

Social Computing

Syllabus

Web 2.0 and 3.0, Social Computing in Business-Shopping, Marketing Operational and Analytical CRM, E-business and E-commerce – B2B B2C, Mobile Commerce

5.1 Introduction

Human beings are social by nature. Living and learning together, communicating with and helping each other have been the hallmark of human society. We are at our best when in groups that we feel comfortable with, and at our worst when we see those around us as "different" in some way. We can not live in isolation. It is perhaps then unsurprising that our use of computing and computer tools has turned to the social elements of our lives as well. In fact, if we look at the world around us we find people using electronic medium more to get socially connected.

Internet was a revolution. It introduced web technologies which have brought a huge change in the lives of people everywhere. Billions of people hooked to it, make it the biggest society on earth. From an initial stage when it was a platform to exchange messages through e-mails and search for information (static in nature) it has reached a stage of social media, shopping, transactions, information availability in every form and about just anything. The benefits are so much and so many that we cannot afford to miss it. Businesses are quick to see and avail a huge opportunity which this new world offers.

Through this chapter you are going to learn about the new computing tools that are helping people and businesses change their fortunes.

5.1.1 Social Computing

Social computing is an area of computer science concerned with the collaboration of social behavior and computational system. It is basically the use of computer and the internet for social purposes. In social computing, the internet allows users to interact with each other through many mediums. Before the internet, computers were largely used as tools for increasing productivity. The Internet introduced a social element where users could network, share interests, publish personal insights and use their computers for more than just doing a job faster. Blogs, e-mails, instant messaging, social network services, wikis and other services are the media through which people interact with each other.

Social computing can also benefit businesses to a great extent if it is used for business purposes. For example, social computing can be used to market products and promote customer relations. Online marketing and viral marketing are two types of promotional advertising that have grown out of social computing.

5.1.2 Benefits

1. It offers a technology-based platform that lowers the cost for individuals to create and distribute contents.
2. It gives the combined effect of TV, radio and magazines for getting and exchanging information.
3. There is an increasing acceptance of information coming out from non-authoritative sources such as social media site, blogging and micro blogging sites.
4. It offers people to form their own community for raising support for any issue, developing a concept, sharing information for mutual benefits.
5. It allows people to showcase their ability by promoting themselves and creating a market for themselves.

5.1.3 Benefits for Organizations

1. Increased collaboration

The collaborative exchange of ideas is essential to the success of challenging business initiatives, including software architecture and design, project management and organizational transformation. Tools such as social networking sites, discussion groups and wikis enable people to connect with one another virtually while enhancing and extending face-to-face interaction.

Organizations see improved collaboration surrounding creation of user groups and complex design. In each case, participants from otherwise isolated parts of the organization share problems and solutions, reducing redundancy and increasing common functionality.

2. Enhanced innovation

Use of social computing creates a new stage for innovation, where ideas are more easily exposed and patterns recognized. As communities discuss new ideas in public forums, innovative thinking emerges. For example, Amazon uses social computing (especially wikis) extensively in the development of new features for Amazon.com.

3. Better productivity

The social computing builds the collective intelligence of the community which leads to increased productivity as a result of more efficient access to correct information. This reduces the time needed and accelerates the early stages of a project and simplifies future iterations.

4. Better employee relations

Social computing allows employees to connect more easily with one another and with the corporation. Shared connections enhance face-to-face interactions and a sense of belonging. Social networks, blogs and wikis create a forum for the voice of the employee to be heard. As a result there is a lower rate of attrition, and employees are generally more productive and have a better sense of the overall objectives of the company.

5. Better promotion and public relations

Many organizations today use public-facing social computing as a means of projecting its brand. From executive blogs to consumer communities, organizations are trying their hand at increasing customer loyalty in innovative ways.

5.2 World Wide Web (WWW)

The World Wide Web (WWW) is a network of online content that is formatted in HTML and accessed via HTTP. The term refers to all the interlinked HTML pages that can be accessed over the internet. The World Wide Web was originally designed in 1991 by Tim Berners-Lee. The World Wide Web is most often referred to simply as "the Web."

Development phases of Web

- **Phase 1 (Web 1.0):** According to Tim Berners-Lee the first implementation of the web, representing the Web 1.0, could be considered as the "read-only web." The average internet user's role was limited to reading the information which was presented to him in the form of static web pages. There was very little in the way of user interaction or content contribution.
- **Phase 2 (Web 2.0):** The lack of active interaction of common users with the web lead to the birth of Web 2.0. Now even a non-technical user can actively interact & contribute to the web using different blog or social platforms. According to Berners-Lee's, the Web 2.0, or the "read-write" web has the ability to contribute content and interact with other web users. This interaction and contribution has dramatically changed the landscape of the web. This era empowered the common user with a few new concepts like Blogs, Social-Media & Video-Streaming. Publishing your content is only a few clicks away! Examples are Twitter, YouTube, Facebook, etc.
- **Phase 3 (Web 3.0):** Today in 2019, we're living in this phase. Web 3.0 technology is becoming part of our everyday life. The Web 3.0 would be a "read-write-execute" web. The Web 3.0 promises the potential for applications that can speak to each other directly, and for broader searches for information through simpler interfaces.
- **Phase 4 (Web 4.0):** The next step is actually an alternate version of what we already have. Mobile technology led us to experience the social web in a completely different way...from lap-top to always on. The web needed to adapt to its mobile surroundings. Web 4.0 technology is a mobile version of web 2.0

5.3 Web 2.0

Web 2.0 means the internet applications which allow sharing and collaboration opportunities to people and help them to express themselves online.

"**Web 2.0 is the business revolution in the computer industry caused by the move to the internet as a platform, and an attempt to understand the rules for success on that new platform.**" – Tim O' Reilly.

Web 2.0 is an improved version of the web 1.0, characterized specifically by the change from static to dynamic or user-generated content and also the growth of social media. Web 2.0 concept focuses on rich web applications, web-oriented architecture and social web.

Web 2.0 examples are Google Maps, Google Docs, Flickr), YouTube, wikis, blogs, social networking like Facebook, micro-blogging apps like Twitter, podcasting like Podcast Alley & content hosting services and many more.

5.3.1 Key Aspects of Web 2.0

At a conceptual level, Web 2.0 is concerned with establishing and maintaining online connections between people, services and information. Web 2.0 defines the three key aspects:

- **Interpersonal computing :** It involves person-to-person interactions provided by websites that enable collaborative content creation, sharing and manipulation.
- **Web services :** It involves application-to-application data and service exchanges facilitated by automated connections between web servers and other internet technologies.
- **Software As A Service (SAAS) :** It involves human interactions with digital content through applications delivered over the web freeing the user from locally installed software.

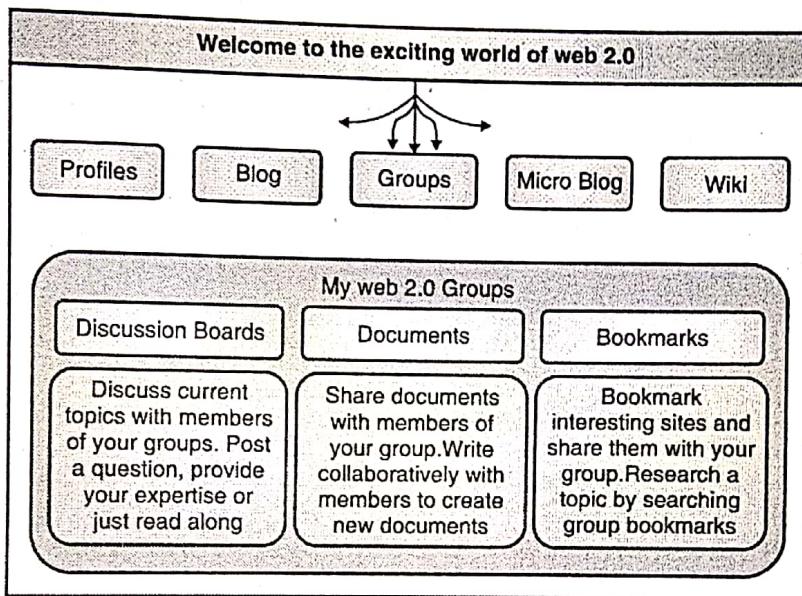


Fig. 5.3.1 : Web 2.0

The interpersonal computing aspects of Web 2.0 are most commonly associated with the development of wikis, blogs, social networking sites, and viral video sites.

- **Wikis** are websites that allow visitors to easily add, remove and edit content, hence enabling the collaborative authorship of comprehensive documents. The best example of a wiki is the multi-lingual, web-based encyclopaedia Wikipedia.
- **Blog** is a chronological, journal-style website which its author or "blogger" maintains like an online diary. There are now a whole host of websites that enable anybody to start their own blog, such as Word Press or Blogger. You can also "micro blog" using Twitter
- **Social Networking Sites (SNS)** enable people to build social networks online. Groups established within such communities are existing friendships and teams and are facilitated by online tools for sending individual messages, file sharing (particularly photo sharing), discussion forums, and online chat. The most popular social networking sites is Facebook.
- **Viral video sites** are websites that allow anybody to post videos online. The significance of viral video sites is that they provide a place to put videos where it is likely that at least some other people will actually find them. The giant of viral video sites is YouTube.

5.3.2 Core Web 2.0 Principles

Web 2.0 developments present both individuals and organizations with many new business and computing opportunities. O'Reilly suggests that the core of Web 2.0 is the following seven principles:

- The web to be used as a new platform for content development and sharing
- Harnessing collective intelligence by aggregating more and better content via social networking sites, wikis, blogs and viral video
- Data as the next Intel inside which suggests that value will increasingly become associated with data and its management
- The end of the software release cycle which will be as a consequence of continually updated SaaS applications accessed online.
- Lightweight programming models which relates to the increased use of more open and more flexible online programming tools and languages in systems development
- Software above the level of a single device which refers to a world in which all data, web services and SaaS applications will become accessible from any desktop or mobile computing device that has wired or wireless internet access
- Rich user experiences which reflect the increasing trend for audio, video and interactive online content

5.3.3 Five Major Features of Web 2.0

1. Free sorting of information permits users to retrieve and classify the information collectively.
2. Dynamic content that is responsive to user input.
3. Information flows between site owner and site users by means of evaluation & online commenting.
4. Developed APIs to allow self-usage, such as by a software application.
5. Web access leads to connect different, from the traditional internet user base to a wider variety of users.

5.3.4 Advantages of Web 2.0

- Available at any time, any place
- Variety of media
- Ease of usage
- Learners can actively be involved in knowledge building.
- Can create dynamic learning communities
- Everybody is the author and the editor, every edit that has been made can be tracked.
- User friendly
- Updates in wiki are immediate and it offers more sources for researchers.
- Provides real-time discussion

The use of web 2.0 technologies and tools attracts greater participation in projects and idea sharing, thus ideally leading to better designs and more efficient production, strengthening bonds with customers and improving communications with partners.

5.4 Web 3.0

Web 3.0 is an intelligent web technology that provides third generation of internet-based services. The term was coined by John Markoff in 2006. He explained, "There is no easy consensus about how to define what is meant by Web 3.0, but it is generally seen as a reference to the semantic Web. While it is not that much more precise a phrase, the semantic Web refers to technology to make using the internet better, by understanding the meaning of what people are doing, not just the way pages link to each other."

Web 3.0 is supposed to be more connected and intelligent with the use of major emerging technology trends like semantic web, data mining, machine learning, natural language processing, artificial intelligence and other such technologies. So Web 3.0 is the idea of a web that will store information in such a way that computers and other devices will understand on their own. FB app and Google Voice search, Apple's Siri are some of the examples of web 3.0.

Chances are that you are pretty familiar with the concept of Web 3.0 already. Every time you buy something on Amazon, the website's algorithm will look at the other items that people who have purchased your product went on to buy and then recommends that to you. So, think about what is going on here. The website is learning from other users what your preferred choices can be and then use it to recommend to you what you may like. In essence, the website itself is learning and becoming more intelligent.

5.4.1 Features that can help us understand Web 3.0

- **Semantic web:** The evolution of the Web 3.0 involves the Semantic Web. The semantic web improves web technologies to create, share and connect contents through search and analysis based on the capability to comprehend the meaning of words, rather than on keywords or numbers.
- **Artificial Intelligence(AI):** Combining artificial intelligence capability with natural language processing in Web 3.0, computers can distinguish information human being wants in order to provide faster and more relevant results. They become more intelligent to fulfill the requirements of users.
- **3D graphics:** The three-dimensional design is being used widely in websites and services in Web 3.0. Museum guides, computer games, e-commerce, geospatial contexts, etc. are all examples that use 3D graphics.
- **Connectivity:** With Web 3.0, information is more connected thanks to semantic metadata. As a result, the user experience evolves to another level of connectivity that leverages all the available information.
- **Ubiquity:** On the web, content is accessible by multiple applications that every device is using. The services can be used everywhere using these devices and applications.

