IOSR Journal of Computer Engineering (IOSR-JCE)
e-ISSN: 2278-0661,p-ISSN: 2278-8727, Volume 17, Issue 5, Ver. IV (Sep. – Oct. 2015), PP 110-117
www.iosrjournals.org

Performance Evaluation and Qos Analysis of SPEED and MMSPEED Routing Protocol in Wireless Sensor Network

Sangeeta Vhatkar[1], HarshKumar Thakar[2], Mohommad Atique[3]
[1]*(Assistant professor, TCET, Ph.D. Scholar P.I.E.T, Nagpur, India)*
[2]*(M.E.I.T (pursuing), Thakur College of Engineering And Technology, University of Mumbai, India)*
[3]*(Associate Professor, P.G. Department of Computer Science S.G.B.A.U, Amravati)*

Abstract : *Wireless sensor network (WSN) is based on distributed event-based system which is used to provide a bridge between the real physical and virtual world. The main aim of the system is to send and receive a data packet with the highest efficiency and quality. In WSN, quality of service (QoS) is to give special delivery service to the applications that need it by guaranteeing adequate transmission capacity, jitter, balancing latency and decreasing data loss. Here we are focus on Stateless Protocol for End to end delay (SPEED) is a Qos based routing protocol to provide real time communication, effective delivery speed and efficiency over the network. Multipath Multi SPEED (MMSPEED) is another Qos protocol is to provide multi-path, efficiency and minimal overhead to the network. This paper presents the study and comparison of SPEED and MMSPEED protocols in ns2.*

Keywords: *WSN, Qos, SPEED, MMSPEED*

I. Introduction

A wireless sensor network (WSN) [1] is a wireless network comprising of spatially dispersed independent devices utilizing sensors to monitor physical or natural conditions. A WSN framework incorporates a passage that gives integration back to the wired world and disseminated nodes.

In Wireless sensor network (WSN) platform, you effectively can monitor your advantages or environment with dependable, battery-controlled estimation nodes that modern evaluations and neighborhood examination and control abilities. Every wireless network can scale from tens to several nodes and flawlessly coordinate with existing wired estimation and control systems.

In a wireless sensor network there are three important parts are taking place which are nodes, software and gateways. The spatially circulated estimation node interface with sensors to monitor resources or their surroundings. The acquired information remotely transmits to the gateway, which can work autonomously or unite with a host framework where you can gather, process, analyze, and present your estimation information utilizing software. Routers are an extraordinary kind of estimation node that you can use to augment WSN distance and reliability.

In the wireless sensor organize there are many routing technique to send a bunch of packet source to destination, in which they are Essentially separated into Quality of Service routing (Qos) [2], Hierarchical routing and location based routing protocol. In this paper, we concentrate on QoS routing protocol, SPEED [3] and MMSPEED [4] routing protocol and comparison of SPEED and MMSPEED protocols.

II. Quality of Service

Late studies are furnished with the confirmation that Quality-of-Service (QoS) [2] routing can improve the network execution by expanding the network use, contrasted with steering that is not delicate to QoS necessities of traffic. So the essential center here is on assessing and looking at the network execution in the WSN having QoS routing. QoS routing is the procedure for the determination of the path to be utilized by the stream of packets, in light of its QoS necessities, e.g., data transfer capacity, throughput and so forth. In QoS based routing, the protocols give diverse needs to distinctive applications, clients, or information streams, or to ensure a certain level of execution to an information stream. There are such a large number of routing protocols in the QoS-based routing like SPEED (Stateless Protocol for End-to-End Delay) and MMSPEED (Multipath Multi SPEED). The principle QoS-based routing protocols that are under thought in this paper are SPEED and MMSPEED as examined in the accompanying area.

