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Effect of AI and other techniques on critical Adhoc Routing scenario

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Abstract : Adhoc networks play a critical role in setting up of infrastructure in emergency or natural calamity situations. In modern times, availability of critical data and transmitting information between various nodes can be lifesaving. The need for setting up an adhoc network in a remote area would help in sending and receiving information with least human intervention. For an efficient adhoc network setup, it is necessary that the system provides good Quality of Service (QoS) parameters. QoS parameters depend on routing protocols which transmit information between various nodes. Adhoc networks mainly employ reactive routing protocols that provide routes between nodes as and when required. Moreover, application of artificial intelligence techniques along with existing routing protocols improves QoS parameters. This paper focusses on the application of various routing protocols along with artificial intelligence techniques in an adhoc network set up in a crucial scenario.

***Index Terms* – Adhoc networks, reactive routing protocols, artificial intelligence**

I. INTRODUCTION

Adhoc networks are self-configuring network of mobile nodes without any pre-established or fixed architecture. Here, network nodes act as routers relaying each other's packets. In single hop adhoc networks several nodes are connected. However, only those nodes that are in communication range of each other can send and receive packets from one another. As applications of adhoc networks diversified it became necessary that all nodes could communicate with one another [1]. Hence, multihop adhoc networks came into use wherein two nodes can communicate via intermediate nodes. For proper communication between various nodes in adhoc networks and for proper utilization of resources, it is required that they have efficient routing protocols. Moreover, the cost of setting up the system is generally moderate. Further, the system does not have any requirement of any pre-existing infrastructure. All these factors have made the adhoc networks suitable for being setup in disaster areas, emergency situations, and military operations. An emerging aspect wherein setting up of adhoc networks for information transfer and data gathering can be looked into is in areas dealing with disaster or emergency health situations like COVID 19 hotspot. The transfer of information between various nodes or users, gathering of information from a particular node and relaying it to central unit as well as sending the data from a centralized unit to a particular node is always very critical in emergency situation or relief operations. The importance of having a robust adhoc network is all the more important in areas that are affected by COVID 19 or for that matter any area facing a critical or an emergency situation. In hotspots or other areas, where there is a high requirement of information transfer as well as information gathering, setting up of wireless adhoc networks can be thought of.

To set up a robust adhoc network, there is a requirement of efficient routing protocols. Adhoc routing protocols can be classified as proactive, reactive and hybrid [2]. In proactive routing protocols, route information is maintained in the form of routing tables. In constantly changing environment, maintaining route information constantly is not possible. Also, saving information in the form of routing tables results in more bandwidth consumption which is not desirable in a resource constrained environment. Reactive or on-demand routing protocols are more popular in that sense. These routing protocols establish routes as and when necessary. As routes are established on-demand it results in bandwidth as well as resource conservation. Ad hoc On Demand Distance Vector (AODV) and Dynamic Source Routing (DSR) are the two popular reactive routing protocols.

2. Routing Protocols

Adhoc networks communicate information packets between various nodes using various routing protocols. Routing protocols find out the routes between various nodes. The routes for information transfer can be directly between sender and receiver. Also, the routes can be between intermediate nodes as and when necessary. Most commonly used routing protocols that have been suggested in literature can be categorized as proactive and reactive routing protocols [3].

2.1 Proactive or Table driven routing protocols

Proactive routing protocols or table-driven routing protocols find and maintain links or routes with all the participant nodes. Maintaining route information to all the nodes is expensive and consumes a lot of bandwidth. Hence, proactive routing protocols are not found to be very suitable for adhoc networks. Also, the routing information is maintained in the form of table which requires a lot of overheads. Also, there would be some nodes that are constantly changing and it is not possible to maintain a routing table. Since the routes are dynamically changing, hence not updating the routing tables may also cause loss of packets. So, proactive routing protocols are not conventionally used with adhoc networks.

2.2 Reactive or on-demand routing protocols

Reactive routing protocols are suited to an on demand system. The technique is suitable for systems like adhoc networks where bandwidth, infrastructure etc. are limited. There are various adhoc routing protocols that have been proposed in literature till now. Prominent among them are discussed below.

