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A Reliable Data Transmission Protocol for Healthcare networks using Wireless-Fidelity (Wi-Fi)

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***Abstract*— The main objective of this project is to support the healthcare networks by come up with the reliable transmission protocol for the transmission of emergency signals. Patient monitoring systems are gaining their importance as the fast-growing global elderly population increases demands for supporting and to look after them. These systems use wireless technologies in *adhoc environment* to transmit decisive emergency signs for medical evaluation. In a multihop Wi-Fi network, the existing systems usually use broadcast or multicast schemes to increase the reliability of signals transmission; however, significantly higher network traffic and end-to-end transmission delay are the results examined from the above stratagies. In our paper, a reliable transmission protocol is exposed based on anycast routing for wireless patient monitoring. Proposed scheme automatically selects the nearest data receiver in an anycast group as a target to reduce the transmission latency as well as the control overhead. Using Optimizing Route Request Response Technique as a benefaction, control overhead is attenuated in the proposed protocol. The new protocol also cut down the latency of path recovery by pioneering route recovery from the intermediate routers of the original path. Based on the reliable transmission scheme, signal from the fall detection system is broadcasted. Performance of the proposed protocol is estimated using Network Simulator (ns-2) and compared with existing basic AODV routing protocol. Simulation results justify that the proposed protocol is felicitous for emergency signal transmission with reliability.**

***Keywords*— Ad-hoc on demand Distance Vector routing protocol (AODV), anycast routing, Wi-Fi**

I. INTRODUCTION

Most of the current Health Care systems try to abide an adequate treatment with more alert and prohibitions. Such an efficacious treatment requires a promptly available Patient Monitoring System [1]. The Patient Monitoring System is a greatly developed technology for monitoring and regulating distinct Human-health parameters. Some of our Human health parameters which include temperature, heartbeat, blood pressure, pulse, etc. need a prolonged monitoring tor effective treatment at reduced cost. The main aim of our paper is to support the above by soliciting healthcare networks which work with the reliable transmission protocol for the transmission of sensitive medical signals. These systems use wireless technologies to transmit vital signs. In a multihop Wi-Fi network, the system use broadcast or multicast schemes to enhance the reliability of signals transmission. The transmission of vital signs in nursing homes and hospitals is usually carried out wirelessly. They are assorted into urgency messages and regularly collected information. There must be immediate transmission of emergency messages, while the regularly collected information can be gathered and transmitted in a given time period. Outdoor and indoor are the two consignments under transmission path for vital signs. Wireless wide area networks (WWANs) technology is used for outdoor transmission, and that of wireless mesh network (WMN) is obligated for indoor transmission [2]. Long term evolution (LTE) and worldwide interoperability for microwave access (WiMAX) are the next generation technologies for WWAN. Both have the same core wireless technologies, but in a distinct manner. They aim at providing wireless broadband access service. WiMAX is especially used in fixed mobile deployments, while the technology of LTE considers irremissible deployments, which runs after compatibility with the existing devices. Since the vital signs can be transmitted with better bandwidth management, these technologies will greatly upgrade the quality of patient monitoring [3].

Wi-Fi is a prominent technology that allows an electronic device to transfer data or connect to the internet wirelessly employing radio waves and it belongs to 802.11standard. Many devices can use Wi-Fi e.g. personal computers, smart phones, video-game consoles, tablet computers, some digital cameras and digital audio players.

In this paper, we present a reliable protocol of packet forwarding that transmits emergency messages with sensitive medical signs on a multihop Wi-Fi network. We setup multiple Wi-Fi data sinks in a network. Our protocol uses anycast to find the closest available data sink. Failure of the path to the original data sink results in our protocol significantly selecting another data sink as the destination. Before the failure link, the transmission path is reconstructed from the last and final node; hence, the latency of path recovery is shorter here than that for the unicast-based schemes which rebuilds a path from source node. As correlated with broadcast/multicast approaches, our protocol significantly minimizes the traffic overhead while sustaining the reliability at the same level.

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Our paper is ordered as follows. Section II briefly consults with the previous work on mobile healthcare systems. Section III describes the reliable transmission protocol. Section IV shows the simulation results and the implemented prototypes. Section V presents our conclusions.

