

Efficient SCT Protocol for Post Disaster Communication

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Abstract: Natural and catastrophic disasters can cause damage to the communication system, the damage may be complete or it may be partial. In such areas communication and exchange of information plays a very important role and become difficult to happen in such situations. So, the rescue systems should be installed in those areas for the rescue operations and to take important decisions about how to make a connection from there to the outside world. Wireless communication network architecture should be setup in disaster areas for the communication to happen and to gather information. Wireless ad-hoc network architecture is proposed in this paper with access nodes. These access nodes acts as hotspot for certain area in which they are set up such that the Wi-Fi capable devices get connected to them for communication to happen. If the mobile battery is drained in such situations wireless charging using microwave is shown in this paper. Performance analysis of the communication transport layer protocols is shown and Efficient SCTP (ESTP) algorithm is developed which shows better results in terms of cumulative packet loss.

Keywords—ESTP; Disaster; Ad-hoc; Wi-Fi; MEOC

1. INTRODUCTION

In day to day life we will come across numerous calamities. It may be natural disasters or the manmade catastrophes. In such situation people are trapped without food, water and communication means. In order to know the information of the people in the disaster area there should be a proper communication system to communicate with the people. Communication and Exchange of information are the two important factors of any disaster response. Resource management in such a situation will be very challenging. In such scenario efficient network management system will improve service provided to the affected ones. [1].

There are many wired and wireless communication networks available. Wireless networks become handy when the wired networks are completely spoiled.[2] [4]. Many wireless networks were setup for the communication, public protection and disaster relief (PPDR) network was introduced for the emergency wireless communication operations, in which the LTE was used because LTE is the main wireless technology for broad band communication in [5] [11] [12]. In disaster areas people face difficulty to communicate inside and the outside the disaster site, heterogeneous wireless network is setup for the communication purpose, first the wireless sensor networks (WSN) are placed in the disaster areas to know the information update of that area and mobile ad-hoc networks (MANET) are also placed in the disaster site for the local communication, then the cellular gateways and satellite gateways are used to communicate to the outside world [7]. Wi-Fi enabled communication devices can be used as nodes and access points. Researchers are behind the development of different architectures, wireless protocols and methods for calamity management. WSNPDM (wireless sensor network protocol for disaster management) and LEACH (low-energy adaptive clustering hierarchy) [3] are good choice of network architectures. Implementing the architectures and performing the analysis of calamity management network will be useful for the mankind.

In this work an efficient SCTP is proposed for communication system to help disaster relief management. Nowadays most of the people carry Wi-Fi capable smart devices equipped with IEEE 802.11, this type of smart phones are used to give access to the system [8]. Satellite communication is used to communicate with the data base center and EOC (emergency operations control center),



MEOC (mobile emergency operations control center). If in case the mobile batteries are drained up, we have used a new technique called microwave charging for the mobile devices to charge the battery pack in this paper. Performance analysis of the transport layer communication protocols are compared and results are plotted, and we have also newly proposed ESCTP algorithm to show better results in cumulative packets received. The system meets with many problems in the existing emergency communication system, the problems can be improved in various ways.

2. RELATED WORK

There are many ways of setting up the disaster relief rescue systems. The rescue systems maybe wired and wireless network systems, when the disaster has happened communication and exchange of information plays a major role in the disaster areas. If the wired networks are completely damaged then the wireless network systems are used for communication purpose. In one of the paper they have set up the wireless sensor nodes in the predicted disaster areas to know the prior information about that area, this sensor nodes sense the information and sends it to base station, it was mainly location based sensors, this sensors sense the information and gives the update but does not anyway help in the communication purpose in [1]. Public protection and disaster relief (PPDR) this architecture is setup in one of the paper for rescue operation, in this integration of satellite and LTE were used and also show how both infrastructure-based and infrastructure-less scenarios were considered but architecture failed to work for the wireless operations [5][6][9]. In later years an emergency communication system (IECS) was proposed by integrating newly- deployed or still-available heterogeneous wireless networks in which WSN, MANET, satellite network and cellular network were all used, in this paper wired network is also considered and shows how both wired and wireless networks are used for communication [7]. If suppose the Wi-Fi equipped smart devices battery is drained up then the communication becomes a problem, so to charge the mobile devices wirelessly microwave charging is used, antenna pole is placed in the disaster area and mobile devices are should be equipped with the rectenna and a filter to receive the microwave frequencies [10].

