Babylonian Journal of Internet of Things
Vol.2024, **pp**. 151–160
DOI: https://doi.org/10.58496/BJIoT/2024/017; ISSN: 3006-1083
https://mesopotamian.press/journals/index.php/BJIoT

Research Article

Construction a virtual central network for all Iraq's fire station

Wasnaa Hadi Ghasab[1] , , Ahmed Adnan Hadi [2] , Alaa.G.K. Alshami [3,7] ,Ahmed Dheyaa Radhi[4] , Rusul Mansoor Al-Amri[5*] , Ayad Hameed Mousa[5]

[1] *College of Management and Economics, University of Kerbala, Kerbala, Iraq*.

[2] *Artificial Intelligence Sciences Department, College of sciences,Al-Mustaqbal University , 51001,Babil, Iraq.*

[3] *Alsafwa University College, Karbala, 56001, Iraq.*

[4] *College of Pharmacy, University of Al-Ameed, Karbala PO Box 198, Iraq.*

[5] *College of Computer Science and Information Technology, University of Kerbala, Kerbala, Iraq.*

[6] *College of Pharmacy, University of Kerbala, Kerbala, Iraq.*

ARTICLE INFO

Article History

Received 29 Jul 2024
Revised: 28 Sep 2024
Accepted 29 Oct 2024
Published 30 Nov 2024

Keywords

virtual central network

fire station

communication Networks

emergency situations

ABSTRACT

Fire stations are crucial in Iraq for protecting human life, property, and vital economic and religious infrastructure. In this paper, a design for a centralized virtual network that brings together all fire stations in Iraq is proposed. The network consists of 18 stations, with each station representing a governorate in Iraq. When a fire occurs in a certain area, citizens can request the service by entering their personal information and the location of the event, which is sent to the centralized network that transfers it to the appropriate station in the area. If the station is not available in the area, the request is sent to the nearest other station to fulfil the request as quickly as possible. This virtual communication network allows for better coordination and simplifies data sharing and communication between different stations. The results showed that the centralized network design contributes to fast response times, rapid response to requests and rapid deployment of fire engines to the incident site. Fire stations can also increase overall efficiency by improving coordination, allocating resources more effectively and monitoring situations in real time. Thanks to the centralization of data, all stations have access to the same set of information, enhancing decision-making, especially in the case of large-scale incidents. Also, the network design is characterized by a high level of security.

1. INTRODUCTION

This Networks play a major role in the process of exchanging information and enhancing efficiency between devices and private systems in organizations [1-3] , as they are represented by local area networks and expand to the Internet, as they consist of hardware, communication protocols and software that facilitate data management and enhance collaboration between people [4-6].

In a centralized network, all communication and data processing is organized and managed through a central server, usually called a central controller, which directs information between connected devices, making it easier to coordinate and secure tasks within the network.[7, 8]

The centralized network shows that the central server acts as the mastermind of the network[9], acting as the focal point in directing and managing all communication processes within the network It also passes information between the devices connected to these servers and shows several benefits[10, 11], including effective control, ease of maintenance and management, increased security, and effective resource sharing[12, 13]. In addition, despite the great benefits of a centralized network, it suffers from some challenges and disadvantages, such as failure of the central server and disruption of the entire network [14-16]. These challenges can be overcome with proper management. a centralized network can be a powerful solution for communicating and coordinating operations in an organization [17-19]. Centralized networks are the best option for organizations in terms of improving efficiency, reducing costs, ensuring information security and accessing that information when it is needed, including emergency services[20, 21].

*Corresponding author. Email: rusul.mansoor@uokerbala.edu.iq

Centralized networks are a vital tool for improving response efficiency in emergency services, especially in fire stations [22-24] . Through these networks, all stations can be connected to a centralized system that enables effective management and coordination of operations via central dispatch centers A centralized network for fire stations can increase the efficiency of operations and enhance coordination between teams, providing greater safety and faster response times[25, 26]. Centralized networks are an essential part of police and law enforcement agencies as well as medical and ambulance services, enabling these organizations to coordinate their operations and exchange information quickly and accurately[27-29] .This helps to improve response and provide instant communication between teams, especially in emergency situations that require rapid intervention[30-32]. Centralized networks provide a robust infrastructure for these organizations, making them an indispensable tool to enhance efficiency and speed of response in dealing with incidents and emergencies, whether in law enforcement or healthcare[33, 34].