2.1 Dynamic Source Routing Protocol

The earliest reactive routing protocol is Dynamic Source Routing (DSR). Here, the sender determines the complete route from source to destination. The packet also includes the route to the destination. Here the intermediate nodes only forward the packets based on the pre-determined route. Intermediate nodes do not make any routing decisions.

The advantage that DSR protocol offers is that a route is dynamically discovered by the source or host node when some information is to be sent. This arrangement is quite suitable for a bandwidth and resource constrained setup as routes are set up only when some information packets are to be transferred. Moreover, any dynamic change in the node positions can also be easily catered to as routes are discovered dynamically and on requirement basis.

Even though there are many advantages as compared to traditional routing protocols but still some problems persist. DSR protocol does not come up with a proper backup routing which should work in case of main route failure. This problem becomes all the more serious when the system has been setup in an emergency situation and transferring data is critical.

2.2.2 Ad hoc on Demand Distance vector Routing Protocol

Adhoc on demand distance vector (AODV) routing protocol also discovers routes as and when necessary. In AODV protocol also a routing table is maintained and whenever any data packet has to be transmitted it is first looked up in the routing table. When the routes are not available in the routing table, route request (RREQ) packets are broadcasted by the source node. If routes are not available in the routing table, then a new route is searched for using route broadcasts. AODV also resulted in lot of routing overhead. Moreover, AODV protocol did not provide any solution to the problem of route failure. Hence in any critical solution route failure in AODV protocol would result in loss of packets.

2.2.3 Ad hoc on Demand Distance vector Backup Routing (AODVBR) Protocol

AODVBR protocol works similar to the AODV protocol. Here, a mesh like structure is created to provide an alternate route. During the route reply phase, the neighbouring nodes hear the route reply packets. In this way different path information is available. However, AODVBR protocol does not provide any resolution when both the primary and secondary route failure occurs.

2.2.4 Ad hoc on Demand Distance vector nth Routing Protocol (AODV nthBR) protocol

AODV nthBR protocol proposes a solution of solving the problem of packet loss due to route failure by providing multiple backup routes [4]. Here, the nodes that are part of routing are selected are based on their energy efficiency. On the failure of any one node an alternate energy efficient node is selected. This technique helps in establishing an adhoc network with least possibility of packets drop and better performance parameters compared to the above mentioned reactive routing protocols.

AODV nthBR protocol provides a stable system as failure of the main as well as the next routes does not lead to route failure. Here when the primary route fails, the next nearest energy efficient node is selected for transferring data. In case the next node also fails another node is searched based on the criteria of energy efficiency. Since route failure chances are less, QoS parameters automatically improve.

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3. Artificial Intelligence and related techniques

Multiple artificial intelligence techniques have been successfully implemented with various adhoc networks. In literature, it was suggested that using artificial intelligence techniques result in better monitoring of nodes and observation of the nodes from the data. Directed diffusion and energy aware routing protocols have been successfully implemented to improve QoS [5]. In directed diffusion technique any information that is required is broadcasted to all the nodes from the base station. All the nodes that receive the request prepare a gradient towards the particular node from where it has received that request. This process is repeated until a gradient is setup from the source node to the broadcasting node. So, basically directed diffusion technique continues doing its task until the targeted node is reached and the targeted node is directly able to communicate with the base node. This approach works very well when one to one communication is required between a particular targeted node and centralized base station. If applied to an adhoc network, it can be used to gather data directly from the targeted node or person and information can be sent to the centralized base station. Also, any urgent or necessary information can be sent to the targeted node directly as well.

Energy aware routing is also used for information transfer [6]. The selection of routes is based on the energy consumption of all the nodes. Here, various paths are used used at different instances. This way energy consumption of all the nodes is reduced. Depletion of energy is less at every node using this technique. So, there is a higher chance of sustainability of adhoc network.

Also, mobility prediction using machine learning approach has also been used to achieve significant improvement in QoS parameters as compared to traditional methods.