A disaster management network architecture for communication purpose is setup wirelessly in our paper, our architecture is different from all the others because it is only based on the wireless communication in disaster relief areas. So we say our architecture is the best method for the rescue operation. Wi-Fi routers are made use as the access points and data base center is used to monitor the disaster area, according to the EOC instructions the MEOC does the rescue operations, if the mobile battery is drained up in the disaster area microwave charging is used on certain constraints to charge the mobile devices. Performance analysis of the transport layer communication protocols were analyzed, in current paper one of the protocol is improved and shown the betterment in the results.

3. SYSTEM MODEL

The system architecture is shown in Fig. 1. In disaster area for setting up the system architecture Wi-Fi routers were made used as the wireless access points, Wireless node consist of two communication equipment, one is used for intermodal communication and other one is used as the access point for end users. A node covers 100 m radius. These nodes are portable so that can be carried to field easily. Nodes are installed in the form of ad-hoc link with a distance less than 100 m of operation area. Wi-Fi capable smart devices are used to connect to the access point. Ad-hoc link network is connected to data base center using long distance communication link. The super node consist of the long distance transceiver unit, it is defined as a gateway to wide area network through which the disaster information can be exchanged. Data base center collect the information from the access points and store the information for decision makings. In worst case scenarios when the disaster happens data base center receives the information from the access nodes, if the disaster is serious data base center passes the information to EOC (emergency operations control center) through the satellite communication, EOC is the main disaster relief operation center which takes the important decisions. EOC notices the

disaster area and immediately give authentication to MEOC (mobile emergency operations control center) to go the disaster area for the rescue operation, nearby MEOC gets connected and moves to the disaster area and establishes the communication path.

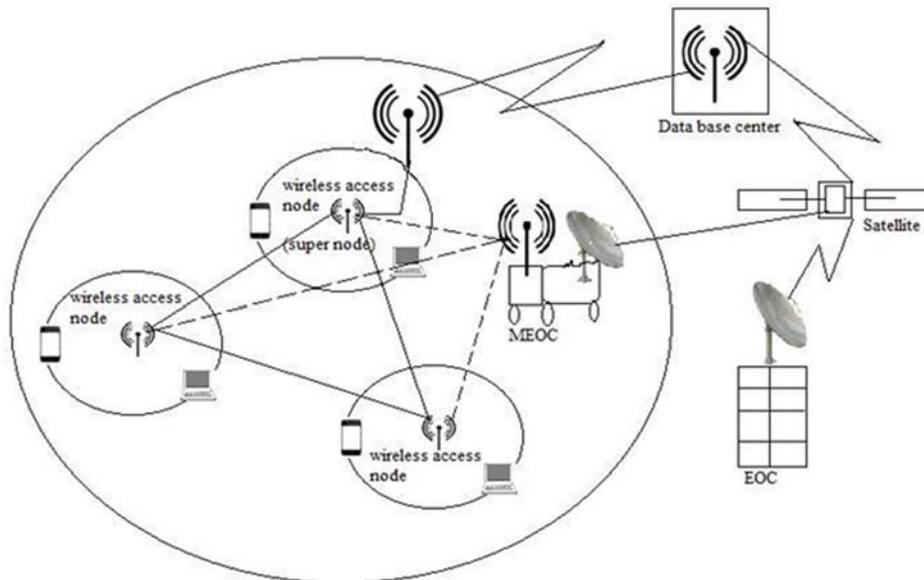


Fig. 1. System architecture

The communication process in the system architecture is shown using a flow diagram. Connection establishment between the devices in system architecture is shown in Fig.2. Step by step flow path is shown in the flow diagram.