The centralized fire station network depends on a unified communications platform and an advanced dispatch system for emergency calls, allowing resources to be allocated quickly and efficiently in real time [35, 36]. Reduce response times Because the system directs teams quickly and directly, it can significantly reduce response time[37] . Increased resource usage efficiency The system ensures that available resources are used as efficiently as possible, as teams are allocated according to priority and need[38, 39]. With this system, the effectiveness of firefighting operations is greatly enhanced, saving lives and protecting property faster and more efficiently[40].

This research paper proposes to build a virtual centralized communications network that includes all firefighting stations represented in 18 Iraqi governorates and connects them to a unified communications system to manage and regulate them during emergencies.

Computer-aided dispatch (CAD) systems are tools used by fire stations in the management, organization and coordination of disasters and emergencies. [41, 42]. Fire stations are equipped with complete and centralized tools to monitor incidents, organize, manage and allocate resources, improve response time and minimize losses during emergencies [43, 44].

2. RELATED WORK

1- In this paper aimed at improving and developing the emergency response in metro stations, simulation models were used to generate colored hierarchical Petri nets to simulate different scenarios. This thesis was conducted at Simanco metro station in Wuhan where Skyline actuator was used. The study showed that the generated model is effective and can significantly reduce the number of firefighters and response time. This research is innovative in using Petri nets coupled with the emergency response process in metro stations to build a multi-objective optimization model and provide an optimal emergency response strategy using simulated data [45].

2- Urbanization significantly impacts fire service, affecting personal health and property safety. Effective fire service plans should address service area delimitation, rescue efficiency, and load balancing, using space partitioning methods. The study integrates street network and historical fire incidence datasets to create a unique constrained Voronoi diagram for delimitating the fire service region, addressing the complexity of fire risk. The study proposes a network partitioning method to extend fire station coverage, utilizing the "Golden 5 min" concept, demonstrating its feasibility in defining service areas over time in Nanjing, China [46].

3- Fire stations contribute to firefighting capabilities, and it is important to define their service areas based on travelling times between stations and danger points. A dynamic estimation system for fire station service areas was developed using real-time travel data from online maps, and combined with a service boundary search algorithm. To validate the system, 39,616 fire danger points in Changsha City were used as the sample dataset. The service areas at different time intervals were determined by calculating the travel times from stations to points of interest. The results showed that the actual service areas are much smaller than the area defined in Chinese standards. The results also showed that the service areas are smaller under traffic congestion. Thus, it is recommended to pre-deploy fire trucks to minimize response times. The system can also be used to estimate service areas for other fire stations[47].

4- The management of information and communication processes in firefighting is vital in firefighting operations and serves to organize and coordinate these processes. However, the communication management system has not received sufficient attention. The paper analyses the current state of standardization and inconsistencies in the management of firefighting telecommunication operations and offers suggestions and solutions for the future development of the firefighting industry. The researchers emphasize the importance of standardizing the management of information and communication processes and creating a centralized management platform to cover various aspects of the project. The aim is to achieve better organization and coordination of firefighting processes and communications. This will help to improve firefighting performance and efficiency and mitigate potential impacts [48].

5- The article addresses the topic of how network leadership manages and responds to network-wide tensions. The focus is on how leadership manages tensions within the network through the integration of network leadership within the

organizational sphere and the influence of environmental and demographic dynamics on the formation of network tensions. For example, the crisis response network of the Antwerp Fire Service is examined, which has evolved from a centralized, peripheral network to a smaller and denser network. Based on the article's analysis, insights are provided regarding network leadership practices to identify network tensions and their response to the first COVID-19 wave based on internal network characteristics and environmental and demographic dynamics of the organizational field [49].

3. METHODOLOGY

The paper proposes a centralized virtual network architecture for Iraqi fire stations. This concept was established using Cisco Packet Tracer 8.2.2 software. This tool is a robust network simulation environment that supports several situations, including routers, switches, and firewalls, and can be used to teach networking principles while improving usability and visibility.

