Performance Evaluation of AODV and DSDV Routing Protocols through Clustering in MANETS

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Abstract: A Mobile Ad-hoc Network (MANET) is self configuring network that eliminates the complexity of infrastructure and allows devices to communicate wirelessly. Messages are transferred from one node to another without any involvement of base station. Each device must maintain proper information of routing and packet delivery. As number of nodes increases, the complexity of MANET increases in various ways. This can be possibly achieved through cluster generation. Clustering provides more efficient use of resources in large dynamic networks. Clustering achieve communication scalability for a large number of nodes and high mobility. Through this paper we analyze the behaviour of AODV and DSDV routing protocols through cluster generation in MANETS NS2 provides a substantial support for simulation over wireless network.

Index Terms: AODV, Clustering, DSDV, MANET.

I.INTRODUCTION

A Mobile Ad Hoc Network (MANET) is a collection of mobile nodes (hosts) which communicate with each other via wireless links either directly or relying on other nodes as routers [1]. MANETS does not depend any base station for message transfer. Nodes in MANETS have random movement. Therefore, the network topology changes very rapidly and is unpredictable. All network activities, such as path discovery, packet delivery have to be executed by the nodes itself, either individually or collectively. A MANET is an autonomous group of mobile nodes that communicate over slow wireless links. Manet is kind of wireless self configuring adhoc network and a network of mobile routers connected by wireless links [1].

APPLICATIONS OF MANETS:

Mobile Ad hoc networking has gained importance with its widespread applications. These are used everywhere where there is either little or no communication. These allow the devices to maintain connections to the network as well as easily add and remove devices to and from the network [6].

1. Military battlefield

The modern battlefield demands reliable communication in all means. Most communication devices are installed in mobile vehicles, tanks, trucks etc. MANETS are robust when nodes disappear due to destruction or mobility. Through this multi-hop communication, soldiers can easily communicate to remote soldiers via data hoping and forwarding from one device to another [6].

2. Sensor Networks

Another application of MANETs is sensor networks. These are used to detect numerous properties of an area like temperature, pollution, etc. The capabilities of each sensor are very limited, and every sensor must depend on others in order to forward

data to a central computer. Each sensor has a limited computing capability and is prone to failure and loss [6].

3. Commercial Sector: MANETS are used in disaster relief efforts for example, fire, flood, or earthquake. Certain emergency rescue operations must take place whenever certain damage happens. Information is transferred from one rescue member to another through a small hand held device. There are many other commercial scenarios which include ship-to-ship ad hoc mobile communication etc [6].

II.CLASSIFICATION OF ROUTING PROTOCOLS

Routing is the mechanism of forwarding data packets to the destination using efficient path is measure by various metrics like no.of hops, traffic, security, etc. In ADHOC network each host node acts as a specialized route itself. It helps in transferring data from source node to destination node within the network [1].

PROACTIVE ROUTING PROTOCOLS:
Proactive routing protocols perform routing from source node to destination node periodically. These protocols maintain the shortest path routes by periodically updating the views of network topology. The main advantage of proactive protocol is they provide lower latency in data delivery and the possibility of supporting applications that have quality-of-service constraints. Its main disadvantage is bandwidth wastage while sending update packets periodically even when they are not necessary. Some Proactive MANET Protocols include: Destination-Sequenced Distance Vector (DSDV), Optimized Link State Routing (OLSR), Fish-eye State Routing (FSR), etc [1].

REACTIVE ROUTING PROTOCOLS:
The Reactive protocols minimize routing overhead. These protocols determine routes only when they are needed. Typically, these protocols perform route discovery operation between the source and the destination when the source needs to send data packet and the route to the destination unknown. Reactive routing protocols resort to a new route discovery only when the existing one breaks [1]. As long as the route is live they perform route maintenance operations.

