is not physically connected to the organization's system. The communication between the user device and site's information systems uses different methods for transferring and synchronizing data, some involving the use of Radio Frequency (RF) technology.

III. Benefits of Mobile Computing

In general, Mobile Computing is a versatile and strategic technology that increases information quality and accessibility, enhances operational efficiency, and improves management effectiveness. But, more specifically, it leads to a range of tangible benefits, including the following:

♦   It provides mobile workforce with remote access to work order details, such as work order location, contact information, required completion date, asset history relevant warranties/service contracts.

♦   It enables mobile sales personnel to update work order status in real-time, facilitating excellent communication.

♦   It facilitates access to corporate services and information at any time, from anywhere.

♦   It provides remote access to the corporate Knowledge base at the job location.

♦ It enables to improve management effectiveness by enhancing information quality, information flow, and ability to control a mobile workforce.

IV.   Limitations of Mobile Computing

♦ **Insufficient Bandwidth:** Mobile Internet access is generally slower than direct cable connections using technologies such as General Packet Radio Service (GPRS) and **E**nhanced **D**ata Rates for **G**SM (Global System for Mobile Communication) **E**volution - (EDGE), and 3G, 4G networks. These networks are usually available within range of commercial cell phone towers. Higher speed wireless LANs are inexpensive but have very limited range.

♦ **Security Standards:** When working mobile, one is dependent on public networks, requiring careful use of Virtual Private Network (VPN). Security is a major concern while concerning the mobile computing standards on the fleet. One can easily attack the VPN through a huge number of networks interconnected through the line.

♦ **Power consumption:** When a power outlet or portable generator is not available, mobile computers must rely entirely on battery power. Combined with the compact size of many mobile devices, this often means unusually expensive batteries must be used to obtain the necessary battery life. Mobile computing should also look into Greener IT in such a way that it saves the power or increases the battery life.

♦ **Transmission interferences:** Weather, terrain and the range from the nearest signal point can all interfere with signal reception. Reception in tunnels, some buildings, and rural areas is often poor.

♦ **Potential health hazards:** People who use mobile devices while driving is often distracted from driving, and are thus assumed more likely to be involved in traffic accidents. Cell phones may interfere with sensitive medical devices. There are allegations that cell phone signals may cause health problems.

♦ **Human interface with device:** Screens and keyboards tend to be small, which may make them hard to use. Alternate input methods such as speech or handwriting recognition require training.

4.8.5 Green Computing

Green Computing or **Green IT** refers to the study and practice of environmentally sustainable computing or IT. In other words, it is the study and practice of establishing/ using computers and IT resources in a more efficient and environmentally friendly and responsible way. Computers consume a lot of natural resources, from the raw materials needed to manufacture them, the power used to run them, and the problems of disposing them at the end of their life cycle. This can include "designing, manufacturing, using, and disposing of computers, servers, and associated subsystems - such as monitors, printers, storage devices, and networking and communications systems - efficiently and effectively with minimal or no impact on the environment".

The objective of Green computing is to reduce the use of hazardous materials, maximize energy efficiency during the product's lifetime, and promote the recyclability or biodegradability of defunct products and factory waste. Such practices include the implementation of energy-efficient Central Processing Units (CPUs), servers and peripherals as well as reduced resource consumption and proper disposal of electronic waste (e-waste).

I.   Green Computing Best Practices

Government regulation, however well-intentioned, is only part of an overall green computing philosophy. The work habits of computer users and businesses can be modified to minimize adverse impact on the global environment. Some of such steps for Green IT include the following:

1.   Develop a sustainable Green Computing plan

♦   Involve stakeholders to include checklists, recycling policies, recommendations for disposal of used equipment, government guidelines and recommendations for purchasing green computer equipment in organizational policies and plans;

♦   Encourage the IT community for using the best practices and encourage them to consider green computing practices and guidelines.

♦   On-going communication about and campus commitment to green IT best practices to produce notable results.

♦   Include power usage, reduction of paper consumption, as well as recommendations for new equipment and recycling old machines in organizational policies and plans; and

♦ Use cloud computing so that multiple organizations share the same computing resources thus increasing the utilization by making more efficient use of hardware resources.