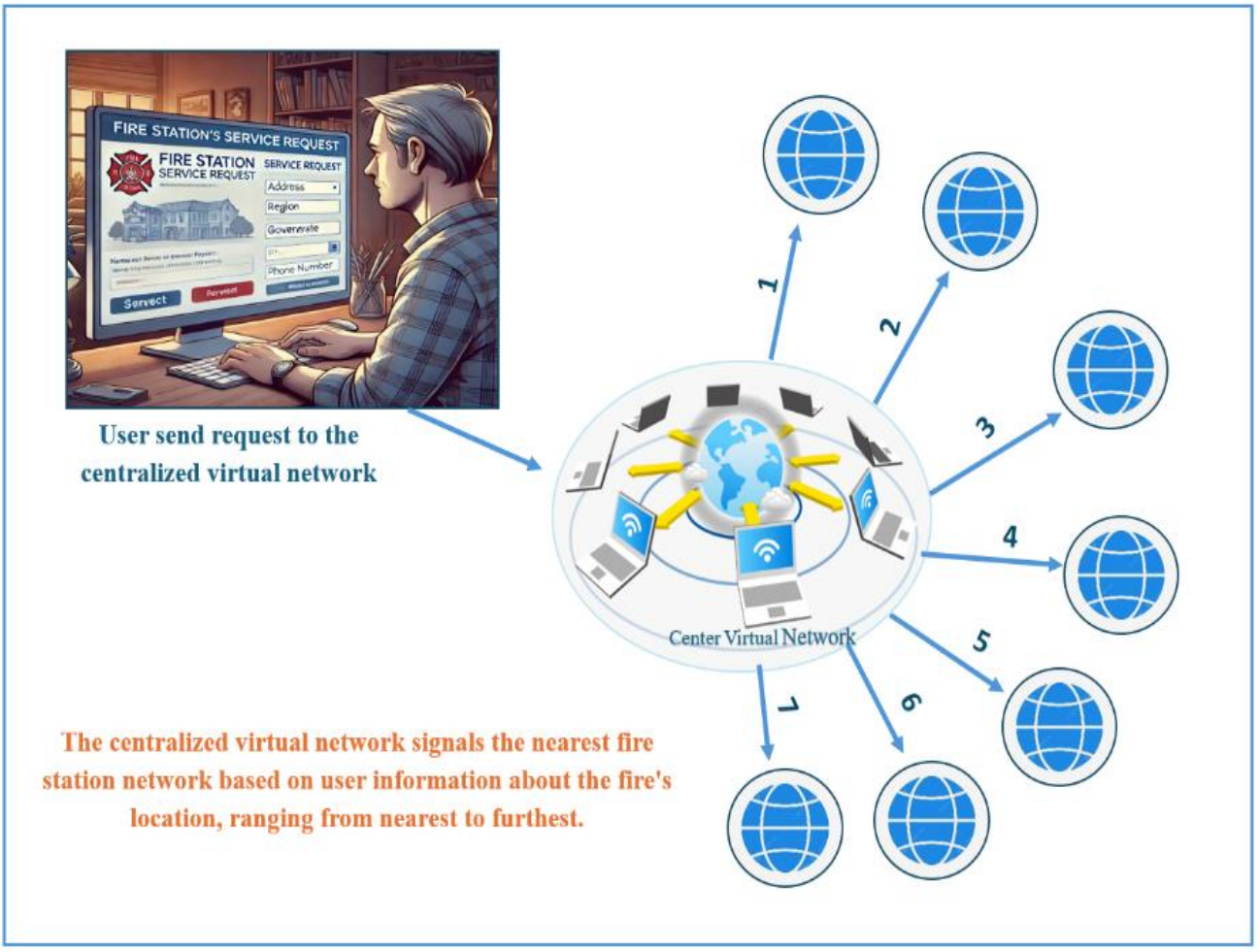

Fig. 1. illustrated the proposed work for a virtual network center to an Iraqi fire station

1- The user (citizen) requests a service from the fire station through the webpage where he/she enters his/her information including (address of the house, region and governorate where the fire is located, name of the person reporting the incident, and the phone number of this person).

2- The virtual central network receives and transfers requests to the fire station's network in the fire-affected area, ensuring prompt response to the required massage.

3- If the fire station network is unavailable in the intended area and fails to respond promptly, the request will be transferred to another nearby network.

Researchers established a virtual network in Iraq, connecting all (18) governorates with their own virtual networks, closely linked to the central network.

A webpage has been created for all virtual networks in Iraqi governorates where firefighting stations are located as shown in the figure below:

Fig 2: central virtual networks Iraqi governorates for Fire Station

When you click on the governorate in which the event is located, as shown in the figure above, the interface for the person's information as shown in the figure below will be transferred, the website is designed in both Arabic and English languages to cater to the Arabic community in Iraqi social.

Fig. 3. Informant Information

The centralized network receives a request and transfers it to the destination station's network for immediate response. If the station is unavailable or under maintenance, the network sends the request to the nearest station.

