# INTELLIGENT ANT COLONY BASED QoS OPTIMIZATION ROUTING IN MANET

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**Abstract**

*In this rapid development of technological environment, mobile ad hoc network (MANET) embraces various technical issues due to its open medium and dynamic topology and decentralized wireless nodes. A mobile ad hoc network is a self configured network connected by wireless links. This kind of a network is only exercise for ad-hoc environment since it doesn't have a centralized control. The mobile nodes by utilizing the services of additional nodes within the network to spread the information across the network. Due to its' intrinsic performance of MANETS, Such as periodical change in topology, nodes mobility, resource paucity and dearth of central control. To offer Quality of Service (Qos) to this kind of network would become very arduous task an owing to dynamic environment posture and limited resources. QoS routing is a method of routing information from source to destination based on its resource constraints. In the earlier researchers developed many algorithms to progress the QoS in an ad hoc fashion network, but which are inadequate to overcome End to End delay, throughput and loss of packet. So this paper addresses a naval approach called intelligence with ant colony based Intelligence QoS routing in MANET. In this proposed method a group of node acquired from sporadic interaction in the midst of agents and nodes. This proposed system coherently segregates MANET into clusters comprising static agent and mobile agent. The mobile agent act together with the static agent and other mobile agents to gather about QoS related information and optimal path selection from source to destination to provide a better QoS Simulation and diagnostic results depicts the effectiveness of this proposed scheme.*

KEYWORDS: MANET, QoS, Ant colony, Routing, Route Discovery, Route Maintance

## Introduction

When conventional wireless networks need centralized control rigid infrastructure and necessary requirements for their operation in Mobile Ad hoc Network(MANET) can survive without fixed infrastructure. However the enhancement of MANET directs several issues such as p[ower management ,effective routing, mobility management, dynamic topology changes adverse the QoS delved by the user. The QoS is a assortment of assured parameters such as end to end delay, error rate, available bandwidth, packet loss rate, hop count etc., and labels the network behavior under certain circumstances and make concurrence between source and destination. Due to the periodical changes of network topology the QoS would be an influential factor. Routing algorithm identifies the shortest path to transmits the data from source to destination. Ant colony based Intelligence QoS routing algorithm have been proposed to identify the path to deliver the data from source to destination to fulfill the QoS limitation. The main objective of QoS is to choose an optimal path that must be satisfied about the QoS resource requirements and an efficient utilization of resources. The earlier work have come across the crises like network traffic fluctuation sensing, investigate the continuous status of network traffic and sudden identification of an optimal path is very tedious process. In this paper presents Ant Colony based intelligence QoS method to eradicate these issues to accomplish the aforesaid problems. This proposed method identifies an optimal path, despite dynamic change in the network. This algorithm split the network into two different clusters and a mobile agent would be deployed in each cluster. An onerous responsibility of the mobile agent is to gather the required QoS resource assigning trust vales to each nodes and continuous communication with all the nodes, neighboring mobile agents and static agents to identify the QoS path with secure and reliable for all the nodes in a network. This paper has been organized as

follows, Section 2 reveals about the existing works; section3 discusses the proposed Ant Colony based intelligence QoS routing in MANETs; Simulation and results are in section 4and section5 drawn the conclusion.

**Related Work**

The MANET is widely used in the present life, but it detracts from the problem of QoS during the communication. This paper addresses certain description of the latest technology which is accessible and help to enrich the QoS in mobile Ad hoc Network. Huang.et.al[1] proposed a novel method to hold up QoS in MANETs by uplifting the routine in terms of utilization of bandwidth, latency reduction and the requirements of jitter by establishing a convenient architectures that supports for various protocols. Admission control layer optimization and routing schemes would be considered to carried out this task by using an optimization mechanism[7]. Xiang.et.al[8] presented multicast routing mechanism for MANETs. In this paper the multicast routing protocol has been classified into tree based and mesh based multicasting. The tree based move towards best forward effectiveness and use low bandwidth. Due to the links between the nodes it performance may be despoiled. Renese.et.al[9] addressed cross layer structure which is used for decision making support to the QoS. Zhang.at.al[10] described latency as the QoS disturbing factor and considered that the topology control method is needed to meet the necessity of delay in the network. To meet out the necessity of latency in the network interference and latency have been discussed in this paper. The performance of the system can be improved by advertising an algorithm called interference based topology control method for the latency constrained scheme, interference and latency constraint parameter have been considered together. Particularly this work optimizes the performance by upgrading delay, jitter and the parameters of contention delay.