5.5 Social Computing in Shopping

Social computing in shopping is the combination of social media and e-commerce. It uses all of the key aspects of the social web like friends, groups, voting, comments and discussions and focuses them on the world's favorite activity which is shopping to create social shopping.

Social shopping attempts to use technology to replicate the social interactions found in physical mall and stores. It is like bringing your friends with you on the web while you shop.

Social shopping can take many forms like This Next, a social network devoted to shopping, or Product Wiki, a wiki devoted to product reviews and price comparisons.

Social shopping beats old-fashioned web shopping because it brings all types of products into one place. No more skipping around from site to site searching for that hard-to-find item.

Social shopping also has advantages over going to an actual store to shop. With social shopping, you are one click away from comparing prices, and you can easily find out what other people are saying about that Fossil watch or that Alexis Bittar necklace. And above all, it's fun. If you like shopping, you will love social shopping.

5.5.1 Major Categories of Social Shopping

Social shopping can have a wide range of categories but can largely be divided into five categories:

1. Group buying

Companies like Group on and Living social encourage group of people to buy together at wholesale prices or at special deal of the day.

2. Shopping communities

It brings like-minded together to discuss, share, shop and help communities. Many sites allow users to create custom shopping lists and share them with friends.

3. Recommendations

Recommendations engines allow buyers provide advice to fellow buyers and friends through conversations.

4. Social shopping markets places

They bring sellers and buyers together to connect and transact. This way it performs the role of e-commerce facilitator.

5. Shared shopping mechanism for catalog-based sites : These allow shoppers to form ad hoc collaborative shopping groups in which one person can drive an online shopping experience for one or more other people.

5.5.2 Components of a Social Shopping Website

1. Visual sharing
2. Online discussions
3. How to use product
4. Guides

5.5.3 Benefits for Buyers

1. They can get good deals via group buying, daily specials and more.
2. They can socialize while shopping and receive social support and rewards too.
3. They can know about products/services which never existed for them.

4. They can interact directly with brand representatives easily and quickly.

5.5.4 Benefits for Sellers

1. It improves the overall sales unit productivity.
2. It also increases revenue growth per customer.
3. Sellers can gain feedback from new customers, which is very important.
4. The sellers learn from customers through varying experience
5. It increases customer loyalty and trust.
6. It has the capacity to quickly liquidate overstocked or obsolete merchandise.

5.6 Social Computing in Marketing

Social computing often called social networking or social media is used to describe the way people share their thoughts, opinions and insights online using interactive technologies.

Social marketing is an application of social media. It is the way companies tap into social media to build brand awareness, customer loyalty and sales.

Social marketing aims to develop and integrate marketing concepts with social media to influence behavior of the people and communities for the greater social good.

Significance of Social Marketing

According to Forrester, the three tenets of Social Computing make its collaboration with marketing relevant. The three tenets are:

Communities driving innovation

Institutions facilitating experiences shaped and owned by communities

Communities taking power from institutions

5.6.1 Business Benefits of Social Marketing

1. Consistent audience growth

Every day, thousands of new users join social media sites around the world. One of the most important considerations for any business is how to reach and sell to its target customer audience. For companies that use social marketing, their followings are continuously growing and accessible.

2. Higher search engine ranking

Engagement on social media can lead to more than just direct transactions. It has been proven that social media commerce actually increases traffic to your website which will eventually influence your ranking on search engine results.

3. More authentic engagement and traffic

As already stated, actively working to grow your social media audience is a great first step in eventually making conversions. One of the most significant benefits of social marketing is the engagement and reach that businesses can

get whenever they share content. By showing up in a follower's updates feed on a regular basis, you're participating in a powerful branding opportunity. People who have regular contact with a company are more likely to recommend that company.

4. Customer loyalty and retention

In using social marketing for your business, you are aiming to sell and promote your products/services, but you are also aiming to build good relationships with people. By using this opportunity to engage with prospects, a company can build and maintain relationships that deepen trust and loyalty. This in turn creates customers that are happy and satisfied with your service, who will likely remain clients who make repeat purchases.

5. Business metrics from social media marketing

With your social marketing, you should analyze your efforts, and see if the results provide a positive ROI. Social media marketing makes it easy to measure and evaluate performances. Facebook pages, Instagram business accounts and tweets on Twitter have built-in metrics for impressions, engagements and reach.

5.6.2 Marketing Benefits of Social Media

Social media present great marketing opportunities for businesses of all sizes. You can use social media to:

- Promote the name of your brand and business
- Tell customers about your goods and services
- Find out what customers think of your business
- Attract new customers
- Build stronger relationships with existing customers.

Social media marketing advantages

- Social media can reach millions of people all around the world
- Many forms of social media (e.g. Facebook, Twitter, Instagram) allow businesses to target specific groups, often in particular locations
- Many forms of social media are free for business, and paid options are usually low-cost
- Social media allow you to communicate on a personal basis with individual customers and groups
- You can quickly distribute information to many people
- You don't need high-level skills or computer equipment to participate in social media. The average person with a standard computer should have no difficulty.

Risks of using social media

Marketing through social media also has its risks. These include:

- Wastage of time and money for little or no tangible return
- The rapid spread of the wrong kind of information about your business (e.g. incorrect information accidentally posted by you, negative reviews posted by others)

- You may have to face legal problems if you don't follow privacy legislation and the laws regarding spam, copyright and other online issues.

Key social media services

Different types of social media are good for different marketing activities. The key social media services are:

- **Facebook** - a social networking site that allows you to have conversations with customers, post photos and videos, promote special offers, and more
- **Twitter** - a 'micro-blogging' service that allows you to send and receive short messages from customers and potential customers
- **YouTube** - an online video-hosting service that lets people share their videos
- **Blogs** - internet sites that contain a series of entries or 'posts' about topics of interest to the author, much like an online 'diary'
- **Coupon sites** - websites that offer discount coupons for goods, services and events
- **Online photo-sharing services** - websites that allow users to store, organize and share their photo collections
- **Location-based marketing sites** - websites that deliver targeted marketing messages to customers in particular locations, through mobile devices such as smart phones and tablets
- **Customer review sites** - websites that feature customer reviews of goods and services.

5.7 Customer Relationship Management (CRM)

CRM is an approach for managing an organization's relationships and interactions with current and potential customers. It uses data analysis about customer's history with the organization to improve business relationship. A CRM system helps companies stay connected to customers, streamline processes, and improve profitability. CRM helps users focus on their organization's relationships with individual people including customers, service users, colleagues, or suppliers.

CRM is used as

Technology

CRM is used as a technology product that teams use to record, report and analyse interactions between the company and customers. This is also called a CRM system or solution.

Strategy

CRM is also used as a business' strategy to formulate how relationships with customers and potential customers should be developed and maintained.

Process

As a process CRM helps businesses nurture and manage relationships.

CRM Software

CRM software is used to record customer contact information such as email, telephone, website social media profile, and more. It can store details such as a client's personal preferences on communications. The software then organizes this information to give you a complete record of individuals and companies, so you can better understand your relationship over time.

CRM software improves customer relationship management by creating a 360° view of the customer, capturing their interactions with the business, and by surfacing the information needed to have better conversations with customers.

Why is CRM important?

CRM helps a business to strengthen its relationships with customers, service users, colleagues, partners and suppliers and also keep track of prospects and customers. It is important for customer acquisition and retention. CRM puts everything in one place — a simple, customizable dashboard that can tell you a customer's previous history with you, the status of their orders, any outstanding customer service issues, and more.

Gartner predicts that by 2021, CRM technology will be the single largest revenue area of spending in enterprise software. For forward-thinking businesses, CRM is the framework for that strategy.

5.7.1 Types of CRM

- (1) Operational CRM
- (2) Analytical CRMs
- (3) Collaborative CRMs

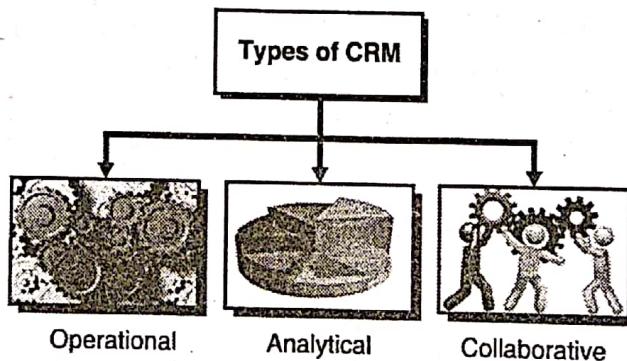


Fig. 5.7.1 : Types of CRM

Operational CRM

An operational CRM assists businesses in managing their day-to-day activities such as marketing, sales, and customer service operations. This is the most common type of CRM and is popular among businesses in a wide range of industries. Some of the operational areas it takes care of are

- **Marketing automation** tools allow you to automate your marketing, so that you can more effectively target customers at various stages of the sales process. For instance, an operational CRM initiates a predictable task like initiating an email campaign whenever a new prospect enters the system.
- **Sales force automation** is a major component of many CRM systems. This feature help an organization manage its pipelines, develop leads and acquire new customers. This might involve automatically tracking a contact and updating its status from prospect to qualified lead once he has completed certain actions or met specific criteria.
- **Service automation** is designed to provide a higher level of customer service. A CRM with service automation can provide helpful information via email, text message, or a phone helpline depending on customer preferences. This not only creates a more consistent customer experience, but it also frees up your team members to focus on more pressing tasks.

Analytical CRM

The function of analytical CRM is to manage the processes of customer acquisition and retention, as well as keep track of customer details. This is helpful for companies that want to collect and analyze a large amount of data.

The three main functions of an analytical CRM system are:

Customer acquisition

Here, the aim is to turn prospects into customers.

Customer retention

It helps in keeping current customers happy and coming back for more.

Managing data

It tracks customer interactions and other information that can improve your bottom line.

The more data your business gathers on consumer behavior and patterns the better you can tailor your marketing and sales strategies to new and existing customers.

Collaborative CRM

This CRM system is designed to improve the customer experience. Collaborative CRM features **streamline communication** for all parties, between the customer and your company and between various departments and stakeholders. It enables companies to **track and share customer data** with everyone from vendors and suppliers to tech support and marketing managers.

Making this information available internally not only strengthens the relationships but also keeps customers happy.

5.7.2 Benefits of CRM

The benefits and advantages of CRM include:

1. **Enhanced contact management** : Every call, question or negotiation from prospects and clients is recorded and made accessible to the entire team with a centralized contact management system. This gives both sales, marketing, and customer service teams a boost in terms of tracking, pipe progression and client history.
2. **Cross-team collaboration** : A CRM system helps people from different parts of a business to work together. A sales team can collaborate with a product team to produce quotations, while a marketing campaign that generates a lead can help a salesperson to have a more informed, tailored conversation with the prospect.
3. **Increased productivity** : With a CRM, follow-up emails can be auto-generated and tested for effectiveness, management can easily access the most recent details of a customer meeting, and customer service administrators can learn the background of a customer without leaving the call.
4. **Effective sales management** : CRM empowers sales managers with data to analyze customer relationships, track sales-related activity, assess deal viability, mobilize extra help when needed, and provide teams with real-time updates. All this improves sales effectiveness.
5. **Accurate sales forecasting** : A single source of right information makes it much easier for sales managers to make accurate forecasts. Sales teams are able to learn from the past and forecast the future through historical data, while predictive analytics makes use of insights from big data to anticipate future customer behavior.

6. **Reliable reporting :** CRM helps get an at-a-glance view of its sales pipeline making it simple to spot potential problems and sort them out in the initial stage. Reports improve team productivity by saving on time that would once have been spent pulling data manually or laboriously creating pivot tables in spreadsheets.
7. **Improved sales metrics :** If you nurture the right prospects in a timely and efficient way by that really matter. CRM data and reporting systems provide insights into conversion effectiveness at various points in the sales process. Once a business better understands its customers, up selling and cross-selling opportunities arise
8. **Increased customer satisfaction and retention :** Having an easily accessible view of a customer's interactions makes it easier to anticipate issues and deal with complaints. This creates a more positive experience for customers who no longer have to move around between departments.
9. **Boosted marketing ROI :** Effective tracking of customers helps businesses to understand what marketing activities and campaigns are effective making it easier for marketers to maximize their budgets and deliver greater ROI.
10. **Better products and services :** A CRM system gathers information from a huge variety of sources. This gives insight into how customers feel and what they are saying about an organization. So businesses can improve what they offer, spot problems early, and identify gaps.

