Efficient Healthcare Data Transmission using ZOLAR Protocol in Wimax Network

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Abstract— In this project, hybrid protocol is constructed for transmitting the emergency healthcare data from moving ambulance and mobile pedestrian, sending patent's physiological data to the hospital is considered in this project. The healthcare data is transmitted using Worldwide Interoperability for Microwave axis (WiMAX) network. Network topology changes frequently due to mobility of the entities involved and routing becomes challenging. To transmit the healthcare data more efficiently hybrid ZOLAR (zone optimize link state location aided routing) protocol is constructed. ZOLAR protocol is constructed by combining the best features of different routing protocols such as ZRP (Zone routing protocol), OLSR(Optimized link state routing) and LAR(Location aided routing) protocols. The performance of ZOLAR protocol is compared with AODV(Ad hoc On-demand Distance Vector routing), ZRP (Zone routing protocol), OLSR(Optimized link state routing) and LAR(Location aided routing) protocols with respect to the performance metrics like Throughput(it is the rate of successful transmission of packets over a network per unit time), Packet delivery Ratio(it is the ration of number of packets delivered to number of packets transmitted over a network) , Average end to end delay(Delay is the time taken to transmit a packet from source to destination over a network) and average jitter(Jitter is the change in time between arriving of packets, it is due to timing drift, route change, network congestion). This performance comparison shows the hybrid ZOLAR protocol transmits medical data more efficiently than ZRP, OLSR, LAR and AODV.

Key words: OLSR, ZRP, AODV

I. INTRODUCTION

Telemedicine is used to exchange medical information from one end to another by the use of electronic communication channel to improve patients' health status. In 20th century for the first time Health care data was sent from distance, 100 electrocardiograms (ECGs) signals transmitted over a distance of 1.5 km successfully. Wireless communications technology is used to send medical data to have flexibility in usage, mobility support, deployment issues and increasing the reach of remote healthcare assistance. Progresses in the wireless communication standards is mainly concentrated on reducing the cost to send the healthcare signal with added mobility to make ease patient cases that could not be efficiently served with the fixed wired communication system. Medical assistance is easily delivered to critical emergency situations, and to a place where a mobile medical unit is essential for addressing trauma, monitoring and care of patient with the help of development in satellite systems, cellular technologies wireless local area networks (WLAN),emerging wireless mesh networks (WMN),mobile ad hoc networks (MANET),Wireless Sensor Network(WSN) and Worldwide Interoperability for Microwave Access (WiMAX).

There are two categories of medical data types: Physiological data (ECG, Blood Pressure etc.) and Morphological data (X-Ray, CT Scan, Colour Doppler etc.). Instead this we can have Hospital Information system data, patient record information and tele-consultation video data are also considered. Healthcare applications data traffic is arbitrary and stipulated based. This is for the reason that amount of existence of emergency or traffic from isolated monitoring sources where data is being sent as per beginning of emergency or else it uses network resources when it is nearly free for patient record maintenance. The medical data types are affected by design metrics for instance end to end delay which ranges from 1s for physiological data and in range of 100 ms-400 ms for audio and video traffic respectively, is required and the affected medical data types are useful reproduced by using other factors such as packet delivery ratio and throughput over a network. Thus routing becomes one of the important task due to which it is related with delivering information packets over network. As in the case of proactive routing, the routes may be predefined or it is performed based on beginning of the demand. In the next scenario, the best possible routes are stored in the routing table while link-state or a topological database stores all other information. Combining the features of protocols hybrid protocol is constructed to optimize the performance of the networks in terms of performance metrics by decreasing the end to end delay and increasing the packet delivery ratio which increases the quality of service (QoS)of a given network for a particular emergency situation.

In mobile WiMAX network, fixed base station (BS) and subscribes station(SS) are connected to public network to cover multiple sectors simultaneously.

Wireless communication channel is expanded by using the verities of wireless routing protocols such as AODV, OLSR, Destination- Sequenced Distance-Vector Routing (DSDV), ZRP, LAR, Landmark Ad Hoc Routing (LANMAR), Source Tree Adaptive Routing Protocol (STAR), Dynamic MANET On demand (DYMO).

In this paper performance parameters of the Location Aided Routing (LAR), Optimized Link State Routing protocol (OLSR), Zone Routing Protocol (ZRP) and Adhoc on-demand distance vector (AODV) routings are considered for the medical scenario. Hybrid ZOLAR(Zone routing Optimized link state Location Aided) protocol is implemented by combining the best features of Zone routing protocol, Optimized link state routing protocol, Zone routing protocol to send the physiological data to the hospital.