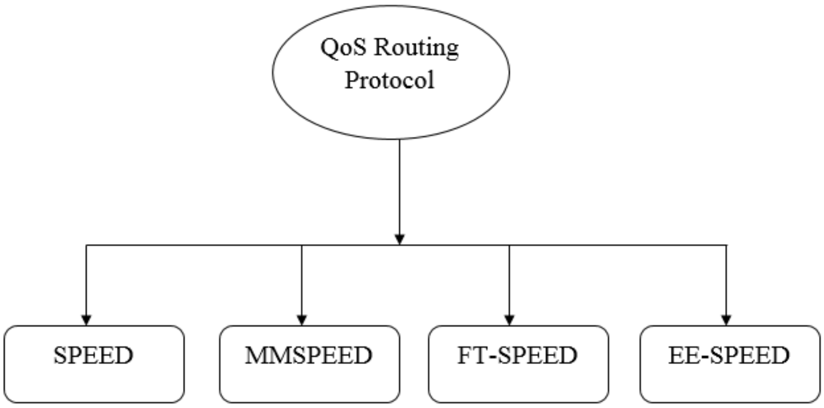

Fig. 1. QoS Routing Protocol [5]

III. SPEED Protocol

In this paper, we build up a Protocol called SPEED [3] that supports soft real-time communication in view of input control and stateless calculations for substantial scale sensor systems. We call a routing administration that gives such capacity, area anycast. SPEED gives the previously stated three sorts of correspondence administrations. SPEED additionally uses geographic locations to settle on restricted directing choices. The distinction is that SPEED is intended to handle blockage and give a soft real-time communication service administration, which are not the primary objectives of past location based routing protocol. Also, SPEED gives an option answer for handle voids other than methodologies in view of planar graph traversal and limited flooding. SPEED gives a blend of MAC layer and network layer adjustment that viably manages such issues. To the best of our insight, no routing algorithm has been particularly intended to give real-time guarantees to sensor networks.

3.1. Design Goals

Our configuration is motivated by the perception that dissimilar to wired networks, where the delay is autonomous of the physical separation between the source and destination, in wireless sensor networks, the end-to-end postponement relies on upon single hop delay, as well as on the separation a packet travels. In the perspective of this, the key configuration objective of the SPEED algorithm is to bolster a soft real-time communication service with a carved delivery speed over the sensor network, so that end-to-end delay is relative to the separation between the source and destination. It ought to be noticed that the delivery speed alludes to the approaching rate along a straight line from the source to the destination. Unless the packet is directed precisely along that straight line, delivery speed is littler than the real speed of the packet in the network. Case in point, if the packet is routed the other way from the destination, its rate is negative. Our algorithm guarantees that this condition never happens.

Upon this soft real-time delivery service, SPEED gives three sorts of real-time communication services, in particular, real-time unicast, real-time area-multicast and real time area-anycast, for sensor networks.

3.2. SPEED Architecture

SPEED keeps up a coveted conveyance speed crosswise over sensor network by both occupying traffic at the network layer and provincially managing packet sent to the MAC layer. Now we are discussing architecture of SPEED protocol.

As indicated in Figure. 2, SNGF is the routing module in charge of picking the following hop competitor that can support the fancied delivery speed. The NFL and Backpressure Rerouting are two modules to decrease or redirect traffic when blockage happens, so that SNGF has accessible contender to choose from. The last mile procedure is given to support the three correspondence semantics said some time recently. Delay estimation is the component by which a node figures out if or not congestion has happened. What's more, beacon exchange trade gives geographic area of the neighbors so that SNGF can do geographic based routing. The subtle elements of these parts are examined in the ensuing areas, individually.

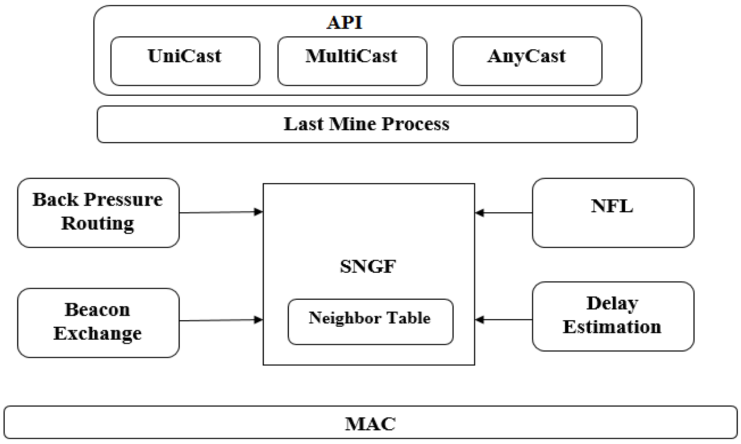

Fig. 2. SPEED Architecture [5]

SPEED Architecture Design Phase
3.2.1 Selection of node
3.2.2 Node Path Selection
3.2.3 Data Transfer
3.2.4 Data Redundancy Phase
Now explain in detail