5.7.3 Benefits of CRM to Business Functions

- **Sales teams** can use CRM to understand their sales pipeline better by gaining access to reliable information about the progress of individual team members in achieving their sales targets and see how well individual sales teams, products and campaigns are performing too.
- **Marketing teams** can use CRM to make forecasting simpler and more accurate. They can clearly see every opportunity or lead, and map out the whole customer journey from enquiry to sale giving them a better understanding of the sales pipeline or prospective work coming in.
- **Customer service teams** can effectively track conversations across channels. Without a common platform for customer interactions, communications can be missed or lost in the flood of information – leading to an unsatisfactory response to a valued customer.
- **Supply-chain, procurement and partner management teams** can manage relationships better. They can track meetings with suppliers and partners, record requests made, add useful notes, schedule follow-ups and stay on top of expected next steps.
- **The HR team** can use CRM to accelerate the recruitment process and track employee performance. CRM can help the HR function by speeding up the process of managing candidates, analyzing resourcing needs and identifying skills gaps, and supporting the pursuit of staff retention targets.

Just imagine, how convenient it would be to consolidate all the streams of data coming from sales teams, customer service staff, marketers and social media—and translate them into actionable business information. A CRM platform lets you manage these streams of information across channels without losing track, and gives sales, service, marketing, and beyond an integrated view.

5.8 E-business

E-business is a buzzword today. It is also called online business. E-business is a kind of business transactions that take place online with the help of the internet. E-business is an abbreviation for electronic business. So there are buyers and sellers doing business transactions without actually meeting personally.

In today's world, we are exposed to various forms of e-business. Since its emergence in 1996, it has grown by leaps and bounds. Some predict that it may very soon overtake brick and mortar stores completely. While that remains to be seen, we cannot ignore the immense role it plays in the current global economy.

Since the late 90s, or even earlier, the development of digitalization not only led to major structural changes in society but also in the economy. Since then, the focus has shifted to the information sector. The systematic use of technology to collect and utilize information laid the foundations of a so-called "information economy," in which competitiveness is achieved through knowledge superiority.

5.8.1 Components of E-business

The core components of e-business are information, communication and transaction. Business partners use digital networks to go through business processes. They use innovative technologies to improve business efficiency. Three key areas are particularly important for e-business:

E-procurement

It is concerned with the electronic sourcing of products and services by companies which help them in reducing costs and efforts.

Online stores

The most visible part of e-business is online stores. The electronic sale of products and services takes place via appropriate platforms, such as online stores.

Online marketplaces

This includes electronic commerce which is done using digital networks to connect the buyers and suppliers of products and services.

There are also two further areas of e-business:

Online communities

This consists of large number of individuals who are prospective customers in this business. An electronic communication network supported by data and knowledge sharing connects these individuals and organizations.

Online companies

They are electronic business corporations which offer goods and services to the consumers. They are like any other traditional organization and store but present online on internet.

5.8.2 Market Participants in E-business

E-business can take place between a large number of market participants: Between businesses and consumers, various private individuals, public administrations, and other organizations such as NGOs.

Generally, these various market participants can be divided into three distinct categories:

- Business (B)
- Consumer (C)
- Administration (A)

All three categories can play the role of either buyer or service provider within the market.

5.8.3 Features of E-business

Some of the features of e-business are as follows:

- It is easy to set up.
- There are no geographical boundaries.
- Running the business is much cheaper than traditional business.
- There are flexible business hours.
- Implementing marketing strategies cost less to the organization.
- Online business receives benefits also from the government.
- A comprehensive IT infrastructure takes care of security and integrity issues.
- There is no personal touch and therefore no personal biases.
- Buyer and seller don't meet personally, which saves time.
- Delivery of products takes time although the logistics have vastly improved.
- There is a transaction risk involved although security system is continuously being improved.
- Anyone can buy anything from anywhere at anytime and for anyone. A person can buy something for other and can get it delivered at his address.

5.8.4 Function of Electronic Business

The most important function of electronic business is to create electronic value. The forms of electronic added value are usually distinguished in the following way:

- **Structuring** : It means making available an overview of a large quantity of information online.
- **Selection** : It means providing specific database information upon request by the users/customers
- **Matching** : This function makes it possible to match the inquiries done by the customers with the product offers given by supplier so that buyers make up their mind.
- **Transaction** : This function takes care of the transaction that takes place when the customer places the order by choosing the appropriate payment methods.
- **Coordination** : This function adds value to the product by offers that different providers combine with their product/services

- **Communication:** This is an important function that has the aim of improving communication between different consumers and suppliers.

Depending on which type of value a company decides to pursue, they can choose one or more value activities – for example the collection, structuring, pre-selection, summary, or distribution of information.

The electronic value creation process involves the following steps:

- **Collecting large quantities of information** to identify data relevant to the product
- **Processing the information** and transforming it into a product
- **Transferring the final information product** to the customer
- **Repeating this process** whenever new information becomes available. Information products are not static and must be kept up to date.

Examples of e-business

There are countless examples of different e-business activities, but here is a brief selection.

The **e-procurement** sector is an important part of e-business. It includes the following activities:

- Implementation of a computerized (application-based) **purchasing system** that supports the whole procurement process, such as checking stock availability and handling the order and payment
- Constructing and operating an **online marketplace** for products and services
- Integrating various electronic supplier catalogs into its own **Enterprise Resource Planning (ERP)** system to support procurement, warehouse management, order processing, production management, and logistics

The **e-commerce** sector includes the following activities:

- **Designing and maintaining an internet presence** and an **online store** which includes products or services accessible from anywhere at all times, multiple payment options, automatic e-mail notifications on orders, and customer support (live chat, hotlines, or help centres)
 - **Developing and provisioning additional content**, such as an informational blog or comparison portal
- Expanding online marketing and targeting advertising to customers, for example by using big data from cookies, purchase behaviour, and customer data

5.9 E-Commerce or Electronic Commerce

E-commerce is a popular term for electronic commerce or even internet commerce. The name is self-explanatory. E-commerce is the meeting of buyers and sellers on the internet. This involves the transaction of goods and services, the transfer of funds and the exchange of data.

Examples of e-commerce

- Amazon
- Flipkart
- eBay
- Fiverr

- Upwork
- Olx
- Quikr

Logging into your Amazon app and purchasing a book is a classic example of an e-commerce transaction. Here you interact with the seller (Amazon), exchange data in the form of pictures, text, address for delivery etc. and then you make the payment.

As of now, e-commerce is one of the fastest growing industries in the global economy. As per one estimate, it grows nearly 23% every year. And it is projected to be a \$27 trillion industry by the end of this decade.

5.9.1 Advantages of E-commerce

- E-commerce provides the sellers with a global reach. They remove the geographical barrier. Now sellers and buyers can meet in the virtual world, without the hindrance of location.
- Electronic commerce substantially lowers the transaction cost. It eliminates many fixed costs that are required in maintaining brick and mortar shops. This allows the companies to enjoy a much higher margin of profit.
- It provides quick delivery of goods with very little effort on part of the customer. Customer complaints are also addressed quickly. It also saves time, energy and effort for both - the consumers and the company.
- One other great advantage is the convenience it offers. A customer can shop 24x7. The website is functional at all times, it does not have working hours like a shop.
- Electronic commerce also allows the customer and the business to be in touch directly without any intermediaries. This allows for quick communication and transactions. It also gives a valuable personal touch.

5.9.2 Types of E-commerce Models

Electronic commerce can be classified into six major categories. The basis for this simple classification is the parties that are involved in the transactions. Here, the two most basic electronic commerce models given:

1. Business To Business (B2B)

Business to business model is more popularly known as B2B model. It is the largest e-commerce model based on revenue and involves transactions of trillions of dollars. In this model both - the buyers and sellers - are business organizations. B2B describes commerce transactions between businesses, such as between a manufacturer and a wholesaler, or between a wholesaler and a retailer or between two manufacturers. The main aim of this model is to increase business efficiency and revenue of the retailers.

The volume of B2B transactions is much higher than the volume of transactions of any other model. The primary reason for this is that in a typical supply chain there will be many B2B transactions involving sub components or raw materials, and only one B2C transaction, specifically sale of the finished product to the end customer.

Advantages of B2B model

- **Better market prediction :** Compared to other business strategies, this model has more market stability. This helps to strengthen the online presence and business opportunities.

- **Better sales :** An improved supply chain management process along with collaborative approach increases customer loyalty which in turn leads to improved sales.
- **Lower cost :** Due to an effective supply chain management process, this model leads to lower cost of business.
- **Data-centric model :** Another advantage is that it relies on effective and factual data to streamline the whole process. In this way, errors can be avoided and proper forecasts can be done.

Disadvantages of B2B model

- **Limited market :** Compared to B2C model, this business model has limited market base as it deals in goods that suit other organizations.
- **Lengthy decision :** Here, majority of the purchase decisions take a lengthy process. The process is lengthy generally because of the involvement of multiple stakeholders and decision makers.
- **Inverted structure :** Compared to other models, here, the buyer has more bargaining and decision making power than sellers. This may demand customizations and lower price rates
- **Marketing challenges :** B2B companies face significant marketing challenges in comparison to B2C as digital marketing is specially challenging. Social media is mostly used to promote B2C.

2. Business to Consumer (B2C)

Business to consumer e-commerce also known as B2C model is the most popular e-commerce model. In this model, goods and services are directly sold to individual customers over the internet. The internet users can use the shopping cart for everything they need. Payment is mostly done through online payment options.

Most internet users are familiar with the B2C model. The model offers easy steps to the consumers to buy just anything. Customers these days prefer this model as they get a lot of products in varying ranges at one place along with different kinds of offers. Apart from that, the consumers don't have to physically visit the stores.

For business organizations, this model offers a lot of advantages and allows them to cater to a huge market where customers are available with varying needs and demands.

Advantages of B2C model

- This model provides the sellers with a huge market in the form of global reach.
- Electronic commerce substantially lowers the transaction cost which allows the companies to enjoy a much higher margin of profit.
- It provides quick delivery of goods with very little effort on part of the customer.
- It saves time, energy and effort for both the consumers and the company.
- A customer can shop 24x7; the website is functional at all times.
- Electronic commerce also allows quick communication and transactions between buyers and sellers.

Challenges of B2C

- High consumer traffic often becomes a big problem as it slows down the searching process.
- A lot of consumers are hesitant to submit their personal data to websites due to safety reasons.



- Customer retention is a big challenge as there is no customer loyalty in general. Customers shift to a different online store quickly.
- The promotional offers and discounts have developed a habit in the customers to buy only when such offers are present. This puts pressure on the companies to maintain profitability. As of now, most of the B2C companies are suffering losses.

5.10 Mobile Commerce (M-commerce)

M-commerce is a kind of e-commerce transaction done with a mobile phone. So M-commerce is the use of mobile phones to conduct any type of business transaction. It takes the help of the e-commerce background and WAP technology.

The use of wireless technology (WAP) to conduct sales of goods, provide services, make payments and other financial transactions, the exchange of information, etc. is the basis of mobile commerce.

M-commerce is actually a rapidly growing sector of e-commerce. Nearly 70% of the online transactions that occur in India happen from mobile phones. Globally, it is a 700 billion dollar industry.

M-commerce is about exploiting new opportunities made available to us thanks to e-commerce. So it involves the advent of new technologies, services, business models and marketing strategies. It differentiates itself in many ways from e-commerce. This is because mobile phones have different characteristics than desktop computers. It has opened so many windows of opportunities for businesses to exploit.

5.10.1 Applications of M-commerce

Other than the straightforward m-commerce transactions of buying and selling of goods and services, they have so many applications. Let us take a look at a few examples.

- **Mobile banking** : Using a mobile application you can perform all your banking functions. It is one step ahead of online banking and has become commonplace these days. For example, in India, there is substantial increase in banking transactions happening on mobile phones.
- **Mobile ticketing and booking** : Making bookings and receiving your tickets on the mobile has become very common today. The digital ticket or boarding pass is sent directly to your phone after you make the payment. Even in India, IRCTC and other services provide m-ticketing services.
- **E-bills** : This includes mobile recharge, electricity, water, gas and many more bills which are easily paid today using mobile phones.
- **Auctions** : Online auctions have now been developed to be made available via mobile phones as well.
- Stock market reports and even stock market trading takes place over mobile applications.

