CS/IT 361 : COMPUTER NETWORKS

PROJECT REPORT ON
"UNIVERSITY MANAGEMENT SYSTEM"

भारतीय सूचना प्रौद्योगिकी संस्थान वडोदरा

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ABSTRACT:-

Computer networks play a pivotal role in shaping the operational landscape of organizations, and this influence is particularly pronounced in the realm of universities. The seamless functioning and insightful analysis of networks within a university setting are indispensable for a myriad of critical functions, including education, administration, communication, e-library services, and automation.

This project aims to provide comprehensive insights into various fundamental concepts such as topology design, IP address configuration, and the intricate process of transmitting information in the form of packets across the wireless networks distributed across diverse

areas within a university. The emphasis is on leveraging the capabilities of Cisco Packet Tracer software to design the network topology, emphasizing the integration of wireless networking systems to enhance connectivity and accessibility.

Within the intricate fabric of this university network, a diverse array of devices are orchestrated to collaboratively contribute to its seamless operation. These include the foundational Router (1941) and Switches (2960-24TT), ensuring the efficient routing and switching of data. The network is fortified with specialized servers, including an Email server, a DNS server for streamlined domain management, and a WEB server (HTTP) for web services. The incorporation of Wireless Devices, specifically Access Points, further expands the network's reach, promoting wireless connectivity in various areas across the university.

This university network consists of the following devices:
1) Router (1941)
2) Switches (2960-24TT)
3) Email server
4) DNS server
5) WEB server (HTTP)
6) Wireless Device (Access Point)

7) PCs

8) Laptops
9) Smartphones

These devices collectively form an intricate ecosystem, interacting seamlessly to facilitate a robust and interconnected university network.

In summation, this project not only addresses the foundational aspects of network design and configuration but also delves into the nuanced implementation of wireless networking systems within the university context. It underscores the importance of a well-structured and efficiently managed network in supporting the diverse functions of a modern university environment.

ACKNOWLEDGEMENT:-

This project was made possible through the concerted efforts and support of several individuals and resources, to whom we extend our heartfelt gratitude:

Faculty Advisor: We express our sincere appreciation to **Dr.Sunandita Debnath**, whose guidance, expertise, and continuous support were invaluable throughout the project. Their encouragement and insights significantly contributed to the project's success.

Family and Friends: We extend our deepest gratitude to our families and friends for their unwavering encouragement, understanding, and patience during the project's execution. Their support was a constant source of motivation.

Research Community and Literature Sources: We acknowledge the valuable insights and contributions of the research community and literature sources that served as the foundation for our project, providing valuable information and references.

Institutional Support: Lastly, we express our appreciation to **TA** for providing the necessary infrastructure, resources, and conducive environment that facilitated the successful completion of this project.

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INTRODUCTION :-

Motivation:

The contemporary landscape is increasingly characterized by the pervasive influence of the digital realm. Technological advancements are propelling the world into an era dominated by digitalization, and educational institutions are integral players in this transformative journey. To align with this digital trajectory, educational campuses are urged to transition into "digital campuses," wherein the adoption of digital networking is paramount. The wireless paradigm emerges as a crucial catalyst in this digital evolution, simplifying connections by reducing reliance on cumbersome wires and cables. Wired connections, by comparison, pose challenges in device tracking and cable management, resulting in disorderly and intricate configurations.

Within the educational domain, wireless networking assumes a pivotal role, serving as the primary conduit for teachers and students to access educational resources. The ubiquity of laptops and smart terminals has intensified the demand for information access anytime and anywhere, a need that traditional cable networks struggle to meet. Thus, the imperative for wireless network integration becomes apparent, constituting a vital component of both digital and wisdom campuses. The wireless network empowers teachers and students to explore the internet using mobile terminals unhindered by cables or location constraints, marking a significant advancement in modern campus infrastructure. While traditional cable networks offer convenience in teaching and research, they fall short in terms of mobility and flexibility, a gap that wireless networks effectively bridge.

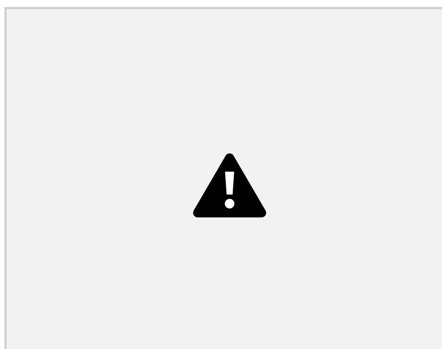
Project Statement:

In this mini-project, our focus revolves around simulating campus networks built on wireless infrastructure. The network is strategically divided into two distinct sets – one catering to the campus area and the other serving the hostel premises. The central objective of this project is to showcase the efficacy of wireless connectivity in university settings, emphasizing mobility as a primary concern. To ensure equitable functionality for all users, including college staff and students, we have incorporated DNS, Email, and HTTP servers, maximizing resource utilization.

The campus network assumes a multifaceted role, offering services such as internet connectivity, data sharing among users (students, teachers, and various university members), and access to diverse web services for different functionalities. The adoption of wireless networking is deemed indispensable for ensuring the seamless operation of these services. As a result, the project underscores the pivotal role played by wireless networks in facilitating efficient and mobile campus operations, addressing the evolving needs of a digitally-driven educational environment.

LITERATURE REVIEW :-

Packet Tracer: An Overview



Packet Tracer, a versatile visual simulation tool crafted by Cisco Systems, stands as a cross-platform solution designed to empower users in creating and simulating contemporary computer networks. Tailored for educational purposes, the software permits the configuration simulation of Cisco routers and switches through a simulated command-line interface. With its user-friendly drag-and-drop interface, Packet Tracer facilitates the seamless addition and removal of simulated network devices. Initially aimed at Certified Cisco Network Associate Academy students, it served as an educational aid, allowing them to grasp fundamental CCNA concepts. Historically, students enrolled in CCNA Academy programs could freely download and use the tool for educational purposes.

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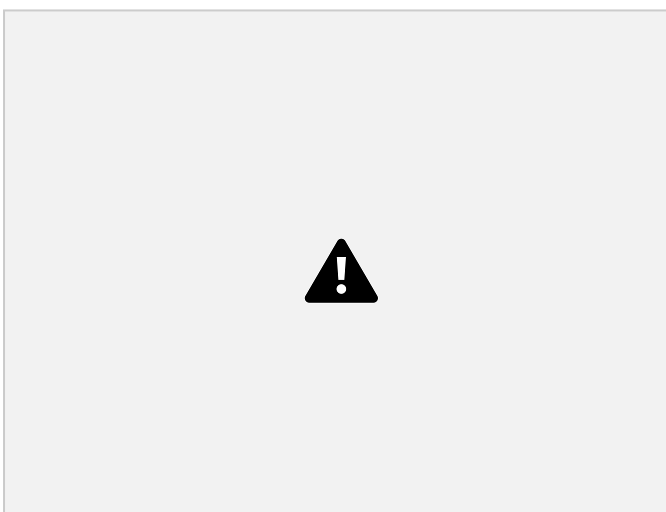
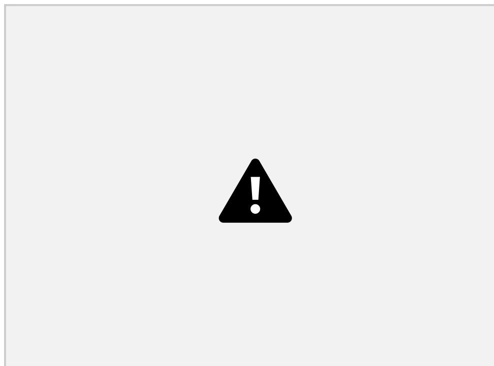
Router



A router, akin to a switch, directs data packets based on their IP addresses, primarily functioning at the Network Layer. Routers link Local Area Networks (LANs) and Wide Area Networks (WANs), employing dynamically updated routing tables to make decisions on packet routing. Routers play a pivotal role in dividing broadcast domains among connected hosts.

