



# 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** Earthquakes are one of the most devastating natural disasters, capable of causing widespread destruction and significant loss of life. These sudden and violent shaking events result from the movement of tectonic plates beneath the Earth's surface, releasing immense amounts of energy. Earthquakes can disrupt critical infrastructure, including buildings, transportation networks, and communication systems, making emergency response and recovery efforts challenging. Recent large-scale earthquakes, such as the 7.8 magnitude quake that struck Turkey on February 6, 2023, have underscored the urgent need for resilient infrastructure and effective disaster preparedness strategies. This study aims to explore the impact of major earthquakes on urban areas and the importance of robust communication networks in ensuring rapid and efficient emergency response.

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

## I. INTRODUCTION

**IN** Recent years, devastating earthquakes have caused extensive damage worldwide, disrupting essential services like internet connectivity. The physical infrastructure supporting internet services, including cables, routers, and data centers, often suffers significant damage during such events, leading to widespread outages. Restoring internet connectivity quickly is vital for communication, access to crucial information, and coordination of relief efforts in affected areas. This article explores the process of redesigning internet infrastructure to tackle the connectivity challenges posed by earthquake-induced disruptions.

**Scenario Explanation :**Following the devastating earthquake, our project begins with the restoration of communication networks by first meeting basic connectivity requirements. Initially, the network manages fundamental communication packages to re-establish the simplest forms of contact. As the system identifies and adapts to increasing demands, its capabilities grow considerably. This progression reflects not only recovery but also the adaptive resilience of our network infrastructure.

In the following Section II (Materials), you have to explain

the components used in your Design. Each component (like equipments) should be defined carefully defining the usage purposes. In Section III (Methodology) you are going to explain your Network Infrastructure by giving details about sub-modules used for constructing your design. In Section-IV (Implementation) you are going to explain the Demo environment. In the final section, you should discuss your Experimental Design by giving pros/cons. Give your future work clues via your conclusions. At the end (like in this document), please share the References used in your work.

## II. MATERIALS

In this section, which materials are used in your Experimental Design Project should be explained. As an guiding example is shared below;

### A. SWITCHES

#### 2926-24tt switch:

The Cisco Catalyst 2960-24TT switch is a managed switch designed for small and medium-sized networks. It has 24 10/100 Ethernet ports and 2 10/100/1000 uplink ports. It directs data traffic by connecting network devices and improves network performance. It optimizes network traffic with Qual-



**FIGURE 1.** 2926-24tt Switch

ity of Service (QoS) support and offers security features such as Access Control Lists (ACL) and 802.1X authentication. It is ideal for small and medium-sized networks, providing high performance and reliability.

### B. ROUTER

#### Isr 4321 Router:

The Cisco ISR 4321 Router is a high-performance router designed for small to medium-sized businesses. It offers flexible connectivity options, built-in security features such as firewall and VPN, and advanced network management capabilities. Its modular design allows for easy upgrades and expansion with different WAN interfaces. The ISR 4321 efficiently directs data traffic, ensuring secure communication and meeting high bandwidth demands. This router is ideal for businesses looking for a reliable and scalable networking solution.



**FIGURE 2.** Isr 4321 Router

### C. PC-PT

These devices are desktop computers that can send packets to other cities by connecting to routers through switches. They play a crucial role in network infrastructure by ensuring reliable data transmission and communication between different network segments. These computers are essential for maintaining connectivity and facilitating effective communication during disaster recovery operations.

### D. WEB SERVER

A web server is a computer system that hosts websites and delivers web pages to users over the internet. It processes incoming network requests over HTTP and several other related protocols. The primary function of a web server is to store, process, and deliver web pages to clients, ensuring that the content is accessible and served efficiently to users' browsers.

### E. WIRELESS ROUTER

It helps devices such as tablets, laptops, and smartphones to connect to the router via wireless technology and communicate with other routers. I used it this way in my project.

