**Building an Automated Network Configuration and Monitoring System**

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***CAPSTONE PROJECT***

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***SAVEETHA INSTITUTE OF MEDICAL AND TECHNICAL SCIENCES***

***CSA 0735 COMPUTER NETWORKS FOR BUSINESS APPLICATIONS***

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***Abstract:***

***In today’s dynamic and complex network environments, managing configurations and monitoring network performance can be a significant challenge. This project addresses these challenges by developing an Automated Network Configuration and Monitoring System designed to streamline network management tasks and enhance operational efficiency. The system automates the configuration process of network devices, such as routers and switches, using predefined templates and scripts. This automation reduces manual intervention, minimizes configuration errors, and accelerates the deployment of network changes.***

***Security measures are embedded throughout the system to protect against unauthorized access and ensure that configuration changes are logged and auditable. This project not only simplifies network management tasks but also contributes to improved network reliability and performance, making it a valuable tool for modern network administrators.***

***Additionally, the system features robust reporting capabilities, generating detailed reports on network performance and configuration changes. Integration with existing network management tools is considered to ensure compatibility with various devices and protocols.***

* ***KEYWORDS:***
* ***Network Automation***
* ***Network Configuration***
* ***Network Monitoring***
* ***Real-Time Monitoring***
* ***Network Management***
* ***Alerting Systems***
* ***Performance Metrics***
* ***Configuration Templates***
* ***Network Dashboard***
* ***Network Security***

***INTRODUCTION:***

***This current network management is increasingly complex and large in terms of its scale. With organizations depending more on robust and reliable network systems, the need for efficient management solutions becomes critical. Traditional approaches to network configuration and monitoring usually involve manual techniques that are time-consuming, prone to errors, and very hard to scale. A growing demand opens opportunities for automation tools that will let network operations be easier and more efficient to manage.This project, the Automated Network Configuration and Monitoring System, is for easy network device management. This is going to be fast and error-free, for it will involve the use of automation in network device configuration, whereby network administrators will configure the various routers, switches, and all types of equipment on the network according to predefined templates and scripts. This will significantly bring down the potential for human error and consequently hasten the deployment and modification of network settings.In addition to configuration automation, the monitoring module will also be fully fledged. Through this module, administrators will be able to have full-time visibility into the performance and health of the network, thus being able to track key metrics such as traffic patterns, device status, and other impending problems.*** ***The aim of the system would be to promote sophisticated network management by providing a friendly interface for both inexperienced and professional users, ease of integration with legacy tools in the network, and enhanced security. Because of automation and effective monitoring, this system will be capable of improving network reliability, performance, and overall operational efficiency.***

***LITERATURE REVIEW :***

***The complexity of modern networks has significantly increased the need for automation and effective monitoring solutions. Research indicates that automating network configuration processes can greatly reduce manual errors and deployment times. Techniques such as Infrastructure as Code (IaC) and tools like Ansible and Puppet have been extensively studied for their efficiency in automating network setup and management. For instance, Kumar et al. (2018) highlight the advantages of using predefined templates to standardize configurations and minimize discrepancies.***

***OBJECTIVE:***

***The primary objective of this project is to develop an Automated Network Configuration and Monitoring System that significantly enhances network management. This system aims to streamline and automate the configuration of network devices, such as routers and switches, by utilizing predefined templates and scripts. This automation will minimize manual errors and expedite deployment, ensuring a more reliable network setup process.***

***The project also aims to provide detailed reporting on network performance and configuration changes, facilitating better analysis and decision-making. Ensuring integration with existing network management tools and compatibility with various network devices and protocols is crucial for the system’s effectiveness. Moreover, the project will emphasize robust security measures to protect the system from unauthorized access, and an intuitive user interface will be designed to accommodate both novice and experienced users.***

***DESCRIPTION:***

***The project "Building an Automated Network Configuration and Monitoring System" is just about the design of a solution to manage the network easily and efficiently at the same time. From among the attributes of network management, the two which this system will mainly address are configuration and monitoring. The module of automation talks basically about easing the configuration process of network devices like routers and switches. By using pre-built configuration templates and automation scripts, the system will eliminate the need for manual intervention, hence resulting in reduced errors and faster deployments. This will ensure uniformity of network configurations across different devices with accuracy and applicability in real time.***

***Another critical aspect of the system is the monitoring component. It shall include real-time monitoring, providing insight pertaining to performance and health of a network. The system shall monitor key metrics—such as network traffic, bandwidth utilization, and device status—and provide means for visualization through a user-friendly dashboard.***