Canels.et.al[11] introduced admission control based method to hold up the QoS for MANETs with the aid of cross layer structure. This work mainly focused to resource utilization efficiency by admission control strategy. Adaptive admission scheme has been implemented to estimate end to end available bandwidth. The system may opted for the configuration parameters and to adopt the system resources to execute the task effectively by taking into consideration of various mobility parameters. In the genre of MANET to offer better QoS become very tedious task. So Frias .et .al[12] advertise a routing scheme for MANET to provide QoS for the multimedia applications. To overhaul this issue, a multi path routing scheme has been introduced to enrich the performance by combine multipath routing with cross layered structure.

Likewise a different approach for QoS provisioning in MANET by shijie.et.al[13] expressed cross layer based scheme and hob based scheme. In this method one hop neighbor based scheme fulfill the gap between MAC layer and overlay architecture using cross layered scheme. P.Goudarzi.et.al[14] stressed the probability of erroneous in packet is very high due to the MANET fashion. This approach includes Bi-predicative and predictive frames to increase the QoS by implementing effective method. This method begins with a model to examine the information and parameters which concerned about the routine of this network by advertising packet error and delay in transmission.

2. Existing Works

The previously proposed algorithm provides certain solution to end-to –end delay and throughput and control the packet loss. This algorithm is a combination of reactive and proactive characteristics'. But this algorithm given insufficient information and inaccurate parameters. Since it addresses the problem of resource constraints with maximum probability of satisfying QoS. The proposed method is Ant Colony based intelligence QoS approach for MANETs. It computes the synthetic QoS of MANETs using various QoS metrics to sublimate the overall network performance.

3. Ant Colony Based Intelligence QoS Routing:

Ant colony approach is a heuristic based representation of generic problem and the behavioral changes of an Ant. It accepts the scouring behavior of real ants. When more than one path existing from a nest to food, the ant may initiate walk randomly. When it moves towards food and return back to the nest, it lays chemical particles called pheromone, which serves as the route between the ant. Consecutively the stranger ants suppose enter into the network will take a path which holds maximum pheromone concentration and strengthen the path that has been chosen.

In this scenario ,this proposed method will give the solution to the problem by moving parallel and asynchrously on the suitable defined graph. It provides the way for solution construction, updating of pheromone and suitable interaction in the process of solution. This method enthused by the foraging activities of ant colonies targets discrete optimization problem.

Solving Network problem.

Network Routing Solution using Ant Colony :

MANET Routing is very arduous problem due to the behavior of networks such as dynamic topology changes and heavy traffic may differ hypothetically by the time varying nature. The decentralized posture of network routing is mapped with multi agent nature of Ant colony algorithms. This network can be represented in a graph where the vertices represents set of routers and the links represents the link to the routers in the network. At present network routing identification issue is just discovering the set of minimum cost link between nodes available in the corresponding graph which will be done easily by this algorithm.

Common characteristics of ACO routing Algorithm

The underneath set of prosperities classify ACO instances for routing issues:

1) Enable traffic adaptive and multipath routing
2) It depends on both active and passive information monitoring and gathering
3) Make use of stochastic components
4) Setup links in a shortest path scheme for load balancing
5) Provide limited sensitivity to parameter settings.

