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Efficient Communication in Post Disaster Environment Using Delay Tolerant Network (DTN)

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Abstract: Natural disasters such as earthquakes, floods, and hurricanes can cause severe damage to communication infrastructure, hindering rescue and recovery efforts. In such scenarios, it is critical to establish reliable communication channels to coordinate rescue and relief operations. This paper proposes the use of Delay or Disruption Tolerant Network (DTN) as a means of communication in post-disaster environments. The paper presents the design and implementation of a DTN-based communication system and evaluates its performance in terms of network coverage, data transmission rate, and energy consumption. The experimental results show that the proposed system can provide reliable communication with low energy consumption and high data transmission rates. The paper concludes by discussing the potential of DTN for disaster communication and identifying future research directions in this field.

Keywords: Delay or Disruption Tolerant Network (DTN), Post Disaster Environment, network coverage, data transmission rate, energy consumption.

I. INTRODUCTION

DTN: A delay or Disruption Tolerant Network (DTN) is a type of network designed to provide communication channels in situations where traditional network connections may not be available or are interrupted. DTN is used in scenarios where there are delays in message delivery, such as space communications or remote areas with limited infrastructure. DTN uses a store-and-forward mechanism where messages are passed between nodes until they reach their destination. DTN can work in a variety of communication environments, making it a promising technology for post-disaster communication. DTN-based systems can provide reliable communication channels with low power consumption and high data rates. The aim is to explore the challenges and opportunities of information communication in a post-disaster setting. The effectiveness of various technologies such as Bluetooth and network connectivity in developing communication systems will be examined. Factors such as network reliability, power, and user access will also be considered. By reviewing the current state of research, this article aims to provide an overview of the challenges and opportunities for information communication in a social setting that has been subsequently destroyed. This will help develop effective disaster communication strategies and empower affected communities.

II. RELATED WORK

There are so far some existing works in this field of Bluetooth Mesh, whose primary focus was to build smart home architectures to demonstrate the use of smart home control system or smart cities, etc, also the researchers have previously worked on this with the use of drones and SDN-based networks, which have its own pros and cons. This paper focus is to provide a self-communication network without depending on any central network infrastructure. The article "Disaster Management Using Mobile Ad Hoc Networks: A Survey" by S. Ali et al. provides a comprehensive overview of the application of mobile ad hoc networks (MANETs) in disaster management. It covers network design, routing protocols, security, and application areas. The authors discuss the advantages, limitations, and challenges of using MANETs in this context, offering valuable insights into current research and suggesting future directions [1].

The article "Wireless Mesh Networks for Emergency Communications" by S. Lindsey and C. Rodriguez discusses the use of wireless mesh networks (WMNs) in emergency communication scenarios. The paper highlights the advantages of WMNs over traditional wireless networks in terms of reliability, scalability, and self-organization. The authors describe the design and deployment of a WMN-based emergency communication system, which consists of mesh routers, access points, and handheld devices. They also discuss various routing protocols that can be used in WMNs, such as AODV and OLSR, and analyze their performance in emergency scenarios. The paper concludes by highlighting the potential of WMNs for emergency communication and identifying future research directions in this field [2]. The article "Disaster Response Network: A Wireless Mesh Network for Emergency and Disaster Scenarios" by R. Bagrodia et al. introduces the design and implementation of a wireless mesh network (WMN) called the Disaster Response Network (DRN). The DRN is specifically designed for rapid deployment in disaster-stricken areas. It utilizes mesh routers, access points, and mobile devices, employing a distributed algorithm for network formation and self-organization. The paper discusses the hybrid routing protocol used in the DRN, combining proactive and reactive approaches.

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Experimental evaluations highlight the DRN's efficacy in providing reliable communication during disaster situations [3]. The article "A Novel Framework for Communication in Disaster Scenarios using Drones" by D. V. Bhaskar et al. introduces a novel framework for communication in disaster scenarios using drones. The authors address the limitations of traditional communication methods and propose a drone-based system as an alternative. The system comprises drones equipped with communication and sensing capabilities, enabling them to provide wireless connectivity and gather real-time data in affected areas. The paper details the system's design and implementation, presenting experimental results that validate its effectiveness in reliable communication and data collection during disasters. The authors conclude by highlighting the potential of drone-based communication systems in disaster management and suggesting future research directions [4].

III. SYSTEM MODEL

The proposed system model utilizes Delay or Disruption Tolerant Network (DTN) as a communication solution in post-disaster environments. The DTN-based communication system is designed and implemented to provide reliable communication channels for coordinating rescue and relief operations. The system consists of a network of nodes that act as message relays and communicate with each other using store-and-forward mechanisms [5].

The communication nodes are equipped with a DTN protocol stack, which ensures reliable message delivery in the presence of network disruptions and node mobility. The DTN-based system uses opportunistic networking to establish communication links between nodes. When two nodes come into proximity, they exchange messages and store them until they can be forwarded to their destination [6,7].