II. REVIEW OF LITERATURE

Elizabeth M. Royer, University of California, Santa BarbaraChai-Keong Toh has proposed "A Review of Current Routing Protocols for Ad Hoc Mobile Wireless Network." In that AODV is a distance vector routing for mobile ad-hoc networks. Route discovery is initiated on demand which eliminates the need for periodic update of routing table.This dynamic link allocation mechanism introduces low processing and memory overhead, low network utilization, and determines unicast routes to destinations within the ad hoc network. Peculiar feature of this routing protocol is that if a route entry is not used within a stipulated time it will be removed. In this way existence of each reverse route entry is time bound. Its advantage in routing emergency telemedicine traffic is that a route determination procedure initiates only on demand. Thus, when a route is needed, some sort of global search procedure is employed. Network can be used for routing other emergency healthcare data in case request from one node is idle.

Poonam Rautela, Vinod Kumar Mishra, Pankaj kumar has proposed Zone based routing protocol in WSNs for varying zone size. ZRP is a hybrid variety of routing protocol. ZRP divides the complete network into several zones and employs various routing protocols within and between those zones and the selection of these protocols depends upon their optimized applicability. Originating from each node there is a well defined zone centered at concerned node with the defined in terms of parameter 'r' describing radius of this zone in hops. In each such zone a proactive protocol Intra Zone Routing Protocol (IARP) is adopted to maintain the local topology; as it helps in eradicating the initial delays during route searching and link establishment phase. As need for a link in between zones arises Inter Zone Routing Protocol (IERP), a reactive protocol, is used. It is used for finding the path between the source and the destination. Hence reducing memory overhead in storing topology of entire network at each node. Border cast Resolution Protocol (BRP) is an efficient broadcast technique which controls the traffic between such zones, and therefore, reduces the number forwarding in route discovery of IERP. The most appealing feature of this protocol is its adaptive behavior, based on the current configuration of the network and the behavior of the users which is in accordance with the required dynamics of critical healthcare scenarios.

Mohammad A. Mikki has proposed Energy Efficient Location Aided Routing Protocol for Wireless MANETs. LAR is a reactive on-demand source routing protocol which harnesses the location information gained from Global Positioning System (GPS). Advantage of LAR over Dynamic Source Routing (DSR) is that route request packet flooding in former is much optimized due to assisted location information. Based on this location information route request packet for destination is forwarded in specific request zones only, instead of flooding of this information for route discovery in the entire dimension of ad-hoc network. This ultimately reduces end to end delay and transmission of emergency traffic is done with ease and through optimal route.

P A.Jacquet, P.Muhlethaler, T.Clausen, A.Laouiti, A.Qayyum, L.Veinnot has proposed Optimized Link State Routing Protocol For Ad-Hoc network. OLSR is a proactive link-state routing protocol, which disseminates link state information by discovering it with the help of ' hello' and 'topology control' (TC) messages in entire mobile ad-hoc network. This topology information is used by individual nodes to compute next hop destinations for all nodes in the network keeping in mind shortest hop forwarding paths. When a node broadcasts its message, the retransmission of that message by multi point relays (MPR) ensures that the message is received by each of its two messages only the MPR nodes will rebroadcast the message meantime other neighbors will process the message but does not rebroadcast it and hence use of MPR is minimized. To diffuse topology information in the network, nodes periodically exchange Topology Control (TC) messages, with their neighbor. In OLSR, every node broadcasts periodic HELLO messages that contain one-hop neighbor information. The advantage of this schemes is when demand for a route initiates, there is little delay until the route is determined. This is motivation behind using this protocol for emergency healthcare applications as it reduces delay.

A. Scope of the ZOLAR:

1) It increases the throughput.
2) It decreases the average jitter and end to rnd delay.
3) It increases the packet delivery ratio