2. Recycle

♦ Dispose e-waste according to central, state and local regulations;

♦ Discard used or unwanted electronic equipment in a convenient and environmentally responsible manner as computers emit harmful emissions;

♦ Manufacturers must offer safe end-of-life management and recycling options when products become unusable; and

♦ Recycle computers through manufacturer's recycling services.

3. Make environmentally sound purchase decisions

♦ Purchase of desktop computers, notebooks and monitors based on environmental attributes;

♦ Provide a clear, consistent set of performance criteria for the design of products;

♦ Recognize manufacturer efforts to reduce the environmental impact of products by reducing or eliminating environmentally sensitive materials, designing for longevity and reducing packaging materials; and

♦ Use Server and storage virtualization that can help to improve resource utilization, reduce energy costs and simplify maintenance.

4. Reduce Paper Consumption

♦ Reduce paper consumption by use of e-mail and electronic archiving;

♦ Use of "track changes" feature in electronic documents, rather than red line corrections on paper;

♦ Use online marketing rather than paper based marketing; e-mail marketing solutions that are greener, more affordable, flexible and interactive than direct mail; free and low-cost online invoicing solutions that help cut down on paper waste; and

♦ While printing documents; make sure to use both sides of the paper, recycle regularly, use smaller fonts and margins, and selectively print required pages.

5.   Conserve Energy

♦ Use Liquid Crystal Display (LCD) monitors rather than Cathode Ray Tube (CRT) monitors;

♦ Develop a thin-client strategy wherein thin clients are smaller, cheaper, simpler for manufacturers to build than traditional PCs or notebooks and most importantly use about half the power of a traditional desktop PC;

♦ Use notebook computers rather than desktop computers whenever possible;

♦ Use the power-management features to turn off hard drives and displays after several minutes of inactivity;

♦ Power-down the CPU and all peripherals during extended periods of inactivity;

♦ Try to do computer-related tasks during contiguous, intensive blocks of time, leaving hardware off at other times;

♦ Power-up and power-down energy-intensive peripherals such as laser printers according to need;

♦ Employ alternative energy sources for computing workstations, servers, networks and data centers; and

♦ Adapt more of Web conferencing offers instead of travelling to meetings in order to go green and save energy.

II.   Green IT Security Services and Challenges

IT solution providers are offering green security services in many ways. What to look in green security products, the challenges in the security services market and how security services fare in a recession. If administered properly with other green computing technologies, green security can be a cost-efficient and lucrative green IT service for solution providers. The basic aim is to increase the customer's energy savings through green security services and assess that 'how sustainable computing technology can immediately help the environment'. Green IT services present many benefits for clients as well as

providers, but knowing 'how to evaluate a client's infrastructure to accommodate green technology is really a vital issue'.

Moreover, apart from the common security issues, the green security emphasizes the role of security tools, methods and practices that reduce a company's environmental impact. But to estimate the scope, to cope with the lack of green security services in the market and get advice on conserving power and purchasing switches is very important and needs a high level of sensitivity. Learning about the challenges of implementing green security and the best practices is a major hope, as the artifacts are still evolving.

4.8.6 Bring Your Own Device (BYOD)

BYOD (Bring Your Own Device) refers to business policy that allows employees to use their preferred computing devices, like smart phones and laptops for business purposes. It means employees are welcome to use personal devices (laptops, smart phones, tablets etc.) to connect to the corporate network to access information and application. The BYOD policy has rendered the workspaces flexible, empowering employees to be mobile and giving them the right to work beyond their required hours. The continuous influx of readily improving technological devices has led to the mass adoption of smart phones, tablets and laptops, challenging the long-standing policy of working on company-owned devices. Though it has led to an increase in employees' satisfaction but also reduced IT desktop costs for organizations as employees are willing to buy, maintain and update devices in return for a one-time investment cost to be paid by the organization.

In the early 1990s, executing different tasks necessitated the use of different devices. For instance, an mp3 player was needed to listen to music; whereas chores, tasks and schedules were tracked by a PDA. An addition to this, list was a bulky laptop and a camera and it seemed waiting till eternity that we would ever have a single device to suit our different needs. However, remarkable advances in technology in the last decade have made it possible to perform all the above-mentioned tasks using a single hi-tech device. Different technologies can work in synergy with each other, which improves user productivity and convenience.

