AICTE - CISCO VIRTUAL INTERNSHIP

PROJECT REPORT - 2024

CYBER SHIELD
DEFENDING THE NETWORK

Submitted by

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Introduction:

In the rapidly evolving field of cybersecurity, securing network infrastructures within academic institutions is critical. This report presents an in-depth analysis and optimization plan for our college's network topology, focusing on key aspects such as security controls and attack surface mapping. Utilizing Cisco Packet Tracer, we illustrate the current network architecture, identifying potential vulnerabilities and proposing robust countermeasures.

Key recommendations include enhancing firewall configurations, implementing intrusion detection and prevention systems, and adopting secure communication protocols like VPNs.

To further safeguard our network, we emphasize the use of role-based access control (RBAC) and multi-factor authentication (MFA), along with regular security audits and vulnerability assessments. The report also outlines the design of a secure hybrid working environment for faculty and students, featuring controlled access to campus resources and content filtering to prevent misuse. Additionally, cybersecurity awareness training is recommended to foster a culture of security within the institution. By integrating these strategies, we aim to create a resilient network infrastructure that not only protects sensitive data but also supports the academic mission of the college, ensuring a secure and productive environment for all users.

PART 1 – https://github.com/shanthini07/AICTE-INTERN/blob/main/PART1-TOPOLOGY%20DIAGRAM.pkt

The university's campus network is a complex system comprising several key components that are vital for its functionality. At its core are the routers, essential devices that manage the flow of data across various networks. These routers form the backbone of the network, efficiently directing data packets from one network segment to another. Alongside the routers are the switches, which connect and manage multiple devices within the same network segment. Switches are crucial for enabling seamless communication between devices such as computers, printers, and servers within the network.

Firewalls are another critical element of the campus network, tasked with protecting the network by regulating incoming and outgoing traffic based on established security policies. These policies help in blocking unauthorized access and mitigating potential threats. The servers within the network host various essential services, including the university's website, email systems, and databases. These servers are the workhorses of the network, handling data storage, processing, and delivering resources as needed by users across the campus.
Wireless connectivity across the campus is facilitated by strategically placed access points, ensuring comprehensive coverage. These access points enable students, faculty, and visitors to connect to the network wirelessly, promoting mobility and ease of access. The integration of these core components results in a robust and dynamic network capable of meeting the diverse needs of a university environment.

Security is a top priority in the design and operation of the campus network. One key security measure is network segmentation, which involves dividing the network into different VLANs (Virtual Local Area Networks). Each VLAN is tailored to specific user groups, such as administration, faculty, students, and guests. This segmentation helps in managing and controlling network traffic more effectively and provides an additional layer of security by isolating different user groups.