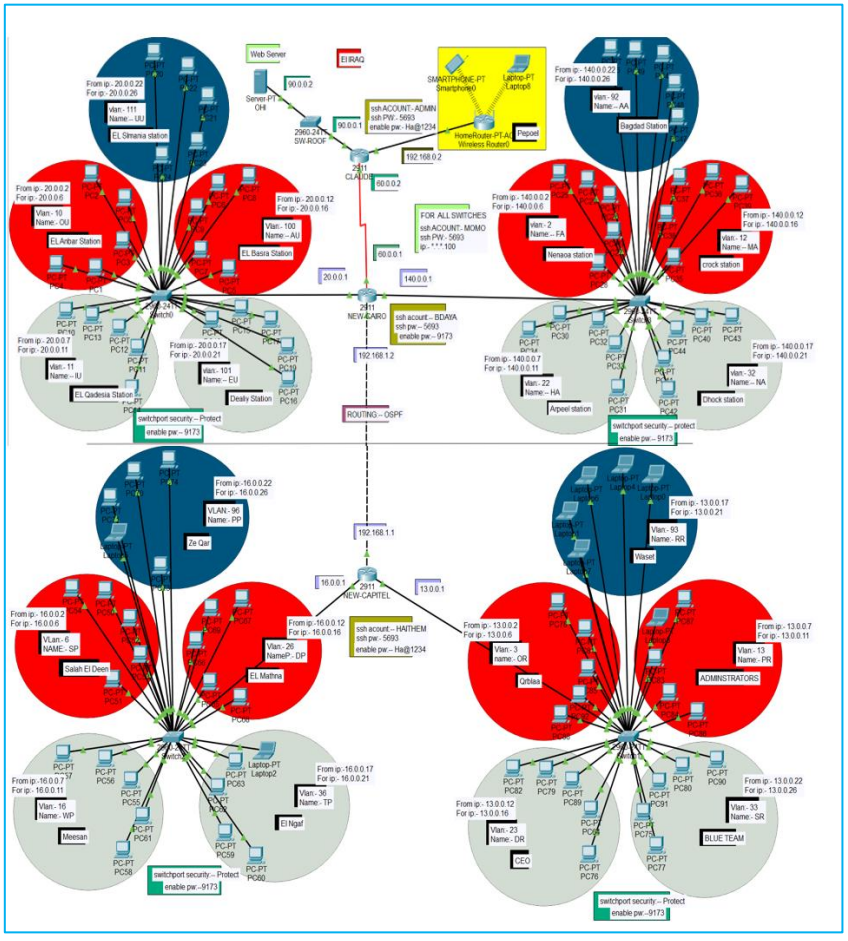

Fig. 4 . central virtual Networks for Iraqi fire station

The wired centralized virtual network was designed to include 18 private networks in each fire station for each Iraqi governorate. The figure (4) depicts a network of fire stations in a specific governorate, each with specialized departments and managed computers configured for receiving requests. Networks are distributed with specific IPs to efficiently manage work, directing client requests to the appropriate station based on its IPs, ensuring the fastest possible response.

The networks were Configuration in a VLAN (Virtual Local Area Network) circuit, with each station having its own name. This allows for individual attention to changes in distribution, maintenance, or defects without affecting the entire network as figure below:

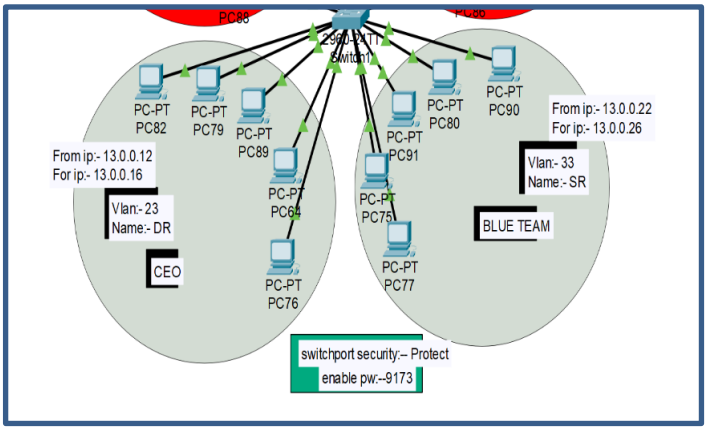

Fig. 6 . additional networks

The connection was made by configuring each switch with four networks, where each switch carries its own vlan for each fire station, which helps in configuring the network for each station.

Each Switch has a unique Security Port, defining all associated owners, which protects it from external attacks. This ensures that any unauthorized entry is rejected, preventing potential security breaches.