I.   Advantages of BYOD

♦   **Happy Employees:** Employees love to use their own devices when at work. This also reduces the number of devices an employee has to carry; otherwise he would be carrying his personal as well as organization provided devices.

♦ **Lower IT budgets:** Could involve financial savings to the organization since employees would be using the devices they already possess thus reducing the outlay of the organization in providing devices to employees.

♦ **IT reduces support requirement:** IT department does not have to provide end user support and maintenance for all these devices resulting in cost savings.

♦ **Early adoption of new Technologies:** Employees are generally proactive in adoption of new technologies that result in enhanced productivity of employees leading to overall growth of business.

♦ **Increased employee efficiency:** The efficiency of employees is more when the employee works on his/her own device. In an organization provided devices, employees have to learn and there is a learning curve involved in it.

II. **Emerging BYOD Threats**

Every business decision is accompanied with a set of threats and so is BYOD program too; it is not immune from them. As outlined in the Gartner survey, a BYOD program that allows access to corporate network, emails, client data etc. is one of the top security concerns for enterprises. Overall, these risks can be classified into four areas as outlined below:

♦ **Network Risks:** It is normally exemplified and hidden in 'Lack of Device Visibility'. When company-owned devices are used by all employees within an organization, the organization's IT practice has complete visibility of the devices connected to the network. This helps to analyze traffic and data exchanged over the Internet. As BYOD permits employees to carry their own devices (smart phones, laptops for business use), the IT practice team is unaware about the number of devices being connected to the network. As network visibility is of high importance, this lack of visibility can be hazardous. For example, if a virus hits the network and all the devices connected to the network need be scanned, it is probable that some of the devices would miss out on this routine scan operation. In addition to this, the network security lines become blurred when BYOD is implemented.

♦ **Device Risks:** It is normally exemplified and hidden in 'Loss of Devices'. A lost or stolen device can result in an enormous financial and reputational embarrassment to an organization as the device may hold

sensitive corporate information. Data lost from stolen or lost devices ranks as the top security threats as per the rankings released by Cloud Security Alliance. With easy access to company emails as well as corporate intranet, company trade secrets can be easily retrieved from a misplaced device.

♦ **Application Risks:** It is normally exemplified and hidden in 'Application Viruses and Malware'. A related report revealed that a majority of employees' phones and smart devices that were connected to the corporate network weren't protected by security software. With an increase in mobile usage, mobile vulnerabilities have increased concurrently. Organizations are not clear in deciding that 'who is responsible for device security – the organization or the user'.

♦ **Implementation Risks:** It is normally exemplified and hidden in 'Weak BYOD Policy'. The effective implementation of the BYOD program should not only cover the technical issues mentioned above but also mandate the development of a robust implementation policy. Because corporate knowledge and data are key assets of an organization, the absence of a strong BYOD policy would fail to communicate employee expectations, thereby increasing the chances of device misuse. In addition to this, a weak policy fails to educate the user, thereby increasing vulnerability to the above-mentioned threats.

4.8.7 Web 3.0

The term **Web 3.0,** also known as the **Semantic Web**, describes sites wherein the computers will be generated raw data on their own without direct user interaction. Web 3.0 is considered as the next logical step in the evolution of the Internet and Web technologies. Initially, the Internet is confined within the physical walls of the computer, but as more and more devices such as smartphones, cars and other household appliances become connected to the web, the Internet will be omnipresent and could be utilized in the most efficient manner.

I.   Underlying Concept

Web 3.0 standard uses semantic web technology, drag and drop mash-ups, widgets, user behavior, user engagement, and consolidation of dynamic web contents depending on the interest of the individual users. Web 3.0 technology uses the "Data Web" Technology, which features the data records that are publishable and reusable on the web through query-able formats.

The Web 3.0 standard also incorporates the latest researches in the field of artificial intelligence.

An example of typical Web 3.0 application is the one that uses content management systems along with artificial intelligence. These systems can answer the questions posed by the users, because the application can think on its own and find the most probable answer, depending on the context, to the query submitted by the user. In this way, Web 3.0 can also be described as a "machine to user" standard in the internet.

II.   **Components of Web 3.0**

♦   **Semantic Web:** This provides the web user a common framework that could be used to share and reuse the data across various applications, enterprises, and community boundaries. This allows the data and information to be readily intercepted by machines, so that the machines are able to take contextual decisions on their own by finding, combining and acting upon relevant information on the web.