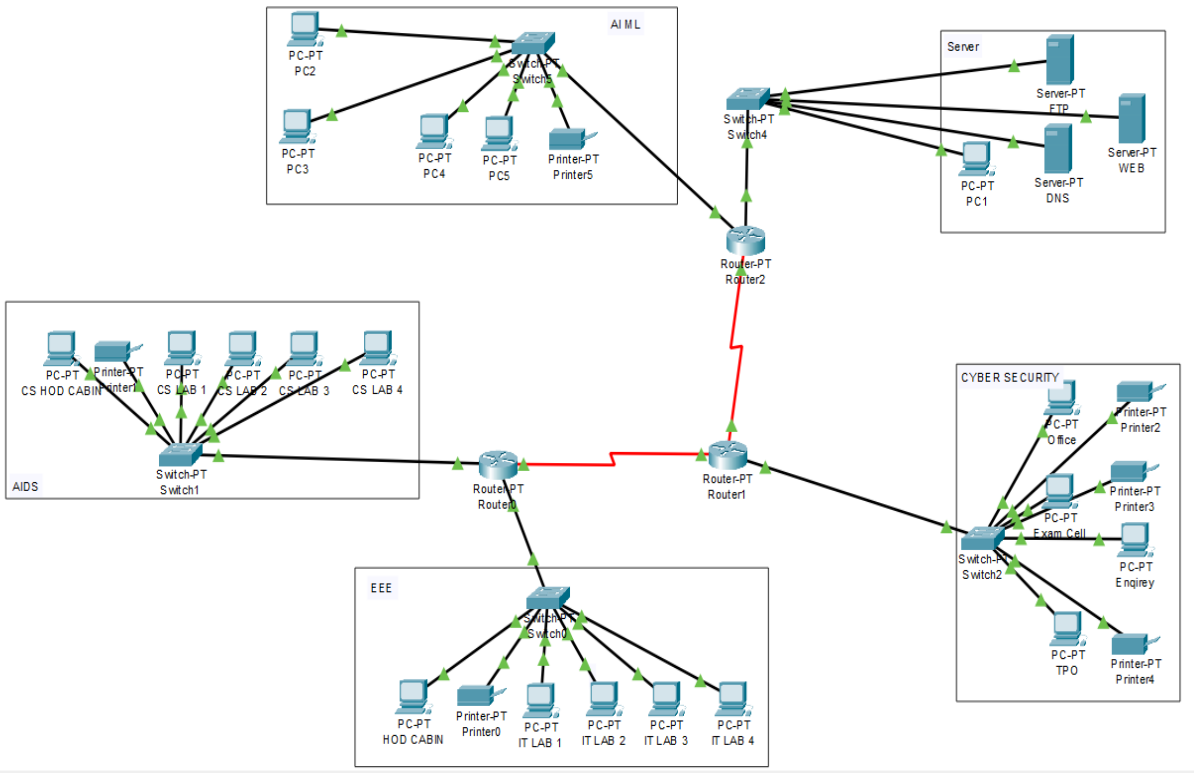
Firewalls are configured with detailed rules to regulate traffic flow between these various network segments. By establishing strict policies, the firewalls ensure that only authorized traffic is permitted between segments, thus protecting sensitive information and maintaining the network's integrity. Additionally, the network employs Intrusion Detection Systems (IDS) to monitor network traffic continuously for signs of suspicious activity. These systems are crucial for identifying and responding to potential security breaches in real time.

The campus network also utilizes robust authentication systems to verify the identity of users attempting to access the network. Systems such as RADIUS (Remote Authentication Dial-In User Service) or LDAP (Lightweight Directory Access Protocol) handle user authentication, ensuring that only authorized individuals can access the network, thus safeguarding sensitive data and resources. Once authenticated, users are subject to authorization systems that employ Role-Based Access Control (RBAC). This approach restricts access to resources based on user roles, ensuring that individuals can only access information and services pertinent to their responsibilities.

For network maintenance and troubleshooting, Cisco Packet Tracer is employed as a primary tool for network mapping. This powerful simulation tool allows network administrators to create detailed network topology diagrams that illustrate the placement and interconnectivity of routers, switches, firewalls, and other network components. By using Cisco Packet Tracer, administrators can visualize the network structure, simulate potential issues, and test changes before implementing them in the live network. This proactive approach helps maintain network reliability and performance.

The network diagram produced using Cisco Packet Tracer serves as a blueprint for understanding the campus network's design and operation. It provides a clear representation of how data flows through the network, highlighting key components and their interconnections. Such diagrams are invaluable for network planning, troubleshooting, and optimizing network performance.

In summary, the university's campus network is a sophisticated and dynamic system designed to support a wide range of activities and services. The core components—routers, switches, firewalls, servers, and access points—work together to provide a reliable and secure network infrastructure. The implementation of security measures such as network segmentation, firewalls, IDS, authentication systems, and RBAC ensures that the network remains secure and resilient against potential threats. Tools like Cisco Packet Tracer aid in the effective management and maintenance of the network, ensuring that it can adapt to the evolving needs of the university community. Through careful planning, implementation, and monitoring, the campus network provides a robust foundation for academic and administrative activities, fostering an environment of connectivity and collaboration.

