

A Revise Study of Computer Networks

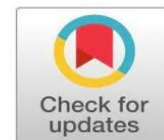
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Publication History

Manuscript Reference No: IJIRIS/RS/Vol.12/Issue06/ISAU26.ISAU10080

Research Article | Open Access | Double-Blind Peer-Reviewed| Article ID: IJIRAE/RS/Vol.12/Issue06/ISAU26.ISAU10080

Received: 08, July 2026, Revised: 28, July 2026, Accepted: 10, August 2026, Published Online: 20, August 2026.

<https://www.ijiris.com/volumes/Vol12/iss-06/01.AJIS0080.pdf>

Article Citation: Pradyun(2026),A Revise Study of Computer Networks. IJIRIS: International Journal of Innovative Research in Information Security, Volume 12, Issue 06 of 2026 pages 332-337

Doi:> <https://doi.org/10.26562/ijiris.2026.v1206.01> **BibTeX Key:** Pradyun@2026Revise

IJIRIS papers should be cited as IJIRIS(International Journal of Innovative Research in Information Security, AM Publications, India 2026, ISSN 2349-7017, <https://doi.org/10.26562/ijiris.2026.v1206.01> The journal's official abbreviation is IJIRIS. **Orcid:** <https://orcid.org/0009-0004-9398-7488> About the License: Copyright©2026 copyright by the authors. This article is an open access and license under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>)

Abstract: The theory of networks is not innovative. In simple terms it means an interrelated set of some objects. For decades we have been familiar with the radio, television, railway, highway, bank and other types of networks. In recent years, the network that is making a significant impact in our day-to-day life is the computer network. By computer network we mean an interrelated set of autonomous computers. The term self-governing implies that the computers can function independent of others. The paper describes the revised study and evolution of computer networks and specifies some of the importance and application of computer networks.

Keywords: ARPANET, Broadcast Network, Point to Point Network, LAN, MAN, WAN, Internetworking, Routing and Congestion Control

I. INTRODUCTION

The history of electronic computers is not very old. It came into existence in the early 1950s and during the first two decades of its existence it remained as a centralized system housed in a single large room. In those days the computers were large in size and were operated by trained personnel. To the users it was a remote and mysterious object having no direct communication with the users. Jobs were submitted in the form of punched cards or paper tape and outputs were collected in the form of computer printouts. The submitted jobs were executed by the computer one after the other, which is referred to as batch mode of data processing. In this scenario, there was long delay between the submission of jobs and receipt of the results. In the 1960s, computer systems were still centralizing, but users provided with direct access through interactive terminals connected by point-to-point low-speed data links with the computer. In this situation, a large number of users, some of them located in remote locations could simultaneously access the centralized computer in time-division multiplexed mode. The users could now get immediate interactive feedback from the computer and correct errors immediately. Following the introduction of on-line terminals and time-sharing operating systems, remote terminals were used to use the central computer.

II. COMPUTER NETWORKS & COMMUNICATION

Computer networks have emerged as a result of the convergence of two technologies of this century computer and communication as shown in Fig.1

