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The Experimental Solution to The Problem of Communication Infrastructure in The Most Deadly Natural Disaster:(230206:0427) of Modern History

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ABSTRACT The proposed solution involves the utilization of specially equipped trucks named "RescueNet" to quickly restore network connectivity in earthquake-affected areas. These trucks are designed to rapidly reach disaster zones and become operational immediately. Consequently, individuals in the affected area can regain access to vital networks shortly after the earthquake, facilitating effective communication for emergency response and rescue efforts.

Essentially, the operation of these trucks is as follows: Upon arrival at the earthquake zone where the network infrastructure has collapsed, the trucks release drones equipped with Access Points (APs). These APs extend the coverage of the local network, making it easier for users to connect to the network. The APs are connected to an Access Point Controller (APC) inside the truck, which is in turn connected to a router. This router establishes a fast and reliable network connection to the Türksat satellite via SD-WAN, ensuring seamless communication. The satellite connection also enables communication with DNS and web servers in the safe zone area, facilitating smoother navigation for users on the network.

The entire setup, including the deployment of drones and APs, will be simulated and tested using Cisco Packet Tracer to verify the feasibility and effectiveness of the solution. This simulation will help identify potential issues and ensure that the system operates efficiently in real-world disaster scenarios.

INDEX TERMS Network, Communication, Network Infrastructure, Network Services, Network Design, Network Demo

I. INTRODUCTION

Restoring network connectivity becomes a critical priority immediately following such events to support emergency response and recovery efforts.

To address these challenges, I propose a solution involving the deployment of "RescueNet" trucks equipped with the necessary technology to rapidly restore network connectivity in earthquake-affected areas. These trucks will be pre-positioned near fault lines in secure areas, allowing them to reach the desired location within a very short time. Equipped with state-of-the-art technology, these trucks are resilient to adverse weather conditions and can quickly respond to disaster zones.

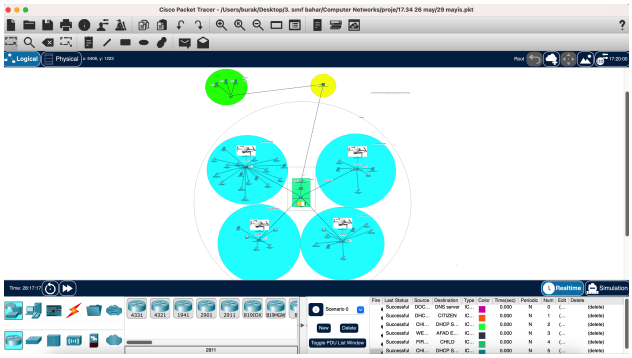

FIGURE 1. Network setup on Cisco Packet Tracer Platform

Upon arrival at the disaster site, the trucks will release drones equipped with Access Points. These drones have high battery capacity and can fly at high altitudes, unaffected by adverse weather conditions such as rain or snow, thanks to their

powerful propellers. If their batteries run low, they can return to the truck to quickly swap out the battery and continue flying. Additionally, depleted batteries can be recharged using the onboard generator. The operational principle is as follows: Access Points on the drones connect to a RescueNet Access Point Controller (APC) located in the truck, enabling communication between the drones and managing the access points. A switch is connected to this controller to improve network traffic management. The switch connects to the SD-WAN router. SD-WAN provides a fast and reliable network connection by connecting to the Türksat satellite.

Security measures are also of great importance. Network security is ensured through encryption and access control. The trucks are equipped with generators powered by sustainable energy sources. The technology and equipment used are carefully selected to provide high performance and durability. DNS and web servers are planned to be located in areas with low earthquake risk, such as Ankara. Given the potential challenges of deploying such physical systems to areas with high earthquake risk, it is more suitable for these large and costly servers to be located in Anatolian regions.

A sufficient number of these trucks should be produced to meet the needs of a city. Assuming each drone would suffice for a neighborhood, considering medium-sized neighborhoods with a radius of 300 meters.