5.10.2 Advantages of M-commerce

- It provides a very convenient and easy-to-use system to conduct business transactions.
- Mobile commerce has a very wide reach. A huge part of the world's population has a mobile phone in their pocket. So the sheer size of the market is tremendous.
- M-commerce also helps businesses target customers according to their location, service provider, the type of device they use and various other criteria. This can be a good marketing tool.

- The costs of the company are also reduced. This is due to the streamlined processes, low transaction cost, low carrying cost and low order processing cost as well.

Disadvantages of M-commerce

- The existing technology to set up an m-commerce business is very expensive. It has great start-up costs and many complications arise.
- In many countries, the networks and service providers are not reliable. It is not the most suitable for data transfer.
- There is also the issue of security. There are many concerns about the safety of the customer's private information, and the possibility of a data leak is very daunting.

Exercises

Answer the following questions in short

- Q. What is social computing? (Refer section 5.1.1)
- Q. Give some examples of SC. (Refer section 5.1.1)
- Q. State the benefits of social computing. (Refer section 5.1.2)
- Q. What is WWW? (Refer section 5.2)
- Q. Define web 2.0 (Refer section 5.3)
- Q. What are the key aspects/components of web 2.0? (Refer section 5.3.1)
- Q. What is blog? (Refer section 5.3.1)
- Q. What are the features of web 2.0? (Refer section 5.3)
- Q. Define web 3.0 (Refer section 5.4)
- Q. What is semantic web? (Refer section 5.4.1)
- Q. What is the use of social computing in shopping? (Refer section 5.5)
- Q. Describe the major categories of social shopping. (Refer section 5.5.1)
- Q. What are the benefits of social shopping? (Refer section 5.5.3)
- Q. What is social marketing? (Refer section 5.6)
- Q. Name some key social media service providers along with their contents. (Refer section 5.6)
- Q. Define CRM. (Refer section 5.7)
- Q. What is CRM software? (Refer section 5.7)
- Q. Describe e-business (Refer section 5.8)
- Q. Describe e-commerce (Refer section 5.9)
- Q. Describe mobile commerce. (Refer section 5.10)

Answer the following questions in detail

- Q. Describe how social computing is beneficial to organizations. (Refer section 5.1.3)
- Q. Write the core principles and advantages of Web 2.0 (Refer sections 5.3.2 and 5.3.4)

- Q. Describe web 3.0 with its features (Refer section 5.4.1)
- Q. What is the significance of social computing in marketing? Explain. (Refer section 5.6.2)
- Q. Describe the benefits of CRM. (Refer section 5.7.2)
- Q. Explain different types of CRM with examples. (Refer section 5.7)
- Q. Describe the features and functions of e-business. (Refer sections 5.8.3 and 5.8.4)
- Q. Describe the advantages and disadvantages of e-commerce (Refer section 5.9)
- Q. Describe B2B and B2C models with their respective advantages. (Refer section 5.9)
- Q. What are the applications and advantages of mobile commerce? (Refer sections 5.10.1 and 5.10.2)

Computer Networks

Syllabus

Wired and Wireless Technology, Pervasive Computing, Cloud Computing Model

6.1 Introduction

Information technology has made a huge impact everywhere be it the life of a person, society, organization or a nation. IT began with the development of computers. Till 1990, computer was mainly used in industries to control different industrial processes. With the advent of micro computer, it started making an impact everywhere. After 1990, the growth picked up pace and microprocessor started changing the whole computer industry. Then came the biggest revolution in the form of computer network particularly of micro computers.

The rest is an impactful history. The growth and development in computer network, computer hardware and software have been phenomenal. We are living in an era where we cannot imagine our life without these networks. We are part of this network on 24x7 basis. There is hardly any area of our life where IT doesn't have a role to play. You have already learnt about it in the previous chapters. Businesses around the world not only use IT systems but also are constantly upgrading the entire IT infrastructure to make more impact in the business world.

This chapter is about computer network and its basics. Your understanding of information system is not complete without adequate understanding of this IT system that provides the backbone to IS.

6.1.1 What is Computer Network?

A computer network is simply an interconnection of two or more computers. The purpose is to exchange information with each other electronically and within no time. A computer network is now easy to set up just anywhere whether it is your home, office or a factory.

The development of computer network has erased distance between two places. One of the most important factors behind globalization has been computer network. Millions of computer networks exist today in this world. They exist everywhere- on land across the world, in water, in space.

Businesses have become dependent on computer network for improving their effectiveness and efficiency. An organization better equipped with IT Infrastructure has taken edge in this highly competitive business world.

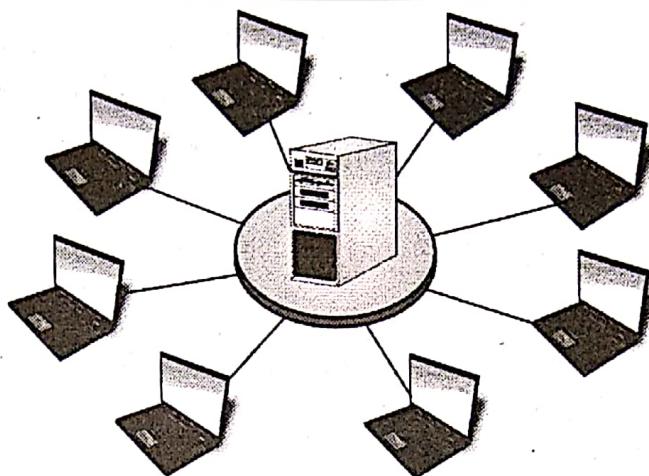


Fig. 6.1.1 : Computer Network

6.1.2 How does a Network Work?

A computer network is first set up by bringing two or more computers together. The computers use some networking devices and a physical medium to get connected with each other. The networking devices could be network interface cards, modems, routers, switches, etc. and the physical medium may be wired or wireless. Then a special software called protocol is used to ensure communication between two computers. The computers then get connected and exchange of messages and information takes place.

6.2 Advantages and Disadvantages of a Computer Network

Advantages

1. Computer network helps people exchange and share messages and information at a fast speed and at a fraction of the cost.
2. It provides a medium of communication to the people in different forms such as text, graphics, voice and video.
3. It acts like a centralized information system that people and organizations use to access information of all kinds from anywhere and anytime.
4. It provides security and confidentiality to the information stored in it which otherwise is very difficult on a stand-alone machine.
5. It helps users across the world to share and develop software and applications.
6. It also provides sharing of files and hardware devices by different users. It saves cost of using multiple devices. For example, a printer in an office is shared by many computers.
7. It connects people and organizations located anywhere in the world.

Disadvantages

1. A computer network may break down causing all the work activities to stop.
2. There is always a security threat. Hackers are active and always try to steal information or take control of a network or computer.
3. Destructive programs like virus and malware put the data and information in danger.

4. The initial cost of setting up a computer network is high and there is continuous upgradation required which further adds to the cost.
5. It provides a platform for people to also spread wrong news and rumors easily causing a trouble for the society and the governments

6.3 Applications of Computer Network

Computer network is nowadays used almost everywhere. It has numerous applications. Some of them can be categorized in the following ways:

1. **Business** : It has many applications in business such as
 - (a) Sharing information, programs, files, software and resources like hardware by employees and branches located at distant places.
 - (b) The employees can access the organization's remote database during their day-to-day operations. This benefits them in taking right decisions, handling a problematic situation or availing an opportunity.
 - (c) Organizations promote e-business and e-commerce with the help of computer networks.
 - (d) Organizations are able to integrate all their operations with the help of computer network, which improves their overall effectiveness and efficiency.
 - (e) IT-enabled services have prospered very fast during last two decades mainly to better communication systems and computer networks.
2. **Education** : Because of computer network, today education system has changed a lot. A student can search for the right institution for admission, apply for admission and then take admission even without actually visiting the campus personally. Online course allow students to attend classes from their homes and appear in online tests too. A computer network offers them vast amount of reading material for studies.
3. **Online banking** : People today don't require to visit their bank branches every now and then or carry cash in their pockets all the time. Online banking allows people to pay bills, book tickets and transfer money at the click of a mouse. It not only saves time for people but also promotes cashless transactions which boost the economy.
4. **Social media** has been a great revolution and the credit goes to computer networks.
5. **Communication** : Computer network has brought a huge change in the way we communicate with others. Today, we can communicate with others present anywhere in the world using text, voice calls or video conferencing.

6.4 Network Components

1. **Hardware devices**
 - (a) **Server** : A server is the most powerful computer in a network. It performs many functions such as –
 - (i) Acts as a medium to interconnect two users. Receives message from one and then forwards it to the other
 - (ii) Acts as a centralized database system and stores user's data and information and lets a user access data of his choice by giving the required authority.
 - (iii) Provides data security and confidentiality by not allowing unauthorized users to get access to the data and information. Also recovers data in case of loss or damage.

- (iv) Allows many users to share the same piece of information and make changes also if required and being done by an authorized user.
- (b) **Client/Node:** It is a general purpose computer used by a user to perform different tasks. A user may or may not choose to store his data on his node.
- (c) **Network devices:** Network devices are various hardware devices used by computers to transfer data and programs to each other. Some of these devices are Hub, Switches, Router, Modems, Ethernet, etc. We will discuss them in the next section.
- (d) **Communication media:** These are the physical medium through which a data signal transfers from one computer to another. These media mainly fall in two categories – wired and wireless. The wired medium wires for interconnection while wireless medium uses air as the medium of communication. We will discuss them in the following sections.

2. Software

Software, as you know, is an essential component of each computer.

- (a) **Network operating system :** A network operating system like Windows 10 server is used on the server. It controls all the functions of a server.
- (b) **Local operating system :** On every node, there is an operating system installed.
- (c) **Protocol :** For a network, a separate software called *protocol* is required. The protocol defines the network architecture. It describes the steps of data transmission between two computers. There are many protocols in different computer networks but the most common is called TCP/IP. It is based on a standard network architecture model called OSI, which describes the structure of a network.

6.5 Types of Network

On the basis of distance, computer network has been divided into three types

1. Local Area Network (LAN)
2. Metropolitan Area Network (MAN)
3. Wide Area Network (WAN)

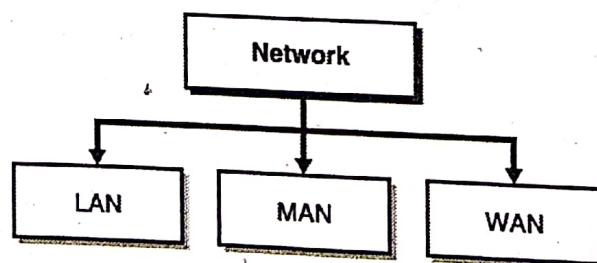


Fig. 6.5.1 : Types of Network

1. Local Area Network (LAN)

A **Local Area Network** is a privately owned computer network covering a small geographical area, like a home, office, or groups of buildings, e.g. a school network. A LAN is used to connect the computers and other network devices so that the devices can communicate with each other to share the resources. The resources to be shared can be a

hardware device like printer, software like an application program, or data. The size of LAN is usually small. The various devices in LAN are connected to central devices called hub or switch using a cable.

Nowadays LANs are being installed using wireless technologies. Such a system makes use of access point or APs to transmit and receive data. One of the computers in a network can become a server serving all the remaining computers called *clients*.

For example, a library can have a wired or wireless LAN network for users to interconnect local networking devices e.g., printers and servers to connect to the internet.

LAN offers high speed communication of data rates up to 100 megabits per second (Mbps). IEEE, which creates LAN standards, is working on Standardization of 100 Giga bit/s. LANs Network may have connections with other LANs Network via leased lines, leased services.

Types of LAN

There are basically two types of local area networks namely: ARCnet and Ethernet.

ARCNET is one of the oldest, simplest, and least expensive types of local-area network protocol, similar in purpose to Ethernet or Token Ring. ARCNET was the first widely available networking system for microcomputers and became popular in the 1980s for office automation tasks. ARCnet was introduced by Datapoint Corporation in 1977. The specification is ANSI 878.1. It can have up to 255 nodes per network.

Ethernet is a family of computer networking technologies for local area networks commercially introduced in 1980. Standardized in IEEE 802.3, Ethernet has largely replaced competing wired local area network technologies. Ethernet uses a bus or star topology network and supports data transfer rates of 10 Mbps.

Ethernet network uses the CSMA/CD access method to handle simultaneous demands. It is one of the most widely implemented LAN standards. A newer version of Ethernet network, called 100Base-T (or Fast Ethernet), supports data transfer rates of 100 Mbps. Ethernet is a physical and data link layer technology for local area networks (LANs).