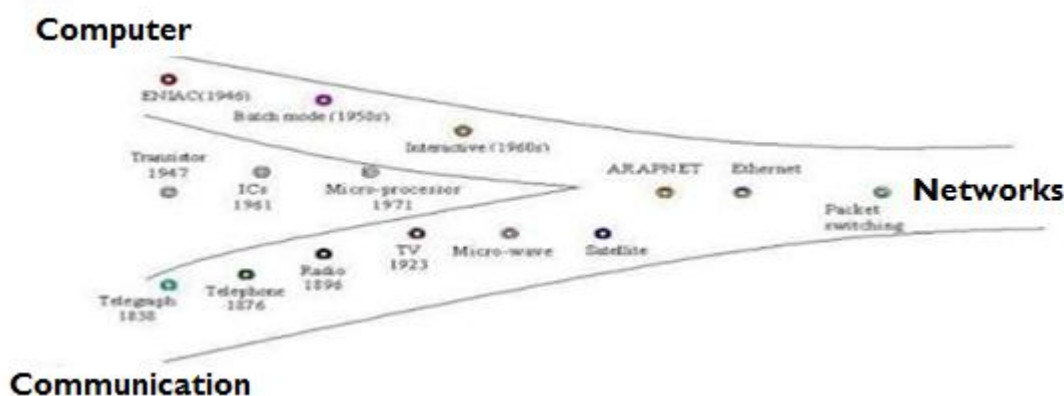


Fig.1 Evolution of computer networks

The consequence of this revolutionary merger is the emergence of a integrated system that transmit all types of data and information. There is no fundamental difference between data communications and data processing and there are no fundamental differences among data, voice and video communications. With the advancement of VLSI technology, and particularly, after the invention of microprocessors in the early 1970s, the computers became smaller in size and less expensive, but with significant increase in processing power. New breed of low-cost computers known as mini and personal computers were introduced. Instead of having a single central computer, an organization could now afford to own a number of computers located indifferent departments and sections. Side-by-side, riding on the same VLSI technology the communication technology also advanced leading to the worldwide deployment of telephone network, developed primarily for voice communication. An organization having computers located geographically dispersed locations wanted to have data communications for diverse applications. Communication was required among the machines of the same kind for collaboration, for the use of common software or data or for sharing of some costly resources. This led to the development of computer networks by successful integration and cross-fertilization of communications and geographically dispersed computing facilities. One significant development was the ARPANET (Advanced Research Projects Agency Network). Starting with four-node experimental network in 1969, it has subsequently grown into a network several thousand computers spanning half of the globe, from Hawaii to Sweden. Most of the present-day concepts such as packet switching evolved from the ARPANET project. The low bandwidth (3KHz on a voice grade line) telephone network was the only generally available communication system available for this type of network. The bandwidth was clearly a problem, and in the late 1970s and early 80s another new communication technique known as local area networks (LAN) evolved, which helped computers to communicate at high speed over a small geographical area. In the later years use of optical fiber and satellite communication allowed high-speed data communications over long distances.

III. CLASSIFICATION OF COMPUTER NETWORK BASED ON TRANSMISSION TECHNOLOGY

A. Broadcast Networks

A single communication channel that is shared by all the machines on the network. Point-To-Point Networks: This network consists of many connections between individual pairs of machines. To go from the source to destination a message (or packet) may have to visit one or more intermediate machines.