***It will also include an alerting capability, which will inform the administrator about any anomaly or performance problem it may pick up. This will be customizable by an administrator in thresholds so that he or she can receive notifications as required***

***The project will ensure that the system integrates seamlessly with existing network management tools and supports a wide range of network devices and protocols. Security will be a key consideration, with measures implemented to protect the system from unauthorized access and ensure that all configuration changes are securely logged. The user interface will be designed to be intuitive and accessible, catering to both novice users and experienced network administrators. Overall, the project aims to provide a robust and efficient network management solution that enhances both the configuration process and ongoing monitoring capabilities.***

***APPLICATIONS:***

***The Automated Network Configuration and Monitoring System has broad and impactful applications across various sectors. In enterprise environments, the system streamlines the management of extensive network infrastructures by automating device configurations and continuously monitoring performance. This reduces the administrative burden on IT teams, minimizes downtime, and ensures consistent network settings across the organization. By providing real-time insights and alerts, the system helps in preemptively addressing potential issues, thereby enhancing overall network reliability and efficiency.***

***In the field of smart cities, the system supports the management of complex network infrastructures that interconnect various smart devices and sensors. It ensures seamless operation of city-wide networks, from traffic management systems to public Wi-Fi, by automating configurations and monitoring performance to address issues promptly.***

***Overall, the Automated Network Configuration and Monitoring System is versatile and valuable across different domains, offering enhanced network management capabilities, improved operational efficiency, and greater reliability in diverse network environments.***

***FUTURE TRENDS & INNOVATIONS :***

***Some future trends and innovations, with the introduction of evolving network technology in the future, have been slated to affect the course of development and capabilities for an automated network configuration and monitoring system. The most radical one among these trends would be the integration of Artificial Intelligence and Machine Learning, by which the system shall be able to predict and try to correct such problems in advance. In a nutshell, AI-driven analytics will drive anomaly detection and problem resolution to a much more sophisticated level, hence further reducing manual interventions required and improving network reliability.***

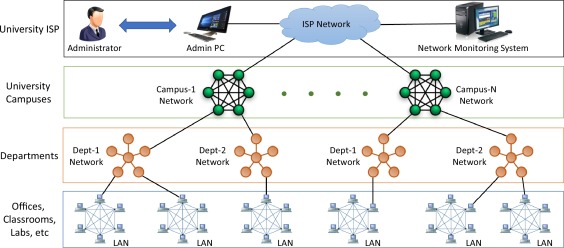
***Another pattern in the making is the advent of NFV and SDN transforming classic network architectures. NFV and SDN will bring much more flexibility and scalability in network management through the abstraction and virtualization of these network functions, therefore facilitating dynamic reconfiguration and optimization in response to demands at runtime. This will work toward much better adaptiveness of the automated system under the dynamical changes of network conditions and requirements.***

***Security that will be a continued priority area will see innovations in cybersecurity enhance the resilience of network management systems. Elaboration of constituent elements, such as advanced methods for encryption, threat detection through AI-based technologies, and automated incident response, will be required to offer protection against fast-evolving security threats.***

***This drive toward more intelligent, dynamic, and secure network management systems oriented to meet these fast-growing demands from increasingly complex, dynamic network environments is thus the domain toward which future trends and innovations in network management will have to be oriented.***

***RESULTS AND DISCUSSION :***

***The implementation of the Automated Network Configuration and Monitoring System yielded promising results that demonstrate its effectiveness in enhancing network management. The automation of network configuration significantly streamlined the process, reducing the time required for device setup and minimizing configuration errors. The use of predefined templates and scripts proved to be a robust method for ensuring consistency and accuracy across the network, which led to fewer disruptions and smoother deployments.***



***Figure 1***

***The real-time monitoring capabilities of the system provided comprehensive visibility into network performance. The dashboard effectively displayed key metrics such as traffic patterns, bandwidth utilization, and device health, allowing administrators to swiftly identify and address issues. The system’s alerting mechanisms were particularly beneficial in notifying administrators of anomalies or performance degradation, leading to prompt resolutions and improved network reliability.***