3.2.1. Selection of nodes

- Initialize all the network parameters.
- Determine the number of nodes, initial energy, BS location.
- Data Transmission starts from the BS or any participated node
- A participated node broadcast a route request message to obtain the distance of each node.
  For neighbor's n1, n2, n3….. n99.
  Compare a (n1), a (n2), a (n3)…. a (n99) from a source node.
  - At the source node when the nearest node will send the acknowledgement. All received messages are transmitted to the next nearest node.
  - The process continues until all nodes have been traversed

3.2.2. Node Path Selection

Once a node is initialized, then the second phase is Node path selection.in this phase the path of the data transmission is selected.

- In the node path selection phase it take location of all participated nodes, which is given by the node selection phase to find the path around the network.
- Once it takes location of all the nodes, then it will save all the distance of all the nearest neighbor.
- Then it takes an input value from the user in which it takes source node, destination node and the number of packets which has to be sent.
- Then it will send the request to all his neighbors to find the nearest node to transmit the data packets.
- All the neighbor sends its location, then the source node calculates the distance from all neighbor nodes.
- The formula of the calculation is :
  $X =: \sqrt{((x2 - x1)^2 + (y2 - y1)^2)}$ (1)
- This procedure continues till the data packets send to its destination.

3.2.3. Data Transfer

- In the data transfer phase actual data is transmitted from source to destination.
- Once it find the result from the node selection phase, it takes the minimum distance result from the neighbor node.
- Then it starts sending data packet to the nearest neighbor node with the minimum delay and maximum efficiency.
- To find all the data transfer path it will use Stateless Non-Deterministic Geographical Routing mechanism (SNGF)

3.2.4. Data Redundancy Phase

- In the data transmission if any case data replication occurred, then the same amount of data should transmit more than one time. By this the system power, efficiency and other factors may affect.
- To resolve this problem here we are taking one intermediate node among the participated node into the transmission and give the same amount of data.
- By this it will send this data to the destination again. Therefore, no any chance of replication or redundancy.

IV. MMSPEED Protocol

SPEED protocol has some drawback like SPEED is quite scalable. The SPEED protocol provides only one network-wide speed, which is not suitable for differentiating various traffic with different deadlines. Also, it is constrained to give any insurance in the reliability domain. To conquer this issue they present Multi-Path Multi-Speed Protocol.

The Multipath and Multi-SPEED Routing (MMSPEED) protocol is an expansion of the SPEED protocol. It is wanted to give probabilistic QoS separation respect to timeliness and reliability domains, which compasses over network layer and medium access control (MAC) layer. The critical target is to give the QoS partition in two quality territories, in particular, reliability and timeliness, with the goal that packets can pick the most legitimate combination of service of service options depending upon their timeliness and reliability requests. For the convenient conveyance of packets, MMSPEED gives a numerous delivery speed choices for each approaching packet. Every approaching packet is put in fitting lines as indicated by its speed class. After this the packets in the best speed line are served on the reason of the FCFS, trailed by the accompanying most noteworthy speed line et cetera. Some other noteworthy property of MMSPEED is an end-to-end QoS provisioning with neighborhood decisions at each middle of the node hub without end-to-end path revelation and support. This characteristic is vital for scalability to broad sensor networks, network elements self-adaptability to, and suitability to both aperiodic and periodic traffic flows.

4.1. MMSPEED Architecture

The MMSPEED routing protocol is arranged with two critical objectives are localized packet routing without global network state update and a priori path setup, to giving separated QoS choices in timeliness and reliability fields. For the restricted packet routing without end-to-end path delivery and support, we grasp the geographic directing instrument based on location awareness. Foremost, we assume that the packet's destination is characterized by a geographic location as opposed to node ID as justified in the SPEED protocol. Moreover, every sensor node is taken up to be aware of geographical location using GPS or distributed location service.

