University of Barishal

Basic Computer Networking
(2nd Batch)

Project Report on

"Enhancing Connectivity: A Study on Basic Computer Networking in Campus Areas"

Submitted To:

Md. Rashid Al Asif

Assistant Professor

Dept. of Computer Science & Engineering

University of Barishal

Submitted By:

Name : Sadika Marzia

St. ID : 02-002-17

Department : Economics

"Enhancing Connectivity: A Study on Basic Computer Networking in Campus Areas"

Abstract

This report provides a comprehensive overview of basic computer networking concepts, focusing on the foundational principles, components, and protocols that enable modern communication systems. It explores the key elements of a network, including hardware such as routers, switches, and servers, as well as software protocols like TCP/IP, DNS, and DHCP. The report delves into the structure of networks, such as LANs, WANs, and wireless networks, while examining data transmission methods, addressing schemes, and network topologies. A special emphasis is placed on the importance of network security, highlighting best practices and common challenges such as unauthorized access and data breaches. The report also discusses the practical applications of networking in everyday life, including the Internet, cloud computing, and IOT integration. Finally, it outlines future trends and research directions in computer networking, emphasizing areas like AI-driven automation, scalability, and the transition to next-generation technologies such as 5G and quantum networking. This document serves as a valuable resource for understanding the essentials of computer networking, providing insights for students, IT professionals, and anyone interested in the evolving landscape of networked systems.

Introduction

A computer network, also known as a data network, is a telecommunications infrastructure enabling computers to exchange data through data connections. These connections, established via cable or wireless media, facilitate the transmission of information between networked computing devices. Examples of such devices include personal computers, phones, servers, and networking hardware. The Internet serves as one of the most prominent examples of a computer network. Network nodes within these systems originate, route, and terminate data, supporting a wide array of applications such as web browsing, shared use of servers and printers, as well as email and instant messaging. The design and implementation of computer networks involve considerations such as transmission signals, communications protocols for organizing network traffic, and factors like size, topology, and organizational intent. Computer networks are essential for sharing information, resources (like printers and files), and connecting to the internet. Networking allows collaboration in business, supports remote work, connects devices in homes, and is the backbone of communication technologies like email, video conferencing, and social media. The fundamental concepts of computer networking, focusing on VLANs, static and dynamic routing, and the Routing Information Protocol (RIP). In modern networks, these components play critical roles in organizing and managing network traffic efficiently.

VLANs (Virtual Local Area Networks) are used to logically segment the network, grouping devices based on function, department, or security level rather than physical location. VLANs improve security and reduce broadcast traffic, ensuring that devices within the same VLAN can communicate easily, while isolating traffic from other VLANs.

Routing is essential for connecting different network segments, allowing communication between VLANs and external networks. We will explore both static and dynamic routing:

- **Static Routing** involves manually configuring routes between network segments, giving administrators precise control over data paths.
- **Dynamic Routing** enables routers to automatically learn and adjust to network changes, using protocols to share routing information and select optimal paths.

RIP (Routing Information Protocol), one of the simplest dynamic routing protocols, which enables routers to exchange routing information periodically. RIP uses a distance-vector algorithm to calculate the best routes based on hop counts, making it suitable for smaller networks.

This report will analyze the interactions between VLANs, static and dynamic routing, and RIP, highlighting their roles in optimizing network performance, security, and scalability. By examining a network design that incorporates these elements, we aim to provide a practical understanding of how each component contributes to an organized and efficient network infrastructure.

Related Work

The background of computer networking highlights its evolution from simple, localized systems to complex, global infrastructures. Networking technologies such as VLANs, routing protocols, and security measures are essential to ensure efficient, scalable, and secure communication. With the growth of the internet, cloud computing, and mobile technology, networking has become a critical part of daily life, supporting everything from business operations to personal communications.

