"PERFORMANCE ANALYSIS OF MULTIPLE GATEWAY FOR WSN USNG VARIOUS NETWORK PARAMETER"

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Abstract : In standard wireless sensor networks, generally single sink node is to be used to collect the sensor data and collected is to be stored and accessed by the external users of WSN. Conversely single sink node or a gateway be the single point for the failure of network. To evade this problem multiple gateway based WSN is employed. Increasing the lifetime of the wireless sensor network(WSN). Requires energy efficient algorithms to be implemented. For such algorithms to be implemented. For such algorithms to be devised it requires a multigateway based implementation where the routing between cluster node and base station be optimized In order to check the performance of multiple gateway deployment different network parameter is to be analyzed by designing the scenario of multiple gateway with Fixed and Random position of gateway coordinator. In addition, analyze the multiple gateway with path-loss model. This method was analyzed in the qualnet simulator. The multiple gateway method was analyzed with different protocol like AODV, LANMAR, LAR, and ZRP when compared with other protocol they give best throughput, end-to-end delay and packet delivery ratio and provide good transmission between nodes.

IndexTerms **– Wireless sensor network, Qualnet 6.1, Gateway nodes, Routing Protocol, Path-loss models.**

I. INTRODUCTION

Natural disaster emergency response systems use wireless sensor networks (hereinafter, referred to as WSNs) to collect data from the environment. Typical WSNs have only one sink node to collect and store the measured data from many tiny sensor nodes. The measured data packets are sent using the multihop-based data forwarding method. In the context of disaster response, the single sink node-based WSN model can cause a single point of failure and users of WSNs cannot acquire emergency information data. WSNs also are specifically susceptible to attacks like overhearing.
Because a single sink node aggregation of all data from the network is not for sure an expeditious solution when dealing with large size WSNs, like e.g. in applications for monitoring natural areas. Indeed, as the network grows, the quantity of information that must be delivered to the sink by surrounding nodes increases creating traffic and energy ingestion bottlenecks. A promising alternative approach is based on the use of additional concentration nodes, gateway

In many scenarios, the collaborated sensor data are collected and data is transmitted for processing to application services. These servers can be reached through a sink node that is linked to a local or geographical network through a communication interface with a different technology with respect to the WSN. Since the transmission range of sensor nodes is often much smaller than the area covered by the WSN, sensors cooperate to deliver information to the sink node through multi-hop paths. The location of the gateway significantly influences the overall operation and performance of the network. When the gateway is located far from data sources, many sensors are involved in relaying data packets and hence energy consumption grows. In addition, longer paths boost data latency and risk an increase in packet drops. The optimal routing scheme has been designed for the sensors to transmit the data directly with the base station being in their own regions. In this work, different routing protocols are compared with ZRP, AODV, LAR and LANMAR to analyze the multiple gateway based WSN. From these protocols, examine which protocol provide better result for the deployment of multiple gateway for WSN.

II. LITERATURE REVIEW

Here they discussed about why the qualnet simulator is used for Real Time User Interface [RTUI] [2]. Because new real time user interface is investigated for the QualNet-based network evaluation and testing. With the aid of RTUI, a reliable human-in-the-loop framework is accomplished so that the human factors such as the GUI programs on local host or remote host can interact with QualNet-based simulator and changes the pre-configured parameter or condition of the network model to realize the impact of such parameter in the measurements. Experiment results demonstrate that the investigated RTUI works efficiently and the parameter or condition of the network model can be manually and dynamically changed, leading to better network model evaluation and function debugging[2].In a WSN the utilization and saving of energy more challenging thing. Because to increase the lifetime of network, the main aim to develop new efficient energy saving method is discussed in this paper energy saving is by calculating average distance between sensor nodes and choosing an appropriate cluster head nodes [3].

The Gateway Placement problem has been briefly studied in literature. The latter type of problems investigate the way of moving gateways to react in front of topology changes, failures, new QoS parameters or simply to balance the energy consumption among

sensor nodes. Even through many works of this class exist [8, 11], this type of problems is out of the scope of our work. The placement of gateway is more important in a large area network like habitat monitoring in environment and military appliances. If the more number gateways are to be placed in certain partition of cluster of nodes for each cluster gateways are assigned. For the placement of multiple gateway[12].

III. WIRELESS SENSOR NETWORK

Wireless Sensor Networks are the networks for communication, control, sensing, and actuation. A WSN is composed of low cost, low power, multifunctional sensor nodes that are small and communicate wirelessly over short distances. The sensor nodes collaborate to sense and collate information about the environment, through a set of transducers and radio receiver, and to forward informationtowardsacentralgatewaynode. It also includes sensor node, sink node, a connection to the Internet or satellite and a task manager node. The information collected from the sensors are transmitted to the gateway by compressing the data. In this nodes in the WSN are connected each with other node distributed in the system and nodes comprised to utilize less power and processing time these interconnected nodes are communicated wirelessly. Their neighbor and servers or other terminal unit through a wireless network. They use a multi-hop routing protocol to communicate with spatially distant nodes.