Significant Description

Hello Ant:The source node initially transmits Hello message as <Source node Address, Hop count=1> is promulgated periodically every seconds to every node 'i ' in the network. After receiving Hello message from the neighbor node 'j' will reply with an acknowledgement <Address(j), Address(i)>. Now the source node I may receive this acknowledgement and identifies the delay between the two nodes calculated by the time interval of sending and receiving messages. Without a tarry for a while node j enter into the neighbor table and initial pheromone value $\tau ij$ = 0.1is placed on the path.

Route Request Ant:

The Route Request message holds <Source Address, Destination Address, Hop Count=1, Starting Time= current time, Bandwidth = Available Capacity of leaving link, A list of visited node> is disseminated and it is received by the destination. At every node the hop count will be gradually increased and the node id will be enter into the list of visited nodes. The bandwidth will be estimated as Bandwidth= min(Bandwidth of outgoing path, Bandwidth in the received Route Request).

Route Reply:

Once the destination receives Route request then it will be converted into a Route reply <destination address, source address, Hop count, Request Arrival time,, reply starting time>, A list of nodes to be visited>. This message will be directed to the source node. When the data is transmitted between the nodes, none of the intermediate node may update the contents of the message and hop count. Each node notifies the content to which it has to be transmitted.

Route Discovery Method:

1. Let s and D be the source and destination respectively and Let D, be the QoS requirement delay, B be the Bandwidth and Hop Count HC.

2. The source node S begins to transmit a Route request message to destination D via intermediate nodes from the continuous hello messages.

3. The route request packet also collects the transmission latency. Processing delay, accessible capacity and the number of hops visited from each link.

4. When the destination receives this Route request it transformed into Route reply and transmitted towards the source. This would travel on the same way of route request but in the reverse direction.

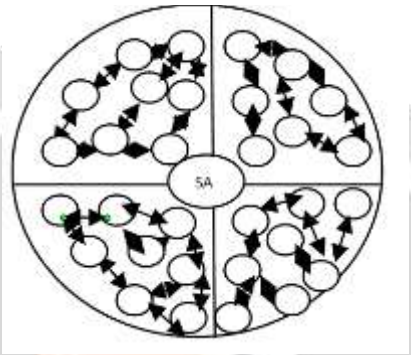
5. Either the source or the intermediate node receive this route reply, the node identifies the delay, bandwidth and hop count upon the received message and to the respective destination. So it estimates the probability of path preference to reach the destination.

6. if the probability of estimated cost vale is greater than the required value, then it is established and accumulated in the memory.

7. The highest probability of cost estimation will be considered as a best path and the data transmission will be carried out through this path.

Proposed algorithm

This paper imposes Ant colony based Intelligence QoS routing algorithm. This proposed method consists of two phases (i) Route discovery (ii) Route maintenance phase. When the source node wants to transmit a data to the intended destination, it starts with route discovery phase. Once the route is identified then data can be exchanged between two nodes. During the transmission of the data it has to retain its path to the destination. This process will be carried out in different cluster where each cluster consists similar types of nodes. The nodes within the transmission range can form a cluster. In this method a Static Agent (SA) would be deployed in each which has extreme resources and split the MANET into two different clusters. The SA form and transmits an MA to each cluster and it establishes a path from source to destination based on the information offered by the MAs. As MA developed by using Ant colony based intelligence QoS optimization routing algorithm it frames a collection of neighbor nodes and it may have a periodical interaction with each other. Throughout the interactions the nodes within the cluster can distribute the resource information.