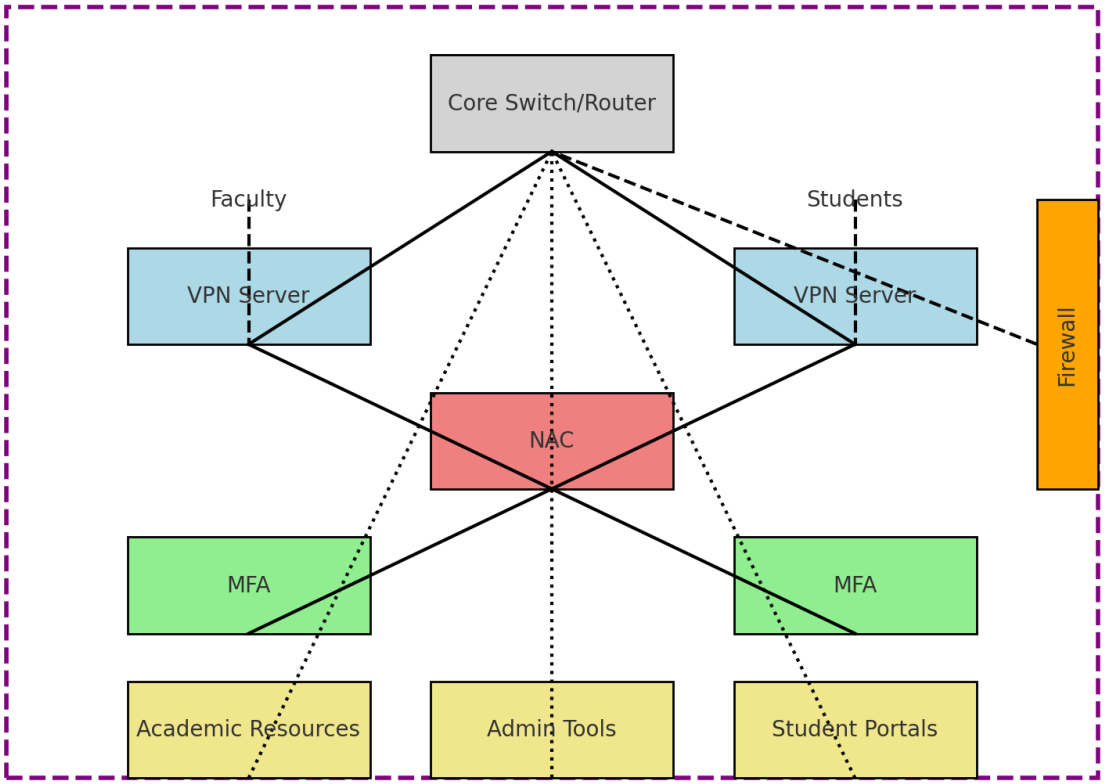


PART 2- https://github.com/shanthini07/AICTE-INTERN/blob/main/PART2-configuration.png

The university's campus network must meet the evolving needs of its faculty and students, ensuring secure access to resources both on-campus and remotely. Faculty members require secure access to academic databases, administrative tools, and communication platforms. Similarly, students need secure access to learning management systems, online libraries, and student portals from any location. Additionally, campus network services should be restricted from public internet access to protect sensitive data. These requirements demand robust security measures to prevent unauthorized access and cyber threats.

To address these requirements, the proposed solution integrates several key components into the existing network infrastructure. The first component is a Virtual Private Network (VPN), which will provide secure remote access to campus resources. VPNs establish encrypted tunnels, ensuring data transmitted between remote users and the campus network is protected from interception and tampering, allowing faculty and students to access resources securely from any location.

Multi-Factor Authentication (MFA) adds an extra layer of security for remote access by requiring users to provide two or more verification factors. This significantly reduces the likelihood of unauthorized access by making it harder for attackers to compromise user accounts.



Network Access Control (NAC) ensures that only authorized devices can connect to the network. NAC systems assess the security posture of devices attempting to connect and enforce policies to ensure compliance, preventing potentially compromised or non-compliant devices from accessing the network.

Incorporating a Zero Trust Architecture (ZTA) is another essential component. Zero Trust assumes threats can exist both inside and outside the network perimeter, enforcing strict access controls and continuous monitoring. ZTA principles ensure that all devices, whether inside or outside the network, are continuously authenticated and authorized.

The updated network diagram integrates these new components into the existing topology. VPN servers are added for secure remote access, NAC systems for device compliance, and MFA components to enhance authentication security. This comprehensive update ensures the network meets the evolving security and access requirements of the university community.

The proposed solution addresses several key risks and offers significant advantages. One primary risk addressed is unauthorized access. Implementing VPN and MFA ensures only authenticated and authorized users can access campus resources, significantly reducing the likelihood of unauthorized access. VPNs provide encrypted tunnels for data transmission, protecting sensitive information from being intercepted or tampered with during transit, preventing data breaches.

Device security is another critical risk addressed. NAC ensures only compliant devices are allowed to connect to the network by enforcing security policies and assessing the security posture of devices. This prevents compromised or insecure devices from accessing network resources, reducing the risk of malware infections and other security threats.