II. RELATED WORK

Data transmission can be categorized into four mechanisms, unicast, multicast, broadcast, and anycast. Both multicast and broadcast are one-to-many data transmission, but multicast communication must specify the address of the multicast group to identify the potential receivers. Since multicast and broadcast can deliver messages to multiple receivers, they are appropriate for the applications demanding confining data integrity. Even though, their impairment stems from the large number of packets that may retard the transmission rate. Unicast differs from precedent two modes in that it delivers packets only to a single receiver. Unicast transmission has the minimal traffic overhead; additional method of path recovery must be lugged out to find another receiver when the path to the receiver declines.

TABLE 1.Transmission Modes

Mode / Property	Unicast	Multicast	Broacast	Anycast
Communication Mode	One to One	One to Many	One to All	One to Any
Membership	Single	Multiple	Multiple	Multiple
Destination	Node	Group	All	Group

Anycast is a new network routing technique in which messages from a sender are routed to the topologically closest receiver in a group of probable receivers. This is assigned as anycast group. The receivers which are in same anycast group are identified by the same anycast address [4]. Anycast can be handled as a subclass of multicast that finds the nearest receiver. As compared with the existing communication modes, anycast has lesser traffic overhead than broadcast and multicast. Anycast also has larger fidelity than unicast since it is appropriate for identifying a different receiver. However, anycast routing raises the complexity of the network devices.

Anycast has been applied in the following applications.

1) ***The closest or best server selection***: A client can advertise with the closest server with an anycast address. This application can be appropriate to hold emergency calls (e.g., call for an ambulance).

2) ***Service identification***: Anycast addresses can be used to find out unique services, such as domain name system and HTTP proxy in the Internet.

3) ***Developing system reliability***: We can assign an anycast address to multiple servers scattered. If one of the servers went down, packets will be routed to another nearest server without obstructing service [5].

4) ***Policy routing***: Consider that an anycast address is assigned to the network interfaces of a group of routers. By defining the anycast address in the hop-by-hop routing option, packets are forced to transmit via one of the routers in the group [6].

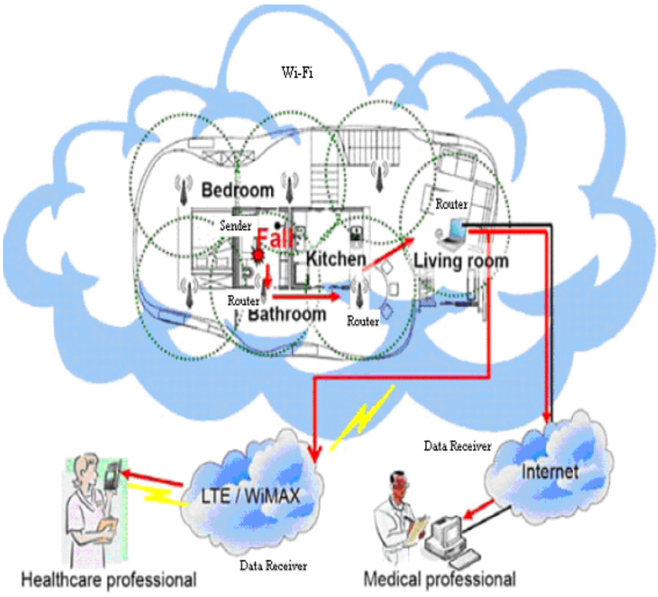

Figure 1.Methodology Used

III. RELIABLE TRANSMISSION PROTOCOL

In our network structure, we characterize the nodes into three types: sensor, router, and data receiver. Originally, the sensor node picks up vital signs and envelops these data in the form of packets. Then, the sensor node disseminates packets to a data receiver through the nearby available router. We assume that the sensor node is versatile. Thus, there will be a persistent change in the path to the data receiver. Router node holds the authority for forwarding messages to a data receiver. Since we are using an anycast routing protocol, the data receiver is the neighboring one. The data receiver node actually acts as a data sink, which collects substantial information and transmits to the medical/emergency center. As mentioned earlier, the data receiver node can be combined with WWAN technologies, such as WiMAX or LTE, to achieve a seamless platform of wireless patient monitoring. In our case, the router nodes form a multihop WMN. To ensure acknowledged transmission, our proposal is a reliable transmission protocol based on the Ad hoc On-Demand Distance Vector (AODV) routing protocol [7].