By using the aforesaid information the MA chooses nodes which assure QoS necessities provided by the source node. This process would repeat until the destination node identifies the entire selected node from source to destination through an optimal path. Based on the resource information given by the neighbor nodes, the MA calculates the trust value and allotted to all the nodes in the group. Each node disseminates the information to the MA, provided by the residual (RM) and total memory(TM), Computational speed up(CS), transmitter power, loss of packets(LP) and total power of node (TN) and neighbor nodes feedback($F^i$nb). The feedback of the i$^{th}$ node will be computed by

$$F^i\text{nb}=\frac{\sum_{i=1}^{M} Fk}{N}$$

Where $F_k$ is the feedback of k$^{th}$ node and it consists of the information related to the number of received packets and its acknowledgement. N is the total number of neighboring nodes. $F^i$nb will be defined as

$$\int_{0.5}^{\infty} F^i\text{nb di}$$

The trust value will be computed for the i$^{th}$ node, $TV_i$-is computed by

$$TV_i = \frac{RM}{DM}$$

Where loss of packets and $\alpha$ = 0; if LP =0
1; Otherwise

The trust value represents the nodes reliability and it selects the nodes which is appropriate for steadfast routing. This consistent node may support for the selection of the alternative path for the flourish routing of the packet from the source to destination. This process would repeat until the frontier node of a cluster reached. The continuous interaction between MA among the nodes in a group will update the QoS resource information and other trust value. The MA of the cluster disseminates the available bandwidth, number of consistent nodes, estimation of links, latency between nodes and links etc.. to the SA when it has interaction and record it in its database. In this paper addresses the underneath QoS limitation and their mathematical illustration

1. Bandwidth Available: The available bandwidth of the path is BW(m,n). The unused bandwidth at any path of the link from the source S and destination d and it is provided by, BW(P) = min{BW(path)}, Where P = s →i …. . . →d and path = {(s, i), (i, j), . . . , (t, d)}
2. Latency: It is the sum of transmission, reception, propagation, processing and transmission on all the links on P and source node and delay is specified by Delay(P)= $\sum_{i\in path} Delay(i) + Delay(s)$.3
3. Loss of Packet Rate: It is a break of link known as loss(p)= 1-$\prod_{i\in path}(1 - loss(i))$
4. Cost: It is the total number of hops from source to destination specified as Cost(P)=$\sum_{i\in path} Cost(i)$

Many applications and services are required for various QoS constraints. The source node calculates the needed QoS such as $BW_{req}$, $C_{req}$, $D_{req}$, and $LP_{req}$ are needed bandwidth, Cost , delay and loss of Packets respectively. These are the constraints to establish an optimal QoS path from the source to the destination are as follows

Bandwidth Constrained =BW(P)≥$BW_{req}$ , Delay Constrained : Delay(P)≤ $D_{req}$, loss constrained loss(P)≤$LP_{req}$ , Cost(P)≤$c_{req}$ ;

5. TV of nodes on a path P, the QoS path can written as

   Optimal QoS=BW(P)*Delay(P)*loss(P)*Cost(P)*$\frac{\sum_{j=1}^{n} TV}{n}$

Where n is the number of intermediate nodes in the path. When the source node initiates a data transmission to the destination it calculates the resource information and assign to the MA. The MA identifies an optimal QoS path to the destination from the source using Antcolny intelligent based QoS method. This is exactly appropriate for the allocation of required resource and allocating an alternative path, etc. it drawn from the intelligence group through periodical interaction between MA, SA and all the nodes in the group.

1. Resource Message(RM)=<SA, SN, info, MA> where SA represents address of the source node; SN signify the nodes sequence number; info reveals QoS resource information about nodes ; MA means mobile agent address in a group.
2. Agent Trust Value Message(ATVM)=<SA, SN, Info, NA> where SA indicates address of the source MA; SN specifies nodes sequence number; info reveals available and needed QoS data and links; NA describes the address of the MA in a group
3. Agent QoS Value Message(AQVM)= <SA, SN, Info, NA> where SA represents address of the source node; SN illustrates nodes sequence number; Info express reveals available and needed QoS data and links
4. Required QoS Messages(RQM)=<SA, SN, Info, NA> where SA describes the address of the source node ; SN= nodes sequence number; info conveys available and needed QoS data and links; NA signifies the address of MA's neighborhood.
5. Available QoS Message(AQM)=< SA, SN, info, MA> where SA exposes the address of SA; SN means the nodes sequence number; info represents QoS information and optimal link from the source to the destination; MA divulges the address and information about MA.