♦   **Web Services:** It is a software system that supports computer-to-computer interaction over the Internet. For example - the popular photo-sharing website Flickr provides a web service that could be utilized and the developers to programmatically interface with Flickr in order to search for images.

To conclude, Web 3.0 helps to achieve a more connected open and intelligent web applications using the concepts of natural language processing machine learning, machine reasoning and autonomous agents.

As technology evolves new application are coming into use. These applications are further changing the way individuals/businesses/government interact with each other and do business. Moving ahead, a new concept Web 4.0 is set to evolve; proposed to be autonomous, proactive, content-exploring, self-learning, collaborative, and content-generating agents based on fully matured semantic and reasoning technologies as well as Artificial Intelligence. These services will support adaptive content presentation that will use the Web database via an intelligent agent. Examples might be services interacting with sensors and implants, natural-language services or virtual reality services.

4.8.8 Internet of Things (IoT)

I.   Definition: The **Internet of Things (IoT)** is a system of interrelated computing devices, mechanical and digital machines, objects, animals or people that are provided with unique identifiers and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction. For example:

(i)   Washing machines with Wi-Fi networking capabilities can connect themselves to home Wi-Fi. Once these machines are so connected, they can be controlled through machine manufacturer mobile APP from anywhere in the world.

(ii) India's living legend of cricket appearing in an Advertisement for water purifier informs that, the water purifier is Wi-Fi enabled. When the purifying agents deplete in the machine, it connects to home Wi-Fi and informs the service agents of the company.

All above examples are from products being sold in India.

II. Future: Gartner, the technology researcher has projected that by 2020 the IOT business across the world would increase to USD 1.9 Trillion. In rupee terms at current exchange rate (INR::UDS=67.50::1) it comes to a staggering ₹ 1,34,0,00,00,00,00,000.00 or keeping it simple virtually equal to India's GDP today.

III. Applications: Some of the applications are as follows:

♦   All home appliances to be connected and that shall create a virtual home.

   a.   Home owners can keep track of all activities in house through their hand-held devices.

   b.   Home security CCTV is also monitored through hand held devices.

♦   Office machines shall be connected through net.

   a.   Human resource managers shall be able to see how many people have had a cup of coffee from vending machine and how many are present.

   b.   How many printouts are being generated through office printer?

♦   Governments can keep track of resource utilizations / extra support needed.

a. Under SWACHH mission government can tag all dustbins with IOT sensors. They (dustbins) generate a message once they are full. Being connected to Wi-Fi, they can intimate the cleaning supervisor of Municipal Corporation so that BIN can be emptied.

♦ As a research study, individuals have got themselves implanted with electronic chips in their bodies. This chip allows him / her to connect to home / office Wi-Fi. Once connected person can enter home / office and perform designated function. This chip becomes individual's authentication token.

♦ *<u>Wearables:</u> Just like smart homes, wearables remain another important potential IoT application like Apple smartwatch.*

♦ *<u>Smart City:</u> Smart cities, like its name suggests, is a big innovation and spans a wide variety of use cases, from water distribution and traffic management to waste management and environmental monitoring.*

♦ *<u>Smart Grids:</u> Smart grids are another area of IoT technology that stands out. A smart grid basically promises to extract information on the behaviors of consumers and electricity suppliers in an automated fashion to improve the efficiency, economics, and reliability of electricity distribution.*

♦ *<u>Industrial Internet of things:</u> One way to think of the Industrial Internet is by looking at connected machines and devices in industries such as power generation, oil, gas, etc. for monitoring and improving control efficiency. With an IoT enabled system, factory equipment that contains embedded sensors communicate data about different parameters, such as pressure, temperature, and utilization of the machine. The IoT system can also process workflow and change equipment settings to optimize performance.*

♦ *<u>Connected Car:</u> Connected car technology is a vast and an extensive network of multiple sensors, antennas, embedded software, and technologies that assist in communication to navigate in our complex world.*

♦ *<u>Connected Health (Digital Health/Telehealth/Telemedicine):</u> IoT has various applications in healthcare, which are from remote monitoring equipment to advance and smart sensors to equipment*

integration. It has the potential to improve how physicians deliver care and keep patients safe and healthy.