This study encompasses the planning, design, and simulation of the proposed network solution using Cisco Packet Tracer. This simulation evaluates the effectiveness and feasibility of the solution by identifying potential issues and ensuring the system operates efficiently in real-world disaster scenarios. Simulations conducted using Cisco Packet Tracer allow us to see how the theoretically designed system would work in practice, enabling the identification of weaknesses and improvements to be made.

A. CISCO PACKET TRACER SIMULATED WEBSITE

In our project, the website created using Cisco Packet Tracer has been an important tool to better understand the infrastructure and communication processes of the RescueNet system. This website is designed as part of the RescueNet project aimed at providing fast and reliable communication in disaster areas.

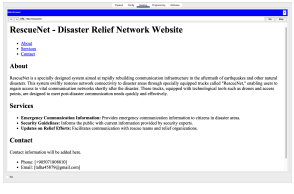

FIGURE 2. rescuenet Web Page

II. MATERIALS

In this section, I explained the materials I used.

A. DRONES

The drones used for RescueNet are crucial tools in rebuilding communication infrastructure. These drones are equipped with high battery capacity, allowing them to cover wide areas by flying at high altitudes. Their robust propellers enable them to operate without being affected by adverse weather conditions.

FIGURE 3. Drones

B. SWITCH

It offers simple management interfaces, making it easy for network administrators to use. Advanced security options ensure the protection of the network and enhance data security. Its energy-efficient features help businesses reduce energy costs and provide an environmentally friendly option. With its durable and reliable structure, the Cisco 2960 Series provides long-lasting and stable network performance.

C. ACCESS POINT CONTROLLER

Access Point Controller is a device that centrally manages access points (APs) in a network. Used by network administrators, this control point facilitates the management of wireless network infrastructure. Its functions include:

Configuration Management: Enables centralized configuration of all access points, allowing network administrators to apply the same configuration consistently across multiple points.

Security Management: Defines and implements security policies in the network. It manages security measures such as user authentication, encryption settings, and access controls.

Performance Monitoring and Management: Monitors the performance of access points, tracks user traffic, manages bandwidth, and optimizes network performance.

D. ACCESS POINTS

Access Points are devices that provide connectivity in wireless communication networks. These points enable devices such as computers, phones, tablets, etc., to access the wireless network. Access points in the network are used to facilitate users' connection to the network and data transmission.

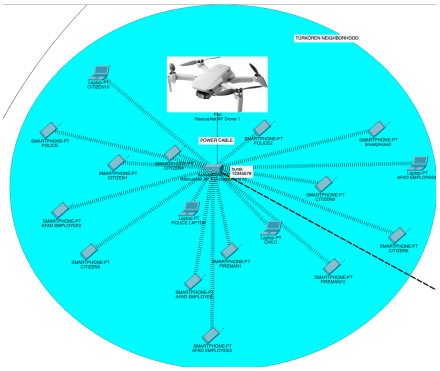

FIGURE 4. Access Point setup on Cisco Packet Tracer

E. DNS SERVERS

In the RescueNet system, DNS servers are responsible for resolving domain names to IP addresses, ensuring smooth communication within the network. These servers help users navigate effectively on the internet by translating domain names into corresponding IP addresses, enabling access to web resources and services.

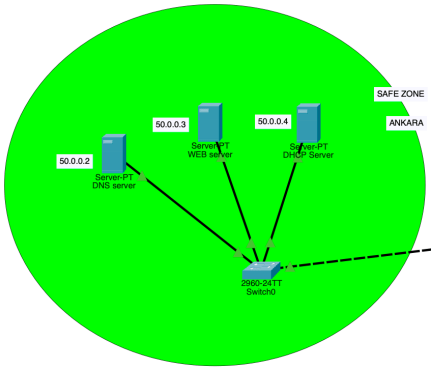

FIGURE 5. Dns and Web Servers setup on Cisco Packet Tracer

F. WEB SERVERS

In the RescueNet system, web servers play a critical role in providing access to essential web-based services and resources in disaster areas. These servers host websites containing valuable information such as emergency communication details, security guidelines, and updates on relief efforts. By hosting web content locally, web servers ensure access to critical information for users in disaster areas, even when internet connectivity is limited or unavailable.