3.1 A WSN NODE

WSN node consists of five main components, a processing unit, memory, transceiver, sensors and power supply. The processor unit is responsible for making the WSN node to communicate with other sensor nodes, and execute application code. The memory unit can store the node's programs, including the network stack and application programs. The transceiver allows the node to communicate with the neighbor nodes. One of the most important components of a WSN node is power supply, which provides the node with life, and is normally limited so that once the node's power is exhausted the node can no longer operate. The sensor component consists of two parts: first, there is the analogue sensing component that physically measures environmental characteristics such as temperature; second, there is the analogue to digital converter that transfers the environmental readings into a digital representation that can be handled by the node processor.

3.2 PROTOCOLS OVERVIEW

Here some of the routing protocols are comparing to analyze multiple gateway for wireless sensor network. They are as fallows

AODV:

The Ad Hoc On Demand Distance Vector (AODV) is constructed based on the DSDV algorithm. The DSDV algorithm to monitor the list of routing table and AODV protocol was builds and it is an improvement of AODV over DSDV algorithm. In AODV protocol node does not exists on the same path and it not monitor the routing information or not involved in the routing table exchange. Hence, AODV is classify as pure route acquisition system.

LANMAR:

"Landmark Routing for Large Scale Wireless Scale Wireless Ad-Hoc Network with Group Mobility" is an effective Proactive routing protocol is the evolved method of Fishery Routing Protocol (FSR). The routing table and node gaps can be evaluated using hop count on a particular network topology. LANMAR reflects specific address in its node range system and enables LANMAR to explore and maintain a specific path. Route knowledge to communicate with each other in a particular chain's command area.

LAR:

"Location-Aided Routing**"** a mobile ad-hoc network consists wireless network hosts that may move often. The LAR uses a new mechanism to detect the routing between source to destination this protocol was developed to improve the routing performance in ad-hoc network. In the location-aided routing protocol performs based on the location information, which helps to reduce the limits the search for new route from the same 'requested by zone'. By utilizing the location information.

ZRP:

Zonal Routing Protocol is a hybrid wireless networking routing protocol it uses both reactive and proactive routing protocol while sending the data over the network. The Proactive routing uses additional bandwidth to maintain routing information, while reactive routing contains long route request delays. Reactive routing also ineffectually floods the entire network for route determination.

3.3 PATH-LOSS MODELS

Path-loss model in wireless sensor network verify the behavior of network. Path loss model in a wireless sensor network is the major component for the analysis and framework of communication system and path loss model is the attenuation of EM wave through the free space.

1. ***FSFL.***

Free space path model is the communication between two points in Line of sight (LOS). In a telecommunication, free space path loss model is attenuation between the two fed points of antenna.

$$FSPL(db) = 20log_{10}(d)$$

FSPL=Free Space Path Loss

2. Two Ray model (TR).

Two-ray ground reflected model is a radio propagation, which expects the path loss between transmitting antenna and receiving antenna with in LOS. Typically, the two antenna are in a different height or distance.

$$\Delta\emptyset \approx \frac{4\pi hthr}{\lambda d}$$

III Performance Metrics

The performance metrics helps to characterize the network that is substantially affected by the routing algorithm to achieve the required Quality of Service (QoS). In this work, the following metrics are considered.

1 Average Jitter

Delay is the change is the difference between delay-introduced units throughout the communication route. That is the time difference at the time between reaching of one packet to other. The jitter is a usually used an indicator of network stability.

2 End-to-End delay

In the Network delay is the total latency that packet has taken to reach from source node to destination node. The end-to-end packet latency is the sum of the process delay, packet transmission delay, propagation and queuing delay.

3 Packet Reception

Packet reception is the ratio of total number of packet delivered to the destination through the CBR traffic application.

$$Avg\ jitter = ((packet\ arrival + 1) - (packet\ start + 1)) - ((packet\ arrival) - (packet\ satrt))/n - 1.$$

4 Throughput

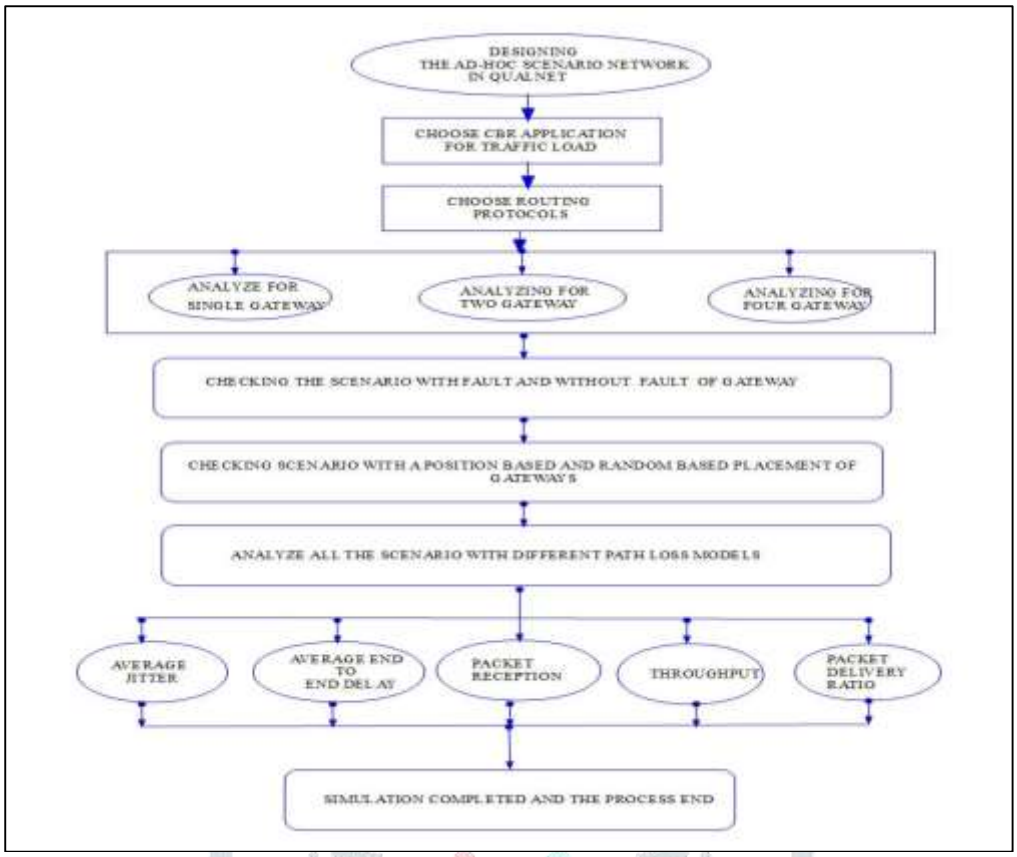
Throughput is nothing but total number of packets transferred to the destination. And it is the measure of the data rate(bits per second) produced by the CBR application. The equation shows the calculation of TP, packet size of the ith packet reaching to the destination.