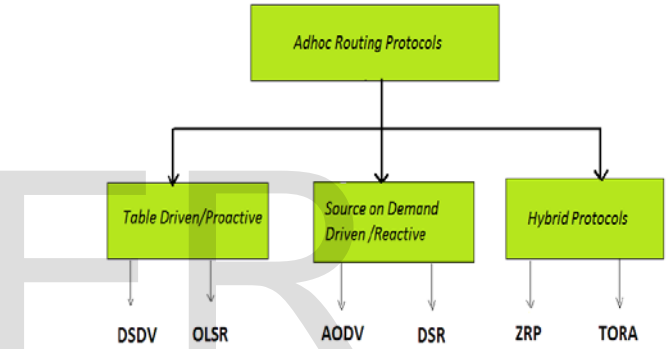

figure1: classification of Routing Protocols in MANETS

III. LITERATURE REVIEW

Routing in MANETs
In an ad hoc network, mobile nodes communicate with each other using multi hop wireless links. There is no stationary infrastructure; for instance, there are no base stations. Each node in the network also acts as a router, forwarding data packets for other nodes. A research issue in the design of ad hoc networks is the development of dynamic routing protocols that can efficiently find routes between two communicating nodes. The routing protocol must be able to keep up with the high degree of node mobility that often changes the network topology [6]. In a

large network, flat routing schemes produce an excessive amount of information that can saturate the network. In addition, given the nodes heterogeneity, nodes may have highly variable amount of resources, and this produces a hierarchy in their roles inside the network. Nodes with large computational and communication power, and powerful batteries are more suitable for supporting the ad hoc network functions (e.g., routing) than other nodes.

CLUSTER BASED ROUTING

Cluster-based routing is a solution to address nodes heterogeneity, and to limit the amount of routing information that propagates inside the network. The idea behind clustering is to group the network nodes into a number of overlapping clusters. Clustering makes possible a hierarchical routing in which paths are recorded between clusters instead of between nodes. This increases the routes lifetime, thus decreasing the amount of routing control overhead. Inside the cluster one node that coordinates the cluster activities is cluster head (CH) [3], [6]. Inside the cluster, there are ordinary nodes also that have direct access only to this one clusterhead, and gateways. Gateways are nodes that can hear two or more clusterheads. Cluster based routing schemes organize the nodes into clusters to reduce communication overhead and routing problems. Thus a virtual network infrastructure is formed which resembles fixed network infrastructure. This is crucial for scalability of routing protocols and the security infrastructure. The major issues to be handled by a cluster based routing protocol is to divide the dynamic mobile network into clusters and handle the routing, packet delivery and data forwarding issues [6].

IV. CLUSTERING

Clustering is a process of dividing the network and group into substructures, called as clusters. In MANETS clustering has many advantages when compared with other networks. After dividing, a particular node is elected as a Cluster Head (CH) [3]. The Head node is selected by basing on a specific metric or combination of metrics. Some of the parameters are ID of a node, weight of a node, degree or mobility of a node etc. Nodes within a cluster communicate with the cluster Head. Each cluster head communicates with another cluster head which decreases the unnecessary traffic flow. Cluster Gateways helps in connecting with the adjacent clusters. There-fore, each and every cluster composes of a cluster head, gateways and member nodes. Clustering in MANET thus improves the efficiency and reduces the chances of interference thereby increasing the network throughput [3].

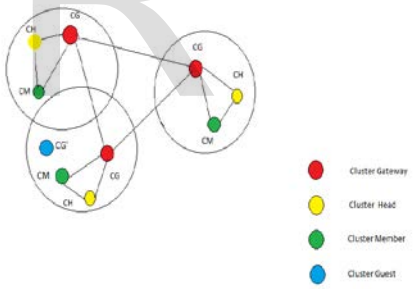

Figure2: Cluster architecture

DISTRIBUTED CLUSTERING

This process undergoes the certain steps. First, each node learns contact probabilities of other nodes. It is not necessary that a node stores information of all other nodes in network. Second, a node decides to either join or leave a cluster based on its contact probabilities to other members of that cluster [4]. A node leaves the current cluster if its contact probabilities dropped by cluster members. Each and every cluster has a

cluster gateway; it is formed when the cluster grouping is done. This algorithm is event- driven in nature. Specifically, a node joins a new cluster if it qualifies to be a member. A node leaves the current cluster if it joins a new cluster and it is no longer qualified to be in the current cluster. Whenever nodes meet together, they undergo the synchronization process for updating their information [4].