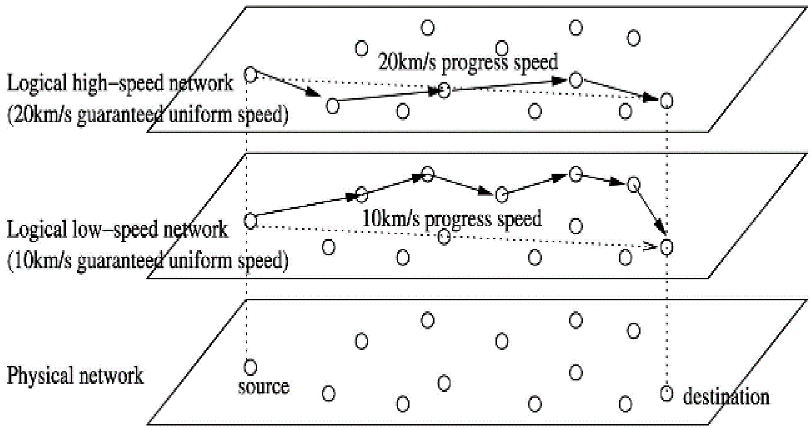

Fig. 3. MMSPEED Architecture [4]

The range information can be exchanged with brief neighbors with "discontinuous area upgrade packets." Therefore, every node is aware of its quick neighbors inside its radio extent and their regions. Utilizing the neighboring areas, every node can mainly settle on every packet routing decision such that packets progress geographically towards their last destinations. In the event that every last node exchanges the packet to a neighbor closer to the objective range, the packet can inevitably to be conveyed to the destination without global topology data. The localized geographic routing has the accompanying three focal points in sensor systems: Adaptability to a huge and dense sensor network.

No path setup and recovery response time-suitable for both discriminating aperiodic and periodic packets.

Every packet path disclosure bringing about self-adjustment to network elements. Our objective is to give ensured packet delivery benefits in both auspiciousness and dependability domain while saving the advantages of localized geographic routing.

MMSPEED provide service differentiation and probabilistic QoS ensures in the reliability and timeliness domains. For the timeliness area, we give different network-wide speed options so that different traffic types can dynamically pick the best possible speed alternatives for their packet relying upon their end-to-end deadlines. For the dependability domain, we utilize probabilistic multipath forwarding to control the amount of packet delivery paths relying upon the obliged end-to-end reaching probability. These systems are actualized in a localized manner with dynamic remuneration to compensate for the mistakes of local choices as packet advancement towards their destinations. Since the proposed instruments work locally at every node without global network state data and end-to-end path setup, it can spare charming properties, for example, scalability for large sensor networks, to network dynamics, self-adaptability and propriety for earnest aperiodic and periodic packets. As a result, MMSPEED can altogether enhance the viable limit of a sensor arrange regarding the number of streams meeting both reliability and timeliness requirements.

4.2. MMSPEED Architecture Design Phase

4.2.1. Selection of Node

- Initialize all the network parameters.
- Determine the number of nodes, initial energy, and Base Station location.
- Data Transmission starts from the BS or any participated node
- A participated node broadcast a route request message to obtain the distance of each node.
  For neighbor's n1, n2, n3….. n99.
  Compare a (n1), a (n2), a (n3)…. a (n99) from a source node.
- At the source node when the nearest node will send the acknowledgement, all received messages are transmitted to the next nearest node.
- The process continues until all nodes have been traversed.

4.2.2. Path Discovery

- In this phase path should be discovered among the nodes, here we are dealing with the multi-speed Protocol so path should be selected into multiple path.
- In the next step here it is used the main multi-path construction with the layer method which is:

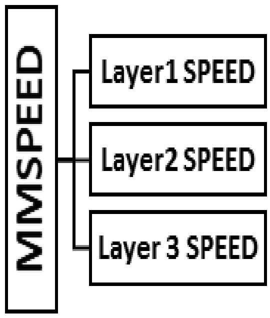

Fig. 4. MMSPEED Layer

- Then it will send the request to all his neighbors to find the nearest node to transmit the data packets.
- All the neighbor sends its location, then the source node calculates the distance from all neighbor nodes.
- The formula of the calculation is :
  X=: $\sqrt{((x2 - x1)^2 + (y2 - y1)^2)}$. (2)
- This procedure continues till the data packets send to its destination.

4.2.3. Data Transmission

- In data transmission phase the first it checks all the node positions and initialize all the nodes on the network, then the data should be transmitted on all the nodes to n1, n2, n3….. n99. i.e. HELLO WORD.
- After receiving acknowledgement by all the nodes the nearest nodes are sending data to its neighbor node
- Once it gives the ack to the neighbor, then hope node should be declared and then the data transmission should take place.