♦ <u>*Smart Retail:*</u> *Retailers have started adopting IoT solutions and using IoT embedded systems across several applications that improve store operations, increasing purchases, reducing theft, enabling inventory management, and enhancing the consumer's shopping experience.*

♦ <u>*Smart Supply Chain:*</u> *Supply chains have already been getting smarter for a couple of years. Offering solutions to problems like tracking of goods while they are on the road or in transit or helping suppliers exchange inventory information are some of the popular offerings.*

IV. **Risks:** Internet of thing is an evolving phenomenon. The nature of risk is carries is based on academic logics and available practical experiences. The risk listed are those which are most discussed for IOT today. As technology evolves issues shall crop up. The risk due to IOT has various facets to it:

(A) **Risk to Product manufacturer**

Manufacturers may be out of business in few years if IoT becomes a necessary product feature.

♦ **Data storage and analytics:** The manufacturers will to ensure the huge data generated from IOT devices is kept secured. Hacking / Loosing this data may be distractors for entity as well as the individual to whom it relates to.

(B) **Risk to user of these products**

♦ **Security:** This is the greatest risk due to IOT. As home devices / office equipment's are connected to network they shall be hit by all network related risks, including hacking, virus attacks, stealing confidential data etc.

♦ **Privacy, autonomy and control:** There is a huge risk that individuals may lose control over their personal life. Their personal life can be hacked and made public. The other major concern is who has the ownership of this personal data. For example: A person daily eats a burger at 12.00 in night and takes bottle of chilled hard drink with it. S/he uses his / her mobile to operate the griller and refrigerator. The griller and refrigerator are both sold by say XYZ ltd. This data is available on XYZ database.

      o   Who owns this information?

      o   The data can be used by insurance companies to deny an insurance claim saying the person was a habitual drinker or raise his / her medical insurance premium as the person is having a risky life style.

            Above illustrates the big risk IOT may create for individuals.

    ♦   **Intentional obsolescence of devices:** This may happen due to -

      o   Companies which want to bring a new product may force users to dump the old products. This they can do by disabling the operating software of old product.

      o   A manufacturer is bought out by another manufacturer. The buyer does not support old products sold.

(C) **Technology Risk**

Platform fragmentation and lack of technical standards are situations where the variety of IoT devices, in terms of both hardware variations and differences in the software running on them, makes the task of developing applications tough.

(D) **Environmental Risk due to Technology**

These studies are being done to see the impact on house air quality, due to use of heavy earth metals in devices. There no definitive data available as of now, but the risk is being considered.

4.8.9 Artificial Intelligence (AI)

I. **Definition:** Intelligence, as defined in Chambers dictionary; "The ability to use memory, knowledge, experience, understanding, reasoning, imagination and judgement to solve problems and adapt to new situations". The ability described above when exhibited by machines is called as **Artificial intelligence (AI)**. It is intelligence exhibited by machines. For example:

i.   This technology is being used in autonomous vehicles, the google car.

ii.   Apple online assistant Siri is supposed to use it.

II. **Applications**

Artificial Intelligence is being used in the following applications:

    ♦   Autonomous vehicles (such as drones and self-driving cars);

- Medical diagnosis, in cancer research. Predicting the chances of an individual getting ill by a disease;

- Creating art (such as poetry);

- Proving mathematical theorems;

- Playing games (such as Chess or Go), and predicting the outcomes. Say which number on a lottery ticket may win;

- Search engines (such as Google search);

- Online assistants (such as Siri);

III.   Risks

1.   AI relies heavily of data it gets. Incorrect data can lead to incorrect conclusions.

2.   AI (robots) carries a security threats. Countries are discussing to have a KILL button in all AI capable machines. This is important otherwise someday machine may start controlling humans.

3.   AI in long term may kill human skills of thinking the unthinkable. All data shall be processed in a structured manner, where machines shall provide solution based on their learning over a period of time. These machines shall not have capability of thinking out of box.

IV.   Controls

The set of controls in AI will be extremely complex because of the nature of processing of information and must be dealt with based on the nature of the AI tool and the purpose, etc.

4.8.10 Machine Learning

I.   Definition: Machine Learning is a type of Artificial Intelligence (AI) that provides computers with the ability to learn without being explicitly programmed. Machine learning focuses on the development of computer programs that can change when exposed to new data. The process of machine learning is similar to that of data mining. For example:

- Machine learning has been used for image, video, and text recognition, as well as serving as the power behind recommendation engines. Apple SIRI is a good example.