When a node initiate to transmit data to the destination, it estimates the necessarily of QoS resources such as $BW_{req}$, $C_{req}$, $D_{req}$, and $lp_{req}$ and disseminates with the MA during the communication. The MA frames a group which comprises similar types of nodes and allocates a trust value by ATVM and chooses a node that gratifies the QoS requirement specified by the source node using AQVM. The MA wanders to the next node within the cluster and executes the same until boundary node is reached. The chosen node creates an optimal path from the source to the destination in the cluster. Suppose if the destination node belongs to other cluster MA1 node acquire the destination node cluster information from the source and it frames a cluster which includes MA2 and MA3. The MA1 periodically interacts with all other nodes in the cluster. Throughout the interaction the nodes distribute information such as cluster information and optimal QoS path related information by AQVM.

The MA1 identifies an optimal QoS path from the source to the destination based on the needed QoS. If the neighbor node doesn't have any information about the destination then each neighbor node forms a group consists of the neighbor MA. All the MAs' within the cluster may distribute information and assign a QoS path the respective MA.

When any node attempts to be failed on the optimal QoS path, then the MA takes response from its neighbor node and assigns an alternate path in the network. The SA makes an alternate optimal path by using its gathered information when the MA fails. Perhaps the SA node fails, then a node has a strong resource to turn into the SA and rationally divides the network into cluster. Thus identifying an optimal path of QoS from source to destination issue will be resolved by the intelligence based QoS algorithm and assigning trust value to the cluster is given below.

Algorithm for Trust Value assignment in a cluster

1. Start
2. Let n and nb and BN represents the number of clusters and number of neighbor node and boundary nodes respectively
3. Let M be the node in which the mobile node can runs
4. Let S and D be the source and destination respectively
5. For cluster k=1to n do
6. SA creates and deploys $MA_k$ at $k^{th}$ cluster
7. End for
8. For cluster k=1 to n do
9. If n≠BN then
10. $MA_k$ at node M forms a group which consists of nb
11. For p=1 to nb do
12. $MA_k$ collects QoS resource information as well as node resource information
13. Calculate and allot TV for $p^{th}$ $_{node}$ of $cluster_k$
14. End for
15. $MA_k$ sends all QoS information of a group to SA and moves to next node in $cluster_k$
16. M=next node
17. End if
18. End for
19. End

Antcolony QoS

While iteration<MAX_ITERATION and
num_best_sols< NO_MORE_SOLUTIONS
do
for M=1,…., M Max
Ant M→find_route()
Ant M→join()
If Ant M→route_val> Best_Val then
Best Val=Ant M→route_Val
Best_route=AntM->route
Num_better_solutions=0
end if
end for
pheromone_Update(Best_route)
num_better_solutions=num_better_sols+1
end while

Ant colony intelligent based QoS

1. Start
2. Let realistic path rp=0,T=0,
3. Source node S request data to the destination D
4. S calculates $BW_{req}$,$LP_{req}$,$C_{req}$, $D_{req}$ and transmits to MA
5. If M≠D and M≠BN then
6. MA frame a cluster and creates and transmit RQM
7. The nodes in a cluster replies by transmitting RM, which comprises the parameters of QoS
8. MA roams in and around the cluster and N represents next node
9. End if
10. If D€ the same cluster
11. MA collects the parameters of QoS at all the available link to D
12. For i=1 to available path do
13. If QoS conditions fulfils for a path then
14. Calculate shortest QoS path by fp=fp+1
15. End if
16. End for

17. Else
18. If T≠0 then
19. End
20. Else
21. MA informs $BW_{req}$,$LP_{req}$,$C_{req}$, $D_{req}$ to SA by S; SA creates a cluster which comprisesall MA
22. For i=1 to m-1 do
23. T =1 Go to step 4
24. End for
25. End if
26. end

Simulation and results discussion

This proposed method have been implemented using NS2. By using Adhoc on Demand Distance Vector (AODV) algorithm. Nearly 900 nodeshave been taken with mobility 25 m/sec and 60 m for communication range of each simulation.