Before preceding our protocol, we briefly describe the merits of the technique of AODV. The AODV is an on demand algorithm, which frames routes to the destination only as chose by source nodes. There are two types of packets used in the route establishment, route request (RREQ) and route reply (RREP). When a source node tries to communicate with a

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destination whose route is unknown, it will broadcast an RREQ packet across the network. This RREQ contains the address of the source node, the current sequence number, broadcast identifier and the most recent sequence number for the destination of which the source node is alive of. Nodes that receive an RREQ renovate their information for the source node and set up backward pointers to the source node in their routing tables. A node that acquires an RREQ sends an RREP if it either is the destination or has a route to the destination. The RREP is sent to the source by unicast. Contrarily, the router node rebroadcasts the RREQ to its nearby neighbors. Each node keeps record of the RREQ's source address and the broadcast identifier. When a node picks up an RREQ that it has already refined, the RREQ is simply neglected As the RREP proliferates back to the source, nodes that receive the RREP set up forward pointers to the destination in their routing tables. Once the RREP is received by the source code, it starts to transfer data packets to the destination. Each node updates its routing information for a destination if it receives an RREP with a lesser hop count. The route will be kept in the routing table as long as it is required. To ensure the freshness of routes, AODV uses sequence numbers too. If a link failure occurs on an active route, the node upstream of the break propagates a route error (RERR) message to the source node to notify the event of an impassable destination. After it receives the RERR, the source node reinitiates route discovery to recapitulate data transmission.

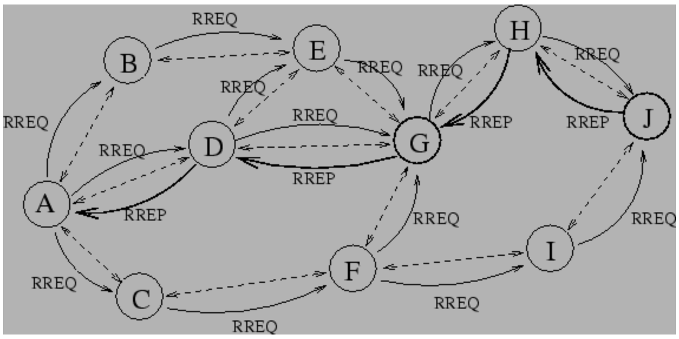

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Figure 2.AODV Protocol

AODV has the advantages of self-starting, loop free and scalability. However, the reliability of the transmitted data cannot be ensured by AODV. Hence, we improve the reliability of AODV by introducing the capability of anycast routing. Besides, we deploy multiple data receivers in a WMN. With anycast routing, the source node can disseminate to the closest data receiver. Further, we use a hybrid approach that combines the mechanism of reliable data transmission with anycast routing in order to achieve adequate route recovery.

Our new protocol has five message types, which includes RREQ, RREP, RERR, DATA, and Acknowledgment (ACK). The first three messages, RREQ, RREP, and RERR, are collected from AODV and are used for controlling the routing information. When an active path to the data receiver is found out, only then the DATA message is transferred. When an entire DATA message is gained by the data receiver, it delivers an ACK message back to the source node.