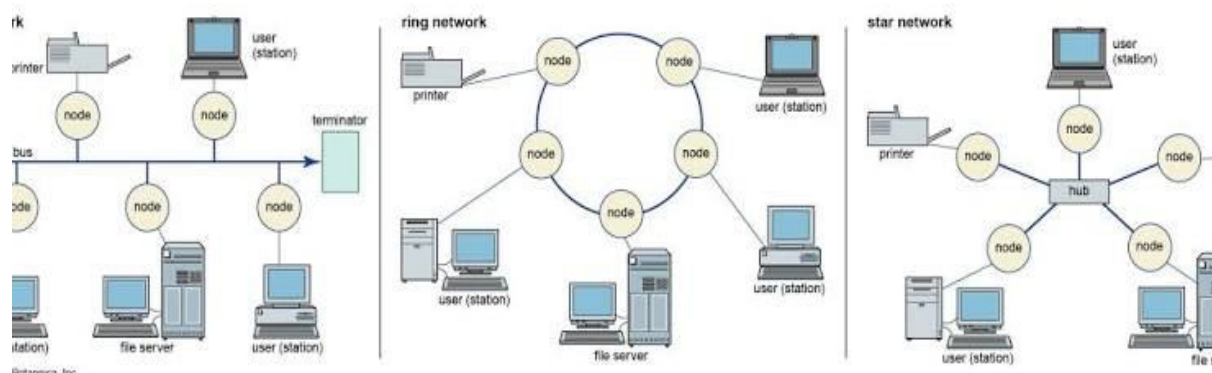


Fig. 2 Broadcast network based on shared bus

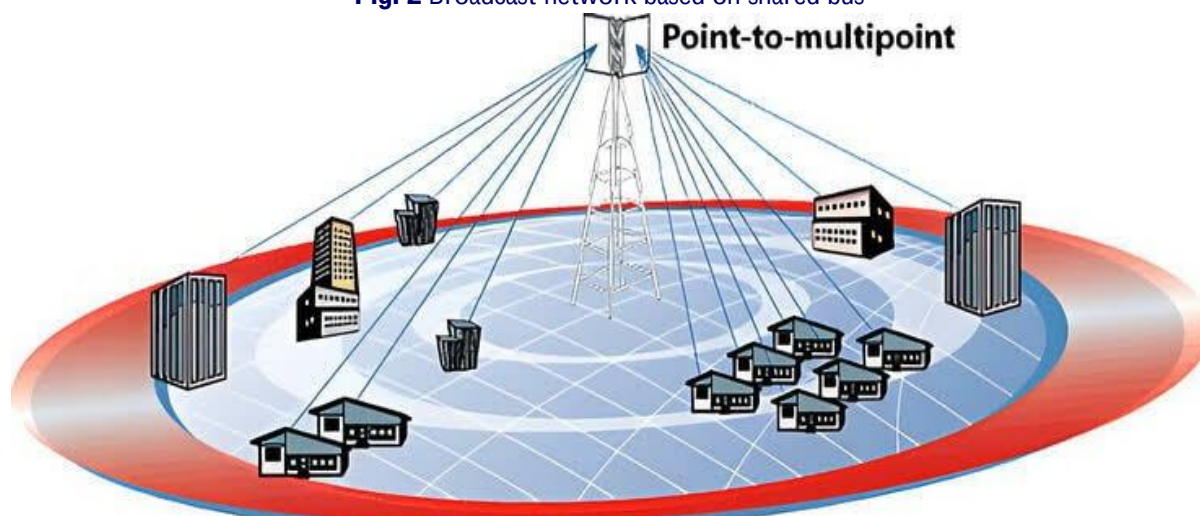


Fig.3 Communication network based on point-to-point communication

B. Classification of Computer Network Based on Scale

Local Area Network (LAN): It is privately owned communication systems that cover a small area, say a building or a complex of buildings. Length is about 10 meters to few kilometers and operates at a high speed like 10 MBps to 1000 MBps.

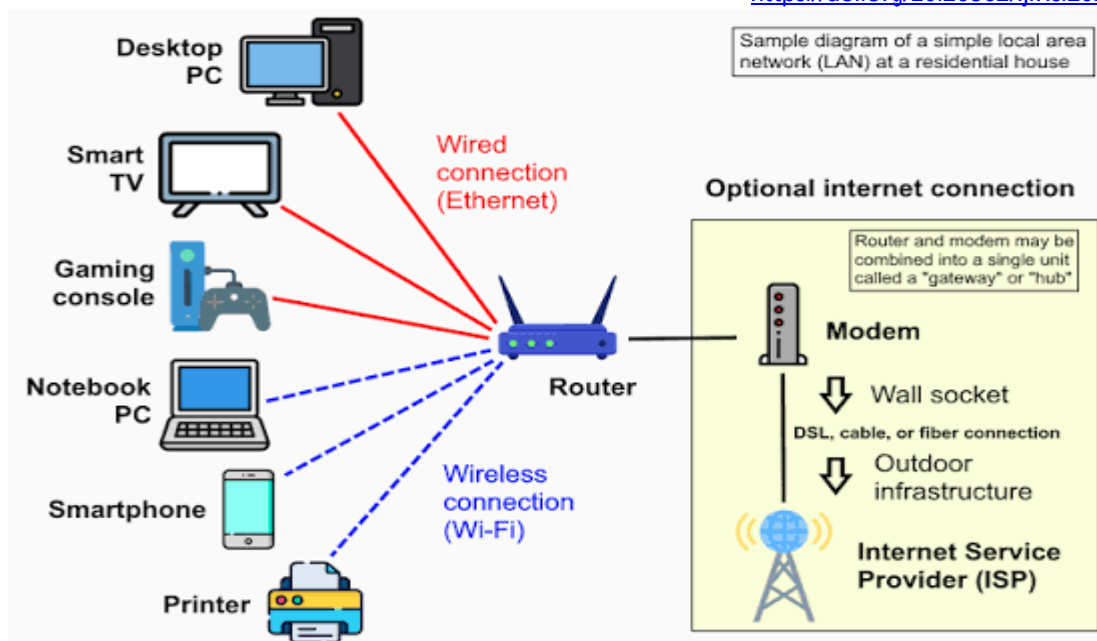


Fig. 4 Local area network

C. Metropolitan Area Network (MAN)

It is public or privately owned communication system that typically covers a complete city. Speed is about 10 Mbps and follows DQDB (Distributed queue double bus) standard. Its reliability is moderate.

D. Wide Area Network (WAN)

It covers a large geographical area. Data transfer rate is low (Few KBps to 10 MBps) and error rate is much higher.