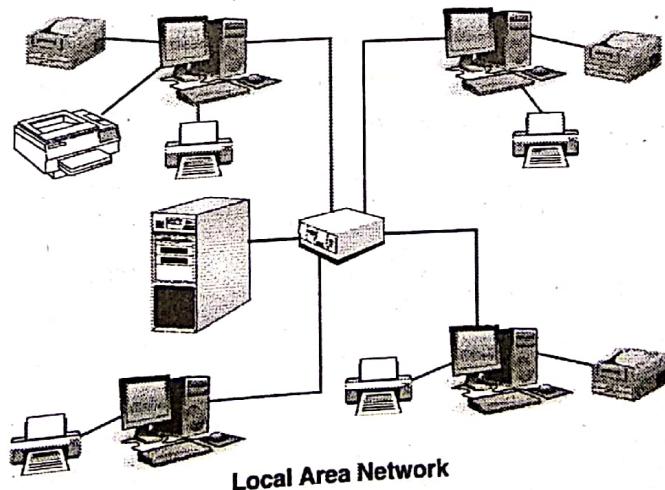


Fig. : 6.5.2 : LAN

2. MAN (Metropolitan Area Networks)

MAN stands for Metropolitan Area Networks. It is one of the types of network. MAN is larger than a local area network and as its name implies, covers the area of a single city. MANs rarely extend beyond 100 KM and frequently comprise of a combination of different hardware and transmission media. It can be a single network such as a cable

TV network, or it is a means of connecting a number of LANs into a larger network so that resources can be shared LAN to LAN as well as device to device.

A MAN can be created as a single network such as cable TV network, covering the entire city or a group of several Local Area Networks (LANs). In this way, resource can be shared from LAN to LAN and from computer to computer also. MANs are usually owned by large organizations to interconnect its various branches across a city.

MAN is based on IEEE 802.6 standard known as DQDB (Distributed Queue Dual Bus). DQDB uses two unidirectional cables (buses) and all the computers are connected to these two buses. Each bus has a specialized device that initiates the transmission activity. This device is called head end. Data that is to be sent to the computer on the right hand side of the sender is transmitted on upper bus. Data that is to be sent to the left hand side of the sender is transmitted on lower bus.

The two most important components of MANs are security and standardization. Security is important because information is being shared between dissimilar systems. Standardization is necessary to ensure reliable data communication.

A MAN usually interconnects a number of local area networks using a high-capacity backbone technology, such as fiber-optical links, and provides up-link services to wide area networks and the internet.

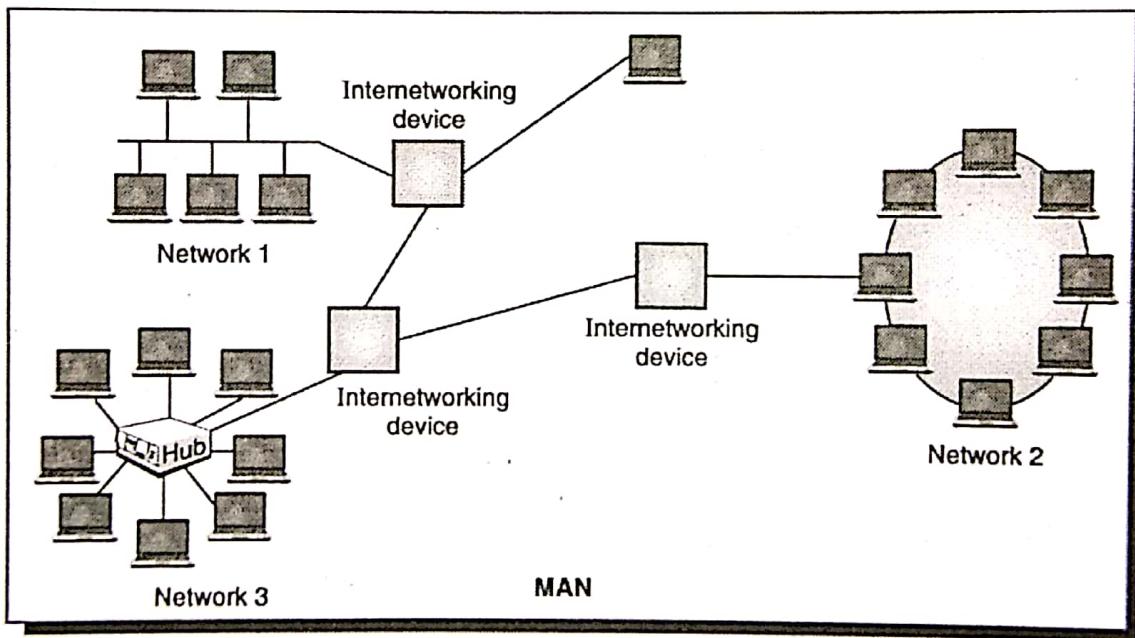


Fig. 6.5.3 : MAN

Wide Area Networks (WAN)

A wide area network (WAN) is a telecommunication network. A wide area network is simply a LAN of LANs or network of networks. WANs connect LANs that may be on opposite sides of a building, across the country or around the world. WANs are characterized by the slowest data communication rates and the largest distances. WANs can be of two types: an enterprise WAN and global WAN.

Computers connected to wide area networks are often connected through public networks, such as the telephone system. They can also be connected through leased lines or satellites. The largest WAN in existence is the internet. Some segments of the Internet, like VPN based extranets, are also WANs in themselves. Finally, many WANs are corporate or research networks that utilize leased lines.

Numerous WANs have been constructed, including public packet networks, large corporate networks, military networks, banking networks, stock brokerage networks, and airline reservation networks.

Organizations supporting WANs using the internet protocol are known as Network Service Providers (NSPs). These form the core of the internet.

By connecting the NSP WANs together using links at Internet Packet Interchanges (sometimes called "peering points") a global communication infrastructure is formed.

WANs (wide area networks) generally utilize different and much more expensive networking equipment than do LANs (Local Area Networks). Key technologies often found in WANs (wide area networks) include SONET, Frame Relay, and ATM.

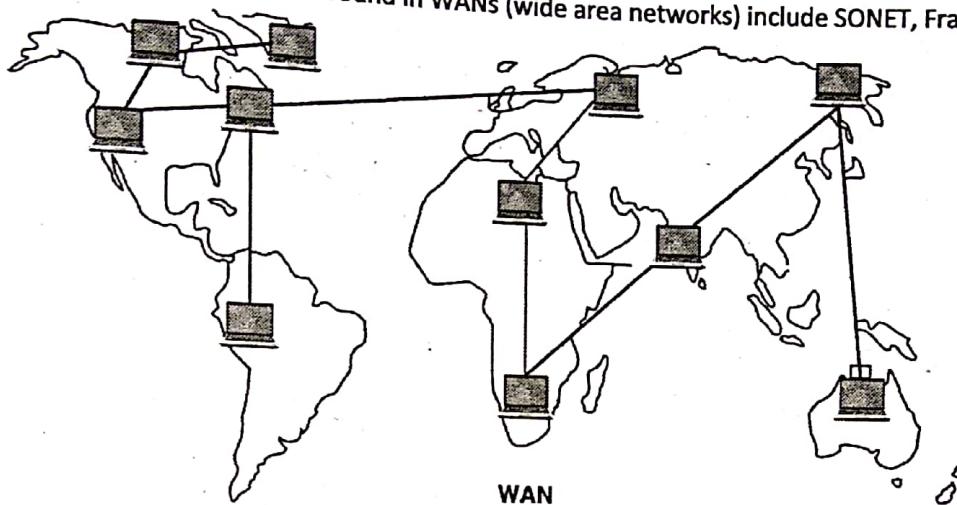


Fig. 6.5.4

6.6 Computer Network Architecture

Computer network architecture is defined as the physical and logical design of the software, hardware, protocols, and media of the transmission of data. Simply, we can say, that is how computers are organized and how tasks are allocated to the computer

The two types of network architectures are used

- Peer-To-Peer network
- Client/Server network

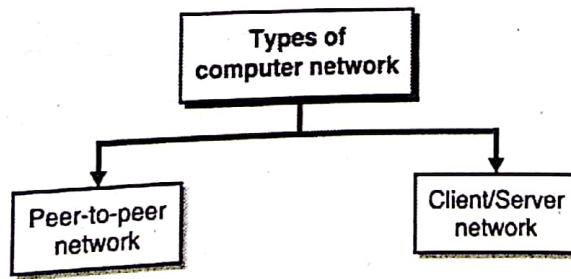


Fig. 6.6.1 : Network architecture types

6.6.1 Peer-To-Peer Network

- Peer-to-peer network is a network in which all the computers are linked together with equal privilege and responsibilities for processing the data.
- Peer-to-peer network is useful for small environments, usually up to 10 computers.

- Peer-To-Peer network has no dedicated server.
- Special permissions are assigned to each computer for sharing the resources, but this can lead to a problem if the computer with the resource is down.

Advantages of peer-to-peer network

- It is less costly as it does not contain any dedicated server.
- If one computer stops working other computers will not stop working.
- It is easy to set up and maintain as each computer manages itself.

Disadvantages of peer-to-peer network

- In the case of Peer-To-Peer network, it does not contain the centralized system. Therefore, it cannot back up the data as the data is different in different locations.
- It has a security issue as the device is managed itself.

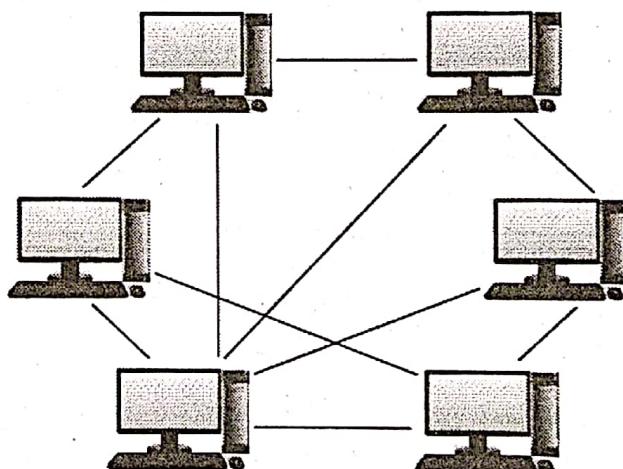


Fig. 6.6.2 : Peer-to-peer network

6.6.2 Client/Server Network

- Client/Server network is a network model designed for the end users called clients, to access the resources such as songs, videos, etc. from a central computer known as server.
- The central controller is known as a **server** while all other computers in the network are called **clients**.
- A server performs all the major operations such as security and network management.
- A server is responsible for managing all the resources such as files, directories, printer, etc.
- All the clients communicate with each other through a server. For example, if client 1 wants to send some data to client 2, then it first sends the request to the server for the permission. The server sends the response to the client 1 to initiate its communication with the client 2.

Advantages of client/server network

- A client/server network contains the centralized system. Therefore, we can back up the data easily.
- A client/server network has a dedicated server that improves the overall performance of the whole system.
- Security is better in client/server network as a single server administers the shared resources.

- It also increases the speed of the sharing resources.

Disadvantages of client/server network

- Client/Server network is expensive as it requires a server with large memory.
- A server has a Network Operating System (NOS) to provide the resources to the clients, but the cost of NOS is very high.
- It requires a dedicated network administrator to manage all the resources.

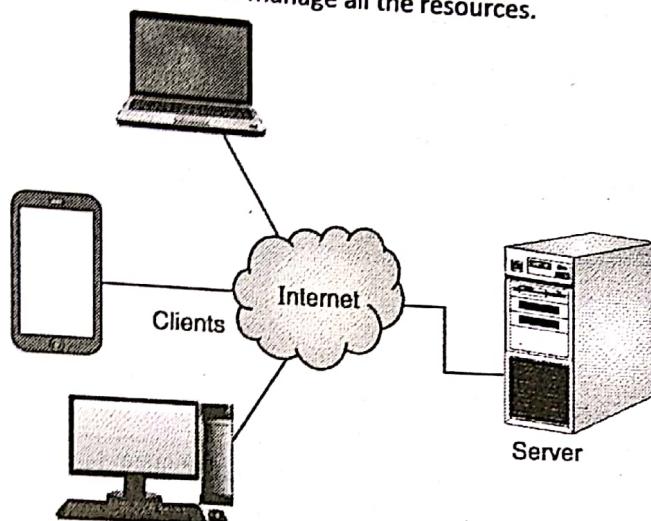


Fig. 6.6.3 : Client/Server network

6.7 Network Topology

Network Topology is the way in which computer systems or network devices are connected with each other. Topologies may define both physical and logical aspect of the network. Both logical and physical topologies could be same or different in a same network.