Switch



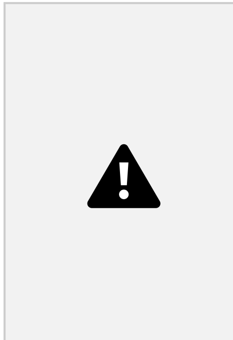
A network switch, alternatively called a switching hub or MAC bridge, is hardware that connects devices within a computer network through packet switching, forwarding data to

the intended destination device. Acting as a multiport network bridge, it utilizes MAC addresses for data forwarding at the data link layer (layer 2) of the OSI model. Some switches extend functionality to data forwarding at the network layer (layer 3), earning them designations like layer-3 switches or multilayer switches.

Network Packet

A network packet, a formatted unit of data within a packet-switched network, comprises both control information and user data, commonly referred to as payload.

Server



Servers, the backbone of networked systems, provide resources, data, services, or programs to client machines over a network. Varied server types include web servers, mail servers, and virtual servers, each catering to distinct functionalities.

Numerous networks incorporate one or more standard servers, and the servers employed in our project encompass the following categories:

***DNS Server:**

DNS, or Domain Name System, servers function as application servers providing a user-friendly naming method for computers, rendering IP addresses easily readable. Operating as a widely distributed database of names, DNS servers, including the one in our project, can be utilized to request information about an unfamiliar computer name. When a user seeks the address of a system, a DNS request is dispatched to the DNS server, which then responds with the requisite IP address gleaned from its database of names.

***WEB Server:**

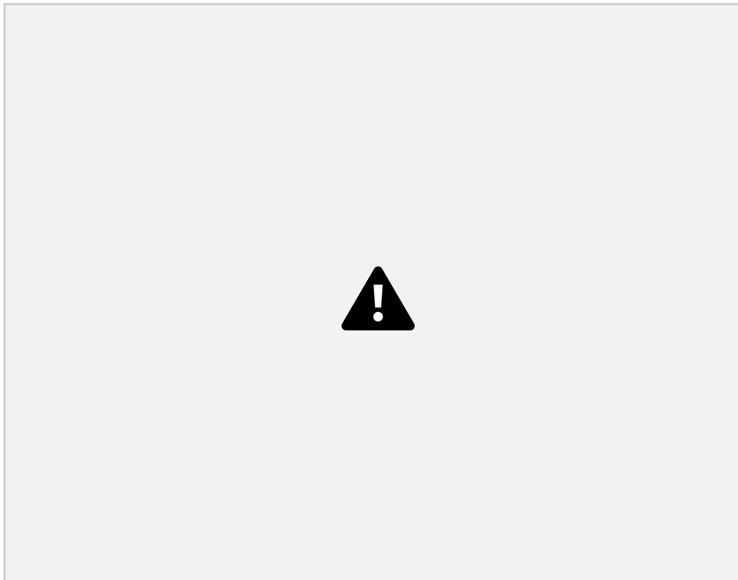
In the contemporary market, web servers hold a prominent position. These servers, categorized as a specialized form of application server, host programs and data requested by users across the Internet or an intranet. Web servers play a pivotal role in responding to requests from browsers on client computers for web pages or other web-based services.

***EMAIL Server:**

An email server, a critical component in our project, manages and dispatches emails over a network, adhering to standard email protocols. For instance, the SMTP protocol is responsible for sending messages and handling outgoing mail requests, while the POP3 protocol receives messages and manages incoming mail. When users log on to a mail server through a webmail interface or email client, these protocols seamlessly orchestrate the connections in the background.

Wireless Network

A wireless network transmits access signals to workstations or PCs, facilitating mobility among devices while maintaining a continuous network connection. Additionally, it imposes heightened security requirements.



Ethernet

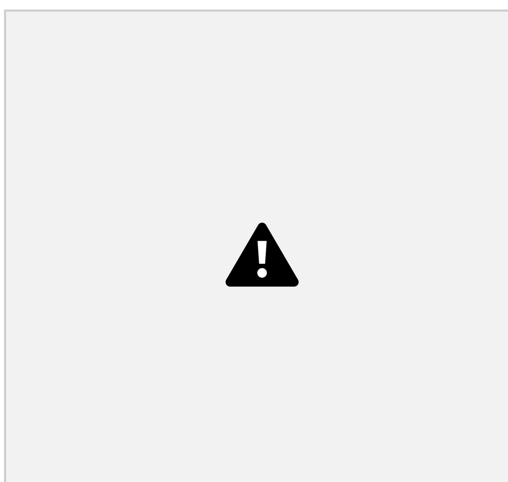
The network's backbone, Ethernet, comprises cabling capable of transferring data at a rate of 100mb/s. It serves as a system connecting multiple computers to form a Local Area Network (LAN), employing protocols for information transmission and to prevent simultaneous transmissions by multiple systems. Our network utilizes Gigabit Ethernet for data transfer at 1000 Mbps.

Computing Device

Computing devices encompass electronic tools processing user inputs and delivering end results. These devices include smartphones, PC desktops, laptops, printers, and more.

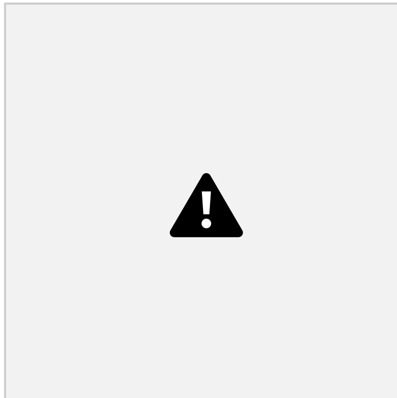
Internet Protocol (IP)

An essential protocol facilitating internet functionality, IP assigns unique numbers to each network, enabling machines to address one another across a network. Implemented at the internet layer in the IP/TCP model.



SSH Protocol

Secure Shell (SSH) empowers users to remotely access and manage devices securely. All transmitted data over a network, including usernames and passwords, is encrypted, providing protection against eavesdropping. SSH operates as a client-server protocol.



Benefits of Wireless Networking over Wired Networking

The advantages of wireless networking over traditional wired setups are manifold. These include:

1. **Mobility:** Users enjoy the freedom to move within the network area with computing devices, maintaining connectivity without cable concerns.

2. **Less Hassle:** Reduction in cable usage minimizes chaos and simplifies connection maintenance.

3. **Accessibility:** Extends network access to challenging areas, ensuring connectivity throughout the organization.

4. **Expandability:** Enables network expansion by accommodating new users and locations without additional cable infrastructure.

5. **Guest Access:** Provides secure network access for guest users while safeguarding network resources.

Despite these advantages, wireless networks pose challenges, including security issues and relatively slower speeds with lower bandwidth compared to direct cable connections.

Simulation Environment

Our network topology simulations are seamlessly achieved using Cisco Packet Tracer. The software offers a simulation mode, allowing users to observe packet flow and delve into detailed OSI layer information by clicking on individual packets. Packet Tracer serves as an

extensive platform for realistic simulation, enhancing learning and teaching experiences by supporting multi-user collaboration within a lifelike experimental environment.

METHODOLOGY:-

To enhance the comprehensibility of our project, we have organized the content into distinct steps, outlined below:

1. Software and Hardware Requirements:

Before delving into the implementation phase, it is imperative to ensure that the following prerequisites are met:

- **Proper Workstation:** A mid to high-range laptop that meets the required specifications.

- **Packet Tracer by Cisco:** The essential software for network simulation. **- 8 GB RAM:** Adequate random-access memory for smooth functioning.

- **Processor (Any 10,000+ Average CPU Mark Scored):** Ensuring the processing power meets the project demands.

- **16 GB Dedicated Hard Disk Space:** Sufficient storage allocation for project files.

- **USB 3.0+ Port:** A USB port to facilitate connectivity.

2. Brief Knowledge about Our Approach:

Our project revolves around the implementation of a wireless network designed for a university campus. This implementation is visually represented through a virtual simulation

using Cisco Packet Tracer, a robust platform that provides extensive capabilities for testing projects through simulation tools.

Key Points:

- **Wireless Network for a University Campus:** The wireless network we propose is specifically tailored for a university campus setting.

- **Virtual Visualization:** We have employed Cisco Packet Tracer to create a virtual representation of the network, offering a substantial platform for users to experiment and validate their projects using simulation tools.

- Educational Campus Context: The wireless network serves to streamline access to educational resources, serving as a vital platform for the exchange of information among teachers and students.

- Ease of Access: By implementing a wireless network, we aim to make it more convenient for both educators and students to access crucial educational materials, fostering an environment conducive to seamless information exchange.

By following these steps and prerequisites, we aim to ensure a smooth and well-supported implementation of our wireless network project within the university campus.