G. SD-WAN DEVICES

A router equipped with SD-WAN optimizes wide area network (WAN) traffic, thus enhancing efficiency. SD-WAN technology offers intelligent traffic routing capabilities among different network connections. It can manage various connection types such as fiber, DSL, and LTE, thereby improving network performance. In the 'RescueNet' system, the LTE component is utilized. Data traffic from Turksat satellite is received by the router and optimized using SD-WAN routing algorithms. These algorithms consider various factors to efficiently route traffic flows. The data received from Turksat satellite is processed by the router and then directed to appropriate destinations.

H. SATELLITE

Turksat satellite provides satellite-based internet services and offers internet access to users through Wi-Fi access points. It plays a critical role in establishing communication infrastructure and providing fast and reliable internet access in disaster areas. Since there is no satellite option in Cisco Packet Tracer, I used a router instead to demonstrate the connection. I placed a satellite image on the router to represent the connection in this way.

I. BATTERIES

Batteries are critical for ensuring the security of network systems against power outages. In the RescueNet system, batteries are used to charge the drones' batteries and are located in the truck.

III. METHODOLOGY

A. SUBNETS

There is a subnet that I show in the drawing of my project. This subnet is 255.255.255.0 subnet mask. But there will be more than one truck in the general part of my project. The trucks will all represent a different network, and therefore they will all represent a different subnet mask.

Subnets are used to divide our network into smaller and more manageable pieces. Each subnet has a specific IP address range and subnet mask. These subnets are used to route and isolate traffic between devices on the network.

B. NETWORK TOPOLOGY: STAR TOPOLOGY WITH ACCESS POINT CONTROLLER

Our network topology adopts a structure known as the star topology. In this setup, our Access Point Controller establishes direct connections with other devices, including Access Points and the main network switch. This configuration allows for the network to be easily managed with a central control point. The Access Point Controller facilitates the management of all access points in the network from a centralized location, streaming network administration. However, in the event of a failure of the Access Point Controller device, the entire network can be affected. To mitigate this scenario, backup trucks can be utilized.

IV. IMPLEMENTATION

The logic of the "RescueNet" trucks is as follows: Our SD-WAN device connects to two different networks. The first network operates on the 192.168.1.0 subnet and is connected through the GIG0/0/0 port. Users connecting to this network receive IP addresses according to this subnet's IP address distribution. For example, a smartphone might have an IP

address of 192.168.1.8. (I assigned static IP addresses to ensure that the IP addresses are orderly.).

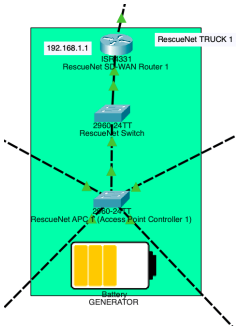

FIGURE 6. Network equipment inside the truck

The second network is a satellite connection located on the GIG0/0/1 port with an IP address of 10.0.0.1.

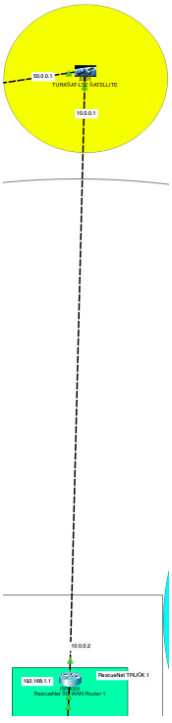

FIGURE 7. Satellite connection with truck

This connection enables data transmission via satellite. (I set it up this way to demonstrate the data exchange.) Thus, we achieve a network structure that integrates with both networks and consists of various devices. This structure not only meets users' communication needs but also provides a fast and reliable solution for re-establishing communication infrastructure in disaster areas.