III. SYSTEM ARCHITECTURE

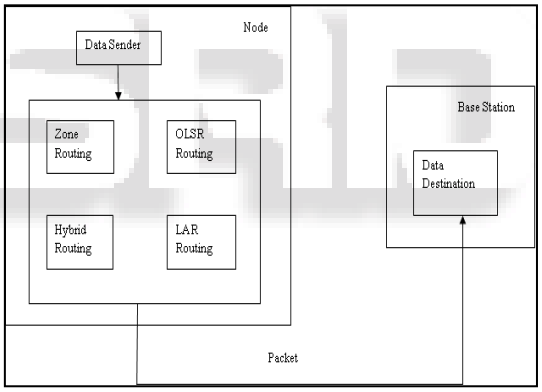

Fig. 1: Architecture Diagram for the System

System Architecture includes two modules, node subsystem and basestation subsystem. Node subsystem takes care of sending packets to base station. Base station collects the pockets and processes the received data. A sensor network contains number of nodes. Nodes doesn't have enough communication range to communicate with the base station, hence multiple hop routings are used between the nodes to transmit the data from node to base station. Node uses multiple hop routings to communicate with the base station. Node contains data sender module to send the packets. Data sender module directs the node to send packets to base station. Routing layer contains four protocols, ZRP, OLSR,LAR, Hybrid protocol. Routing layer is used to find the path node to base station. In ZRP, the network area is divided into different zones(clusters). Each cluster has cluster head. A node in the cluster which has highest potential is considered as cluster head. Each cluster head communicates with another cluster head and transmits packets to base station. when the potential of the cluster head is reduces it becomes normal node. The next cluster

head is selected based on the node which has highest potential. In OLSR protocol, each node exchanges the information of neighbourhood node and each node receives the information about all other neighbourhood node. This information is stored in a neighbourhood table. Each node exchanges the neighbourhood table information. Based on this neighbourhood table, graph is constructed. Dijikstar's algorithm is used to find the path from one node to another node. In this algorithm shortest path is calculated by considering the weight of the path. The shortest path means the path which has less weight. LAR protocol is used to know the location information from source to destination. The path is determined by sending packets to the node which is nearer to the destination. Hybrid protocol constructed by combining the best features of ZRP,OLSR,LAR protocols. ZRP is used to split the network area and to transmit packets through cluster head. OLSR is used to routing between cluster head and fix the path with in the cluster. LAR is used to routing between zones(clusters), it finds the next hop to determine the path to destination.

IV. IMPLEMENTATION

Implementation is the stage of a project when the theoretical design is turned in to a working system. Implementation is the phase where the system goes for actual functioning. Hence in this phase one has to be cautious because all the effect undertaken during the project will be fruitful only if the software is properly implemented according to the plans made.

A. Code Snippet for Network Establishment:

Traffic generation in NS-2 is based on the objects of two classes, the class Agent and class Application. Every node in the network that needs to send and receive traffic has to have an agent attached to it. On top of an agent runs an application. The application determines the kind of traffic that is simulated. There are two types of agents in NS-2: UDP and TCP agents. The simulations to send traffic on top of a TCP object is achieved by File Transfer protocol, for simulating bulk data transfer. The code for generating traffic between node n0 and n5 is

```
Set tcp [new agent/TCP]
        $tcp set class_2
        Set sink [new Agent/TCPSink]
        $ns_attach-agent          $node_(0)
$tcp
        $ns_attach-agent $node_(5) $sink
        $ns_connect $tcp $sink
        set ftp [new Application/FTP]
        $ftp attach-agent $tcp
        $ns_at 1.0 "$ftp start"
        $ns_at 3.0 "$ftp stop"
```

To create constant bit rate Traffic sources between node n0 and n5. Create UDP Agent and attach Agent to n0. Set Packet Size to 512 bytes and set CBR rate to 200 Kbits/sec. Attach Application to agent. This is achieved by.

```
set udp0 [new Agent/UDP]
$udp0 set class_ 1
$ns attach-agent $node_($nodetosend) $udp0
set cbr0 [new Application/Traffic/CBR
$cbr0 set interval_ .01
$cbr0 attach-agent $udp0
set inter [new Agent/LossMonitor]
$ns attach-agent $node_($destnode) $inter
$ns connect $udp0 $inter
set ti [$ns now]
set tf [expr $ti+0.2]
```

For terminating the simulation the following code is used where stop is set to the value 50 seconds.

```
for {set i 0} {$i<40) } {incr i} {
$ns_at $val(stop)
}
$ns_at $val(stop)
Proc stop {} {
Global ns_tracefd namtrace
$ns_ flush-trace
exec nam out.nam
}
```