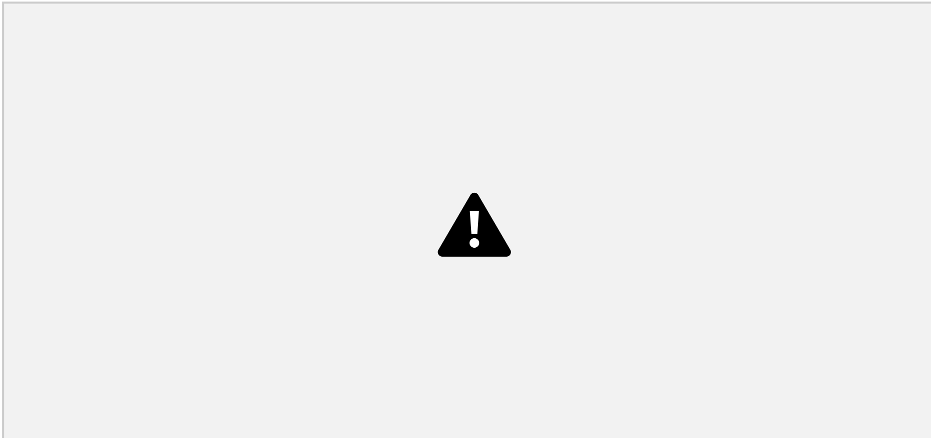


Figure 1: Shows the wireless connection access by various tool

3.Network Requirements:

For the wireless university network project, we are considering the network outline of Manipal University Jaipur, with a focus on two primary areas:

1. Campus Area:

- The Campus Area is subdivided into various access points, including:
  - Dome Building
  - Library
  - Academic Blocks (8th and 9th)
  - Server Center

- IT Consulting

2. **Hostel Area:** - The Hostel Area is further segmented into Boys Blocks and Girls Blocks.

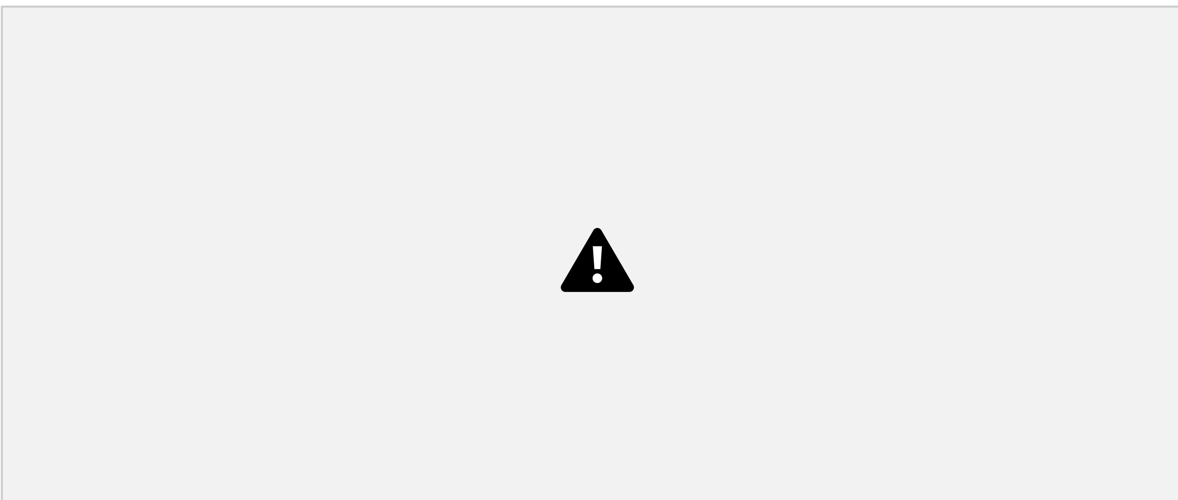


Figure 2: Basic Layout of Wireless Access Points in the Institute

This structured network division allows us to effectively manage and cater to the unique requirements of different areas within the university. Each access point serves a specific purpose, contributing to the overall efficiency and functionality of the wireless network. The figure provides a visual overview of the basic layout, showcasing the distribution of wireless access points across the university campus and hostel areas.

Devices Used In The Network :

Devices	Quantity
1) Router (1941)	3
2) Switches (2960-24TT)	3
3) EMAIL server	1
4) DNS server	1
5) WEB server (HTTP)	1

6) Wireless Device (Access	**7**
Point) 7) PCs	**12**
8) Laptops	**10**
9) Smartphones	**2**

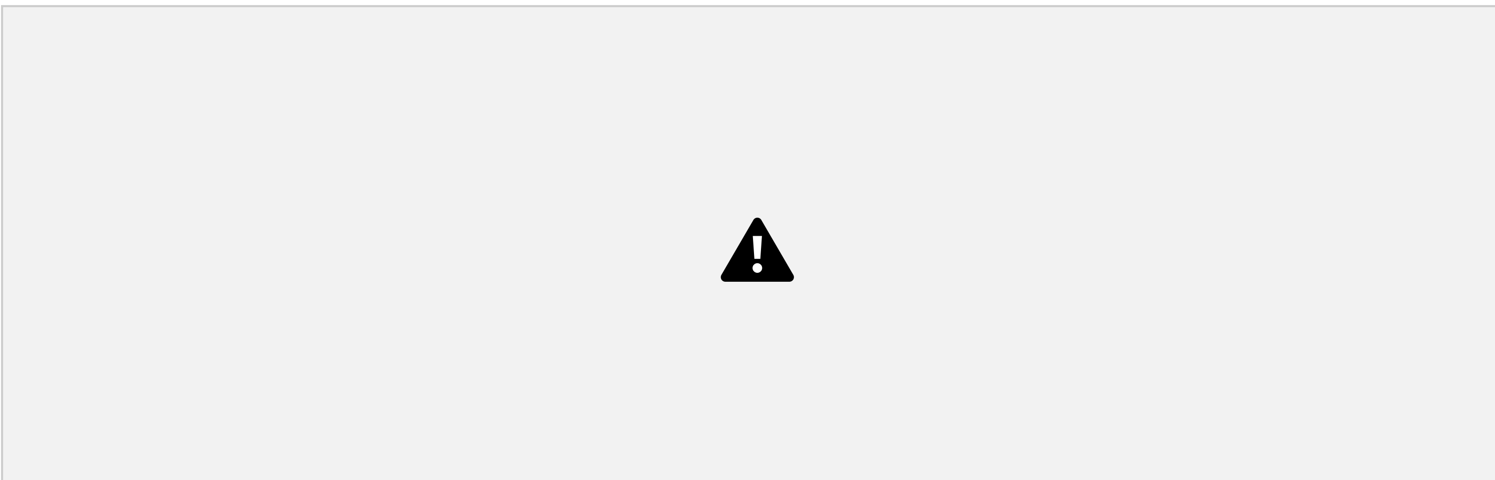


Figure 3: Devices used in the network

4.Implementation and Flow Diagram

In the process of crafting the wireless network for the university, our initial step involved strategically placing the core devices according to the designated layout.

To commence, we positioned the primary router at the central point of the university's layout. This router was then connected to the server switch using a gigabit ethernet port and a copper straight-through cable. Subsequently, serial DCE cables were employed to connect the hostel router and campus router to the main router in the hostel and campus areas, respectively.

The server switch, in turn, established connections with the EMAIL, DNS, and WEB servers.

For the campus area, the campus router was linked to the campus switch, which, in turn, connected to the wireless access points in the academic block (AB1 and AB2), dome building, library, and IT consulting. The wireless access points were then interconnected with various computing devices such as PCs, laptops, and smartphones.

Similarly, in the hostel area, the hostel router was connected to the hostel switch. This switch was then linked to the wireless access points in the boys' block and girls' block. These wireless access points were subsequently connected to computing devices, with each area featuring a dedicated access point accessible only through a password-protected connection.

All interconnections were executed through ethernet ports, encompassing both gigabit ethernet and fast ethernet, employing copper straight-through cables. To enhance comprehension, a flow diagram has been provided below, offering a visual representation of the sequential steps detailed above.