5 Packet Delivery Ratio

Packet Delivery Ratio (PDR) is the ratio between the total number of packets transmitted by a traffic source and the number of packets received by a traffic sink.

IV.METHODOLOGY

Here the qualnet simulator tool is used to reenact the real world network. because in this tool it is easy design network because it is a gui based simulation and also easy to implement and analyze the behavior of the network. The path loss is mainly due to the some effects such as free space, refraction, diffraction and absorption. Moreover, terrain counters, environment, the height, and the placement of antenna influence the path loss. In this project, analyze with the different path loss model like free space and two-ray model. All the scenarios are analyzed with various network parameter like average jitter, end-to-end delay, packet reception, throughput, and packet delivery ratio. For those scenarios, analyze the network with the different Routing protocol like AODV, LANMAR, LAR and ZRP to examine which is the best routing protocol among them for the designing of multiple gateways in WSN. After performing all these condition with various network parameter and with different routing protocol and analyze the result.



1.Flow Diagram

V SIMULATION SETUP

In this project designing the scenario for performance analysis of multiple gateway for WSN by increasing the number of gateway for each scenario with a Fixed and Random gateway placement with a various Routing protocol for each scenario. In addition, examine the scenario with failure of gateways because due some human error or natural disaster there is a chance of gateway failure.