- Hope node sends the ack to its neighbor and all the nodes select one transmission node and send packets to that node in multi path manner.
- After the data should be transmitted at the destination via hope node and multi-layer method, then another hope node should be chose for data transmission.
- This procedure continues till the data packets should receive by destination.

V. Performance Evaluation Of SPEED And MMSPEED Protocol

Simulations are performed to evaluate and compare the performance of the SPEED and MMSPEED protocols. The simulation is set up and parameters used are described in Section 5.1. The performance metrics and Results are used to compare their effectiveness are given in Section 5.2

5.1. Simulation Setup

We set up an evaluation environment using ns-2 [6]. The simulation was performed using this environment in a 1000 x 1000 m^2 sensor field. 100 sensors were randomly deployed in this field and a sink node was placed at the center of the field (i.e., 100,100). Sensor nodes, which initiate the data transmission when an event occurs, are called source nodes and were placed at the border of the sensor field. The rest of the nodes, whose function is to receive and transmit the data packets.

Table 1. Simulation environment settings

Parameter	Value
Area of the sensor field	1000 X 1000 m^2
Sensor nodes	100
Node distribution	Uniform random
Radio range	250m
Initial energy	100J
Data rate	512Kbps
Bandwidth	200kbps
Payload	32 bytes
Wireless channel error	5%

5.2. Results and Discussion

This paper uses NS-2.35 simulator to evaluate the performance of the SPEED protocol by comparing it with MMSPEED protocol. This simulation on various QoS parameters of SPEED such as Packet Drop Ratio, Energy Consumption, Delay and Throughput. Based on these parameters, it eventually engenders the end to end performance of MMSPEED protocol.

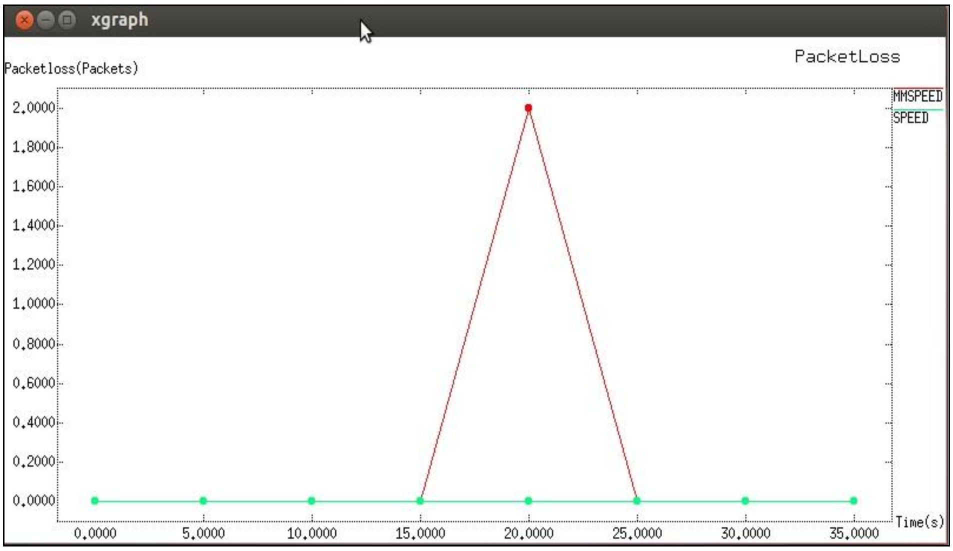

Fig. 5. Packet Loss Ratio

The Figure. 5 shows the packet drop ratio of SPEED and MMSPEED protocol. It is clearly seen that SPEED protocol performs better than MMSPEED. For maximum number of transmitting packet SPEED has 2

% less packet drop ratio than MMSPEED. By this here SPEED out performs MMSPEED in terms of packet delivery.