The proposed solution offers several advantages, enhancing the security and accessibility of campus resources. Secure remote access enables faculty and students to access necessary resources from any location, promoting flexibility and continuity in academic and administrative activities. MFA and Zero Trust Architecture significantly enhance security measures, providing robust protection against a wide range of cyber threats. MFA adds an extra layer of verification, making it more challenging for attackers to compromise user accounts, while Zero Trust principles ensure continuous authentication and strict access controls.

Moreover, the proposed solution is scalable, capable of growing with the university's needs. As the university expands and the number of users and devices increases, the solution can be scaled to accommodate growth without compromising security. This scalability ensures the network remains robust and secure, supporting the evolving needs of the university community.

CONFIGURATION:

```
Router> enable
Router# configure terminal

! Interface Configuration
Router(config)# interface
g0/0
Router(config-if)# ip address 192.168.1.1
255.255.255.0Router(config-if)# no shutdown
Router(config-if)# exit

Router(config)# interface g0/1
Router(config-if)# ip address 192.168.2.1
255.255.255.0Router(config-if)# no shutdown
Router(config-if)# exit

! Static Routing and NAT
Router(config)# ip route 0.0.0.0 0.0.0.0 g0/0
Router(config)# access-list 1 permit 192.168.1.0 0.0.0.255
Router(config)# access-list 1 permit 192.168.2.0 0.0.0.255
Router(config)# ip nat inside source list 1 interface g0/0
overloadRouter(config)# interface g0/0
Router(config-if)# ip nat inside
Router(config-if)# exit
Router(config)# interface g0/1
Router(config-if)# ip nat
outsideRouter(config-if)# exit

! Firewall Configuration
Router(config)# access-list 101 permit ip any
anyRouter(config)# access-list 102 deny ip any
any Router(config)# interface g0/0
Router(config-if)# ip access-group 101
inRouter(config-if)# exit


Switch> enable
Switch# configure terminal

! VLAN Configuration
Switch(config)# vlan 10
Switch(config-vlan)# name
FacultySwitch(config-vlan)# exit

Switch(config)# vlan 20
Switch(config-vlan)# name
StudentsSwitch(config-vlan)# exit
```

! Port Assignment to VLANs
Switch(config)# interface range fa0/1 -
2
Switch(config-if-range)# switchport mode access
Switch(config-if-range)# switchport access vlan
10Switch(config-if-range)# exit

Switch(config)# interface range fa0/3 - 4
Switch(config-if-range)# switchport mode access
Switch(config-if-range)# switchport access vlan
20Switch(config-if-range)# exit

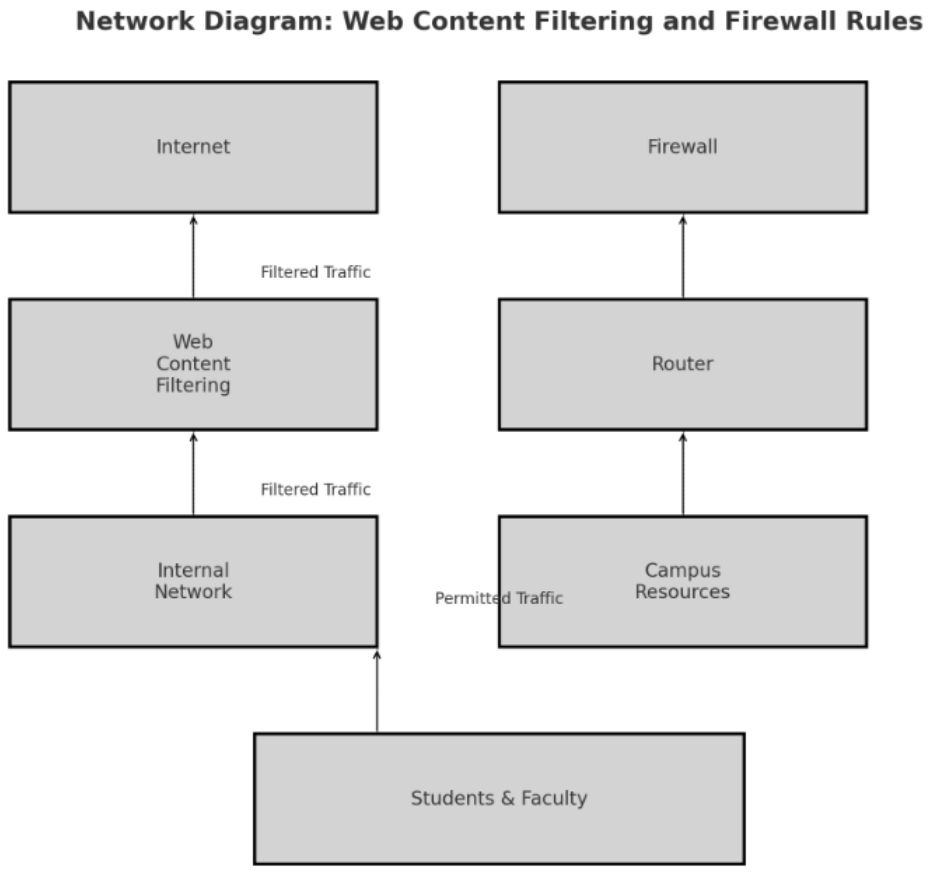
Access Point> enable
Access Point# configure terminal