There are many topologies. Some are discussed below:

6.7.1 Point-to-Point

Point-to-point networks contain exactly two hosts such as computer, switches or routers, servers connected back to back using a single piece of cable. Often, the receiving end of one host is connected to sending end of the other and vice-versa.

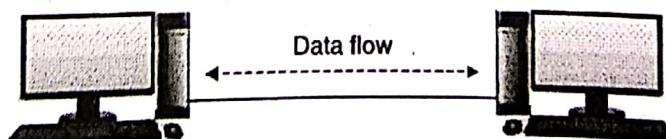


Fig. 6.7.1

6.7.2 Bus Topology

In case of bus topology, all devices share single communication line or cable. Bus topology may have problem while multiple hosts sending data at the same time. Therefore, bus topology either uses CSMA/CD technology or recognizes one host as bus master to solve the issue. It is one of the simple forms of networking where a failure of a device does not affect the other devices. But failure of the shared communication line can make all other devices stop functioning.

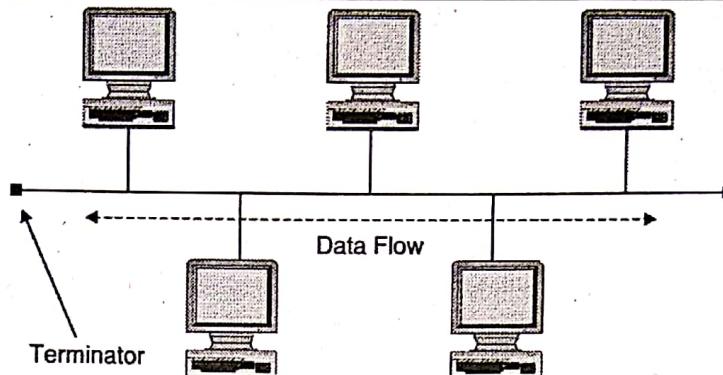


Fig. 6.7.2 : Bus Topology

Both ends of the shared channel have line terminator. The data is sent in only one direction and as soon as it reaches the extreme end, the terminator removes the data from the line.

6.7.3 Star Topology

All hosts in star topology are connected to a central device, known as hub device, using a point-to-point connection. That is, there exists a point-to-point connection between hosts and hub. The hub device can be any of the following:

- Layer-1 device such as hub or repeater
- Layer-2 device such as switch or bridge
- Layer-3 device such as router or gateway

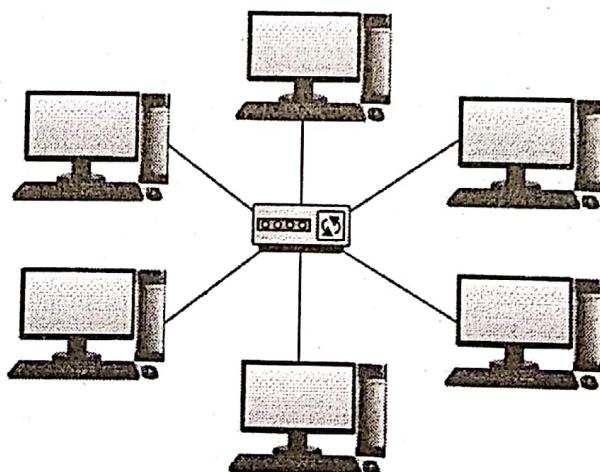


Fig. 6.7.3 : Star Topology

As in bus topology, hub acts as single point of failure. If hub fails, connectivity of all hosts to all other hosts fails. Every communication between hosts, takes place through the hub only. Star topology is not expensive as to connect one more host, only one cable is required and configuration is simple.

6.7.4 Ring Topology

In ring topology, each host machine connects to exactly two other machines, creating a circular network structure. When one host tries to communicate or send message to a host which is not adjacent to it, the data travels through all intermediate hosts. To connect one more host in the existing structure, the administrator may need only one more extra cable.

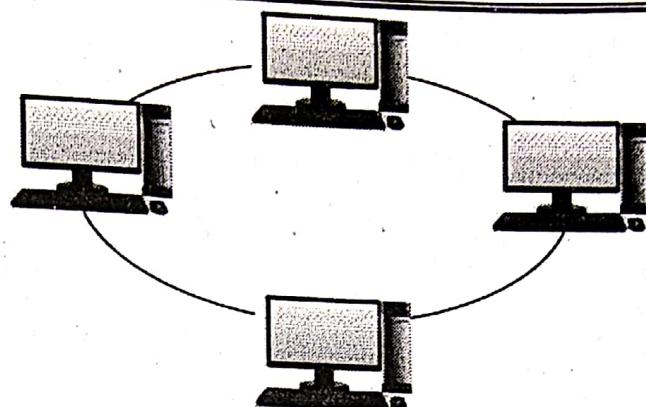


Fig. 6.7.4 : Ring Topology

Failure of any host results in failure of the whole ring. Thus, every connection in the ring is a point of failure. There are methods which employ one more backup ring.

6.7.5 Tree Topology

Also known as hierarchical topology, this is the most common form of network topology in use presently. This topology imitates as extended star topology and inherits properties of bus topology.

This topology divides the network into multiple levels/layers of networks. Mainly in LANs, a network is bifurcated into three types of network devices. The lowermost is access layer where computers are attached. The middle layer is known as distribution layer, which works as mediator between upper layer and lower layer. The highest layer is known as core layer, and is the central point of the network, i.e. root of the tree from which all nodes fork.

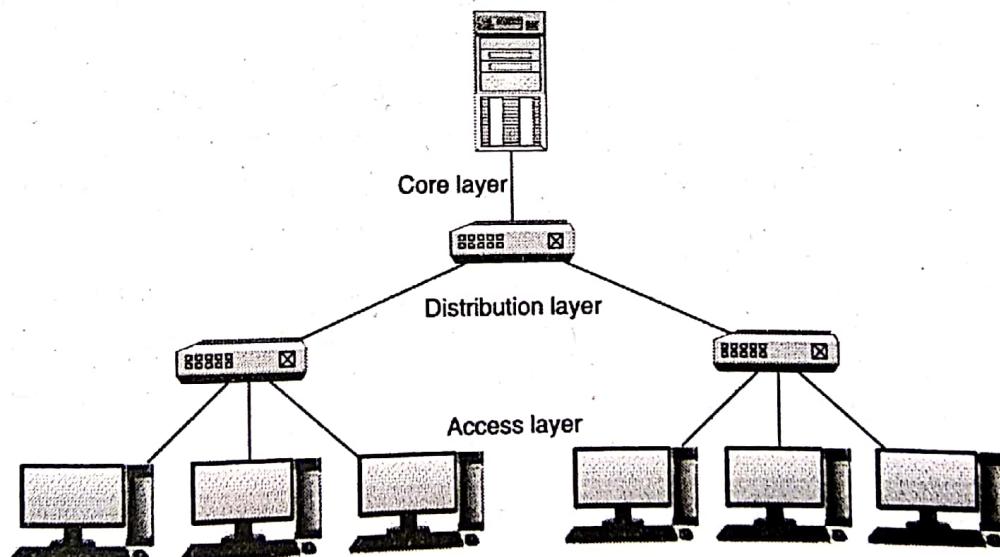


Fig. 6.7.5 : Tree Topology

6.7.6 Hybrid Topology

A network structure whose design contains more than one topology is said to be hybrid topology. Hybrid topology inherits merits and demerits of all the incorporating topologies.

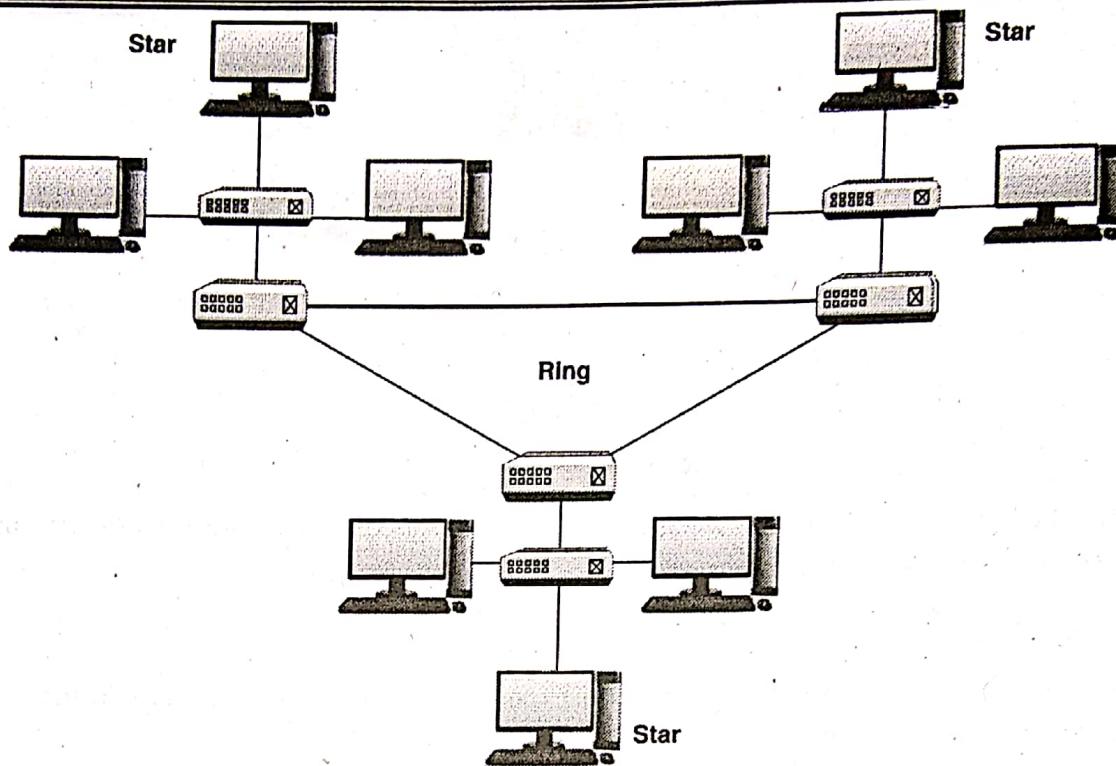


Fig. 6.7.6 : Hybrid Topology

The above picture represents a hybrid topology. The combining topologies may contain attributes of star, ring and bus topologies. Most WANs are connected by means of dual-ring topology and networks connected to them are mostly star topology networks. Internet is the best example of largest hybrid topology.

6.8 Network Devices

In a network, many devices other than computers are used. They play significant roles in network communication. Following are the common devices:

- Repeater :** A repeater operates at the physical layer. Its job is to regenerate the signal over the same network before the signal becomes too weak or corrupted so as to extend the length to which the signal can be transmitted over the same network. An important point to be noted about repeaters is that they do not amplify the signal. When the signal becomes weak, they copy the signal bit by bit and regenerate it at the original strength. It is a 2 port device.
- Hub :** A hub is basically a multiport repeater. A hub connects multiple wires coming from different branches, for example, the connector in star topology which connects different stations. Hubs cannot filter data, so data packets are sent to all connected devices. Also, they do not have intelligence to find out best path for data packets which leads to inefficiencies and wastage.
- Bridge :** A bridge operates at data-link layer. A bridge is a repeater with add-on functionality of filtering content by reading the addresses of source and destination. It is also used for interconnecting two LANs working on the same protocol. It has a single input and single output port, thus making it a 2-port device.
- Switch :** A switch is a multi port bridge with a buffer and a design that can boost its efficiency (large number of ports imply less traffic) and performance. Switch can perform error checking before forwarding data that makes it very efficient as it does not forward packets that have errors and forwards good packets selectively to correct port only.

5. **Routers :** A router is a device like a switch that routes data packets based on their IP addresses. Router is mainly a network layer device. Routers normally connect LANs and WANs together and have a dynamically updating routing table based on which they make decisions on routing the data packets. Router divides broadcast domains of hosts connected through it.
6. **Gateway :** A gateway, as the name suggests, is a passage to connect two networks together that may work upon different networking models. They basically work as the messenger agents that take data from one system, interpret it, and transfer it to another system. Gateways are also called protocol converters and can operate at any network layer. Gateways are generally more complex than switch or router.