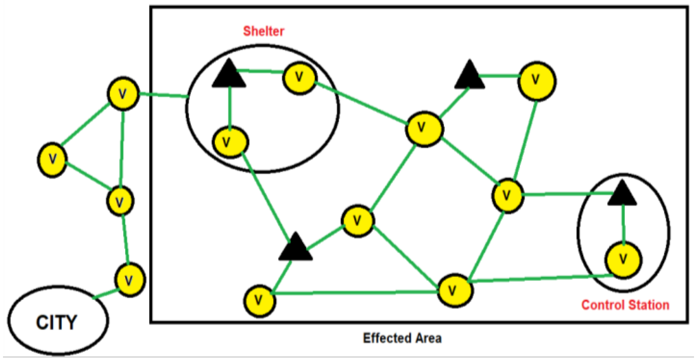

Fig. 1 Disaster Scenario using Delay Tolerant Network

Shelters: Our model includes various types of shelters including -camps, stations and centers as shown in fig 1.

- Main shelter for coordination: One main shelter is established that coordinates all the rescue operation and also acts as storage of all the equipments and relief goods.
- Relief camps: These camps will deploy the rescue team to the nearby areas and houses to collect the information and they will collect relief material and equipments from the main shelter.
- Evacuation centers: This center will evacuate the people during disaster warnings.
- Hospitals: This center will provide the rescue team with the Ambulance and the other medical resources which are required
- Fire Station: Here the Fire trucks will be placed for the emergency.
- Police or Control Station: They will deploy police to gather and transfer the information to the main Shelter.

Moving Agents [8]

- Rescue workers: There will be rescue workers present in each are to help people evacuate and relocate.
- Police: Police will help in monitoring the neighbouring areas and centers and provide the updated information to the main shelter.
- Transporting vehicles: These will help in carrying good from main shelters to the other centers.
- Ambulances and fire trucks: They will called when required and providing the service they will again comeback to their respective centers.
- Volunteers: They may be anyone from public group who is willing to help with the rescue worker for the fast recovering.

Communication and Collaboration between the Agents:

Agents in motion are outfitted with communication tools capable of transmitting data when they are within radio range of one another. Typically, these devices employ short-range radio technology with a limited transmission rate. Rescue workers and volunteers will commonly carry these devices while vehicle operators transport these tools. Each shelters, camp, or station also features comparable communication tools that relay information opportunistically when they encounter other agents or vehicles. These devices are called "DTN-router" as in fig 2 which allows both way communication between the rescue team and the victims[9].

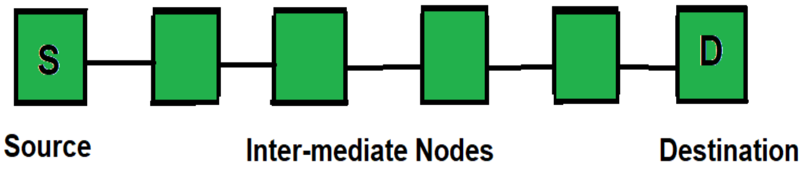

Fig. 2 Multi-hop Communication from source to destination

This model will work in this manner from source to destination (which are the fixed point) through the inter-mediate nodes (pedestrian, cars or trams) with the help of volunteers (or agents).

The performance of the DTN-based communication system is evaluated based on network coverage, data transmission rate, and energy consumption. The experimental results show that the proposed system provides reliable communication with low energy consumption and high data transmission rates [10].

Benefits:

In a post-disaster scenario, communication plays an important role in rescue, relief, and recovery efforts. Here are some of the benefits of setting up communication in a post-disaster situation:

- Coordination of rescue and relief efforts among multiple organizations for efficient resource allocation.
- Rapid response by first responders, aiding in timely assessment and actions to save lives.
- Information sharing with affected individuals, providing updates, safety instructions, and resource availability.
- Reunification of separated families through communication channels.
- Coordination and prioritization of infrastructure restoration, including communication networks and vital services.
- Monitoring and assessment of the disaster's impact on people and infrastructure, enhancing preparedness for future events.

IV. CONCLUSION

In this work we have proposed the use of hybrid DTN protocols for post disaster scenarios, where nodes/devices with different mobility patterns can apply different routing rules, in order to improve the exploration of an area searching for a destination, or improve the exploration of the knowledge of nearby nodes/devices [11].

An efficient network can be created through setting up a DTN mesh network using Bluetooth communication, which will help victims and rescue teams to communicate. And this will directly lead in saving lives and infrastructures [12]. In conclusion, the proposed DTN-based communication system is a promising solution for establishing reliable communication channels in post-disaster environments. Future research directions in this field include developing new DTN protocols, optimizing energy consumption, and improving the performance of the system under different network conditions.

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