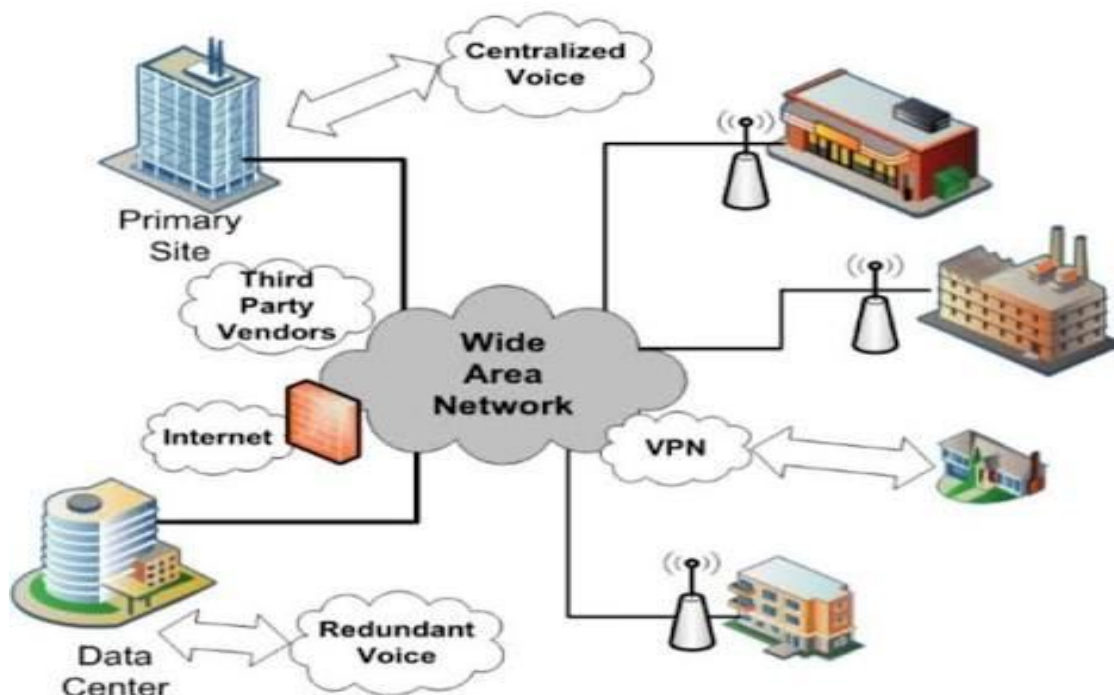


Fig 5 Wide area network

IV. INTERNET

Internet is a collection of networks or network of networks. Various networks such as LAN and WAN connected through suitable hardware and software to work in a seamless manner. It allows various applications such as e-mail, file transfer, remote login, World Wide Web (www), Multimedia, etc run across the Internet. Most people connecting to the Internet nowadays are using a nice little thing they call a Router or DSL Router. The network that people are using will basically look like given below:



Fig. 6 User and Internet

A. Broadcast Communication Network

In broadcast networks, one transmission media is shared by all the users and information is broadcast by an user into the medium. Some examples of broadcast communication networks are:

- Local Area Network (LAN)
- Packet Radio Network
- Cellular Telephone Network
- Satellite Network

These networks can be characterized by the following three parameters:

- Transmission Media
- Topology
- Medium Access Control (MAC) Techniques

V. INTERNETWORKING

To make the computer networks more useful and suitable for many emerging applications, it is necessary to connect individual heterogeneous networks, both LAN and WAN, distributed across the world using suitable hardware and software in such a way that it gives the user the illusion of a single network.

VI. MOBILITY

When a host is connected to one link or network, it acquires an IP address and all communication happens using that IP address on that link. As soon as, the same host changes its physical location, as it moves into some different area / subnet / network / link, its IP address changes accordingly and all communication happening on the host using old IP address. IPv6 mobility provides a mechanism which equips a host with an ability to roam around among different links without losing any communication/connection and its IP address. IPv6 support for IP mobility in devices.

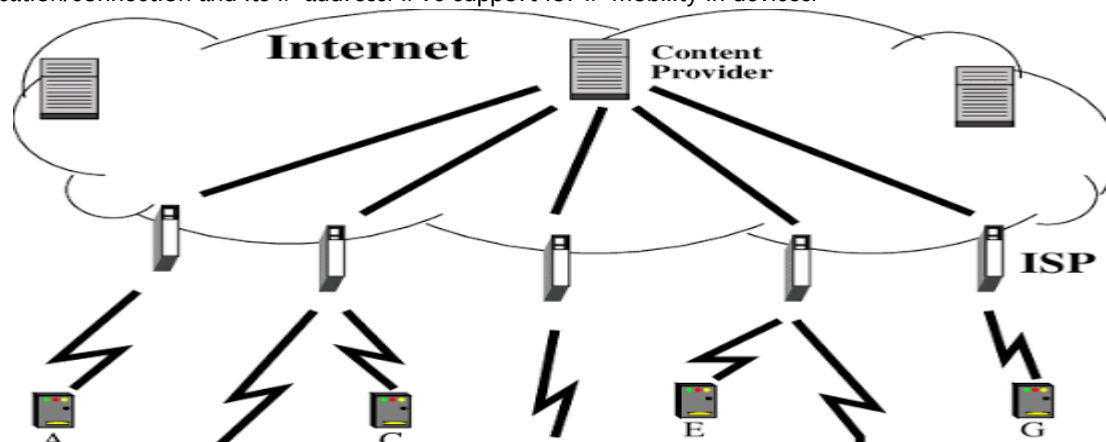


Fig.7 Mobile devices accessing internet service

VII. Wireless Network

Wireless networks support a stand-alone configuration as well as an integrated configuration with 10/100 Mbps Ethernet LANs. The 2.4 GHz/5 GHz Wireless Access Point also provides repeater and bridging services that can be configured independently on either 5 GHz or 2.4 GHz radio interfaces.