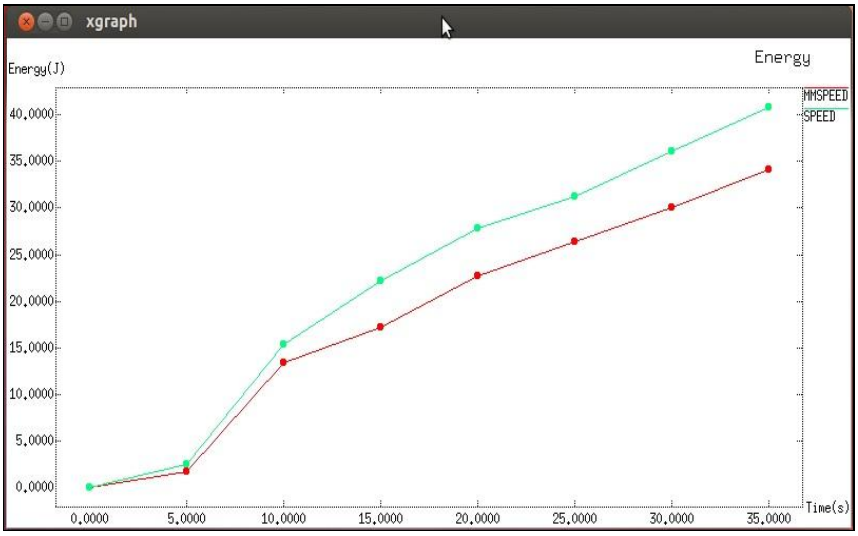

Fig. 6. Energy Consumption

Figure. 6 shows the energy consumption of both protocols. For a successfully transmit data MMSPEED consumes 16.36% less energy than SPEED. This is clearly shows that MMSPEED surpasses SPEED in terms of saving energy.

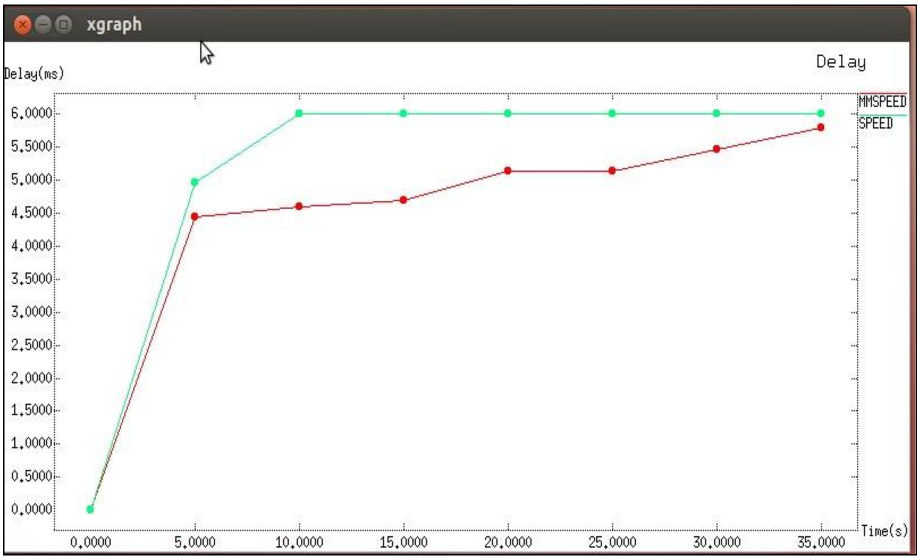

Fig. 7. End to End Delay

Figure. 7 indicates the delay in terms of completion of the communication. For the maximum numbers of packets transferred, MMSPEED has 3.77% less delay than SPEED protocol.