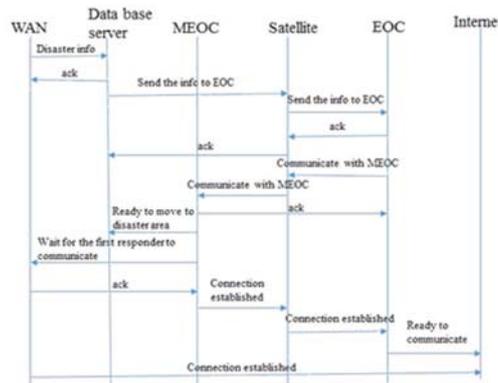


Fig. 2. Connection establishment between the devices in system architecture

After the communication path is established people start communicating with the outside world, but if mobile battery is drained again the communication becomes problem. So we have introduced a technique to charge the battery pack wirelessly and is shown in Fig.3. So we have introduced a technique to charge the battery pack wirelessly and is shown in Fig.3. System design for mobile wireless charging. Microwave charging is considered for charging the batteries. Microwaves are suitable for this use since they are more easily focused into narrow beams, as high data transmission rates and antenna sizes are smaller. We are placing the microwave transmitter pole in the disaster area, and the mobile phones should be equipped with rectenna and filter to absorb this microwaves, thus the more you talk on the phone the more is your mobile phone is charged.

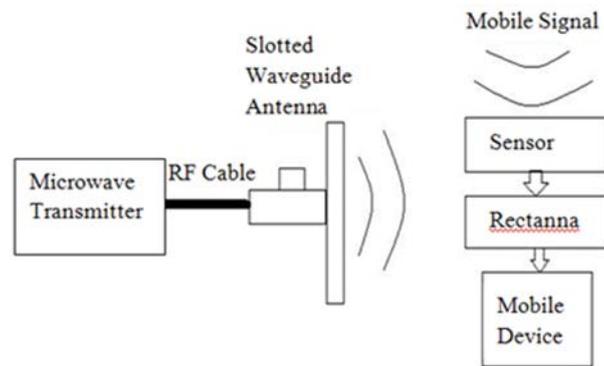


Fig.3. System design for mobile wireless charging.

4. PERFORMANCE ANALYSIS OF TRANSPORT LAYER PROTOCOLS AND PROPOSED ESCTP ALGORITHM

In OSI model the transport layer is responsible for delivering data to the appropriate application process on the host computer. Connection oriented communication is provided by some transport layer protocols . Here we consider three transport layer protocols such as TCP (transmission control protocol), UDP (user datagram protocol) and SCTP (stream control transmission protocol).

TCP provides end-to-end reliable communication, but it is not true for UDP, TCP involves in connection establishment, dividing the steam of data into packets and ordering the packets. UDP is a very simple protocol, it does not provide reliable communication, and UDP packets are called datagrams. TCP is used for many protocols. SCTP provides same service features as TCP and UDP, it is message-oriented like UDP and reliable in sequence transport of messages with congestion control like TCP. SCTP differs only in providing multi-homing and redundant paths to increase resilience and reliability.

We have proposed a ESCTP algorithm to show better results in terms of cumulative packet loss. Here we consider three wireless access nodes into consideration. Also consider the sender and receiver, the data passes through all the three wireless access nodes. For wireless access node routers AQM (advanced quantitative method) is implemented .Steps involved in transferring the packets from sender to receiver are as follows:

Step1: There is a sender and receiver and several access points between them. We consider there are three wireless access nodes between them.

Step 2: Data is transmitted from the sender to receiver.

Step 3: AQM method is implemented in the wireless access nodes because it is efficient way to control network congestion and to maintain queue size stability.