1 FIXED GATEWAY PLACEMENT

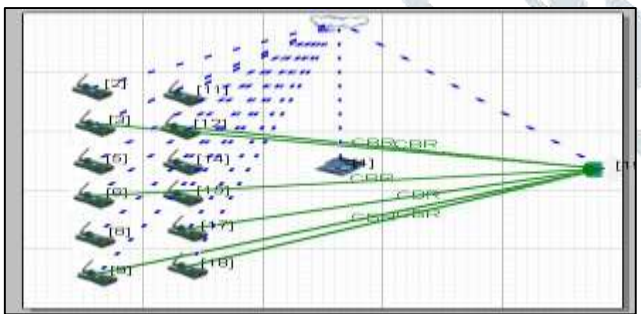


Fig 2.Scenario with a fixed single gateway

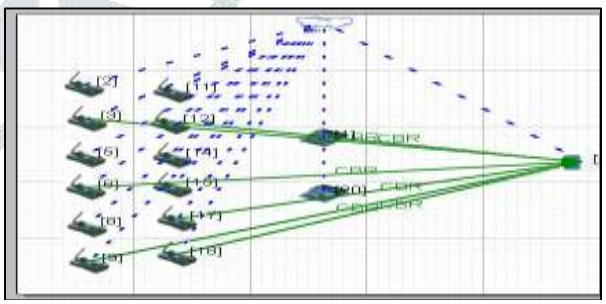


Fig 3. Scenario with fixed two gateway

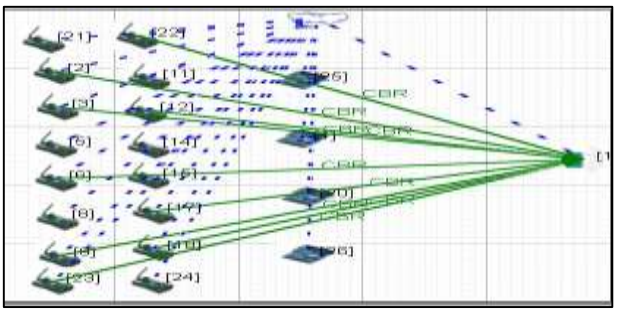


Fig4. Scenario with fixed four gateways

2 RANDOM GATEWAY PLACEMENT

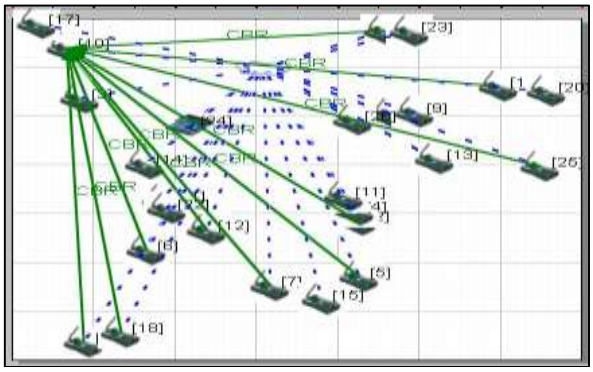


Fig 5. scenario with random single gateways

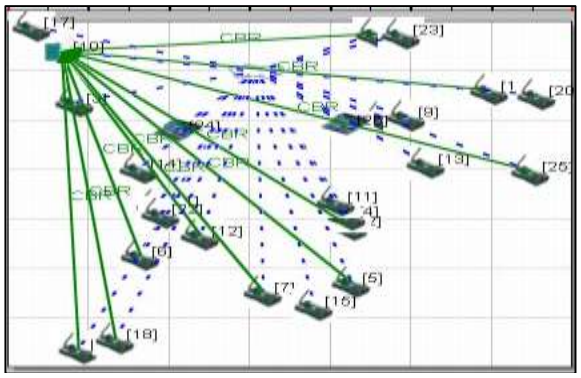


Fig 6.scenario with random single gateways

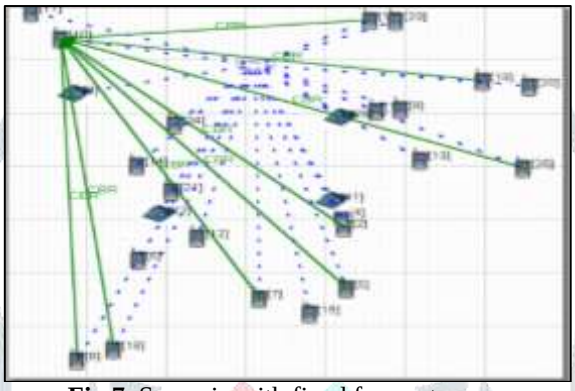


Fig 7. Scenario with fixed four gateways

The scenario with the one two and four random gateway placement with sixteen nodes all these scenarios are run with fault and without fault of gateways. In this simulation scenario, CBR application is used to check the data rate between servers to client. In addition, examine the scenarios with two different path loss models their after this various network parameters are analyzed with a different Routing protocols to determine which is the best routing protocol among them.

By these simulations of scenario with either the fixed and random placement gateway to characterize the single gateway or multiple gateway, placement scheme is better for WSN by analyzing with different network parameters.

3. NETWORK REQUIREMENTS

PARAMETERS	VALUES
Simulator	QualNet 6.1
Physical and MAC model IEEE 802.15.4	IEEE 802.15.4
Terrain 500*500 sq.mt	500*500 sq.mt
Number of nodes	16 nodes with WSN Network; 1, 2 & 4 Coordinators (Gateways) and 1 PAN Coordinator.
Traffic Type	CBR App
Modulation scheme	O-QPSK
Routing protocols	AODV, LANMAR, LAR and ZRP
Path loss Model	Free Space and Two Ray Ground

VI. RESULT AND ANALYSIS

6.1 FOR FIXED GATEWAY PLACEMENT

1. For Single Gateway

The fig 8 shows avrage jitter in this ZRP is less jitter in freespace without fault of G/W in freespase but withfault in Two ray model and in all the cases LANMAR and LAR has the low jitter as compared to all protocols. As shown in fig 9 End-to-end delay AODV,LANMAR and LAR gives almost same and less delay all cases. But in ZRP delay is very high compared to all the protocol. The delay is low in ZRP only at Freespace without fault of gateway.

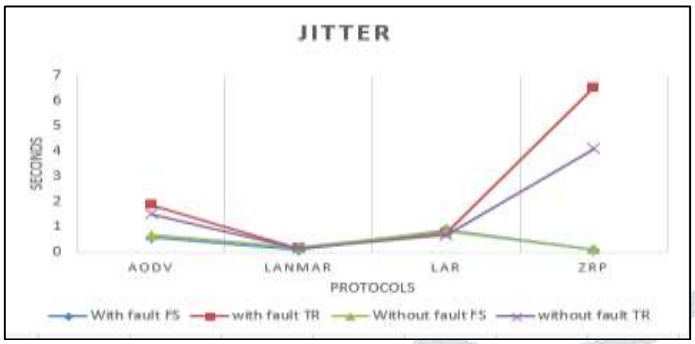


Fig 8. Jitter

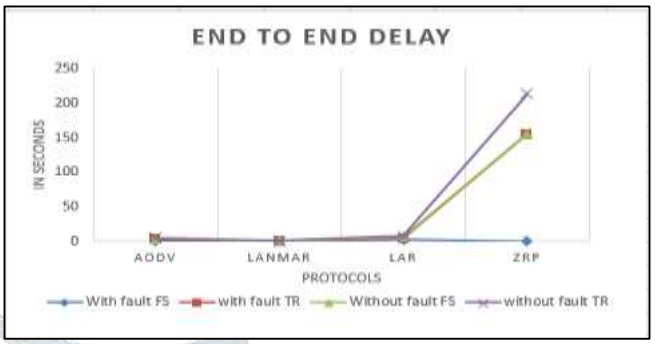


Fig 9. End to End Delay

The throughput and PDR for the single gateway random placement. Here the throughput is high for AODV and ZRP protocol in FS model for both the codition. But it is low for TR pathloss model it will same for LANMAR and LAR protocol also.