- This technology is being is being used in autonomous vehicles, the google car.

II. **Applications:** Virtually all applications were in AI using Machine learning so that some value is added. It includes specifically following application:

   1. Autonomous vehicles (such as drones and self-driving cars),

   2. Medical diagnosis, in cancer research. Predicting the chances of an individual getting ill by a disease.

   3. Playing games (such as Chess or Go), and predicting the outcomes. Say which number on a lottery ticket may win.

   4. Search engines (such as Google search),

   5. Online assistants (such as Siri),

III. **Risk:** Machine learning being an application based on AI, the nature of risk to it remain similar to those posed by AI systems.

4.9 CASE STUDIES

I. **Category: Flipkart started as e-commerce and has now moved to m-commerce space.**

Back in 2007, when Flipkart was launched, Indian **e-commerce** industry was taking its beginner steps. The company is registered in Singapore, but their headquarters are in the city of Bangalore, India. The promoters are Binny Bansal and Sachin Bansal. They left their jobs in Amazon to start their own business. One can easily call that a risky move.

Flipkart began selling books to begin with. It soon expanded and began offering a wide variety of goods. Innovating right from the start, Flipkart has been home to few of the striking features of Indian e-commerce. Flipkart success in the first few years of its existence. Flipkart raised funds through venture capital funding. As the company grew in stature, more funding arrived.

Flipkart addressed to major issues in online purchasing in India. Indians love to pay after checking the products so Flipkart was the first to implement the popular **'Cash On Delivery'** facility, which every online shopping website in India offers as an option today. Second major issue Flipkart addressed was timely delivery. It was more of a cultural revolution to ensure the whole supply chain was revamped and sensitized to issue of timely delivery.

II. **Category: JUGNOO started as a m-commerce company.**

Jugnoo is an auto-rickshaw aggregator, focused on doubling the driver's efficiency and earnings, and providing affordable

transportation to the masses on a tap. There are around 5 million auto-rickshaws in our country, whereas the utilization is only 30%. It started operation in October 2014 from Chandigarh.

Despite being one of the most popular and economical modes of public transportation in India, auto-rickshaws have remained highly underutilized due to inefficiencies prevalent in the conventional hailing procedure such as availability and fares. Jugnoo was started with a vision to overcome these roadblocks by bringing structure into this space, aggregating auto-rickshaws via technology, thereby, enabling optimum utilization of resources.

III.   Category: OYO started as a m-commerce company.

OYO means **"ON YOUR OWN"**. OYO Rooms was nothing but an idea to create India's largest chain of efficient, young, standardized rooms with an intention to build the coolest chain of no add-on rooms which might not have Spa, Gym etc. like the star hotels but will live upto the basic standards & high expectations for prices like never before. They have few basic amenities including, clean rooms, clean linen, AC, clean bathroom, free Wi-Fi, free breakfast.

The teenage boy – Ritesh Agarwal is the young Founder and CEO of OYO Rooms - fastest growing Branded network of hotels offline & online. OYO rooms do nothing out of the box but provides travelers the coolest yet cheapest efficient, young, standardized rooms with no add-ons attached to it!

SUMMARY

Today electronic commerce is ruling the world. Every day there is a start-up in the e-commerce / m-commerce space. This is forcing traditional businesses to adopt to this new way of doing business. E-commerce/M-commerce both have related sets of risks and necessary controls to be put in place. They are generating huge benefits to society in terms of saving costs and time. E-commerce and M-commerce being the new way doing business has its run ins with law also. The legality/implications of such transactions are being tested in courts across the world including India. Laws are being updated / amended to keep pace with these new business trends. Emerging technology like Internet of Things, AI, Machine learning is changing the way humans interact with technology. These technologies are automating human tasks and creating options to carry those tasks which could not have done previously.