Further, work on energy conservation and selection of cluster head has also been done [9]. This is achieved using proposed network partitioning using manageable clusters. This technique can be used especially in areas where number of users or nodes are more but bandwidth is limited. Here, a self-organizing map (SOM) is chosen for preparing clusters. Managing clusters is easy and it also reduces the data traffic. Data values are transferred from the node to the base station or central node with the help of intermediate nodes. Hence, it saves bandwidth to a considerable extent.

Results

A comparison of the results obtained after simulation of AODV, DSR, AODV and AODV nthBR protocol is given below

The results are simulated using MATLAB considering 60 nodes in the network and nodes moving at a speed of 20 m/sec

1.1.1 Packet Delivery Fraction

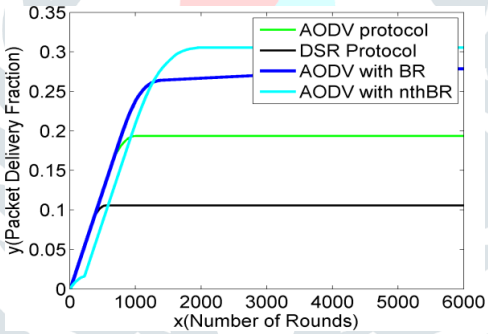

Fig. 1. Comparison of Packet Delivery Fraction

In Fig. 1, the packet delivery fraction is found to be maximum when AODV nthBR protocol is used for routing. This is because the packet loss is minimum as multiple backup routes are available on failure of the selected route. Also, the energy efficient nodes are selected resulting in faster delivery of information and low loss. In critical or emergency situations where collecting and receiving information is very important AODV nthBR protocol can be implemented.

1.1.2 End to end delay

From Fig.2, it can be seen that end to end delay is least when AODV nthBR protocol is used followed by AODV protocol. Since emergency or critical areas demand least delay for information transfer. So, AODV nthBR protocol, followed by AODV and DSR can be used as a routing protocol in the adhoc network

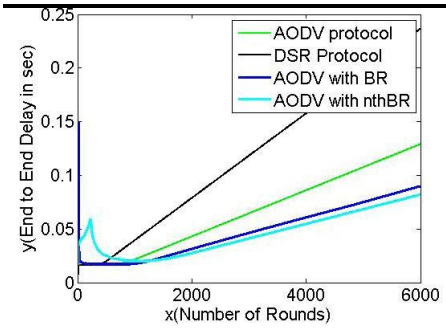

Fig. 2. End to end delay

References

[1] Rao M., Singh N.: Quality of Service Enhancement in MANETs with an Efficient Routing Protocol. In. Proceedings of the IEEE International Advance Computing Conference, pp. 381-384, (2014).

[2] Ghalib S., Kasem A., Ali A.: Analytical Study of Wireless Ad-Hoc Networks: Types, Characteristics, Differences, Applications, Protocols. In. Proceedings International Conference on Futuristic Trends in Networks and Computing Technologies, pp. 22-40, (2020).

[3] Goyal P., "Simulation Study of Comparative Performance of AODV, OLSR, FSR and LAR Routing Protocol in MANET in Large Scale Scenarios", IEEE International Conference on Information and Communication Technologies, pp. 282-286, 2012.

[4] Rao M., Singh N.: Performance Evaluation of AODV nthBR Routing Protocol under Varying Node Density and Node Mobility for MANETs. In Indian Journal of Science and Technology, Vol.8, Issue 17, pp. 1-9, (2015)

[5] Barbancho J., Leon C., Molina F.J., Barbancho A.: Using Artificial Intelligence in Routing Schemes for Wireless Networks. In. Journal of Computer Communications, Elsevier, Vol. 30, Issues 14-15, pp. 2802- 2811, pp. 45-49, (2007).

[6] Lee Z-J., Cho So-T., Lee C-Y., Peng B-Yu.: AODV with Intelligent Priority Flow Scheme for Multi-hop Adhoc Networks. In Vietnam Journal of Computer Science, Vol.3, pp. 259-264, (2016).