5.Configuring IP Addresses

We have attached the screenshots of all the IP configuration below:

1. **Main Router Configuration :**

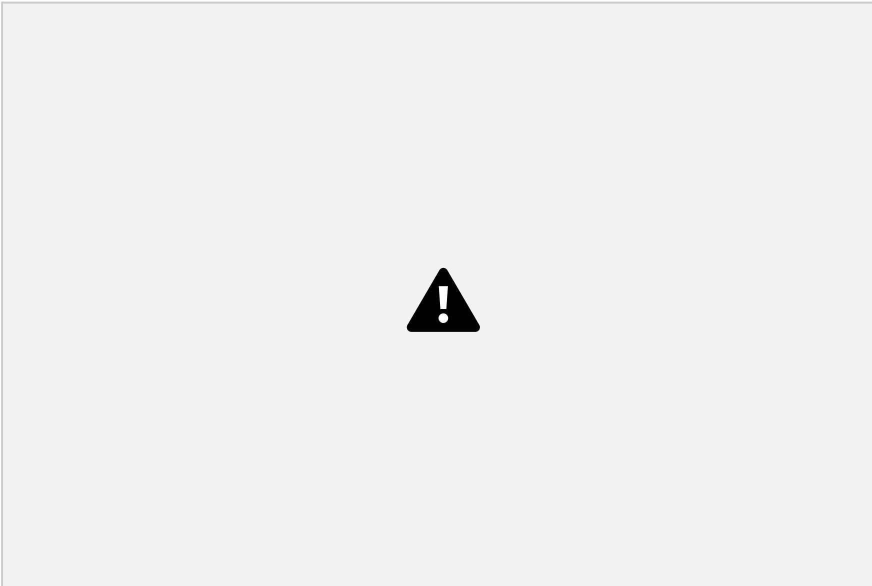
2. **DNS Server :**

3. Web Server :

4. E-MAIL Server :

5. College Router :

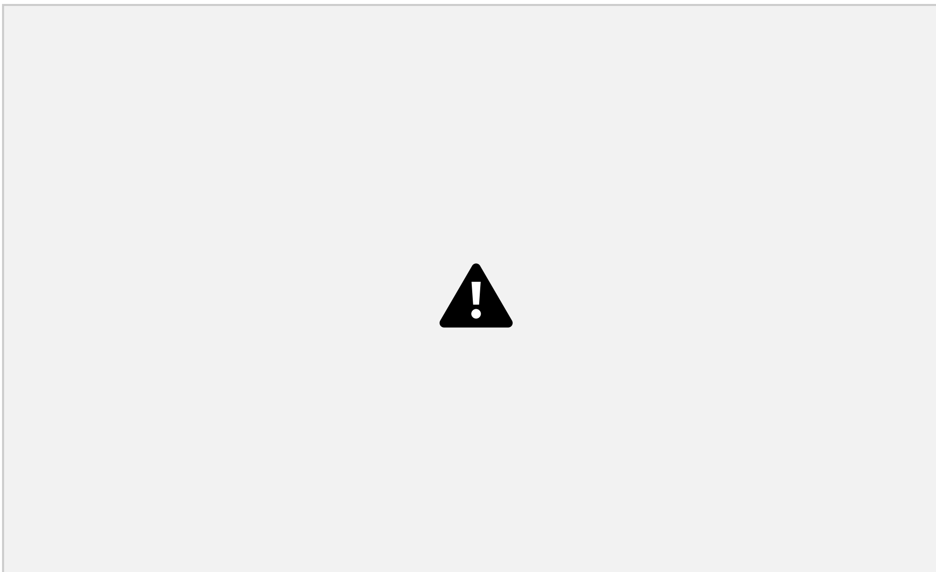
6. Academic Block 1 :



IP Address are as follows :

192.168.1.14- Laptop
192.168.1.15- PC
192.168.1.16- Laptop
192.168.1.17- PC
Subnet Mask- 255.255.255.0
Default Gateway- 192.168.1.1
DNS Server- 192.168.2.3

7. Academic Block 2 :



IP Address are as follows :

192.168.1.10- Laptop

192.168.1.11- PC

192.168.1.12- Laptop

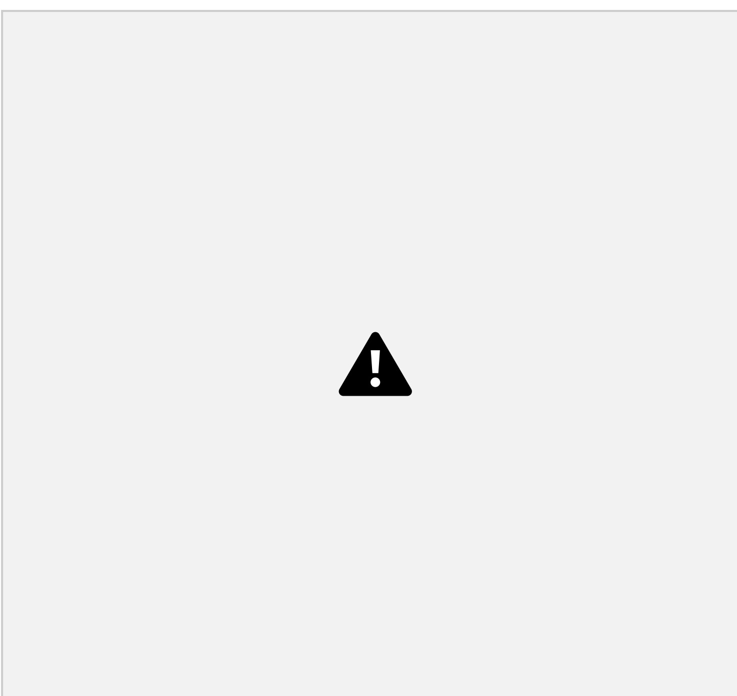
192.168.1.13- PC

Subnet Mask- 255.255.255.0

Default Gateway- 192.168.1.1

DNS Server- 192.168.2.3

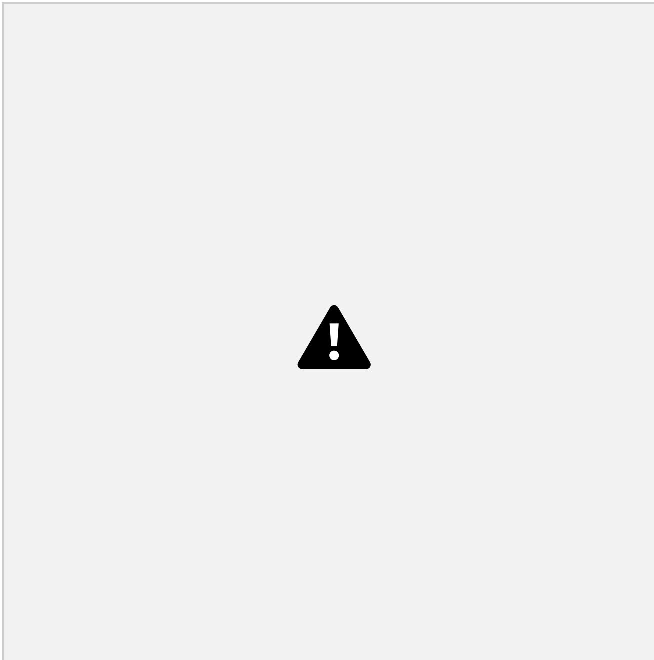
8. Dome Building :



IP Addresses are as follows :

192.168.1.2- PC
192.168.1.3- PC
192.168.1.4- Laptop
Subnet Mask- 255.255.255.0
Default Gateway- 192.168.1.1
DNS Server- 192.168.2.3

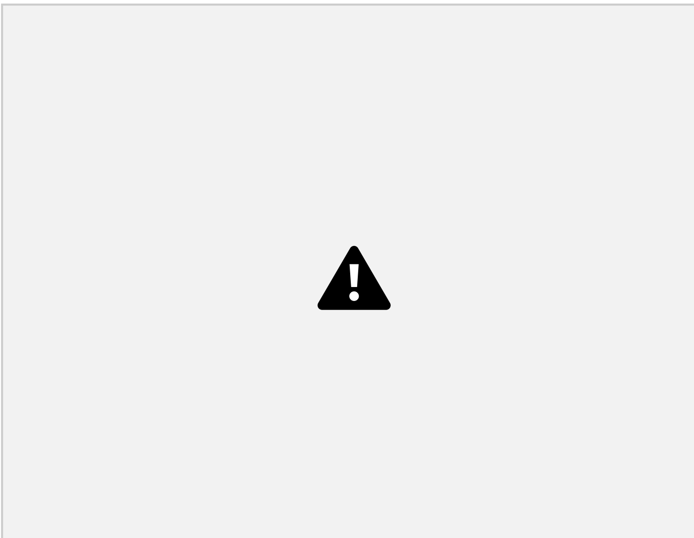
9. Library :