TEST YOUR KNOWLEDGE

Theory Questions

1. Define the following:
   (i)   E- Commerce (Refer Section 4.1)
   (ii) M-Commerce (Refer Section 4.3.4)
   (iii) Machine learning (Refer Section 4.8.10)
   (iv) Bring Your Own Device (BYOD) (Refer Section 4.8.6)
   (v)   Grid Computing Security (Refer Section 4.8.2)

2. Discuss in detail various components of E-Commerce.
   (Refer Section 4.2)

3. Discuss the architecture of Networked Systems.
   (Refer Section 4.3)

4. Differentiate Traditional Commerce and E- Commerce.
   (Refer Section 4.1.2)

5. What are the risks associated with E-Commerce Transactions that are high as compared to general Internet activities?
   (Refer Section 4.5)

6. Explain efficiency improvement due to E- Business.
   (Refer Section 4.1.4)

7. Define the Guidelines for E - Commerce.
   (Refer Section 4.6.1)

8. Explain the types of Network Architecture.
   (Refer Section 4.3)

9. What are the ways of protecting your e-Commerce business from intrusion?
   (Refer Section 4.5)

10. Explain Digital Payments? Define different Types of Digital Payments?
    (Refer Section 4.7)

11. What are some drawbacks of Digital Payments?
    (Refer Section 4.7.3)

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12. What do you mean by "Cloud Computing"? Discuss its characteristics.
    (Refer Section 4.8.3)

13. Differentiate between different types of clouds in Cloud Computing.
    (Refer Section 4.8.3)

14. Discuss various components of Mobile Computing.
    (Refer Section 4.8.3)

15. Discuss some best practices of Green Computing.
    (Refer Section 4.8.3)

Multiple Choice Questions

1. Which one of the following is not an Operating system?
   (a) Android
   (b) Blackberry OS
   (c) FireFox OS
   (d) Chrome OS

2. In two-tier architecture, _____ is an interface that allows user to interact with the e-commerce / m-commerce vendor.
   (a) Presentation Tier
   (b) Database Tier
   (c) Physical Tier
   (d) Application Tier

3. FEMA stands for _____.
   (a) Foreign Exchange Management Activity
   (b) Foreign Exchange Management Act
   (c) Foreign Exchange Managerial Act
   (d) Foreign Enterprise Management Act

4. UPI stands for _____.
   (a) Universal Payment Interface
   (b) Unified Proximity Interface
   (c) Unified Payment Interface
   (d) Unified Payment Interaction

5.   BHIM (Bharat Interface for Money) is an example of _____.

  (a)   Mobile App

  (b)   Mobile Hardware

  (c)   Mobile Operating System

  (d)   Mobile Wallet

6.   Which of the following is not a best practice under Green Computing?

  (a)   Dispose e-waste according to central, state and local regulations

  (b)   Purchase of desktop computers, notebooks and monitors based on environmental attributes

  (c)   Power-down the CPU and all peripherals during extended periods of inactivity

  (d)   Use Cathode Ray Tube (CRT) monitors than Liquid Crystal Display (LCD) monitors

7.   GSM stands for _____.

  (a)   Global Service for Mobile Communication

  (b)   Global System for Mobile Communication

  (c)   Global Semantics for Mobile Communication

  (d)   Global System for Mobile Code

8.   Which of the following is the correct sequence of Mobile Computing?

  (i)   The user enters or access data using the application on handheld computing device.

  (ii)   Now both systems (handheld and site's computer) have the same information and are in sync.

  (iii) The process work the same way starting from the other direction.

  (iv)   Using one of several connecting technologies, the new data are transmitted from handheld to site's information system where files are updated and the new data are accessible to other system user.

  (a)   (i), (ii), (iii), (iv)

  (b)   (iv), (iii), (ii), (i)

  (c)   (i), (ii), (iv), (iii)

  (d)   (i), (iv), (ii), (iii)

9. AEPS stands for _____.

    (a)   Aadhaar Enabled Payment Station

    (b)   Aadhaar Employed Payment Service

    (c)   Aadhaar Enabled Payment Service

    (d)   Aadhaar Enterprise Payment Service

10. Which instance of SaaS allows users to explore functionality of Web services such as Google Maps, Payroll processing, and credit card processing services etc.?

    (a)   Testing as a Service (TaaS)

    (b)   Communication as a Service (CaaS)

    (c)   Data as a Service (DaaS)

    (d)   API as a Service (APIaaS)

Answers

1	(d)	2	(a)	3	(b)	4	(c)	5	(a)	6	(d)	7	(b)
8	(d)	9	(c)	10	(d)								