1. Network Architecture and Design

Network architecture focuses on structuring and designing networks to meet specific requirements, such as performance, scalability, and reliability. Early networking models like the **OSI (Open Systems Interconnection) model** and the **TCP/IP model** established frameworks for network protocols, allowing different types of systems to interoperate.

- The **OSI Model** by the International Organization for Standardization (ISO) in the 1980s set the standard for how networking functions are divided into seven layers, making it easier to develop and troubleshoot network protocols and devices.
- The **TCP/IP Model**, developed by DARPA, became the foundational framework for the modern internet, with its four-layer model (Application, Transport, Internet, and Network Access) influencing internet protocol standards.

2. Routing Protocols

Routing protocols determine the best paths for data packets to travel across networks. Early routing protocols like **RIP (Routing Information Protocol)** and **OSPF (Open Shortest Path First)** laid the groundwork for more advanced routing algorithms and are still in use today for specific network configurations.

- **RIP (Routing Information Protocol)** was one of the first distance-vector routing protocols, developed in the 1980s. RIP allows routers to share routing information by counting hops to determine the shortest path, making it suitable for small networks.
- **OSPF (Open Shortest Path First)**, developed as a link-state protocol, improved upon RIP by introducing a method to calculate the shortest path using Dijkstra’s algorithm. OSPF's efficiency and scalability make it a standard in larger, enterprise networks.

3. Virtual Local Area Networks (VLANs)

VLANs are used to segment large networks into smaller, isolated networks within the same physical infrastructure. VLANs enhance security, reduce broadcast traffic, and improve network performance.

- The **IEEE 802.1Q Standard** introduced the concept of VLAN tagging, allowing multiple VLANs to coexist on the same physical network infrastructure. This standard remains the foundation of VLAN implementation in modern networking.
- Studies have shown that VLANs improve network efficiency and security by creating logical separations within a network, allowing organizations to manage different departments or functions independently within the same physical space. This segmentation is widely used in enterprise networks and data centers.

4. Cloud Computing and Edge Computing

Cloud and edge computing have transformed network architecture by enabling data processing and storage in remote data centers and at the network's edge, respectively. This paradigm shift has made it easier to scale resources and improve performance in applications that require low latency.

- **Cloud Networking**: Research on cloud networking focuses on enabling scalable, reliable, and secure communication in cloud environments. Technologies such as **SD-WAN (Software-Defined Wide Area Network)** and **VPNs** facilitate secure and efficient connections to cloud resources.
- **Edge Computing**: Edge computing research aims to process data closer to where it's generated, reducing latency and bandwidth usage. Edge computing is particularly beneficial for applications requiring real-time responses, like autonomous vehicles and industrial automation.