IP Addresses are as follows :

192.168.1.5- PC
192.168.1.6- PC
Subnet Mask- 255.255.255.0
Default Gateway- 192.168.1.1
DNS Server- 192.168.2.3

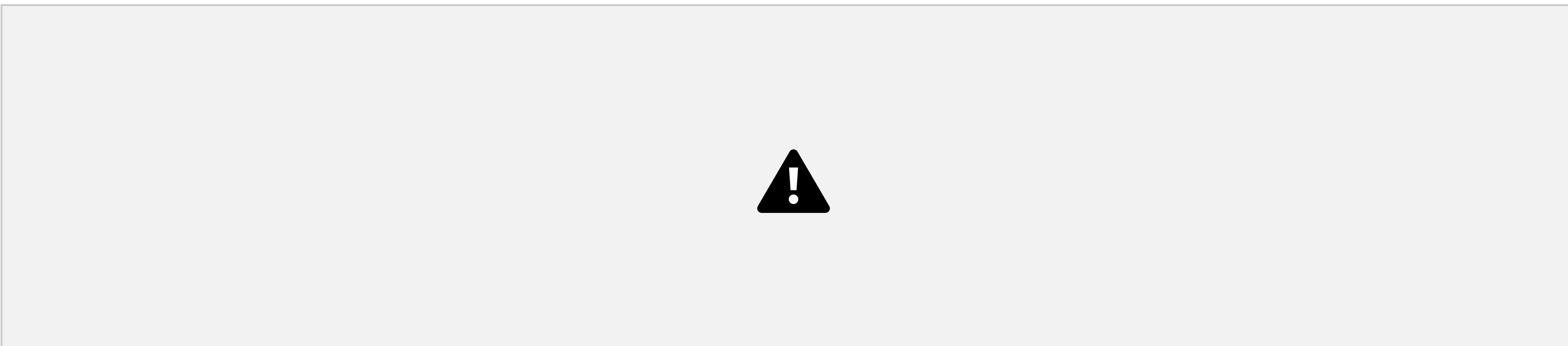
10. IT Consulting :



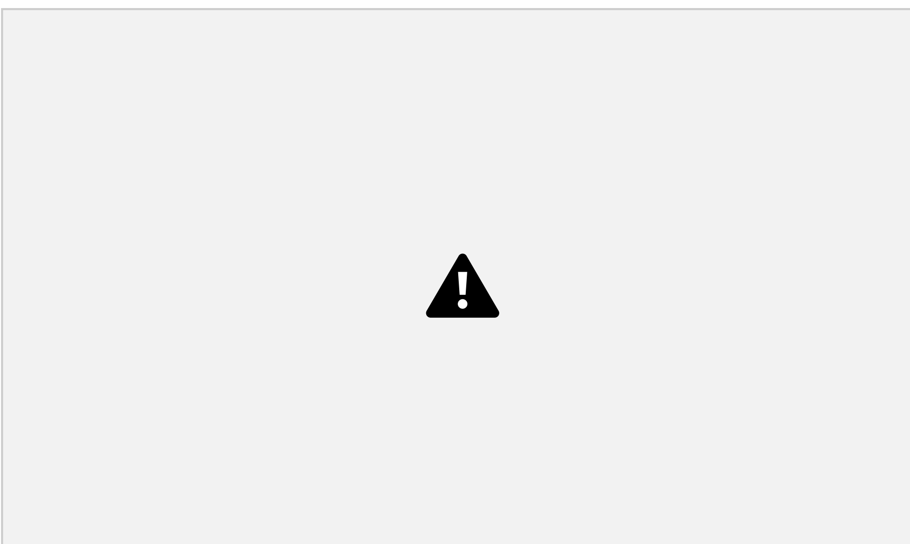
IP Addresses are as follows :

192.168.1.7- Laptop
192.168.1.8- PC
192.168.1.9- PC
Subnet Mask- 255.255.255.0
Default Gateway- 192.168.1.1
DNS Server- 192.168.2.3

11. Hostel Router :



12. Boys Block :



IP Addresses are as follows :

192.168.3.6- PC
192.168.3.7-Laptop
192.168.3.8- PC
192.168.3.9- Smartphone
Subnet Mask- 255.255.255.0

Default Gateway- 192.168.3.1
DNS Server- 192.168.2.3

13. Girls Block :

IP Addresses are as follows :

192.168.3.2- PC
192.168.3.3-Laptop
192.168.3.4- PC
192.168.3.5- Smartphone
Subnet Mask- 255.255.255.0
Default Gateway- 192.168.3.1
DNS Server- 192.168.2.3

14. Wireless Access Point :

SSID	Password
1) iiitv_dome	1234567890
2) iiitv_library	1234567890
3) iiitv_ITC	1234567890
4) iiitv_AB1	1234567890
5) iiitv_AB2	1234567890

6) iiitv_boys 1234567890

7) iiitv_girls 1234567890

6. Securing the network

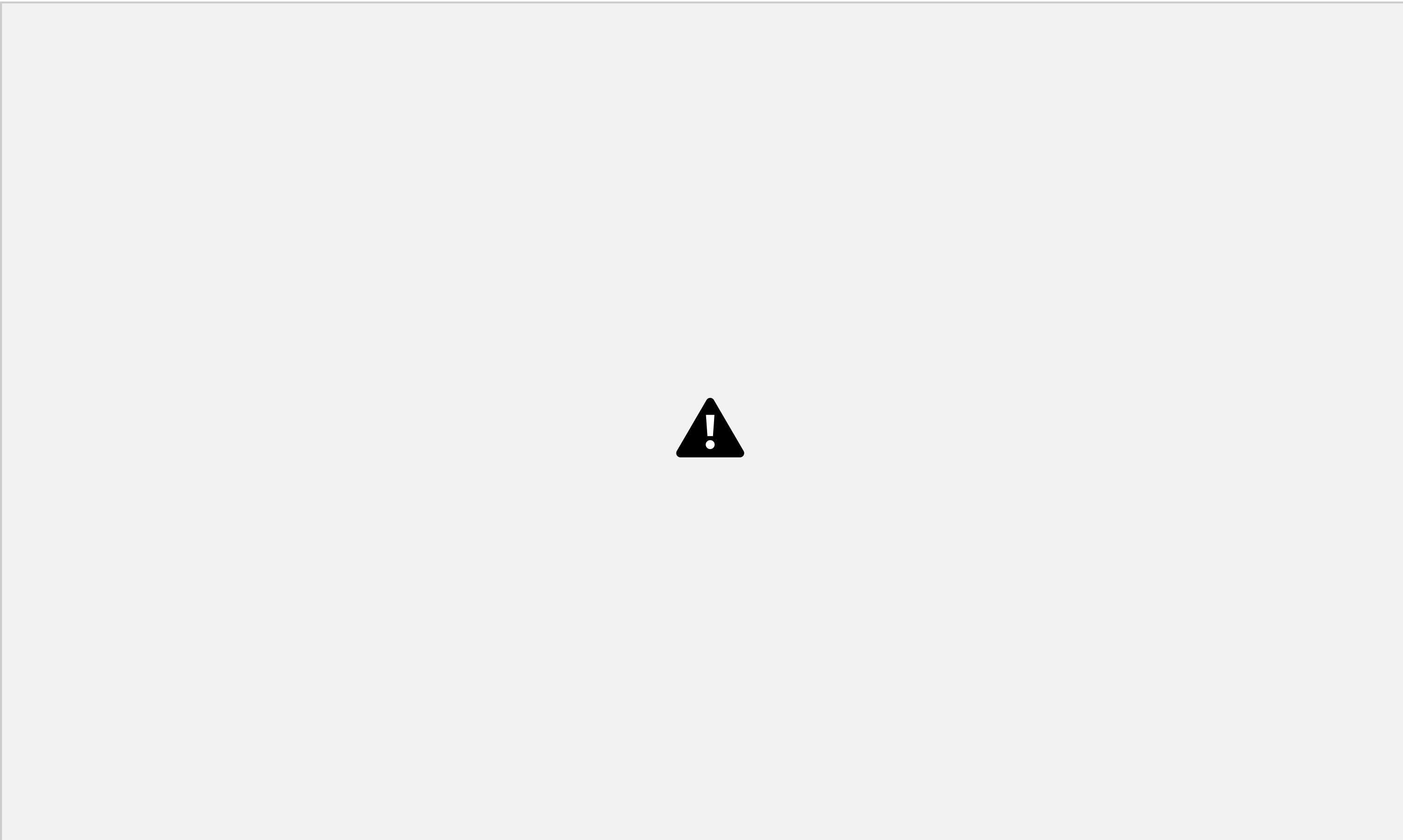
Passwords are used in accessing the router and all the wireless networks **(mentioned in step 5 wireless access point)** to make the access limited to University authorized users only.