! Faculty SSID
Access Point(config)# interface dot11radio
0Access Point(config-if)# ssid FacultySSID
Access Point(config-ssid)# vlan 10
Access Point(config-ssid)# authentication
openAccess Point(config-ssid)# end

! Student SSID
Access Point(config)# interface dot11radio
0Access Point(config-if)# ssid StudentSSID
Access Point(config-ssid)# vlan 20
Access Point(config-ssid)# authentication
openAccess Point(config-ssid)# end

PART 3 - https://github.com/shanthini07/AICTE-INTERN/blob/main/PART3-TOPOLOGY%20DIAGRAM.pkt

To ensure that students focus on educational content and are protected from potentially harmful online material, the university needs to restrict access to irrelevant or harmful websites using campus resources. This can be achieved by implementing effective measures to monitor and control internet usage, ensuring the network is used appropriately and efficiently.



The proposed solution includes several key components to be integrated into the existing network infrastructure. A primary component is **Web Content Filtering**, which involves using devices or software to categorize and filter web traffic based on predefined policies. By categorizing websites and applying filters, the system can block access to non-educational and potentially harmful websites, ensuring that students only access relevant content.

In addition, **Firewall Rules** will be updated to restrict access to specific categories of websites further. Firewalls, which are already a crucial part of network security, can be configured with specific rules to block access to unwanted website categories. These rules enhance the existing security measures by adding another layer of control over internet usage.

The updated network diagram will incorporate web content filtering devices and updated firewall rules. These components will work together to create a secure and focused online

them from irrelevant or harmful content.

This solution addresses several key risks and provides significant advantages. One primary risk is the misuse of resources. Implementing web content filtering and updating firewall rules restricts access to non-educational and potentially harmful websites, ensuring students focus on educational content and are not distracted by irrelevant online material.

Another critical risk addressed is network congestion. Blocking unnecessary content reduces bandwidth usage, ensuring efficient use of network resources. This helps maintain optimal network performance, especially during peak usage times, and prevents slowdowns caused by high bandwidth consumption from non-educational content.

The proposed solution offers several advantages. Improved productivity is a significant benefit, as restricting access to non-educational websites ensures that students remain focused on their studies and educational resources. Limiting distractions allows students to make better use of their time and resources, leading to enhanced learning outcomes.

Enhanced security is another crucial advantage. Preventing access to malicious websites reduces the risk of malware infections and other cyber threats. This protection ensures that the network remains secure and that students' personal information and campus resources are safeguarded.
To implement the proposed solution effectively, several policies will be established:

1. **Allow Educational Sites**: Permit access to educational and research websites to ensure students have the resources they need for their studies.
2. **Block Social Media**: Restrict access to social media platforms during school hours to minimize distractions and encourage students to focus on educational content.
3. **Block Explicit Content**: Prevent access to adult content and other inappropriate websites to protect students from harmful material.
4. **Allow Campus Resources**: Ensure that all campus resources, such as the university website, email, and online libraries, are always accessible.

CONFIGURATION:

Router> enable
Router# configure terminal
Router(config)# ip dns server
Router(config)# ip domain lookup
Router(config)# ip name-server 208.67.222.222 Router(config)# ip name-server 208.67.220.220Router(config)# exit