AODV ROUTING PROTOCOL WITH CLUSTERING:

AODV routing algorithm provides reliable and secure data transmission over the MANETS. This Protocol uses an on demand approach for finding routes, that is a route can be established only when it is required by the source node for transmission of data packets. This protocol uses destination sequence numbers to find the frequently used recent path. In AODV the source node and the intermediate nodes store the next-hop information. In reactive routing protocol, the source node floods the Route Request (RREQ) packet in the network when a route is not available for the preferred destination. AODV and other on-demand routing protocols is that it uses a destination sequence number to determine an up-to-date path to the destination [1]. A Route Request maintains source sequence number, destination sequence number, broadcast identifier, and time to live field. Destination sequence number indicates the freshness of the route that is accepted by the source. An intermediate node receives a Route Request, it forwards a route reply if it has a valid route to the destination. The route validity at the intermediate node is determined by comparing the sequence number at the intermediate node is determined by comparing the sequence number at the intermediate node with the destination sequence number in the Route Request packet [1].

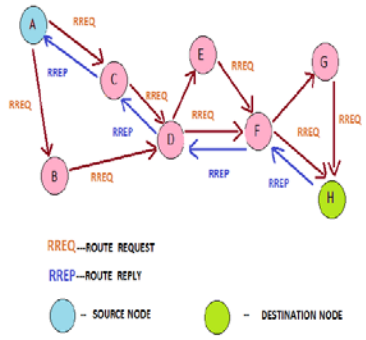

Figure3: AODV Network

DSDV ROUTING PROTOCOL WITH CLUSTERING

DSDV is a table-driven routing algorithm. Each and every mobile station maintains a routing table with all available information such as, next hop, the number of hops to reach to the destination, sequence number of the destination etc. This protocol uses both periodic and triggered routing updates to maintain table consistency. The Triggered routing updates are used when network topology changes, so that routing information is propagated as quickly as possible [2]. Routing table updates can be of two types – full dump and incremental. Full dump packets carry all information about routing and it requires Network Protocol Data Units (NPDU) where as incremental packets carry only information changed. since the last full dump should fit in one NPDU to decrease the amount of traffic generated. The mobile nodes causes to links break when they move from one place to another place. When a link to the next hop is broken, immediately the route through the next hop is assigned to infinity metric with updated sequence number. This is the only

situation when any node other than the destination node assigns the sequence number. Sequence numbers assigned by the origin nodes are even numbers, The sequence numbers assigned to infinity metrics are odd . A node receives infinity metric, when it has an equal or later sequence number with a finite metric, it triggers to update the route, and the route with infinity metric will get replaced by a new route. When a mobile node receives a new route packets then it is updated and it compares the existing with the previous information in the table. The main advantage of DSDV is, it is one of the early algorithms available. It is suitable for creating ad hoc networks with minimum number of nodes. DSDV updates its routing tables regularly.

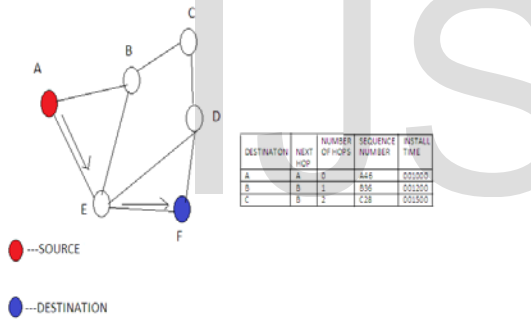

Figure4: DSDV Network [5]

PERFORMANCE METRICS

Packet delivery ratio: The ratio of the data packets delivered to the destinations to those generated by the continuous bit rate sources. Packets delivered and packets lost are taking in to consideration.

PDR= No. Of received packets/No. Average Of sent **packets**

End-to-end delay: The time taken by the packet to reach the destination is called end to end delay so it is the time taken to travel between two ends i.e. source and destination.

AED= ∑ (Received time – sent time)/Total data packets received

Throughput: One of the representations of throughput is the amount of data transferred over the period of time expressed in kilobits per second (kbps).