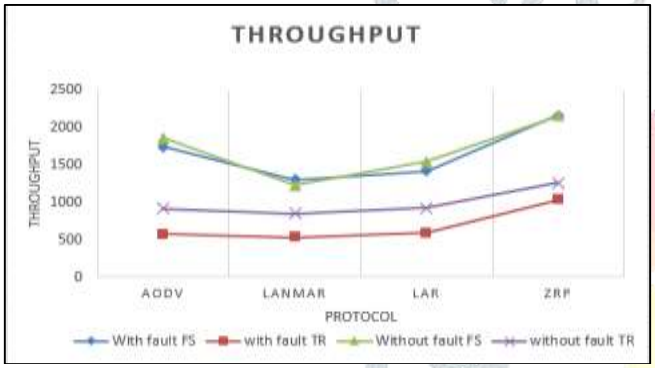


Fig 10. Throughput

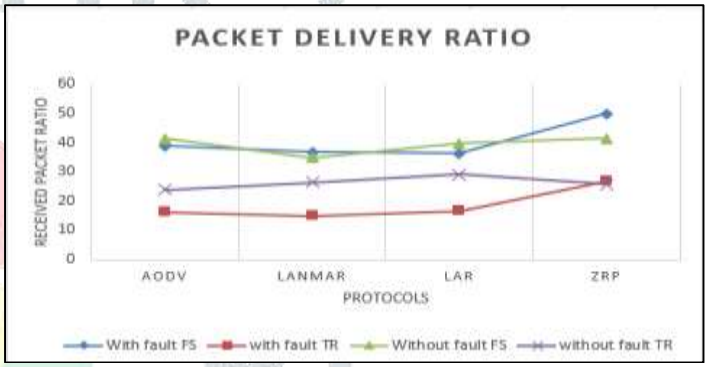


Fig 11. Packet delivery ratio

2 For Two Gateways

For fixed gateway two gateway placement is analysed with different parmeters as depicted in the fig avrage jitter. In this scenario LANMAR has the low jitter as compared to all protocols . The ZRP and AODV gives highest jitter delay for withfault of TR pathloss model. For End-to-end delay AODV,LANMAR and LAR gives almost same and less delay all cases. But in ZRP delay is very high compared to all the protocol for withfault in TR model . The delay is low in ZRP only at Freespace with and without fault of gatewayonly in FS path loss model.

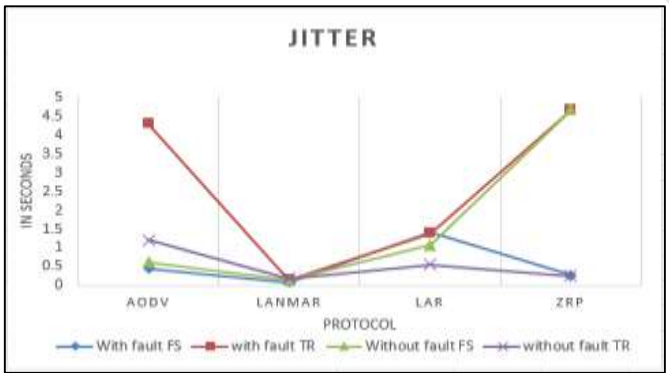


Fig 12. Jitter

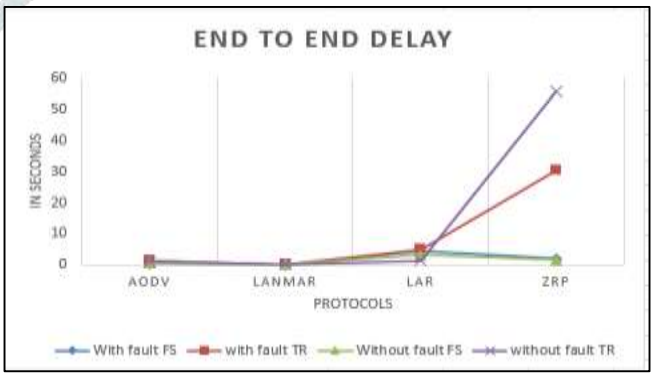


Fig 13. End-to-End Delay

Throughput for AODV and ZRP gives best result but in TR pathloss model with fault of gateway ZRP gives high compared to AODV and other protocols. The metrics values for packet reception are tabulated and plot in below, which shows the PDR value

for AODV, LANMAR and ZRP gives almost same for random placement of gateway. but LAR protocol gives the worst result in two ray path loss model it was better only for free space.