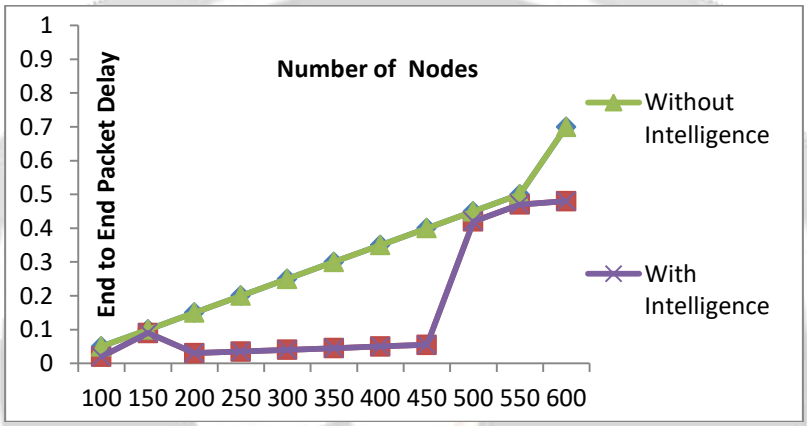



Fig 2(a) Number of Nodes (VS) End to End Delay

This graph shows that the proposed method diminishes the packet delay compared with the QoS without intelligence method. This method improves the performance of a network when the number of nodes gradually increases also it builds with intelligence when communication take place between the nodes. In the earlier method gives certain delay due to poor reliability of the algorithm for data transmission. So that, the transmitted data might be obstructed by some intermediate nodes from the group of nodes. Due to this the transmitted data may subjected to latency in a travel path to reach the destination within the stipulated time period. But the proposed method resolve this problem of latency in the transmitted data. Since, this method uses an optimal path from the source to destination to transmit a data.

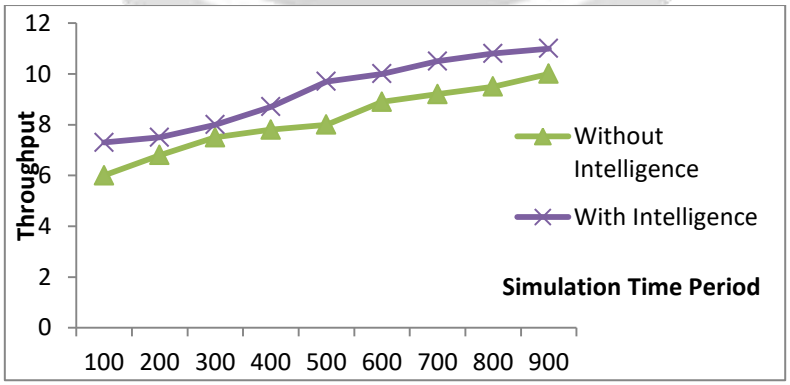



Fig 2(b) Simulation Time Period (Vs) Throughput

This graph represents the simulation analysis of time with throughput. In the existing system expresses the minimum level of throughput due to certain delay and packet loss. Since, in the earliest method exposes that, the number of nodes increases is indirectly proportinal to the throughput level. The fragile method doesn't provide a better quality of data transmission while it is transmitted through various intermeidate nodes. The intermeidta node may hold the data for certain time period, so it may halt the subsequent data transmission. But this proposed method, the intelligence algorithm will expedite the data transmission and increase the throughput level. So compared with the existing method, this proposed method gives the better peroformance.