Routers are also secured with ssh (Secure Shell). Routers and their assigned passwords are mentioned below:

Router Name Passwords
1)main_router Console password: cisco ssh password: admin

2)Router1 (College Router) Console password:iiitv@123 ssh password: admin
3)Router2 (Hostel Router) Console password:iiitv@123 ssh password: admin

FOCUS ON HIGHLIGHTED PORTION :



Connectivity of wireless network on computing devices

7. Task Distribution :

1. Project Manager : (YASH KUMAR SINGH - 202151181)

- Oversee the entire project and ensure that it aligns with the defined goals and objectives.
- Coordinate communication and collaboration among team members.
- Monitor the progress of each team member and address any challenges.

2. Network Architect : (AKSHAT PATEL - 202151014)

- Design the overall architecture of the wireless network for the university. - Define the placement of core devices, routers, switches, and access points. - Ensure that the network design meets the scalability and performance requirements.

3. Packet Tracer Specialist : (KALP PATEL - 202151109)

- Utilize Cisco Packet Tracer to simulate the designed network.

- Implement the networking topology within Packet Tracer.

- Validate the functionality and feasibility of the proposed network in the simulation environment.

4. Server and Security Specialist : (JIGAR KANAKHARA - 202151068) -

Implement and configure servers, including DNS, web, and email servers. -

Establish security measures such as console passwords and SSH protocol. -

Ensure that the servers are secure and function seamlessly within the network.

5. Documentation and Presentation Specialist : (PRATYAKSHA TAILOR - 202151118)

- Create a comprehensive project report that includes an abstract, introduction, methodology, results, and conclusions.

- Develop detailed documentation for the network configuration and specifications.

- Prepare a visually engaging presentation summarizing the project .

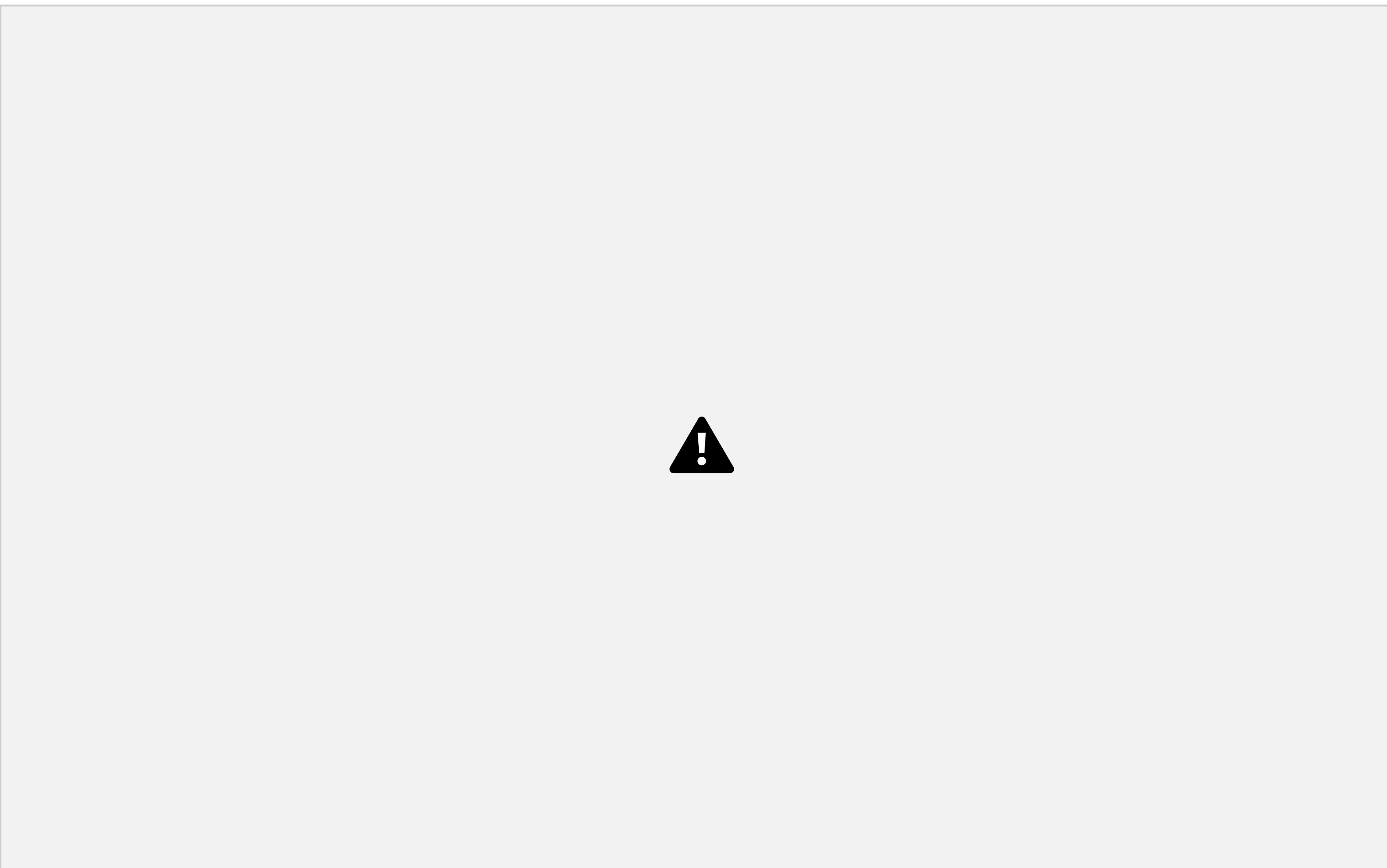
RESULT:-

Finally, we have combined all the steps as mentioned in methodology and implemented the desired wireless network for University. We have a complete network providing various facilities to the teaching staff, non-teaching staff, and students.

(The complete diagram of the University Area Network Scenario created in Packet Tracer environment)