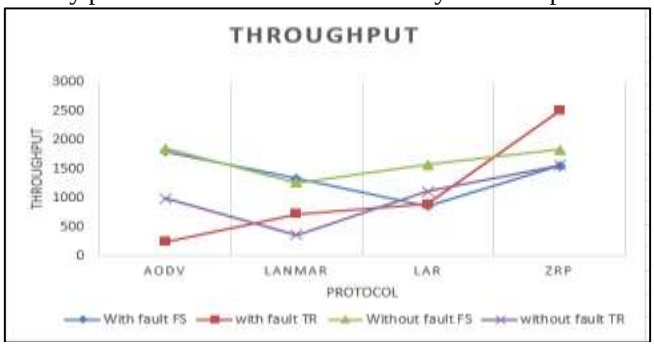


Fig 14. Throughput

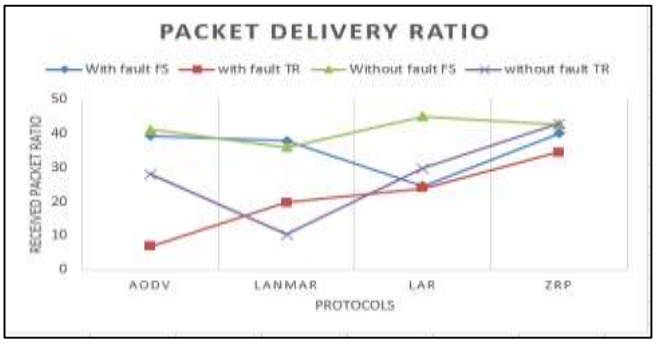


Fig 15. Packet delivery ratio

3. For Four Gateway

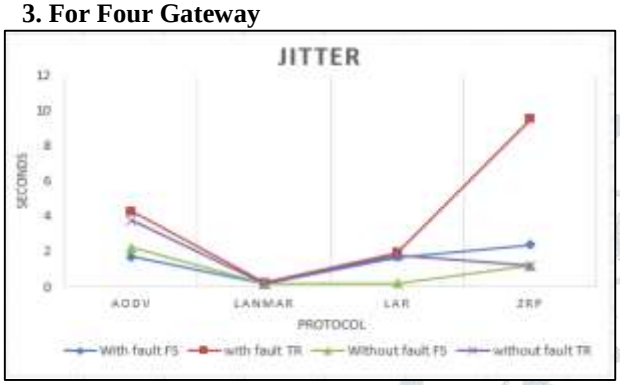


Fig 16. Jitter

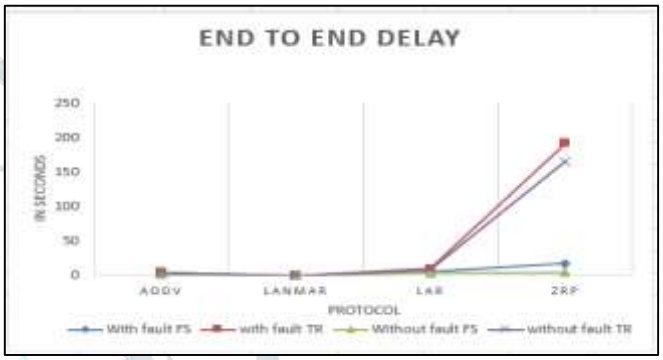


Fig 17. End to End Delay

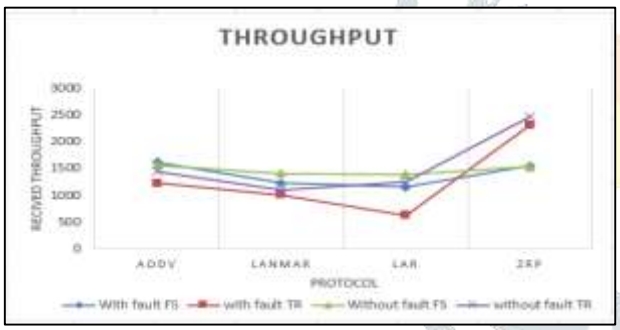


Fig 18. Throughput

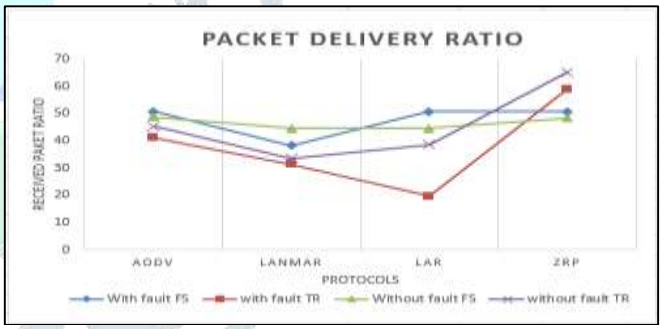


Fig 19. Packet delivery ratio

The metric values are tabulated and ploted for the packet delivery ratio with a fixed placement of gateways. The PDR is high for ZRP in addition to this AODV also gives the better performance but LANMAR and LAR gives an average result. In two ray path loss model LAR gives the worst performance. Hence AODV and ZRP protocol are best choise for multiple gateway. This over all results analysis for all the performance matrics for fixed placement of gateway as the gateways are increased packet throughput and reception also increases respectively.

6.2 FOR RANDOM GATEWAY

1. FOR SINGLE GATEWAY

In which jitter is very high in the LAR protocol for TR model withfault of gateway and the LANMAR and AODV gives a low jitter value and ZRP gives average jitter with respective of all cases. And for end to end delay AODV and LANMAR, gives almost same and less delay all cases. However, in LAR and ZRP protocol for TR model with and without fault of gateway the end-to-delay is increases.