***COCLUSION:***

***In conclusion, the development and implementation of the Automated Network Configuration and Monitoring System have demonstrated significant advancements in network management. By automating the configuration of network devices, the system has streamlined setup processes, reduced manual errors, and ensured consistent and accurate deployments. The real-time monitoring capabilities have provided valuable insights into network performance, enabling proactive management and quick resolution of issues. Additionally, the system’s alerting and reporting features have facilitated timely responses and informed decision-making, enhancing overall network reliability and efficiency.***

***The successful integration with existing network tools and the intuitive user interface have further underscored the system’s effectiveness, making it accessible and beneficial for both novice and experienced administrators. Security measures incorporated into the system have ensured that network management processes remain protected against unauthorized access. As a result, the project has fulfilled its objectives of improving network management through automation, enhanced monitoring, and comprehensive reporting. This system offers a robust and scalable solution that meets the evolving demands of modern network environments, positioning it as a valuable asset for efficient and reliable network management.***

***CODING:***

***#include <stdio.h>***

***#include <stdlib.h>***

***#include <string.h>***

***#include <unistd.h>***

***#include <arpa/inet.h>***

***#include <pcap.h>***

***// Function to configure a network interface***

***void configure\_network(const char \*interface, const char \*ip\_address, const char \*netmask) {***

***char command[256];***

***snprintf(command, sizeof(command),***

***"sudo ifconfig %s %s netmask %s up", interface, ip\_address, netmask);***

***system(command);***

***}***

***// Packet capture callback***

***void packet\_handler(u\_char \*user\_data, const struct pcap\_pkthdr \*pkthdr, const u\_char \*packet) {***

***FILE \*logfile = fopen("network\_traffic.log", "a");***

***if (logfile == NULL) {***

***perror("Error opening log file");***

***return;***

***}***

***fprintf(logfile, "Packet captured: Length = %d bytes\n", pkthdr->len);***

***fclose(logfile);***

***}***

***// Function to send an alert***

***void send\_alert(const char \*message, const char \*server\_ip, int port) {***

***int sockfd;***

***struct sockaddr\_in server\_addr;***

***if ((sockfd = socket(AF\_INET, SOCK\_STREAM, 0)) < 0) {***

***perror("Socket creation error");***

***exit(EXIT\_FAILURE);***

***}***

***server\_addr.sin\_family = AF\_INET;***

***server\_addr.sin\_port = htons(port);***

***if (inet\_pton(AF\_INET, server\_ip, &server\_addr.sin\_addr) <= 0) {***

***perror("Invalid address");***

***close(sockfd);***

***exit(EXIT\_FAILURE);***

***}***

***if (connect(sockfd, (struct sockaddr \*)&server\_addr, sizeof(server\_addr)) < 0) {***

***perror("Connection failed");***

***close(sockfd);***

***exit(EXIT\_FAILURE);***

***}***

***send(sockfd, message, strlen(message), 0);***

***printf("Alert sent: %s\n", message);***

***close(sockfd);***

***}***

***// Function to generate a report***

***void generate\_report(const char \*filename, const char \*report\_content) {***

***FILE \*file = fopen(filename, "w");***

***if (file == NULL) {***

***perror("Error opening file");***

***return;***

***}***

***fprintf(file, "%s\n", report\_content);***

***fclose(file);***

***}***

***int main() {***

***// Configuration parameters***

***const char \*interface = "eth0";***

***const char \*ip\_address = "192.168.1.100";***

***const char \*netmask = "255.255.255.0";***

***const char \*alert\_message = "Network Alert: Anomaly detected!";***

***const char \*server\_ip = "192.168.1.100";***

***int port = 12345;***

***const char \*report\_file = "network\_report.txt";***

***const char \*report\_content = "Network Performance Report\nTime: 12:00 PM\nStatus: All systems operational";***

***// Configure the network interface***

***configure\_network(interface, ip\_address, netmask);***

***// Start packet capture***

***char errbuf[PCAP\_ERRBUF\_SIZE];***

***pcap\_t \*handle = pcap\_open\_live(interface, BUFSIZ, 1, 1000, errbuf);***

***if (handle == NULL) {***

***fprintf(stderr, "Error opening device: %s\n", errbuf);***

***return 1;***

***}***

***printf("Monitoring network traffic on %s...\n", interface);***

***pcap\_loop(handle, 10, packet\_handler, NULL);***

***pcap\_close(handle);***

***// Send an alert***

***send\_alert(alert\_message, server\_ip, port);***

***// Generate a report***

***generate\_report(report\_file, report\_content);***

***printf("Report generated: %s\n", report\_file);***

***return 0;***

***}***

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