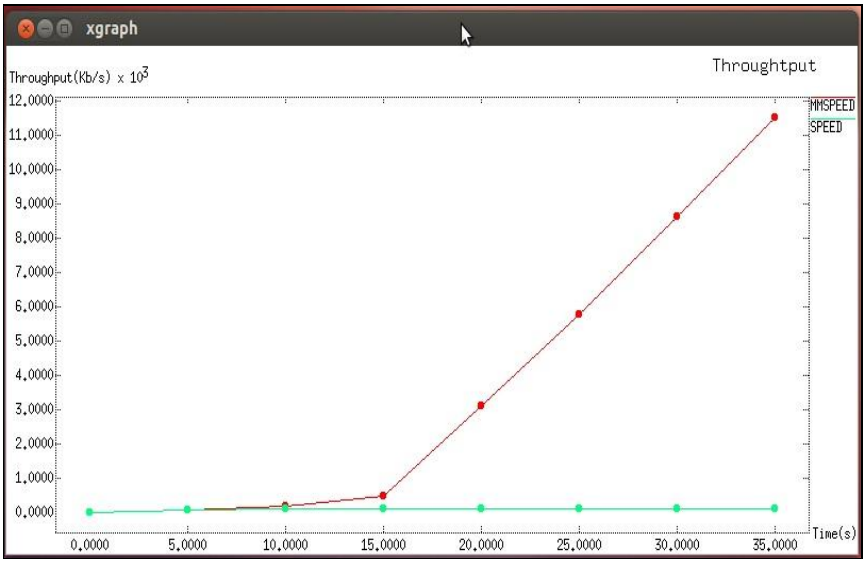

Fig. 8. Throughput

As shown in figure. 8 the throughput of MMSPEED protocol overcome the SPEED protocol. Throughput is measured in packets delivered with respect to time. For transmitting the maximum amount of packet, MMSPEED has 98.94% more throughput than SPEED. Thus MMSPEED has better throughput than SPEED.

VI. Conclusion and Future work

In this paper, we presented an overview of the requirements for QoS based routing protocols, and factors that are a challenge in implementing these protocols in a WSN Each routing protocol is discussed along with their solution to meet QoS requirements. Through simulation, the performance of the SPEED and MMSPEED protocols are evaluated and analyzed with respect Qos parameters. Comparison between SPEED and MMSPEED is performed and QoS is improvised. By the simulation results MMSPEED protocol outperform by 16.36%, 3.77% and 98.94% in terms of Energy Consumption, Delay and Throughput respectively. And SPEED protocol outperform by 2% in terms of Packet Delivery Ratio. Thus, it concludes that the MMSPEED performs better than SPEED Protocol. In future SPEED protocol combined with FT-SPEED (Fault-Tolerance SPEED) and EE-SPEED (Energy-Efficient SPEED) to create a novel Protocol MEGA-SPEED.

References

[1] Akyildiz et al., "A Survey on Sensor Networks," IEEE Commun. Mag., vol. 40, no. 8, pp. 102–144, Aug. 2002.
[2] M. Fonoage, M. Cardei, and A. Ambrose," A QoS Based Routing Protocol for Wireless Sensor Networks," in IEEE 29th International Performance Computing and Communications Conference (IPCCC), pp.122 – 129, Albuquerque, NM, Dec. 2010.
[3] T. He, J. A. Stankovic, C. Lu, and T. F. Abdelzaher, "SPEED: A Stateless Protocol for Real-Time Communication in Sensor Networks," in 23rd International Conference on Distributed Computing Systems (ICDCS), pp. 46 – 55, May 2003.
[4] S. Felemban, E, Chang-Gun L.E.E,"MMSPEED QoS guarantee of reliability and. Timeliness in wireless sensor networks," Mobile Computing, IEEE Transactions, vol. 15, pp. 738 – 754, June 2006.
[5] Harshkumar Thakar, Vhatkar Sangeeta and mohommad atique, "Comparative Study of Speed Protocols in Wireless Sensor Network," International Journal of Computer Applications (IJCA), vol. 120, pp.08-13, June 2015.
[6] NS-2 Simulator, http://www.isi.edu/nsnam/ns/
[7] M. Ibrahim Channa and Irum Memon," Real time traffic supports in wireless sensor network," in Student Conference on Engineering Sciences and Technology (SCONEST), pp. 1 – 6, Karachi, Aug 2005.
[8] T. He, J. A. Stankovic, C. Lu and T. F. Abdelzaher," A Spatiotemporal communication protocol for wireless sensor network," in IEEE Transactions on Parallel and Distributed Systems, vol. 16, pp. 995 – 1006, 2005.
[9] N. A. Pantazis, S. A. Nikolidakis and D. D. Vergados," Energy efficient routing protocols in wireless sensor network: A survey," in IEEE Communications Surveys & Tutorials, vol.15, pp. 551 – 591, 2013.
[10] R. Roustaei, E. Zohrevandi, K. Hassani and A. Movaghar," A New Approach to Improve Quality of Service in SPEED Routing Protocol in Wireless Sensor Network through Data Aggregation," in Second International Conference on Environmental and Computer Science (ICECS), pp. 393 – 397, Dubai, Dec. 2009.
[11] Dargie W. and Poellabauer C., "Fundamentals of wireless sensor networks theory and practice," John Wiley and Sons, pp. 168–183, 191–192, 2010.