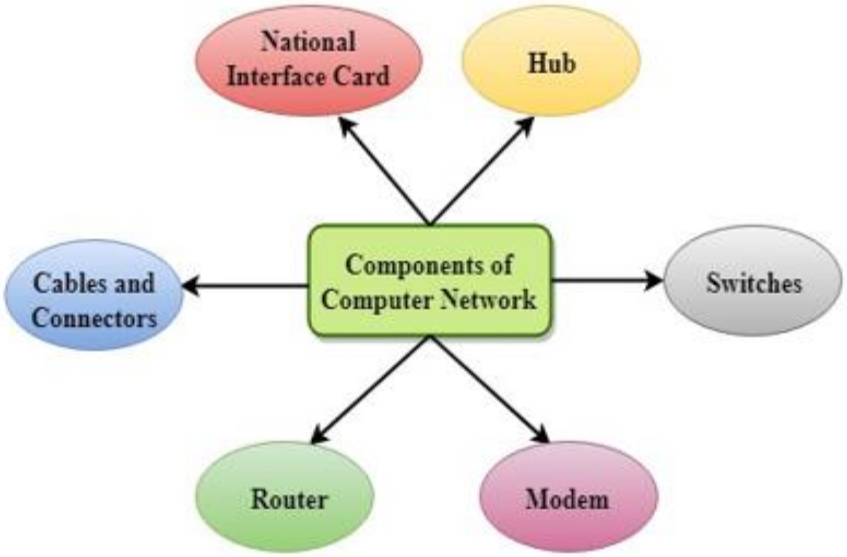


Fig. 1: Components of Computer Network

System Design