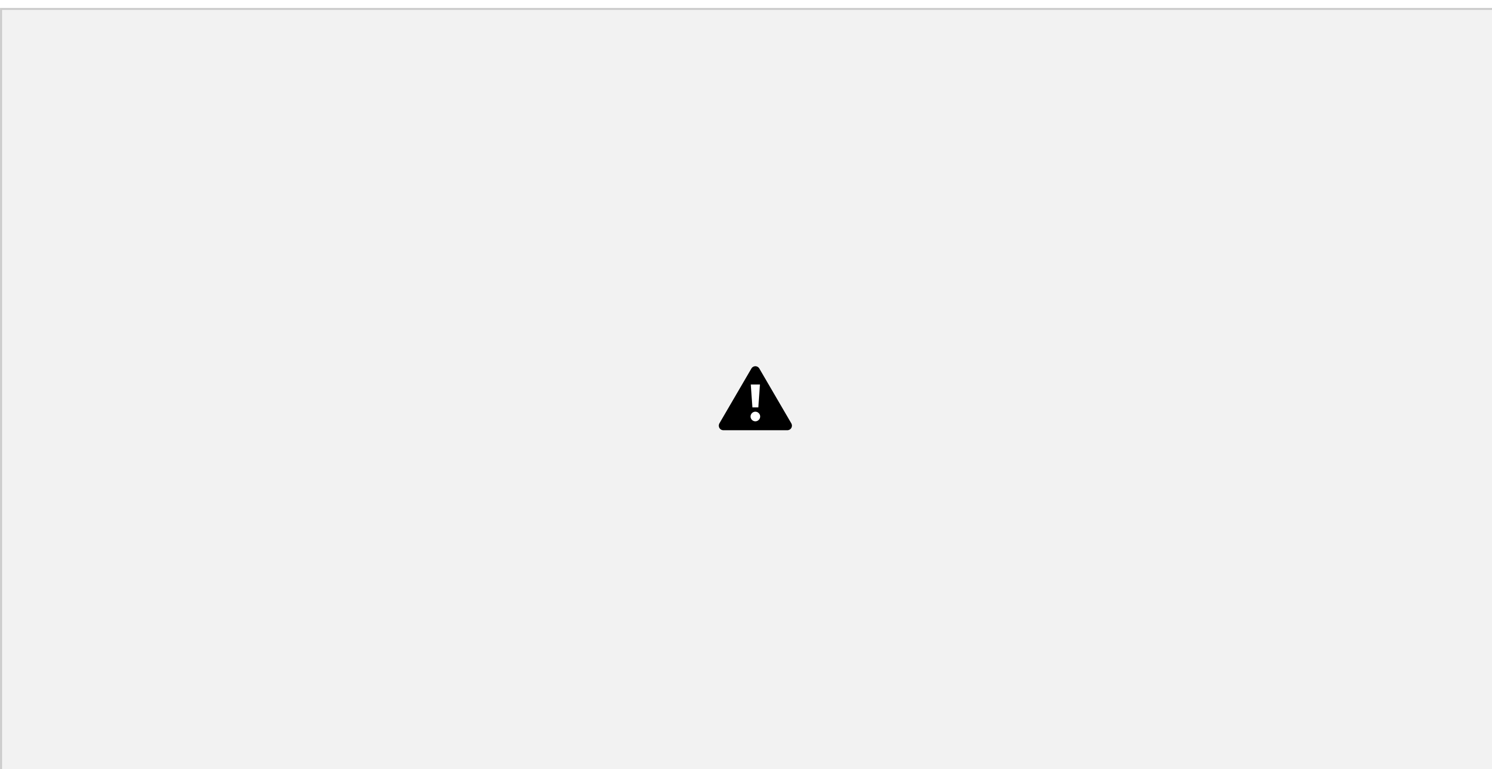
Final Simulation :

In Simulation Mode, you can watch your network run at a slower pace, observing the paths that packets take and inspecting them in detail. The proposed architecture, when simulated on Cisco Packet Tracer, produced results which are demonstrated as follows:

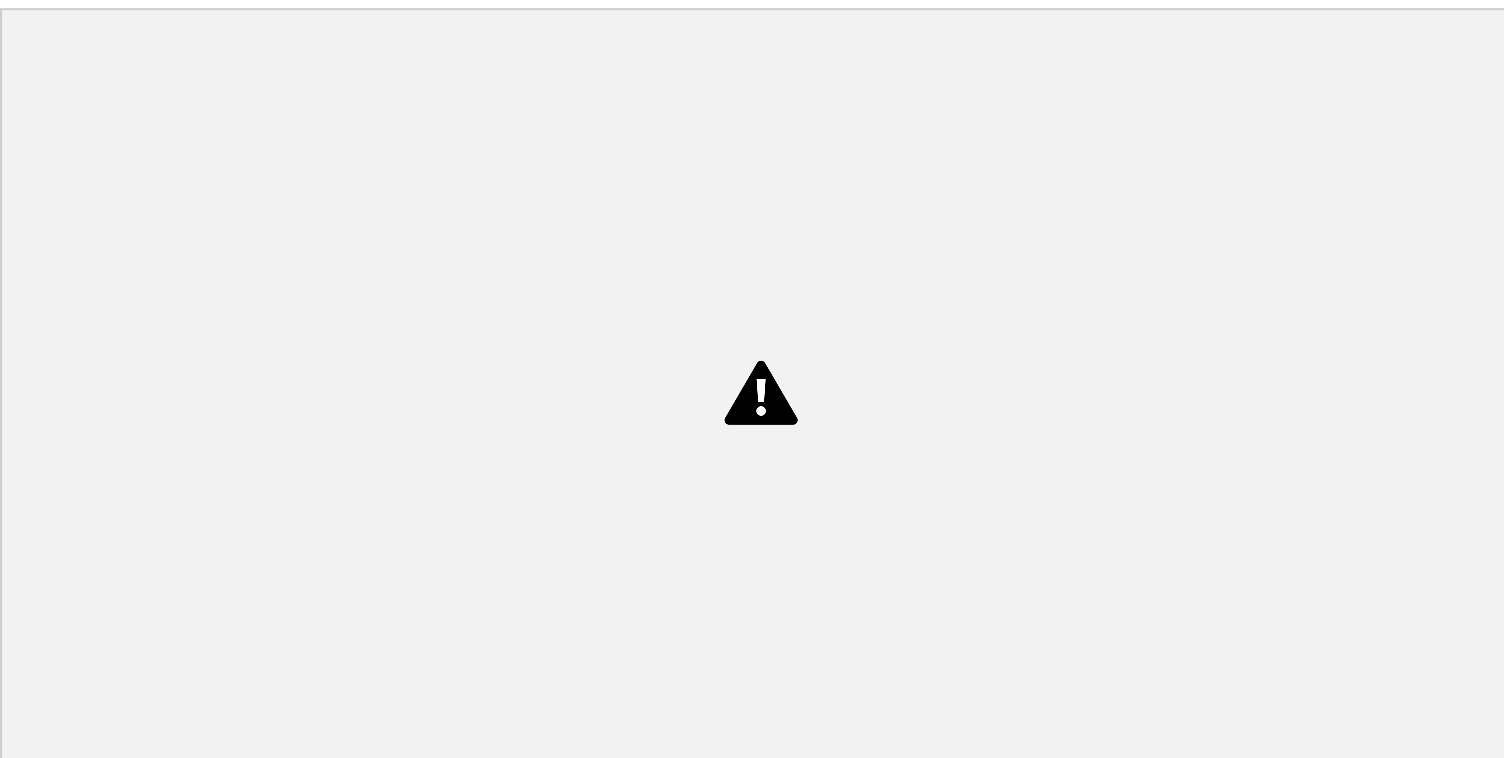


Final simulation for the network system to check all the connections

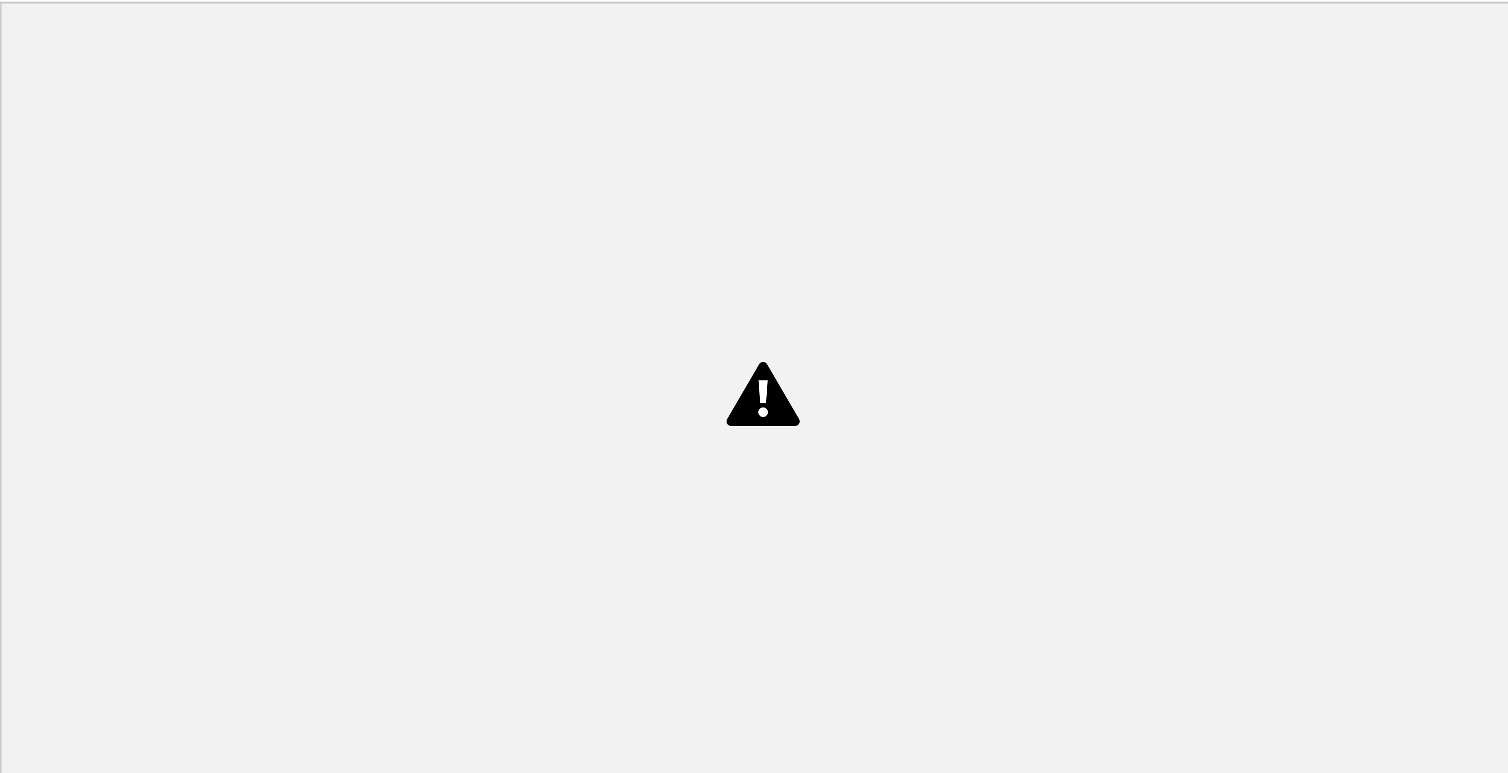
Ping Test: Network connectivity and communication can be tested using the ping command, followed by the domain name or the IP address of the device (equipment) whose connectivity one wishes to verify.