Added a feature Enabling a specific switch configuration secret code enhances the security of the switch and the centralized network.

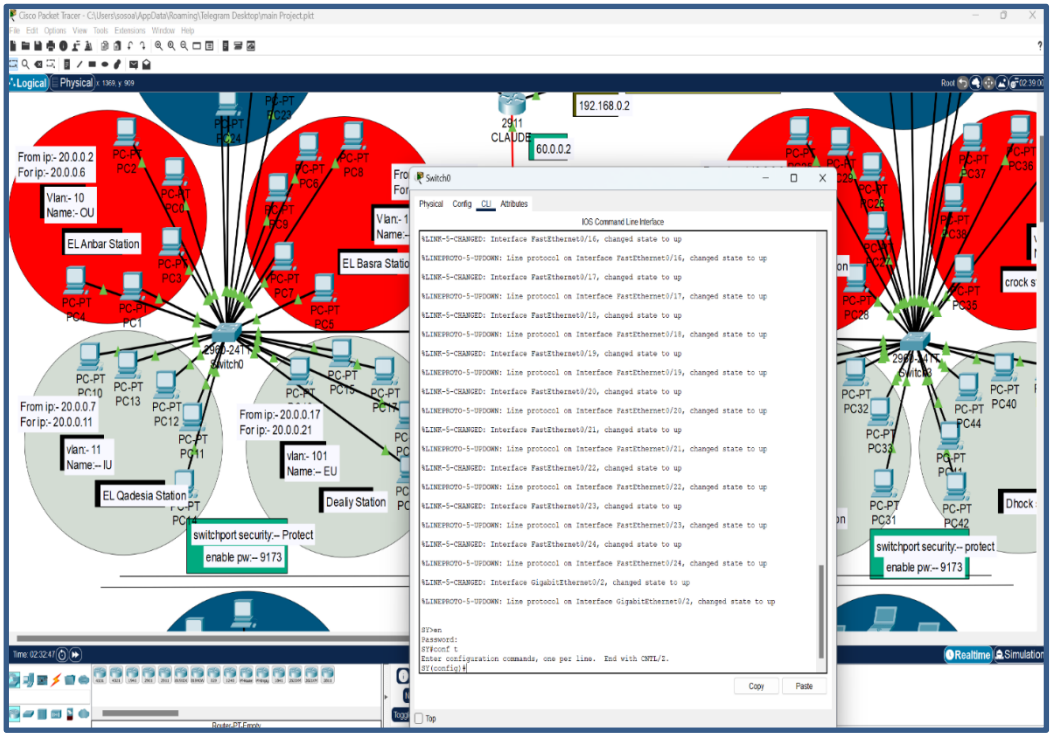

Fig. 7. illustrated added switch port security and enter password

Also used Secure Shell is a secure communication protocol used to remotely access systems and servers over unsecured networks, enabling secure management and control of servers.

The service enables network designers to remotely connect to the network, requiring a special account, password, and network's IP address for any switches.

In this paper network design, four switches were used in each switch; each switch is connected to five fire station networks, so each network has its own IP address, and each switch has its own ssh, password, and IP address in case a remote connection occurs.

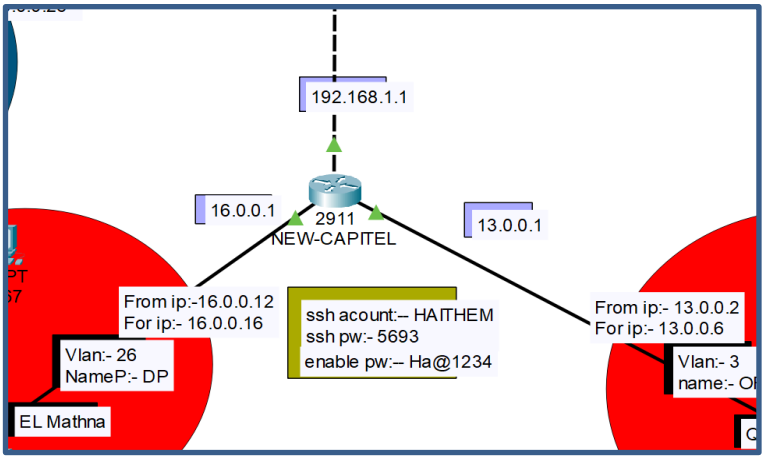

Fig. 8. illustrated secure shell

Three routers connected the network to the fire stations of each governorate, each with an SSH service, account, and secret code. Each router had three IPs, connected to the router using its secret code. This research focuses on OSPF, a fast and lightweight router used in internal IP networks for data routing based on the shortest path algorithm within Layer 3 protocols of the OSI model.