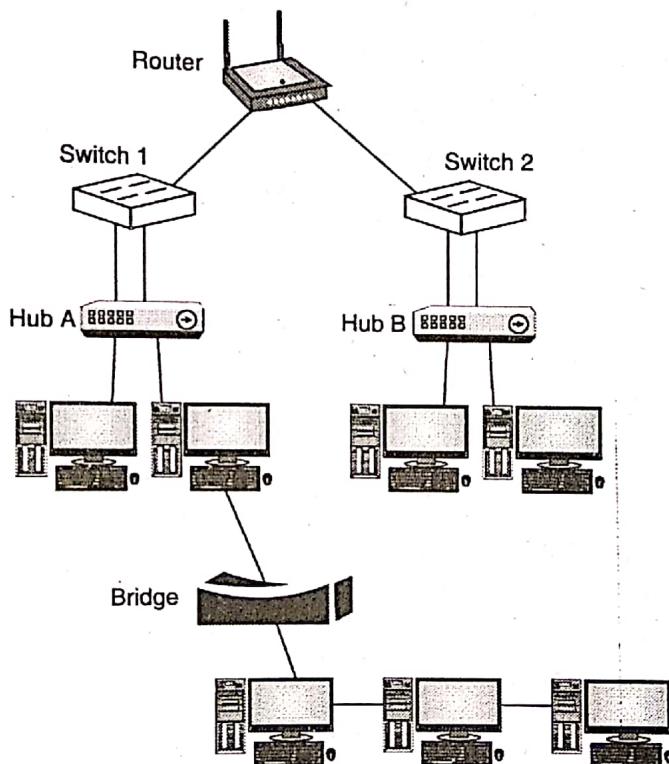


Fig. 6.8.1 : Network devices

7. **Modem :** Modems (modulators-demodulators) are used to transmit digital signals over analog telephone lines. Thus, digital signals are converted by the modem into analog signals of different frequencies and transmitted to a modem at the receiving location. The receiving modem performs the reverse transformation and provides a digital output to a device connected to a modem, usually a computer. The digital data is usually transferred to or from the modem over a serial line. Many telephone companies offer DSL services, and many cable operators use modems as end terminals for identification and recognition of home and personal users.
8. **Access point :** An Access Point (AP) is a wireless device involved in either a wired or wireless connection. An AP operates either as a bridge connecting a standard wired network to wireless devices or as a router passing data transmissions from one access point to another.

Wireless Access Points (WAPs) consist of a transmitter and receiver (transceiver) device used to create a Wireless LAN (WLAN). Access points typically are separate network devices with a built-in antenna, transmitter and adapter. APs use the wireless infrastructure network mode to provide a connection point between WLANs and a wired Ethernet LAN. They also have several ports, giving you a way to expand the network to support additional clients. Depending on

the size of the network, one or more APs might be required to provide full coverage. Additional APs are used to allow access to more wireless clients and to expand the range of the wireless network. Each AP is limited by its transmission range. The actual distance depends on the wireless standard, the obstructions and environmental conditions between the client and the AP.

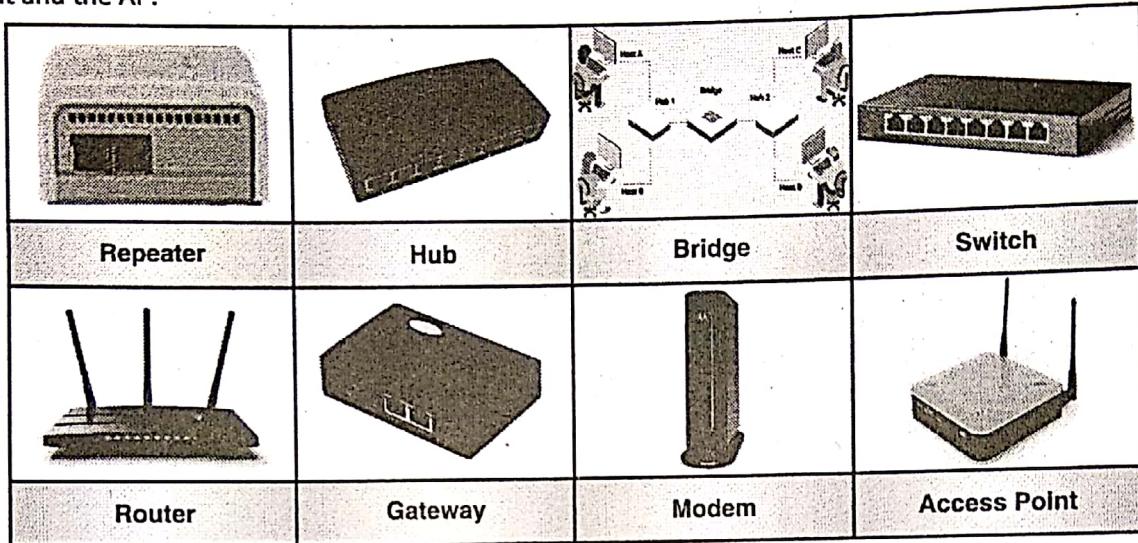


Fig. 6.8.2 : Shows different network devices

6.9 Wired and Wireless Network

6.9.1 Wired Network

A wired computer network is a traditional network of computer and other devices connected with each other through cables of one or another kind such as co-axial, twisted pair or optical fiber. Though in computing terminology, the term "wired" is used to differentiate between wireless connections and those that involve cables.

A wired network is a common type of wired configuration. Most wired networks use Ethernet cables to transfer data between connected PCs. In a small wired network, a single router may be used to connect all the computers. Larger networks often involve multiple routers or switches that connect to each other. One of these devices typically connects to a cable modem or other type of internet connection that provides internet access to all devices connected to the network.

While most of the networks are now wireless, some users still prefer wired devices, since they have a few benefits over their wireless networks. For example, a wired connection is not prone to signal interference that can slow down Wi-Fi connections. Additionally, wired network connections are often faster than wireless ones, which allows for faster data transfer rates.

Setting up a wired network requires network components and architecture that we have already discussed in above sections. So, here our focus will be more on learning about wireless network.

6.9.2 Wireless Network

Wireless network is a computer network set up using electromagnetic waves working at radio signal frequency to communicate among computers and other network devices. Sometimes it's also referred to as **Wi-Fi network** or **WLAN**. A wireless local-area network connects devices such as laptops and mobile phones to the internet and to your business network and its applications. When you connect to a Wi-Fi hotspot at a cafe, a hotel, an airport lounge, or another public place, you're connecting to a wireless network.

This network has become very popular nowadays due to easy setup features and no cabling involved. You can connect computers anywhere in your home without the need for wires.

The two main components are **wireless router or access point** and **wireless clients**.

If you want to set up any wired network, you just need to get a wireless router and attach it to cable or DSL modem. You then set up wireless client by adding wireless card to each computer and form a simple wireless network. Wireless router or access points should be installed in a way that maximizes coverage as well as throughput. Large areas usually require more than one access point in order to have adequate coverage. You can also add an access point to your existing wireless router to improve coverage.

Wireless operating mode

The IEEE 802.11 standards specify two operating modes: **infrastructure mode** and **ad hoc mode**.

Infrastructure mode is used to connect computers with wireless network adapters, also known as wireless clients, to an existing wired network with help from the wireless router or access point.

Ad hoc mode is used to connect wireless clients directly together, without the need for a wireless router or access point. An ad hoc network consists of up to 9 wireless clients, which send their data directly to each other.

Benefits of a wireless network

- **Convenient to use** : You can access your network resources from any location within your wireless network's coverage area or from any Wi-Fi hotspot.
- **Improves mobility** : When you have a wired connection you're not tied to your desk. You and your employees can go online in conference room meetings. You can perform every job while you are on the move.
- **Increases productivity** : Wireless access to the internet and to your company's key applications and resources helps your staff get the job done and encourages collaboration.
- **Easy to set up** : You don't have to use cables, so installation can be quick and cost effective. It's like plug and play.
- **Expandability** : You can easily expand wireless networks with existing equipment, whereas a wired network might require additional wiring.
- **Security** : Advances in wireless networks provide robust security protections.
- **Cost** : Because wireless networks eliminate or reduce wiring expenses, they can cost less to operate than wired networks.

6.10 Transmission Media

In network communications, a **transmission medium** is a physical connection between two computers.

There are two major categories of transmission media:

- **Guided or wired**
- **Unguided or wireless**

6.10.1 Guided Transmission Media

This medium uses cables to connect devices with each other. It is mainly of three types:

1. Twisted pair cables

Twisted pair cables have been around for a long time. They were mainly invented for voice transmissions using telephones. Twisted pair is a widely used medium in networking, particularly in LAN as it is lighter, cheaper, more flexible, easy to install and provides greater speeds than coaxial cables.

Types of twisted pair cables

Unshielded Twisted Pair (UTP)

Shielded Twisted Pair (STP)

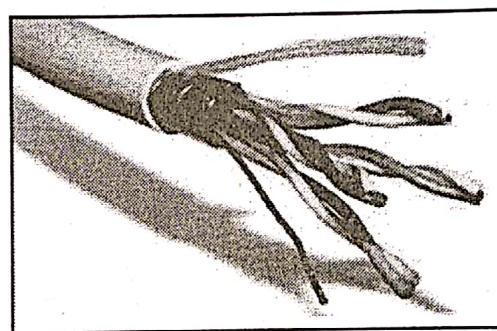


Fig. 6.10.1 : Twisted pair

2. Coaxial cables

The coaxial cables have a central copper conductor, surrounded by an insulating layer, a conducting shield and the outermost plastic sheath. Thus, there are 3 insulation layers for the inner copper cable. There are two basic modes of data transmission in coaxial cables: baseband mode that has dedicated bandwidth, and broadband mode that has distributed cable bandwidth.

Cable TV and analog televisions mainly use coaxial cables. Coaxial cables have better resistance to cross talk than twisted pair cables. The coaxial cables are used for long distance communication. It was used in computer network in early days.

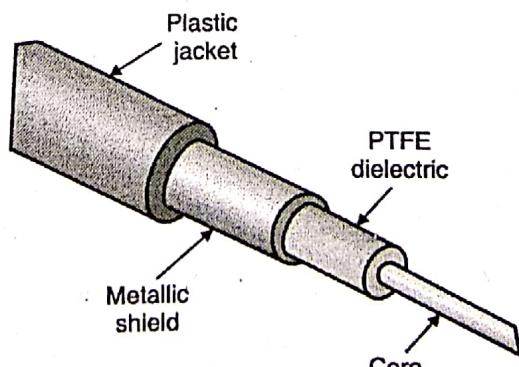


Fig. 6.10.2 : Co-axial cable

3. Optical fibres

Optical fibre transmits signals in the form of light waves. These cables are well-suited for voice, data and video transmissions. Optical fibre is the most secure of all the cable media. Installation and maintenance are difficult and costly. Fibre optic cables have greater transmission speed, high bandwidth, and the signal can travel longer distances, when compared to coaxial and twisted pair cables.

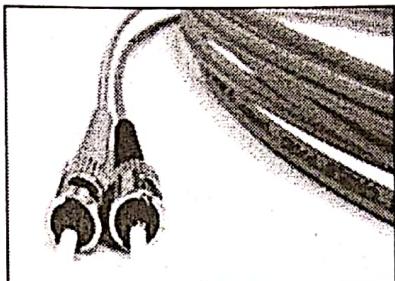


Fig. 6.10.3 : Optical fiber

6.10.2 Unguided Transmission

An unguided transmission transmits the electromagnetic waves without using any physical medium. Therefore it is also known as **wireless transmission**. In unguided media, air is the media through which the electromagnetic energy can flow easily.

Unguided transmission is broadly classified into three categories:

(a) Radio waves

- Radio waves are the electromagnetic waves that are transmitted in all the directions of free space.
- Radio waves are omni directional, i.e. the signals are propagated in all the directions.
- An example of the radio wave is FM radio.

Advantages of radio transmission

- Radio transmission is mainly used for wide area networks and mobile cellular phones.
- Radio waves cover a large area, and they can penetrate the walls.
- Radio transmission provides a higher transmission rate.

(b) Microwaves

Microwaves are of two types

1. Terrestrial microwave transmission
2. Satellite microwave communication

1. Terrestrial microwave transmission

- Terrestrial microwave transmission is a technology that transmits the focused beam of a radio signal from one ground-based microwave transmission antenna to another.
- Microwaves are unidirectional as the sending and receiving antennae are to be aligned, i.e. the waves sent by the sending antenna are narrowly focused.

- It works on the line-of-sight transmission, i.e. the antennae mounted on the towers are in direct sight of each other.

Advantages

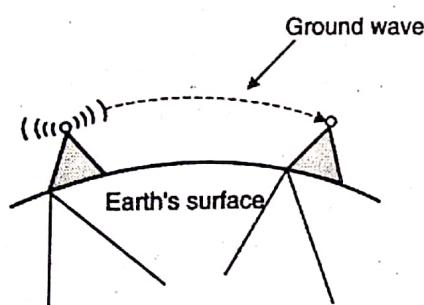
- Terrestrial transmission is cheaper than using cables.
- It is free from land acquisition as it does not require any land for the installation of cables.
- Terrestrial transmission provides easy communication in terrains as the installation of cables in terrain is quite a difficult task.