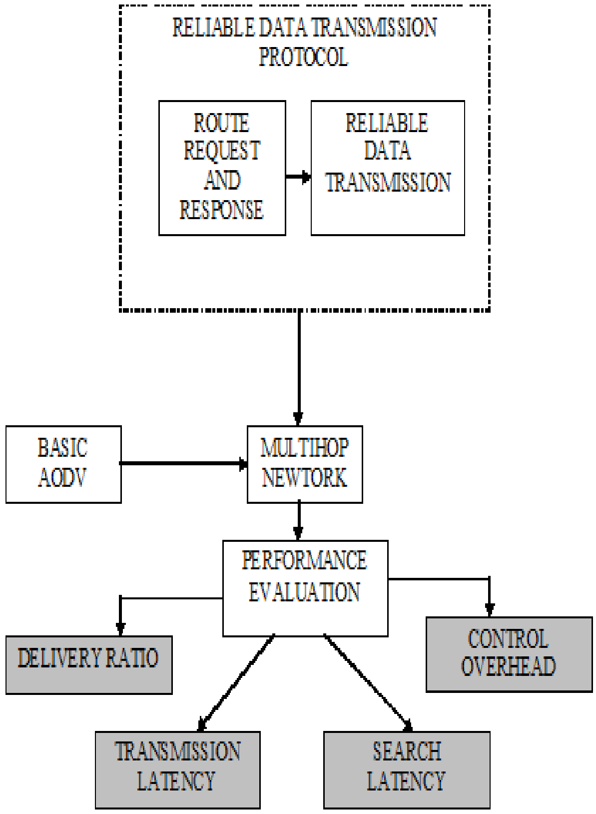

Figure 3.Process Overflow

<u>Performance Metrics</u>:-

- ***Control overhead***

The control overhead shows the total number of the request and reply packets.

$$CO = \frac{\text{Total no of request \& reply packets}}{\text{Total no of packets involved in communication}}$$

- ***Search Latency***

The search latency is the time period from sending the RREQ message until receiving the first RREP message.

$$SL = \frac{\text{Sending of RREQ message}}{\text{Receiving of the first RREP message}}$$

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❖ ***Transmission Latency***

The transmission latency is the time period for a DATA message from the sensor node to its data receiver.

$$TL = \frac{\text{DATA message from sensor node}}{\text{DATA message to data receiver}}$$

❖ ***Packet Delivery Ratio***

The ratio of the number of delivered data packets to the destination. This represents the level of delivered data to the destination.

$$PDR = \frac{\Sigma \text{ Number of packets received}}{\Sigma \text{ Number of packets sent}}$$

IV. ANALYSIS OF PERFORMANCE PARAMETERS

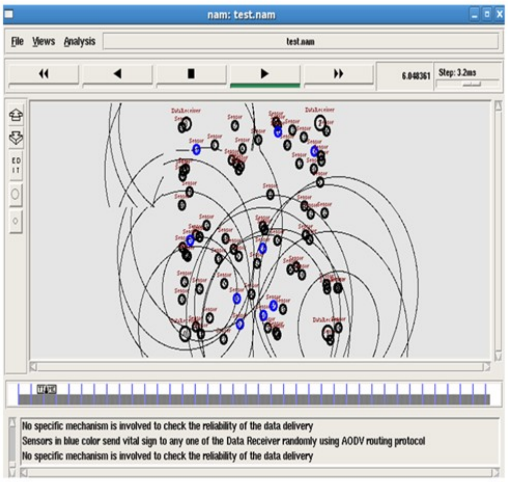

Figure 4.Routing Process

TABLE 2. Simulation Model

Simulator	**Network Simulator 2**
Number Of Nodes	Random
Topology	Random
Interface Type	Phy/Wirelessphy
Mac Type	802.11
Queue Type	DropTail/Priority Queue
Queue Length	200 Packets
Antenna Type	Omni Antenna
Propagation Type	Two-Ray Ground
Routing Protocol	Aodv
Transport Agent	Udp
Application Agent	Cbr
Transmission Power	0.2
Reception Power	0.1
Sense Power	0.1w
Idle Power	0.0w
Initial Energy	100j
Simulation Time	10s