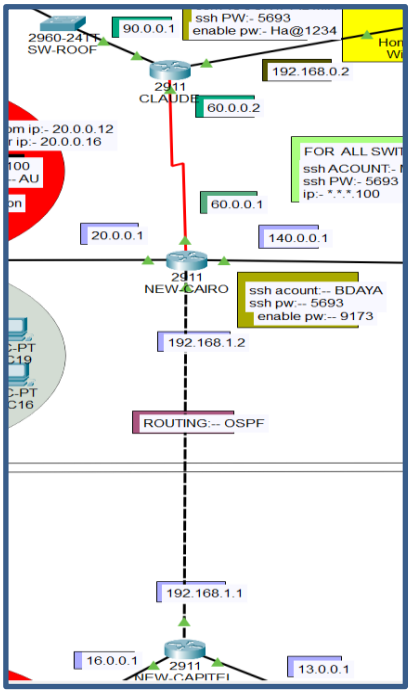

Fig. 9. Explain router OSPF

A user's request is sent to a central server, which processes it to determine its origin. The server then directs the request to the nearest station, waits for a replay, and then directs the request to the nearest station. Once the replay is received, the server sends it to the user, confirming their request has been taken.

4. RESULTS AND DISCUSSION

VCN refers to a centralized digital platform that connects multiple fire stations, enabling them to improve coordination and simplify data sharing and communication between different locations.

The proposed research to design a centralized virtual network for Iraq's fire stations showed good results in terms of

1. Rapid response time, fulfilment of the request and rapid deployment of fire engines to the scene
2. Fire stations can increase overall efficiency by improving coordination, allocating resources more effectively, and keeping an eye on situations in real time.
3. All fire stations may access the same information pool due to data centralization, which facilitates decision-making, especially in the case of large-scale incidents.
4. The network is designed with high security with the addition of remote control via SSH.
5. Dynamic resource allocation helps authorities allocate equipment and firefighters according to current demands by enabling dynamic resource management.

Central Virtual Network Systems for Iraqi Fire Stations: Challenges and Solutions

- Infrastructure Limitations: Poor internet connectivity in rural areas limits the effectiveness of cloud-based or internet-dependent virtual networks.

- Power Supply: Frequent power outages can disrupt the functioning of virtual network systems without reliable power sources.
- Cybersecurity Risks: Centralized systems increase the risk of cyber-attacks due to Iraq's developing national cybersecurity infrastructure.
- Technical Expertise: There is a shortage of specialized personnel for managing and maintaining sophisticated virtual networks in Iraq.
- Funding Constraints: Iraq's post-conflict reconstruction and economic challenges necessitate significant investment in hardware and software, and staff training.
- Inter-agency Coordination: Successful implementation requires effective coordination between various agencies, but bureaucratic hurdles and inefficiencies may slow down system deployment.
- System Reliability: Iraq's technological infrastructure may not guarantee flawless system functionality.
- Data Management and Storage: Efficient data storage, retrieval, and analysis can be challenging without advanced IT infrastructure.

5. CONCLUSION

This proposed research emphasizes the importance of building a centralized virtual network for fire stations because it contributes to improving the performance of fire stations in Iraq
It also shows its importance on rapid response and taking the shortest time to reach the site of the fire incident, this happens through coordination, communication, resource management and allocation. It is not limited to improving the response time, it also has some features such as optimizing the global positioning system, alarm management and data storage.
Building centralized networks for Iraqi fire stations suffers from some challenges that must be addressed in order to be successful. The most important challenges are weak internet networks in remote areas, lack of some infrastructure services, lack of staff to manage the system, and power outages that lead to the disruption of the central network. The importance of security for networks increases the risk of cyber-attacks and requires the development of cybersecurity. This research is considered a serious step to develop the reality of fire station services and in general emergency services in Iraq aimed at maintaining the safety of citizens and organizing emergency situations.

Funding

The absence of any funding statements or disclosures in the paper suggests that the author had no institutional or sponsor backing.

Conflicts Of Interest

The author's affiliations, financial relationships, or personal interests do not present any conflicts in the research.

Acknowledgment

The authors extend appreciation to the institution for their unwavering and Special thanks to University of Kerbala, ,Al-Mustaqbal University, Al-Ameed University and Alsafwa University College Dean's University support and encouragement during the course of this research.

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