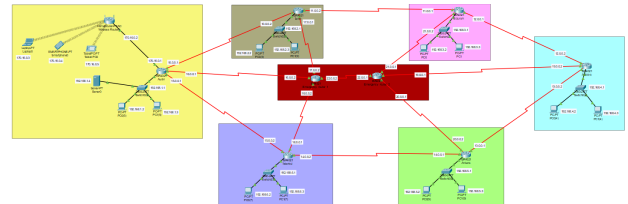
### F. LAPTOP, TABLET, SMARTPHONE

Function as the primary devices for users to access network services, facilitating both personal communication and access to critical information and services during disasters.

### G. NETWORK CABLE

It allows establishing physical connections between network devices such as routers, switches and servers that are necessary for the transmission of data over the network.

## III. METHODOLOGY



**FIGURE 3.** Cisco Packet Tracer Shema

### A. SUBNETS

In this section, I added a color to each city and added the devices I used. In this way, it is easier to observe which devices were used in which city, router connections, etc.

Yellow Area: In the area I named the city of Aydin, I utilized a range of devices to establish a robust network. This included 2 routers (ISR 4321 and Wireless), 1 switch, 1 web server, 2 desktop computers, 1 laptop, 1 smartphone, and 1 tablet. The switches and routers facilitated the sending of packets and messages between devices and routers. The web server allowed access to the provided webpage through devices connected to the router within this area. The router directed our communication and package-sending requests to other cities, ensuring seamless connectivity and efficient data transmission.

Purple, Green, Blue, Pink, Khaki Areas: I named this area the city of Istanbul. In this area, I used 2 desktop computers, 1 switch, and 1 router. By creating 3 network paths from our router, we provided the opportunity to communicate and send packages to other cities and our emergency routers.

Emergency Area: This region is the heart of my project as an idea. The operation of this region is that the 2 routers we have installed share the cities in threes. To give an example, in case of a possible connection problem, when there is a problem between the Aydin and Izmir routers, they can continue to send packets and messages to each other thanks to the emergency routers. So, this area is like a spare tire for communication, which is the basis of my project, and in my opinion, it is indispensable.

### B. ROUTER CONFIGURATION

Router configuration includes the steps necessary to ensure communication on the network. First, you start the router,

go to global configuration mode, and assign a meaningful hostname to the router. The IP address and subnet mask are determined for each interface and the interfaces are activated. In this way, the technological devices in other subnets and the city are communicated with and the packet is sent. This is how the logic and purpose of this system were used for this project.

### C. SERVER CONFIGURATION

It includes the necessary steps to ensure the stability of the server. First, the server is started and basic operating system settings are made. A meaningful host name is assigned to the server and a static IP address is determined. In this way, package-sending communication is provided via the web browser thanks to our technological devices.

## IV. DISCUSSION AND CONCLUSION

### A. DISCUSSIONS

This project ensures seamless communication between cities during and after an earthquake by designing a resilient network. The network employs redundancy with multiple interconnected cities and central emergency routers to prevent single points of failure and provide alternative data paths. Efficient routing is achieved through specific IP addressing and VLANs, while web servers are integrated for essential services. This setup aims to support emergency response operations and maintain critical infrastructure functionality, demonstrating the importance of robust network design in disaster management.

### B. CONCLUSION

The network design successfully meets the objective of maintaining intercity communication during earthquakes by implementing robust redundancy and efficient routing strategies. The use of central emergency routers and integrated services like web servers ensures reliable connectivity even in disruptive conditions. This project highlights the critical role of thorough planning and resilient infrastructure in disaster preparedness, offering a valuable model for similar initiatives aimed at ensuring continuous communication in the face of natural disasters.

### ACKNOWLEDGMENT

The names of the persons and institutions who contributed this project should be mentioned here.

### REFERENCES

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## APPENDIX A MÜDEK PROGRAM ÇIKTILARI

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COMPUTER NETWORKS MidTERM  
Computer Engineering Department  
Manisa Celal Bayar University

## MÜDEK – Course Learning Outcomes and Components

	P C B 1	P C B 2	P C B 3	P C B 4	P C B 5	P C B 6	P C B 7	P C B 8	P C B 9	P C B 10	P C B 11	P C B 12	P C B 13	P C B 14	P C B 15	P C B 16	P C B 17	P C B 18	P C B 19	P C B 20	P C B 21	P C B 22	P C B 23	P C B 24	P C B 25	P C B 26	P C B 27	P C B 28	
CSE 3136																													
Comp Network PCB	✓	✓		✓	✓	✓	✓	✓	✓	✓			✓				✓				✓		✓						

**PCI** Matematik, fen bilimleri ve ilgili mühendislik disiplinine özgü konularda yeterli bilgi birikimi; bu alanlardaki kuramsal ve uygulamalı bilgileri, karmaşık mühendislik problemlerinde kullanabilme becerisi.