Step 4: Packet drop is based on the deviation of the queue length.

Step 5: Each access point has one queue with maximum size Q. Step 6: Queue is shared between the senders, each sender has a proportional contribution in each queue based on its packets application.

Step 7: Proportional contributions are considered as follows

$$\sum_{i=1}^N p[i] = 1$$

Where,

S= number of senders.

P[i]=portion of senders [i] at queue of access point [j]. J= wireless access point number.

5. SIMULATION RESULTS

We have simulated the performance analysis of different transport layer communication protocols and compared there packets received at the sink, path loss and residual energy using MATLAB (R2015a) simulator. The simulation results for packets received at sink verses time is compared for TCP, UDP and SCTP is shown in figure 4. It is shown that SCTP is best in terms of packets received. The simulation results of TCP, UDP and SCTP are compared for residual energy and path loss with respect to time is shown in figure 5.

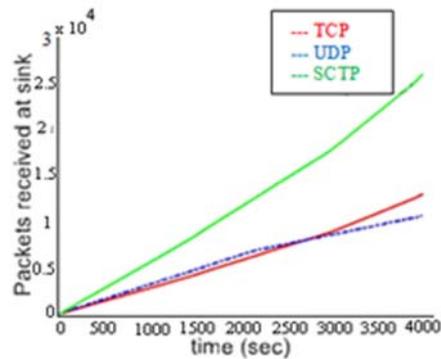


Fig. 4. Packets received at sink vs. Time

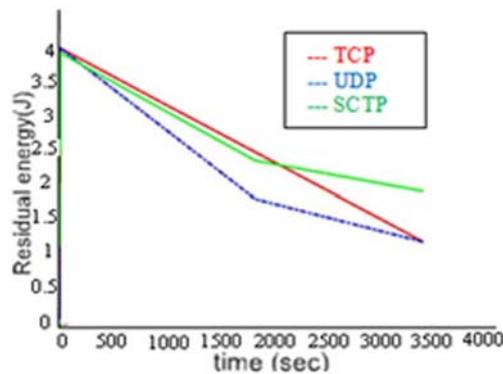


Fig. 5. Residual energy vs. time

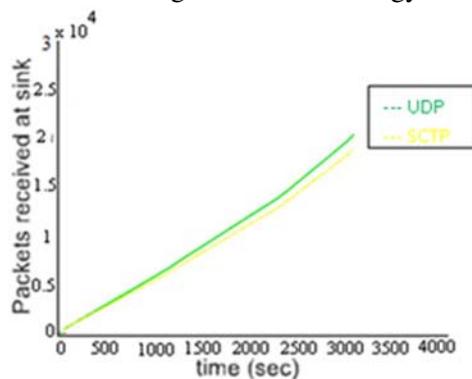


Fig. 6. Packet loss vs. time for existing and proposed SCTP protocol

Both TCP and SCTP control congestion by changing the congestion window size to control the quantity of packets being transmitted. To evaluate the performance of the proposed algorithm, capacity of the link is 20mbps and link delay is set to 10ms. Three wireless access nodes are concerned on each access point. Maximum buffer size of each access node is taken 50 packets. The current simulation

focuses on cumulative packet loss. Fig.6. depicts the cumulative packet loss for ESCTP as well as standard SCTP. Cumulative packet loss at any time of the simulation is concerned as the sum of the packet loss since the beginning of the simulation until that time. The ESCTP has lower cumulative packet loss so the proposed algorithm improves efficiency of transmission.

VI. CONCLUSION

In this paper, we have setup one of the best method of communication system for communication in the disaster area, and also showed how the mobile phones are charged using the microwave charging. Performance analysis of the three standard transport layer communication protocols are shown for packets received at the sink and residual energy. We have also proposed ESCTP algorithm and compared it with the standard SCTP protocol and result is show for cumulative packet loss using the MATLAB simulator.

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