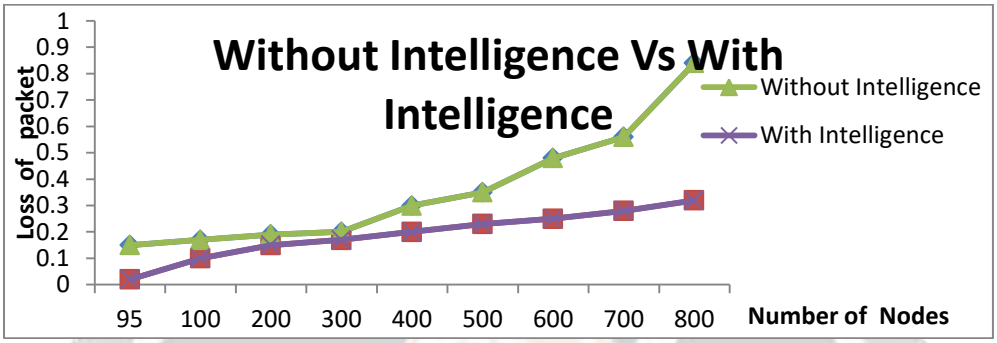



Fig 2(c ) Number of Nodes (Vs) Loss of Packets

Fig 2(c) illustrates that the quality level of the data transmission with respect to the earliest QoS mechanism. In those method have not provided an enough reliable services in the adhoc fashion. In the MANET environment the due to mobility the node may be migrate from one cluster to another cluster. So, the transmitted packet may not reach the intent recipient within the mentioned time duration in the transmitted data. So the transmitted data has to be dropped out by the destination node. In the ad hoc environment the transmitted data has to travel through many intermediate nodes. Due to this the intermediate node either drop the packet or it may transit to another node therefore, this node is not a legitimate receiver for the data; it would drop the data. Thus the loss of packet level leads to very high. According to this proposed method, the transmitted data need not have to travel on a long path in the ad hoc network. Hence the delivery rate will be improved compared with the existing method.

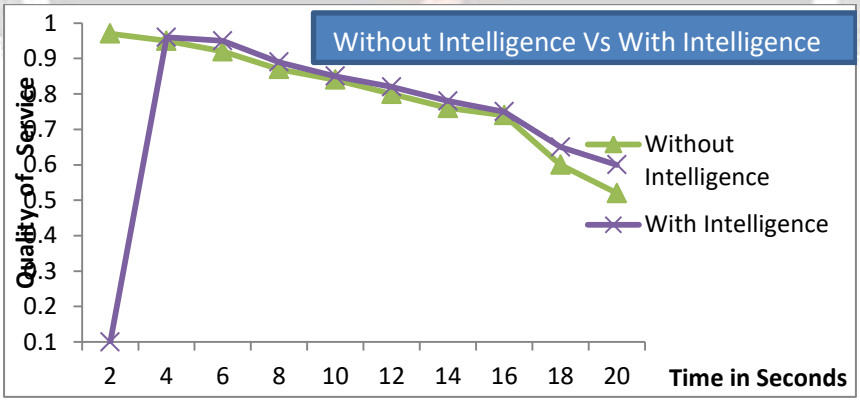



Fig 2(d) Time (Vs) QoS

In the existing method, when considered about the end to end delay, packet loss and throughput from the above graph reveals that the performance has been low by compare with the proposed method. In the proposed system as long as the number of nodes increases, its performance never degraded with respect to end to end delay, loss of packet and throughput. So the proposed method would give better performance by improving the QoS in the MANET environment.

**Conclusion**

The proposed methods concentrated on identifying an alternate optimal QoS path from source node location to destination node location by make use of intelligent AODV optimization technique. This method expressed the working method of the afore said algorithm as well as the trust value and resources of the nodes reliability and multi aspects of QoS constraints such as delay , loss of packets and bandwidth to identify an optimal path. Results acquired in the simulation and graph represents an optimal way of selecting path from source to destination node. Subsequently the acquired results compared with the existing method and it exhibits the drastical improvement in the QoS in MANET comprising end to end delay, loss of packet and QoS.

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