PING TEST FOR EMAIL SERVER

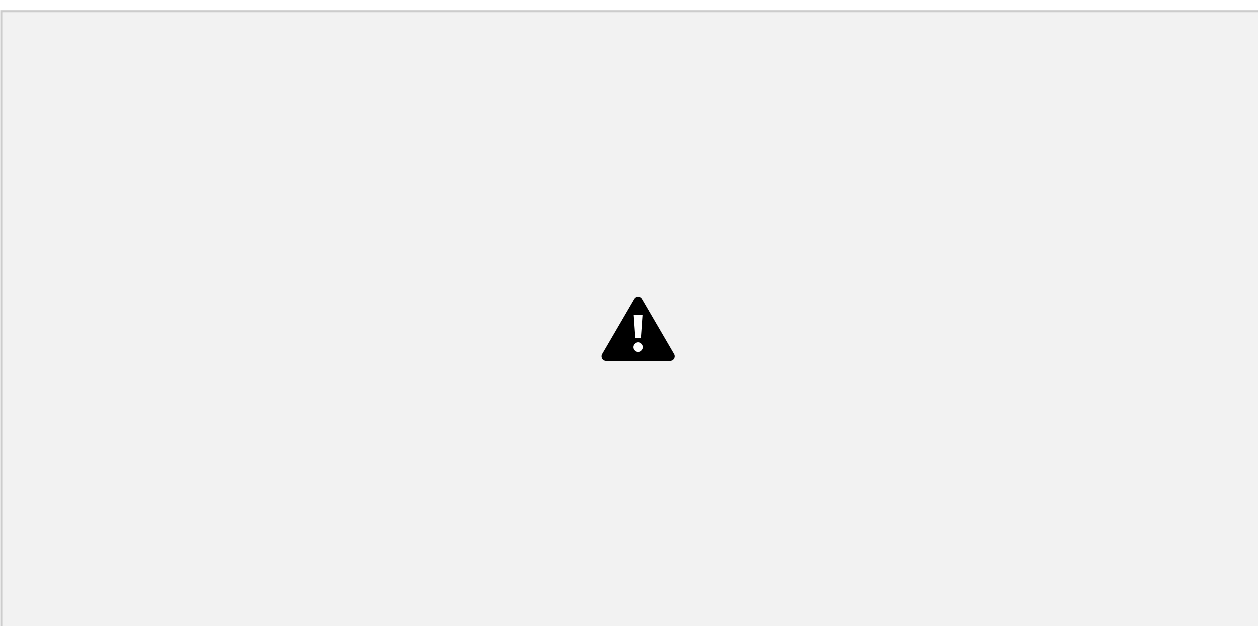


PING TEST FOR DNS SERVER



PING TEST FOR WEB SERVER

ACCESSING WEBSITE FROM A PC :



DOMAIN SETUP :

COMPOSING MAIL :

SEND SUCCESS :

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RECEIVE SUCCESS :

CONCLUSION:-

Our expedition into the realm of "digitalization" initiated a discourse that propelled us to embark on a transformative journey, strategically commencing with the realm of educational institutions. The culmination of this intellectual odyssey manifested in the meticulous design of a wireless network tailored explicitly for a university setting. At the heart of our venture lay a steadfast commitment to championing the pivotal facets of mobility and efficiency within network architectures, prompting a deliberate transition from conventional wired infrastructures to the dynamic landscape of wireless connectivity. This intentional paradigm shift was underpinned by our visionary quest to foster a network environment characterized by pristine organization and minimized complexity.

Within the intricate tapestry of this project, we meticulously architected a University Network leveraging the advanced capabilities of Cisco Packet Tracer. Our design encompasses a sophisticated networking topology that intricately weaves together an ensemble of servers, routers, switches, and end devices, harmoniously distributed across multiple areas. This holistic approach ensures the integration of all requisite features necessary for the seamless functioning of a network that goes beyond mere connectivity.

The strategic inclusion of a DNS server and a web server emerges as a cornerstone in our design philosophy, serving as the linchpins for establishing a coherent communication infrastructure across diverse areas within our network. These servers, meticulously placed, play a pivotal role in facilitating robust communication channels, especially catering to the dynamic exchange of information between students and teachers.

Adding another layer of sophistication, an email server was thoughtfully integrated into our network fabric. This critical component serves as the linchpin for intra-university communication, providing a seamless conduit for email exchanges within the institution's domain. Security, being paramount, found a meticulous implementation through the

incorporation of console passwords and the SSH protocol. These measures, intricately woven into our network design, stand as vigilant gatekeepers, ensuring a secure and confidential transfer of data within the intricate corridors of our wireless university network.

FUTURE WORK :

Envisioning the Future: Opportunities for Advancement

As we traverse the landscape of our nascent network configuration and specifications, it becomes abundantly clear that these represent not just a static blueprint but a dynamic canvas upon which future innovations can be artistically woven. Our current trajectory, characterized by an initial prototype, serves as the foundational bedrock for a journey into the realms of progress and expansion.

The inherent potential of our network design invites a deliberate exploration into avenues for development, pushing the boundaries of what is conceivable. It beckons the infusion of additional functionalities that transcend the present configuration, propelling our network into a realm of heightened support and extended coverage.

Scope for Expansion:

The roadmap to the future unfolds with the promise of a network architecture that transcends its current form. Deliberate expansion, propelled by an understanding of user needs and technological advancements, emerges as a cardinal objective. Imagining a network that seamlessly scales to accommodate the burgeoning demands of users necessitates a nuanced approach. Strategically placing access points, optimizing signal strength, and embracing advanced technologies become key facets in sculpting a network that not only meets but surpasses expectations.

Enhancing Coverage:

The quest for network excellence extends into the realm of coverage enhancement. The strategic deployment of cutting-edge technologies aligns with our vision to fortify coverage across diverse areas. Imagining a future where our network blankets every nook and cranny, we envisage a sophisticated ecosystem where users experience seamless connectivity and unhindered access to resources.

Supplementary Functionalities:

In our pursuit of a forward-looking network, the addition of supplementary functionalities takes center stage. This transcends the ordinary, encompassing advanced security protocols, dynamic load balancing mechanisms, and adaptive Quality of Service (QoS) measures. It is a deliberate endeavor to infuse our network with features that not only meet current needs but anticipate and adapt to the evolving technological landscape.

In essence, the current configuration serves as the overture to an orchestration of possibilities. Our commitment to continuous innovation and refinement aligns with a vision where our network evolves into a dynamic and resilient infrastructure. The canvas of the future beckons, inviting us to explore uncharted territories, pushing the boundaries of what is conceivable, and sculpting a network that stands as a testament to technological prowess and foresight.

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