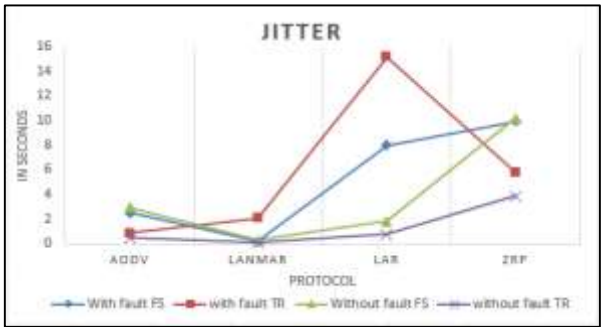


Fig 20. Jitter

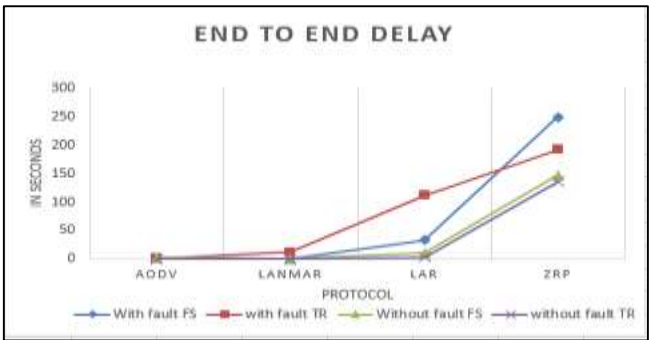


Fig 21. End to End Delay

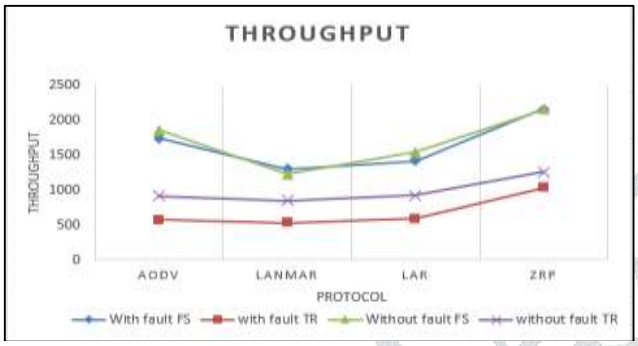


Fig 22. Throughput

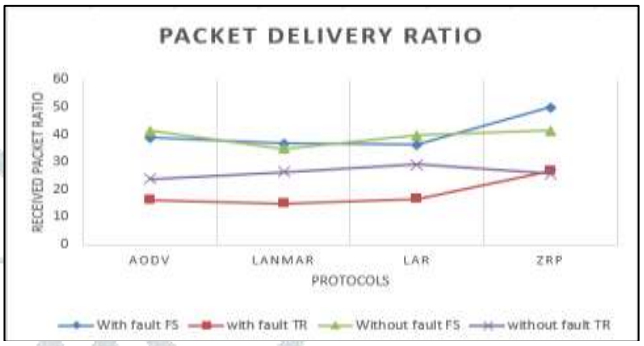


Fig 23. Packet delivery ratio

2. FOR TWO GATEWAY

In which jitter is very high in the ZRP protocol at TR model for with withfault of gateway and the LANMAR andcLAR gives a same jitter value and LANMAR gives very lowjitter with respective of all cases. For End-to-end delay AODV,LANMAR and LAR gives almost same and less delay all cases. But in ZRP delay is very high compared to all the protocol. The delay is low in ZRP only at Freespace with and without fault of gatewayonly in FS path loss model.

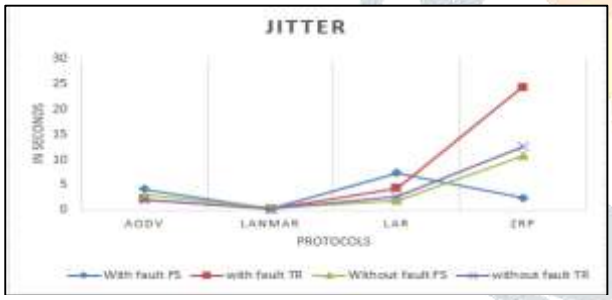


Fig 24. Jitter

Fig 25. End-to-End Delay

The metric values are tabulated and plot for PDR for random placement of two gateway. ZRP gives the best result in all topologies. AODV gives best result only for free-space topologies.

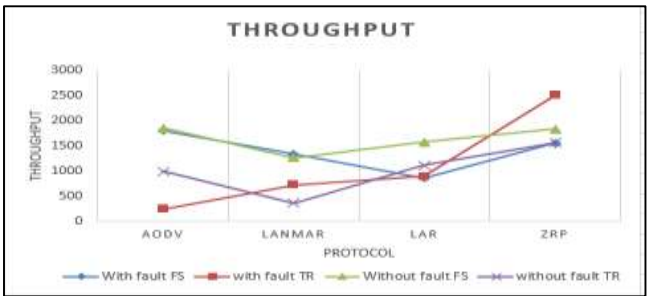


Fig 26. Throughput

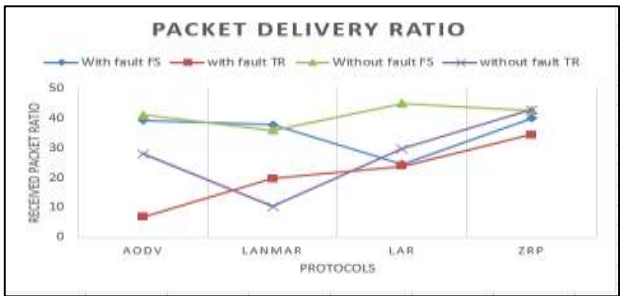


Fig 27. Packet delivery ratio

3. Four Gateway

The metric values are tabulate and plot for random placement of gateway. It shows the ZRP has more jitter for all topologies. End-to-end delay AODV,LANMAR and LAR gives almost same and less delay all cases. But in ZRP delay is very high compared to all the protocol. The delay is low in ZRP only at Freespace with and without fault of gatewayonly in FS path loss model.