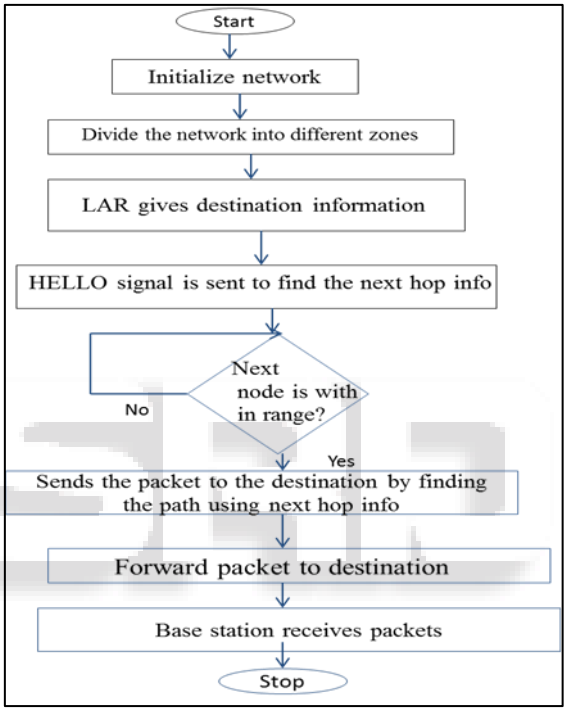

Fig. 2: Flow Chart for Routing

V. RESULTS

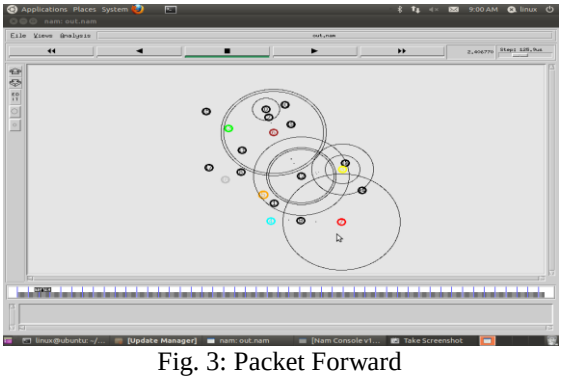

Fig. 3: Packet Forward

Figure shows the cluster head creation for each zone, network establishment and the packet transmitted between the zones.

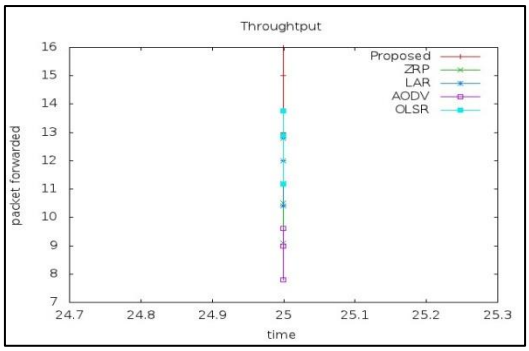

Fig. 4: Graph for Throughput

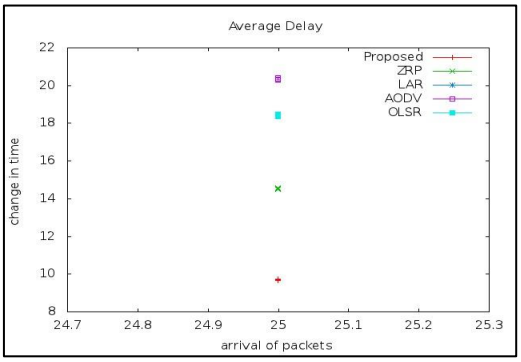

Fig. 5: Graph for Delay

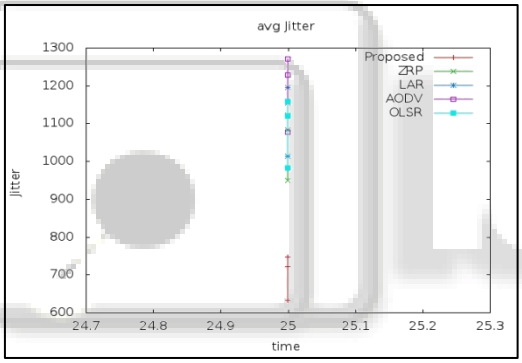

Fig. 6: Graph for Jitter

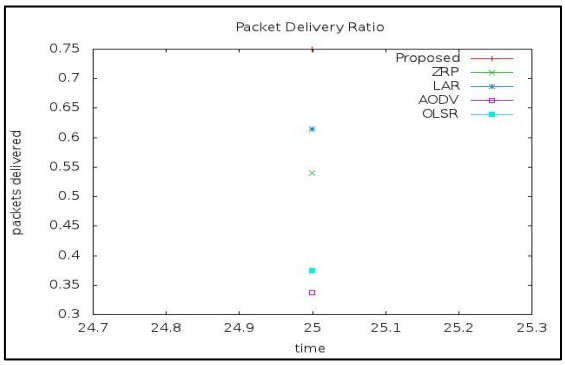

Fig. 7: Graph for Packet Delivery Ratio

VI. CONCLUSION

ZOLAR protocols transmits medical data more efficiently compared to exciting protocols in terms of performance parameter such as throughput, packet delivery ratio, average jitter and end to end delay.

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