2. Satellite Microwave Communication

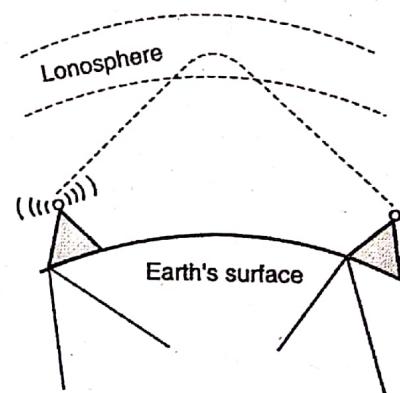
- A satellite is a physical object that revolves around the earth at a known height.
- Satellite communication is more reliable nowadays as it offers more flexibility than cable and fibre optic systems.
- We can communicate with any point on the globe by using satellite communication.

Advantages

- The coverage area of a satellite microwave is more than the terrestrial microwave.
- The transmission cost of the satellite is independent of the distance from the centre of the coverage area.
- Satellite communication is used in mobile and wireless communication applications.



Terrestrial microwave transmission



Satellite Microwave Transmission

Fig. 6.10.4 : Microwaves

6.11 Pervasive Computing

It is a computing environment that proposes a proactive interaction between devices and environment with the goal of making technologies transparent to the user. It goes beyond the realm of personal computers. It is a kind of embedded technology where any device can be imbedded with chips and get connected to an infinite network of other devices.

The goal of pervasive computing, which combines current network technologies with wireless computing, voice recognition, internet capability and artificial intelligence, is to create an environment where the connectivity of devices is embedded in such a way that the connectivity is unobtrusive and always available.

It is also known as ubiquitous computing, which is the study of how computing can be integrated into the environment in a way that makes it easily accessible to users. It includes an emphasis on ease and naturalness of use.

Features

- Pervasive computing consists of inexpensive microprocessors embedded in everyday objects and environments. It creates an environment where computers have the capability to obtain information from the environment in which it is embedded and utilize it dynamically.
- Pervasive computing devices are not personal computers as we tend to think of them, but rather small electronic mobile embedded devices in almost any type of real world object, including cars, tools, watches, household appliances, clothes, and so forth—all communicating through increasingly interconnected networks.
- This is a new dimension of personal computing that integrates mobile communication, ubiquitous embedded computer systems, consumer electronics, and the power of the internet. Camera phones are sometimes seen as a step toward “smart” phones becoming successful pervasive computing devices that allow users to communicate via audio, video, still images, e-mail, and the internet without having to stop and deal with issues such as connectivity and technical issues.
- In pervasive computing environment, all these devices communicate with each other over wireless networks without any interaction required by the user.

6.11.1 Application Areas**Health**

The application of pervasive computing in health is called *u-Health* or pervasive health. The applications are commonly centered in hospital routine management, patients' monitoring or well-being. For example, the treatment of non-communicable diseases (NCDs) can benefit from *u-Health* technologies. The treatment of these diseases is continuous, so the patients must always be aware of their condition, following the treatment planned by the doctor. Furthermore, patients of NCDs should be engaged in the treatment, because some activities are performed daily by themselves and depend on their habits and lifestyle.

Accessibility

The term *pervasive accessibility* indicates a new technology approach to support accessibility. Since the computing is shifting from personal workstations to pervasive computing, accessibility should be thought accordingly with this new computational paradigm. In this sense, the *u-Accessibility* has emerged as a way to improve the quality of life of people with disabilities and the elderly.

Learning

The application of mobile and pervasive computing in the improvement of learning strategies has created two research fronts called *mobile learning* and *pervasive learning*. *Mobile learning* is fundamentally about increasing learners' capability to carry their own learning environment along with them. M-learning is the natural evolution of e-learning, and has the potential to make learning even more widely accessible. In m-learning model, mobile computers are still not embedded in the learners' surrounding environment, and as such they cannot seamlessly obtain information about learner context.

On the other hand, *pervasive learning* refers to learning supported by the use of mobile and wireless communication technologies, sensors and location/tracking mechanisms, which work together to integrate learners with their environments. Pervasive learning systems connect virtual and real objects, people and events, in order to support a continuous, contextual and meaningful learning.

While the learner is moving with mobile device, the system dynamically supports the learning process by communicating with embedded computers in the environment. The essence of pervasive learning is to realize which information can be presented throughout the learners' daily tasks, in different forms and places, and to link this data with the learners' educational process.

Logistics :

Transport is strategic in the supply chain integration, because it can be used to control flows of resources, goods and products. In addition, transport is a significant part of the logistics costs, thus; its management is relevant to enhance efficiency and flexibility in fleet operation. In this sense, companies have used current technologies to obtain precise information to support this management among which stands out the Global Positioning System and its use to implement location systems and monitoring/tracking systems.

Several research works have addressed the use of pervasive technologies to improve the transport logistics. This enables the users to identify whether a vehicle is following a planned route or deviating from the original path.

Commerce :

The use of mobile devices and pervasive technologies to support commerce is commonly classified as *context-aware commerce* or *ubiquitous commerce* (so called *u-commerce*). There are three prerequisites for the success of u-commerce: (1) always be connected with the clients; (2) always be aware of clients' contexts (where they are, what they are doing and what is available around them); and (3) always be proactive, identifying real-time opportunities to meet client needs.

Pervasive computing technologies are used to identify business opportunities for users as clients or suppliers. In addition, it offers a generic approach to support trade in goods and services without domain restrictions.

6.12 Cloud Computing

Cloud computing is the delivery of computing services such as servers, storage, database, networking, software, analytics, etc. over the internet. Using cloud computing services users are able to access software and applications from wherever they are; the computer programs are hosted by an outside party and reside in the cloud. This means that users do not have to worry about things such as storage and power. Moreover, you pay only for the services you use, thus lowering your operating costs.

6.12.1 Advantages of Cloud Computing

Cloud computing is a big shift from the traditional way of using IT resources. Following are the advantages organizations get out of cloud computing:

- **Cost saving :** Cloud computing eliminates the capital expense of buying hardware and software and setting up and running IT infrastructure such as data centres, servers, electricity for power and cooling, the IT experts for managing the infrastructure. All this result in cost cutting.
- **High speed :** Most cloud computing services are offered on demand, so even vast amounts of computing resources can be made available in minutes giving businesses a lot of flexibility and taking the pressure off.

- **Greater scalability :** The benefits of cloud computing services include the ability to scale up fast. It means delivering the right amount of IT resource when it is needed and from the right geographic location.
- **Improves productivity :** On-site data centres typically require a lot of infrastructural requirements like hardware, software, and other time-consuming IT management chores. Cloud computing removes the need for many of these tasks, so IT teams can spend time on achieving more important business goals.
- **Better performance :** The biggest cloud computing services run on a worldwide network of secure data centres, which are regularly upgraded to the latest generation of fast and efficient computing hardware. This offers several benefits over a single corporate data centre
- **Reliability :** Cloud computing makes data backup, disaster recovery and business continuity easier and less expensive because data can be mirrored at multiple redundant sites on the cloud provider's network.
- **Security:** Many cloud providers offer a broad set of policies, technologies and controls that strengthen your security posture overall, helping protect your data, apps and infrastructure from potential threats.

6.12.2 Types of Cloud Computing

Clouds of several different models, types and services have evolved to offer the right solution for your needs. There are three different ways to deploy cloud services: on a public cloud, private cloud or hybrid cloud.

- **Public cloud:** These clouds are owned and operated by a third party cloud service provider to deliver the services over the internet. All the supporting hardware, software and other infrastructure is owned and managed by the cloud provider. You access these services using your browser.
- **Private cloud:** It refers to the cloud services owned by a single organization for its own use. It may be located at the organization's data centre.
- **Hybrid cloud:** Hybrid clouds combine public and private clouds, bound together by technology that allows data and applications to be shared between them. By allowing data and applications to move between private and public clouds, a hybrid cloud gives your business greater flexibility, more deployment options and helps optimise your existing infrastructure, security and compliance.

6.12.3 Types of Cloud Services

Most cloud computing services fall into four broad categories: Infrastructure as a Service (IaaS), Platform as a Service (PaaS), Serverless and Software as a Service (SaaS).

- **Infrastructure as a Service (IaaS):** This is the most basic category of cloud computing services. With IaaS, you take on rent IT infrastructure like servers and virtual machines (VMs), storage, networks, operating systems from a cloud provider on payment basis
- **Platform as a Service (PaaS):** Platform as a service refers to cloud computing services that supply an on-demand environment for developing, testing, delivering and managing software applications. PaaS is designed to make it easier for developers to quickly create web or mobile apps, without worrying about setting up or managing the underlying infrastructure of servers, storage, network and databases needed for development.
- **Serverless computing:** Serverless computing focuses on building app functionality without spending time on managing the servers and infrastructure required to do so. The cloud provider handles the setup, capacity planning and server

management for you. Serverless architectures are highly scalable and event-driven, only using resources when a specific function or trigger occurs.

- **Software as a Service (SaaS):** Software as a service is a method for delivering software applications over the internet, on demand and typically on a subscription basis. With SaaS, cloud providers host and manage the software application and underlying infrastructure and handle maintenance, like software upgrades and security patching. Users connect to the application over the internet, usually with a web browser on their phone, tablet or PC.

6.12.4 Usage of Cloud Computing

You are probably using cloud computing right now, even if you don't realise it. If you use an online service to send email, edit documents, watch movies or TV, listen to music, play games or store pictures and other files, it is likely that cloud computing is making it all possible behind the scenes.

Here are a few examples of what is possible today with cloud services from a cloud provider:

- **Create new apps and services:** Quickly build, deploy and scale applications for web, mobile and API on any platform. Access the resources you need to help meet performance, security and compliance requirements.
- **Test and build applications:** Use of cloud services reduce application development cost and time by using cloud infrastructures.
- **Store, back up and recover data:** Protect your data more cost-efficiently—and at massive scale—by transferring your data over the internet to an offsite cloud storage system that is accessible from any location and any device.
- **Analyse data:** Unify your data across teams, divisions and locations in the cloud. Then use cloud services, such as machine learning and artificial intelligence to uncover insights for more informed decisions.
- **Stream audio and video:** Connect with your audience anywhere, anytime, on any device with high-definition video and audio with global distribution.

Exercises

Answer the following questions in short

- Q. Define computer network. (Refer section 6.1)
- Q. How does a computer network work? (Refer section 6.1.1)
- Q. Write any four advantages of computer network. (Refer section 6.2)
- Q. What is online banking? (Refer section 6.3)
- Q. What is server? State two of its functions. (Refer section 6.4)
- Q. What is protocol? Give an example. (Refer section 6.4)
- Q. Define LAN. Write its advantages. (Refer section 6.5)
- Q. Define WAN. (Refer section 6.5)
- Q. What is Ethernet? (Refer section 6.5)
- Q. Describe client/server network. (Refer section 6.6.2)
- Q. What is network topology? (Refer section 6.7)

- Q. Differentiate bus and star topology. (Refer section 6.7.2 and 6.7.3)
- Q. What is hub? How is different from switches? (Refer section 6.8)
- Q. Differentiate bridge and gateway. (Refer section 6.8)
- Q. What is router? (Refer section 6.8)
- Q. What is an access point? (Refer section 6.8)
- Q. Differentiate between guided and unguided media. (Refer section 6.10)
- Q. What is optical fibre? Write its advantages. (Refer section 6.10)
- Q. What is pervasive computing? (Refer section 6.11)
- Q. What is cloud computing? (Refer section 6.12)

Answer the following questions in long

- Q. Describe the applications of computer network. (Refer section 6.3)
- Q. Describe the hardware and software component of a computer network. (Refer section 6.4)
- Q. Describe and differentiate LAN, MAN and WAN. (Refer section 6.5)
- Q. Describe the types of network architecture. (Refer section 6.6)
- Q. Describe any four network topologies. (Refer section 6.7)
- Q. Describe and differentiate between wired and wireless network technology (Refer section 6.9)
- Q. Describe wireless/unguided transmission media, their usage and advantages. (Refer section 6.10)
- Q. Describe the applications of pervasive computing. (Refer section 6.11)
- Q. Explain different types of cloud computing services. (Refer section 6.12)
- Q. Describe the advantages of cloud computing. (Refer section 6.12.1)

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