**PÇB1** Matematik, fen bilimleri ve ilgili mühendislik disiplinine özgü konularda yeterli bilgi birikimi;

**PCB2** Bu alanlardaki kuramsal ve uygulamalı bilgileri, karmaşık mühendislik problemlerinin çözümünde kullanabilme becerisi

**PC2** Karmaşık mühendislik problemlerini tanımlama, formüle etme ve çözme becerisi; bu amaçla uygun analiz ve modelleme yöntemlerini seçme ve uygulama becerisi.

PCB3

**PÇB4** Bu amaçla uygun analiz ve modelleme yöntemlerini seçme ve uygulama becerisi.

**PC3** Karmaşık bir sistemi, süreci, cihazı veya ürünü gerçekçi kısıtlar ve koşullar altında, belirli gereksinimleri karşılayacak şekilde tasarlama becerisi; bu amaçla modern tasarım yöntemlerini uygulama becerisi

**PCB5** Karmaşık bir sistemi, süreci, cihazı veya ürünü gerçekçi kısıtlar ve koşullar altında, belirli gereksinimleri karşılayacak şekilde tasarlama becerisi;

**PÇB6** Bu amaçla modern tasarım yöntemlerini uygulama becerisi.

**PC4** Mühendislik uygulamalarında karşılaşılan karmaşık problemlerin analizi ve çözümü için gerekli olan modern teknik ve araçları seçme ve kullanma becerisi; bilişim teknolojilerini etkin bir şekilde kullanma becerisi.

**PÇB7** Mühendislik uygulamalarında karşılaşılan karmaşık problemlerin analizi ve çözümü için gerekli olan modern teknik ve araçları seçme ve kullanma becerisi;

**PÇB8** Bilişim teknolojilerini etkin bir şekilde kullanma becerisi

**PC3** Karmaşık mühendislik problemlerinin veya disipline özgü araştırma konularının incelenmesi için deney tasarlama, deney yapma, veri toplama, sonuçları analiz etme ve yorumlama becerisi.

**PCB9** Karmaşık mühendislik problemlerinin veya disipline özgü araştırma konularının incelenmesi için deney tasarlama becerisi

**PÇB10** Deney yapma, veri toplama, sonuçlarını analiz etme ve yorumlama becerisi.

**PC6** Disiplin içi ve çok disiplinli takımlarda etkin biçimde çalışabilme becerisi; bireysel çalışma becerisi.

PCB11    PCB12

**PCB13** Bireysel çalışma becerisi.

**PC7** Türkçe sözlü ve yazılı etkin iletişim kurma becerisi; en az bir yabancı dil bilgisi; etkin rapor yazma ve yazılı raporları anlama, tasarımı ve üretim raporları hazırlayabilme, etkin sunum yapabilme, açık ve anlaşılır talimat verme ve alma becerisi.

PCB14 PCB15 PCB16

**PÇB17** Tasarım ve üretim raporları hazırlayabilme becerisi

PCB18 PCB19

**PC8** Yaşam boyu öğrenmenin gerekliliği konusunda farkındalık; bilgiye erişebilme, bilim ve teknolojideki gelişmeleri izleme ve kendini sürekli yenileme becerisi

PCB20

**PCB21** Bilgiye erişebilme, bilim ve teknolojideki gelişmeleri izleme ve kendini sürekli yenileme becerisi.

**PC9** Etik ilkelerine uygun davranma, mesleki ve etik sorumluluk ve mühendislik uygulamalarında kullanılan standartlar hakkında bilgi.

PCB22

**PCB23** Mühendislik uygulamalarında kullanılan standartlar hakkında bilgi.

**FIGURE 4. MUDEK Program Çıktıları Bileşenleri**