Graphical Representation-

Packet Delivery Ratio

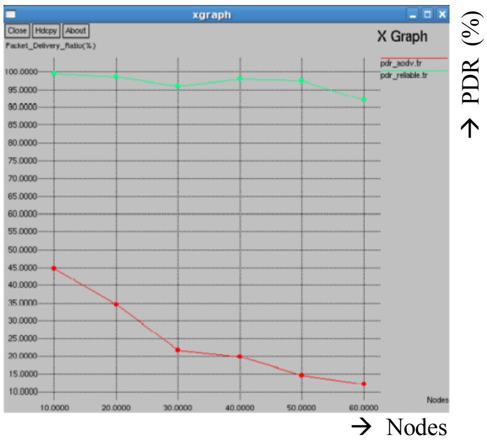

Figure 5. Packet delivery ratio

Control Overhead

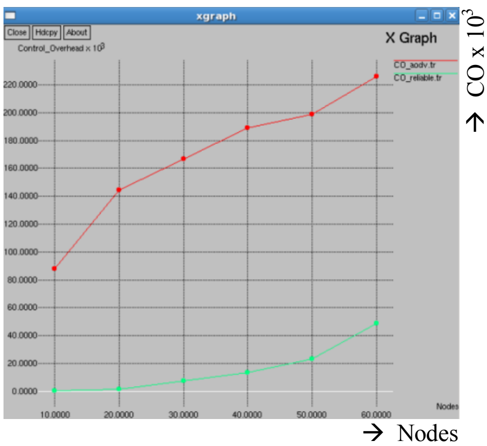

Figure 6. Control overhead

Search Latency

→ ms

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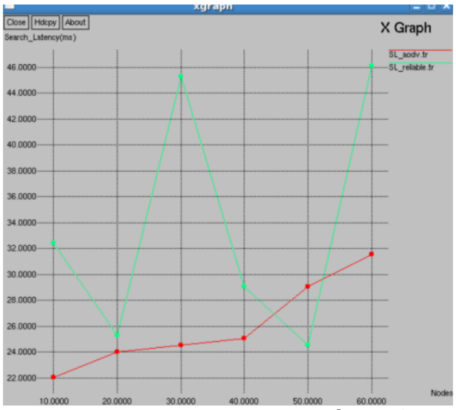
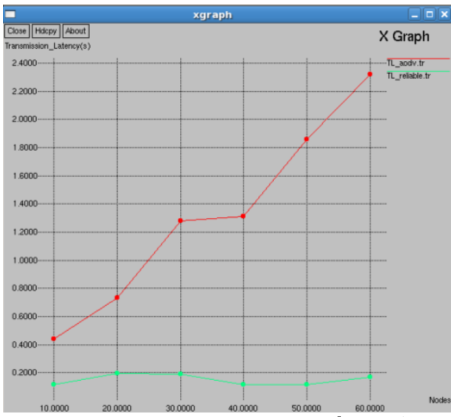


→ Nodes

Figure 7. Search latency

Transmission Latency

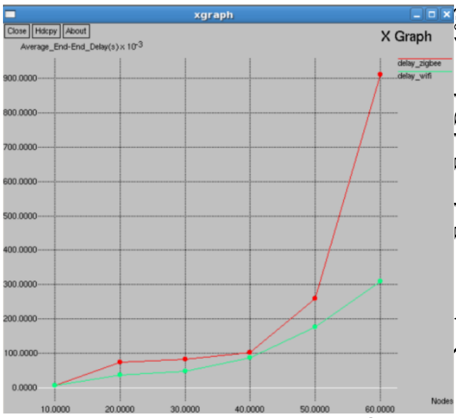


sec ↑

→ Nodes

Figure 8. Transmission latency

Zigbee vs WiFi



↑ Average End to End Delay x 10^{-3}

→ Nodes

Figure 9. Zigbee vs. Wi-Fi

Figure 5,6,7,8, shows the comparative results of the performance parameters such as packet delivery ratio, control overhead, transmission latency, search latency for the existing and our proposed reliable protocol. Current systems use Zigbee for the data transmission; here we have used Wi-Fi for transmission. Our proposed protocol provides the reliable data transfer between the sender and receiver and it is much suitable for the transmission of sensitive medical data.

V. Conclusion

This paper provides a conceptual framework to conceive the role telemedicine plays in the new healthcare paradigm that requires the efficient and effective transmission of health care information/knowledge across an integrated health care network and to point to the importance of various learning processes related to the improvement of telemedicine and its contribution to value-added health care delivery. Telemedicine refers to the use of electronic information and communication technologies to provide and support health care when distance separates the participants.

In this paper, we first studied about patient monitoring systems and telemedicine concepts and analyzed how to implement these strategies through routing protocols. We worked towards transfer of sensitive medical messages in an efficient manner. Here broadcast and multicast routing is used for routing purpose in AODV protocol to improve the reliability of sensitive medical messages, which are sent to the receiver (nearby hospitals). However, significantly higher network traffic and end-to-end transmission delay are the results observed from the above techniques. To overcome this, we have to use anycast routing procedure to choose the nearest receiver for the data transfer process. So that anycast routing for the selection of the nearest receiver to reduce the control overhead and transmission delay and to improve the packet delivery ratio. The simulation for the transfer of messages is performed by using the NS-2 simulator and the communication setup for certain nodes is created. The performance parameters such as PACKET DELIVERY RATIO, CONTROL OVERHEAD, TRANSMISSION LATENCY, and SEARCH LATENCY are calculated and graphical output is obtained.

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