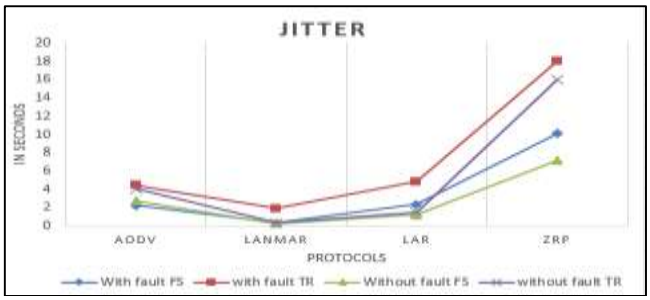


Fig 27. Jitter

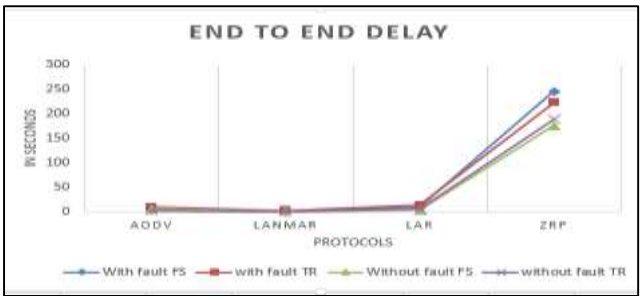


Fig 28. End to End Delay

metric values are tabulated ploted throughput for Random placement of gateway by anaylysing those two parameter ZRP gives best result in all the cases LANMAR and LAR gives average Throughput. But for random placement AODV gives poor result it is better only at freespace pathloss model

The metric values for packet delivery ratio are tabulated and plot for random placement of gateway for a random placement of gateway. Here the ZRP gives best in all the cases. For AODV and LAR gives the average result. In a failure of gateway for free-space and two-ray path-loss model gives worst performance.

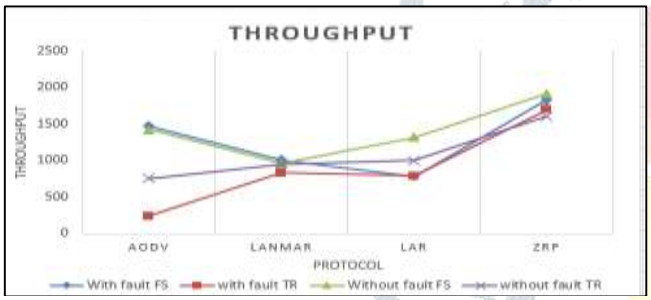


Fig 8. Throughput

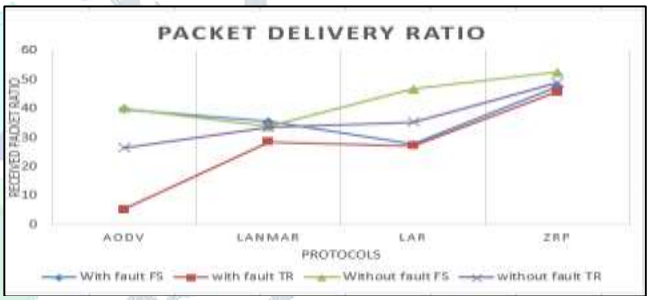


Fig 9. Packet Delivery Ratio

As the number of gateway increase with a random placement, it increases the performance slightly but it decreases for AODV, as increase is the gateways. At the end of simulation by comparing results of both Random and Fixed gateway placemnt of gateway, fixed placement of gateway gives the best throughput and high reception rate. And AODV and ZRP are best protocol for multiple gateway placement. Therefore for multiple gateway placement scheme fixed placement is the suitable method to increase the performance of WSN.

VII CONCLUSION

The proposed multi-gateway-based protocol to reduce energy depletion, to transmit the data quickly by shortest paths. The network lifetime is improved and transmission distance is reduced by placing the gateway nodes at correct position for reducing data loss, in this project, finally I concluded by considering single gateway and multiple gateway deployment in WSN with fault and without fault of gateway and by considering the path loss model effect in the system or network. After analyzing this parameter with various routing protocols then by comparison of result has been done with various parameter likes Jitter, Throughput, End-to-end delay and Packet reception. After this, it can be concluded that multiple gateway gives better throughput with a fixed placement as compared Random placement of gateway. In addition, in single gateway placement, data loss is more and it takes more propagation time compared to the multiple gateway placement in WSN. By considering all those factors AODV and ZRP routing protocol gives the better network for multiple gateway deployment.

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