VIII. ROUTING & CONGESTION CONTROL

When a packet travels from a source to a destination, it is likely to pass through several routers and normally there exist multiple paths between any two source-destination pairs. The routing function of the network layer decides which path a packet to follow from a source node to a destination node. For a connectionless (Datagram type) service, each packet is routed independently, whereas for a virtual-circuit type of service, a route is set up at the beginning and all packets follow the same path. The attributes, which are expected from a routing function, are: correctness, simplicity, robustness, stability, fairness and optimality and the routing algorithms can be classified based on different metrics. Some popular routing algorithms, namely Routing Information Protocol (RIP), Open Shortest Path First (OSPF), Border Gateway Protocol (BGP), Interior Gateway Routing Protocol (IGRP), and Enhanced Interior Gateway Routing Protocol (EIGRP). A packet switched network may be considered as a network of queues. If the rate at which packets arrive and queue up exceeds the rate at which packets are disbursed, the queue size grows without bounds leading to long delay and buffer overflow. Ultimately, it may lead to deadlock, a catastrophic situation in which the throughput drops to zero. The objective of the congestion control is to maintain the number of packets within the network or a region of network below the level at which queuing delays blow up.

A. Benefit Of Computer Networks

- Resource sharing
- Powerful communication medium
- Higher reliability
- Higher flexibility
- Lower cost
- Incremental expansion

IX. CONCLUSION

Computer network can have a large number of computers, which can share software, database and other resources. In the event of failure of one computer, its workload can be taken over by other computers. So, it provides higher reliability than centralized computing system. Requirement of software, hardware, database etc. increases gradually. With the ability to contact anybody from anywhere and more and more people joining the internet with diverse applications, network security has become a very important issue. People are now very concerned about communication in a secured manner through internet, which is essentially an insecure public network. Cryptography has been considered to be the solution to this problem. Suitable encryption/decryption techniques can be used for transfer of data through internet between any two hosts in a secured manner. Cryptography can be applied in a number of ways to achieve secured communication through an insecure communication network. Moreover, many organizations have confidential or proprietary information, such as trade secrets, product development plans, marketing strategies, etc. In centralized computing system, if one computer is not able to serve the purpose, we have to replace it by new one. Replacement of new computer requires lot of investment and effort, which can be avoided in computer network system. If there is need for more, one can buy another powerful computer, add it to computer network and use it. The various resources like computers, peripherals, etc. can be added in a scalable manner.

AUTHOR CONTRIBUTION STATEMENT

Conceptualization: Pradyun Bichagal

Literature Review and Methodology design: Pradyun Bichagal

Software: Pradyun Bichagal

Validation: Pradyun Bichagal

Formal Analysis: Pradyun Bichagal

Investigation: Pradyun Bichagal

Resources: Pradyun Bichagal

Data Curation: Pradyun Bichagal

Writing original draft preparation: Pradyun Bichagal

Writing review and Editing: Pradyun Bichagal

Visualization: Pradyun Bichagal

Supervision: Pradyun Bichagal

Conflict of interest: The authors declare no conflicts of interest.

Data availability statement: Data supporting these findings are available within the article, at <https://doi.org/10.26562/ijiris.2026.v1206.01>, or upon request.

Supplementary materials: The supplementary materials are available at <https://doi.org/10.26562/ijiris.2026.v1206.01>

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About the Author



Pradyun Bichagal ^{ID} is a young innovator and a passionate learner currently studying in 11th Standard at BGS NPS, Bengaluru, India. With a deep interest in electronics and technology, Pradyun enjoys building creative projects that reflect his curiosity and problem-solving mindset. Remarkably, Pradyun has already published one book titled [“Networking Guide”](#) and three patents, demonstrating his strong inclination toward innovation at an early age. His work showcases both imagination and technical skill, making him an inspiring example for young minds interested in science and engineering. Driven, disciplined, and always eager to explore new ideas, Pradyun continues to expand his knowledge and creative abilities. His journey as an author reflects his belief that learning has no age limit and that passion can turn ideas into impactful creations.

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