In the "RescueNet" system, drones are used to distribute Access Points (APs) to expand the coverage area of the local network from within the truck. These APs carried by drones provide connectivity to various devices connected to the local network, including smartphones, computers, and tablets.

The Access Points are crucial for ensuring that first responders and affected individuals can connect to the network quickly and reliably. Each AP is capable of handling multiple connections simultaneously, distributing IP addresses to connected devices and facilitating seamless communication.

Additionally, I integrated DNS and web servers into the network. These servers operate on the 50.0.0.0 network.

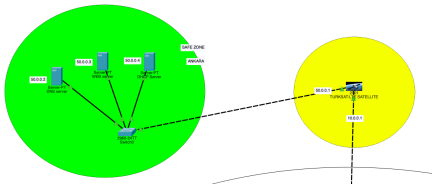

FIGURE 8. Satellite connection with servers

These servers play a critical role in meeting communication needs in disaster areas and providing fast access. At the same time, RIP gateway is used to manage routing within the network. This allows for more efficient and reliable data transmission within the network, while users can access critical information through DNS and web servers. This integration enhances the effectiveness of the system, contributing to the rapid re-establishment of communication infrastructure in disaster areas.

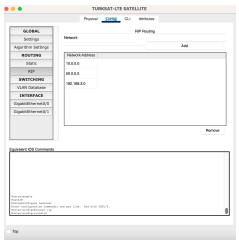

FIGURE 9. RIP code

V. DISCUSSION AND CONCULUSION

A. DISCUSSIONS

1) Cost

Purchasing and maintaining 'RescueNet' vans, drones and network equipment requires significant financial investments. I think this is the biggest obstacle my project faces. High costs may make the applicability and sustainability of the system difficult.

2) Communication Coordination and Integration Challenges

Secondly, strong coordination and integration is required to ensure seamless communication between drones, Access Points and the central network infrastructure. This requires the presence of an experienced and expert team and the creation of a continuous communication network. However, this

challenge can be overcome with a quality team and effective processes.

3) Weather Conditions and Terrain Problems

Another important issue is how to implement such a system in real-world scenarios. Factors such as adverse weather conditions, terrain obstacles and interferences in existing infrastructure may adversely affect the effectiveness and operation of the RescueNet system. These uncertainties highlight the challenges and adaptation requirements the project may face in real-world conditions.

B. CONCLUSION

This project provides an effective solution to re-establish fast and reliable communication infrastructure in disaster areas. The use of the "RescueNet" system can ensure that emergency interventions are carried out more effectively by minimizing the communication gap in disaster areas. Technologies such as drones, Access Points and SD-WAN devices used in the project were designed to quickly meet post-disaster communication needs. As a result, the "RescueNet" system can play a life-saving role by ensuring the rapid re-establishment of communication infrastructure in disaster areas. This project should be considered as part of disaster response strategies and may inspire similar projects in the future.

C. COPYRIGHT ISSUE

The Reports are going to be under the ComVISLab Intellectual Property Rights.(C)Comp.Eng.Dep@MCBU. The Problem Experimental Design Project belongs to Burak Talha Memis

ACKNOWLEDGMENT

I would like to note that this project was completed solely by myself without direct contributions from other individuals or institutions.

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BURAK TALHA MEMIS I am an individual who has been fascinated by technological devices since my childhood and focus on improving myself in this field, particularly in computers. Spending most of my time coding and experimenting with computers, I possess a personality that embraces innovation, which greatly aids me in my studies and projects within the realm of computer engineering. I have acquired proficiency in Python in 2024, and I also have knowledge in Java, SQL, and MATLAB programming languages. My skill set includes strong problem-solving abilities, effective communication skills, adeptness in teamwork and leadership, crisis management capabilities, and proficiency in public speaking.