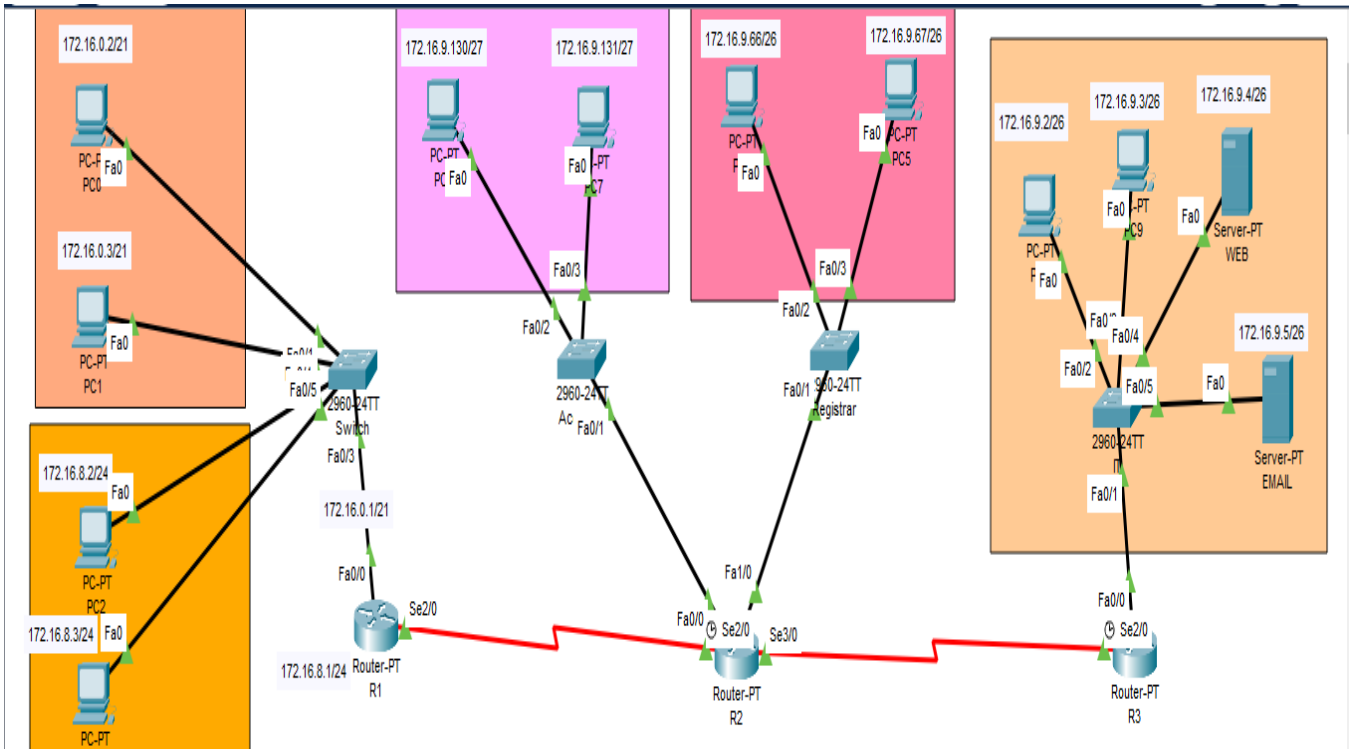
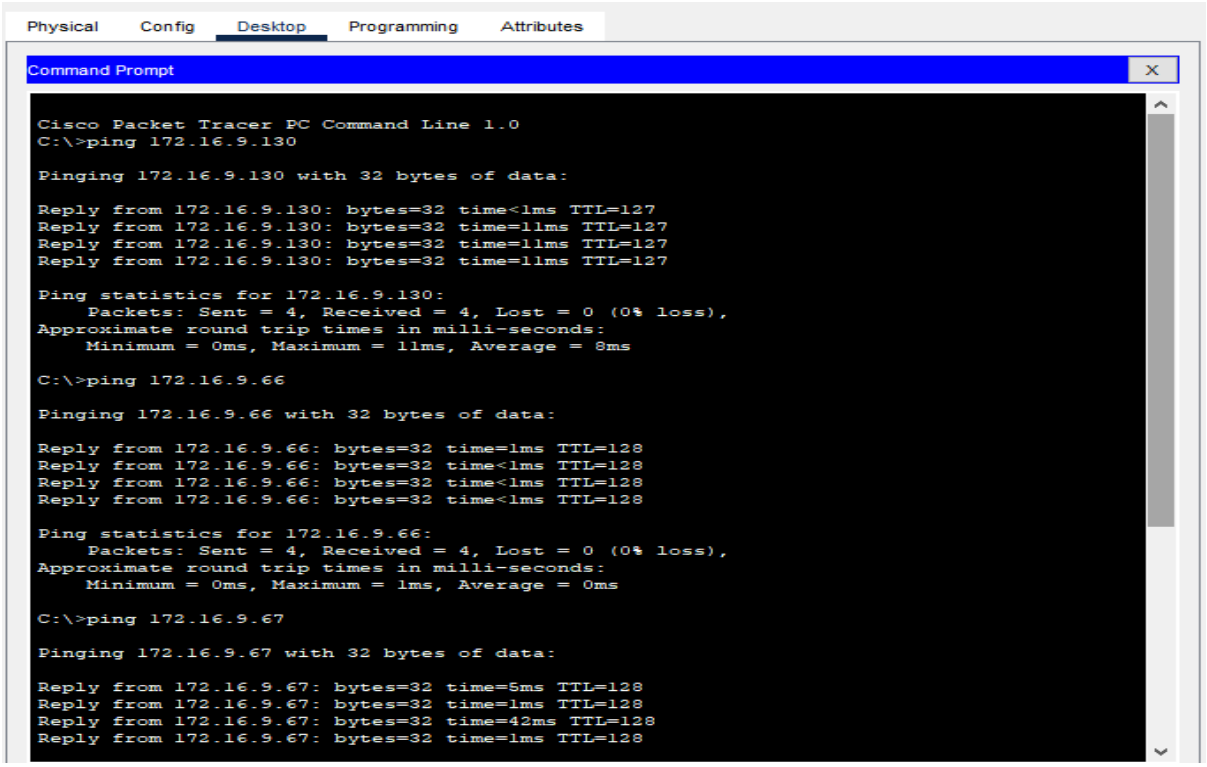


Fig: Network Topology



In this diagram, there are three routers and four switches. Here it illustrates network segmented by subnets, with RIP routing protocol potentially being used for inter-router communication.

Result & Discussion

Router and Switch Configuration:

- Multiple routers (R1, R2, and R3) are used to interconnect different subnets and manage routing between them.
- Serial connections (Se2/0, Se3/0) between routers may represent WAN or point-to-point links to connect different parts of the network.
- Switches are used to connect devices within the same subnet, with specific FastEthernet (Fa) ports linking end devices to the network.

In this table, the IP address and subnet mask for router are giving below:

Router 1	**Router 2**	**Router 3**
int f0/0 IP address 172.16.0.1 255.255.248.0 int f1/0 ip address 172.16.0.2 255.255.0.0 int s2/0 ip address 172.16.9.161 255.255.255.252	int f0/0 ip address 172.16.9.129 255.255.255.224 int f1/0 ip address 172.16.9.65 255.255.255.192 no shutdown int s2/0 ip address 172.16.9.162 255.255.255.252 int s3/0 ip address 172.16.9.169 255.255.255.252	int f0/0 Ip address 172.16.9.1 255.255.255.192 int s2/0 ip address 172.16.9.170 255.255.255.252 int s3/0 ip address 172.16.9.177 255.255.255.252

IP address for PC:

Connectivity	IP Address	Subnet Mask
PC 0	172.16.0.2	255.255.0.0
PC 1	172.16.0.3	255.255.0.0
PC 2	172.16.8.2	255.255.0.0
PC 3	172.16.8.3	255.255.0.0
PC 4	172.16.9.66	255.255.255.192
PC 5	172.16.9.67	255.255.255.192
PC 6	172.16.9.130	255.255.255.224
PC 7	172.16.9.131	255.255.0.0
PC 8	172.16.9.2	255.255.255.192
PC 9	172.16.9.3	255.255.255.192
web	172.16.9.4	255.255.255.192
Email	172.16.9.5	255.255.255.192

 Routers are essential here for inter-subnet communication. They allow devices in different IP ranges to communicate, assuming correct routing protocols or static routes are set up.
 Each router acts as a gateway for its connected subnet, managing traffic flow between various parts of the network.

VLAN

It is a logical grouping of devices within a network that are configured to communicate as if they are on the same physical LAN. Here it is configured in the first switch. There are four PCs in this switch. So, PC 0 and PC 1 with IP address 172.16.0.2 and 173.16.0.3 respectively are on the same VLAN named as students. The PC 2 and PC 3 with IP address 172.16.8.2 and 172.16.8.3 respectively are on the same VLAN named as faculty.

DHCP

It is enabled in the network, one of the servers name "WEB" act as the DHCP server in the third router, providing IP address 172.16.9.4. Devices on the network will automatically request an IP address from the DHCP server. Along with the IP address, the server provides additional network configuration details, such as Subnet mask, Default gateway, DNS server(s).

Conclusion

Basic computer networking forms the backbone of modern communication and data sharing. It involves the seamless integration of devices, protocols, and infrastructure to enable connectivity and resource sharing. Fundamental concepts such as IP addressing, network topology, protocols like TCP/IP, and devices like routers and switches are essential for designing and managing networks effectively. Networking concepts empower organizations and individuals to connect globally, share information, and collaborate efficiently. As technology evolves, the foundational knowledge of computer networking serves as a stepping stone for understanding more advanced systems and technologies, ensuring networks remain robust, scalable, and secure.

Future Work

- **AI and Machine Learning (ML):** Automating network management, traffic optimization, and predictive maintenance using AI and ML tools.
- **Quantum Networking:** Exploring quantum communication protocols for ultra-secure and high-speed networking.
- **IoT Expansion:** Enhancing protocols and architectures to support the growing Internet of Things (IoT) ecosystem.
- **5G and Beyond:** Integrating advanced cellular technologies with traditional networks for faster and more reliable connections.
- **Edge Networking:** Optimizing communication between devices and local nodes to reduce latency.
- **Hybrid Cloud Solutions:** Improving seamless integration between on-premises networks and cloud infrastructures.

References

W. Liu, Z. Wang, X. Liu, N. Zeng, Y. Liu, and F. E. Alsaadi, “A survey of deep neural network architectures and their
applications,” Neurocomputing, 2017, doi: 10.1016/j.neucom.2016.12.038.

G. Edwards, “Methods Review paper Mixed-Method Approaches to Social Network Analysis,” ESRC Natl. Cent. Res.
Methods, 2010, doi: 10.1108/17465640910978391.

A. Hakiri, A. Gokhale, P. Berthou, D. C. Schmidt, and T. Gayraud, “Software-defined networking: Challenges and research
opportunities for future internet,” Computer Networks. 2014, doi: 10.1016/j.comnet.2014.10.015.