Throughput = Total Received Bytes / Elapsed Time

VII. SIMULATION ENVIRONMENT

Network Simulator:
Simulation is defined as reproduction of essential features of something used for study or training. Through simulation, we can build a mathematical model to reorganize the features of an existing phenomenon, system, or process often used with a computer in order to solve problems. There are many network simulators that can simulate the MANET. In this paper we evaluated certain performance metrics such as Packet Delivery Ratio, End-to-End Delay and Throughput in different scenarios i.e., for 15, 20, 25, 30, 35, 40, 45, 50 nodes.

Table 1:

Simulation parameters

Parameter	value
MAC Type	802.11
Protocols	AODV,DSDV
No Of Nodes	15,20,25,30,35,40,45,50
Antenna model	Omni Antenna
Simulation Time	150s
Channel Type	Wireless Channel
Simulation Area	1600m*2550m
Traffic Type	TCP

RESULTS AND DISCUSSIONS:

As already outlined we have taken On-demand (Reactive) routing protocols, namely Ad-hoc On Demand Distance vector(AODV) and Destination sequenced Distance Vector Routing protocol (DSDV). Packet delivery ratio, end to end delay and throughput are calculated for AODV and DSDV. The results are analyzed below with their corresponding graphs. These outcomes are viewed by considering 15, 20, 25, 30, 35, 40, 45 and 50 nodes and their related graphs are generated below.

Throughput:

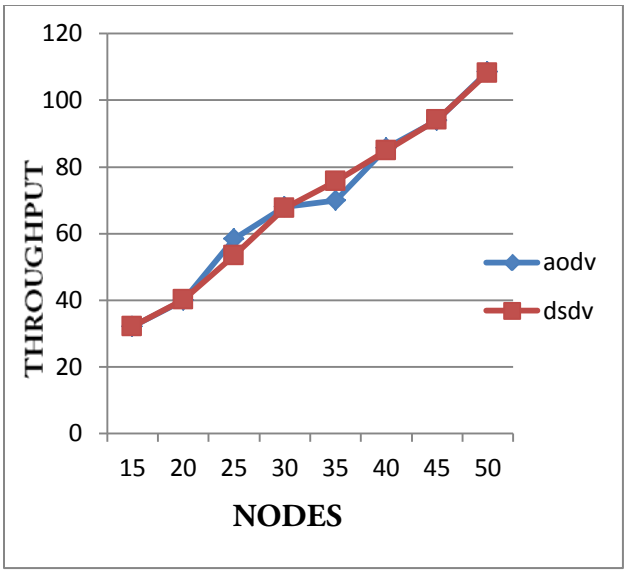

Figure5: Comparison of Throughput in AODV and DSDV

End to End Delay:

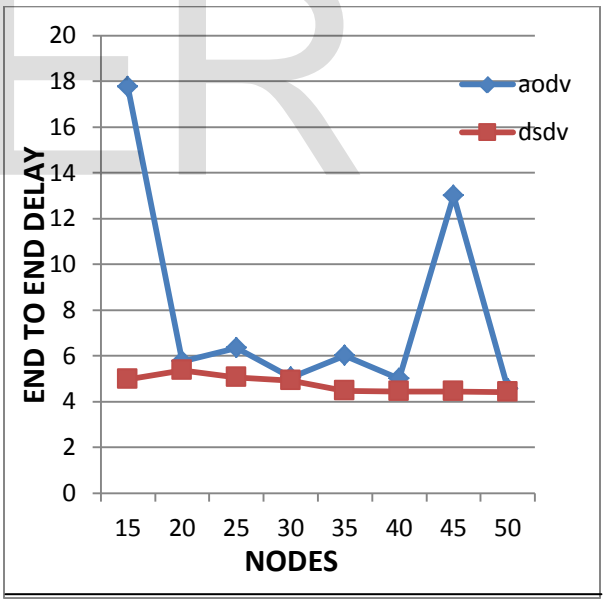

Figure6: Comparison of End To End Delay in AODV and DSDV

Packet delivery ratio:

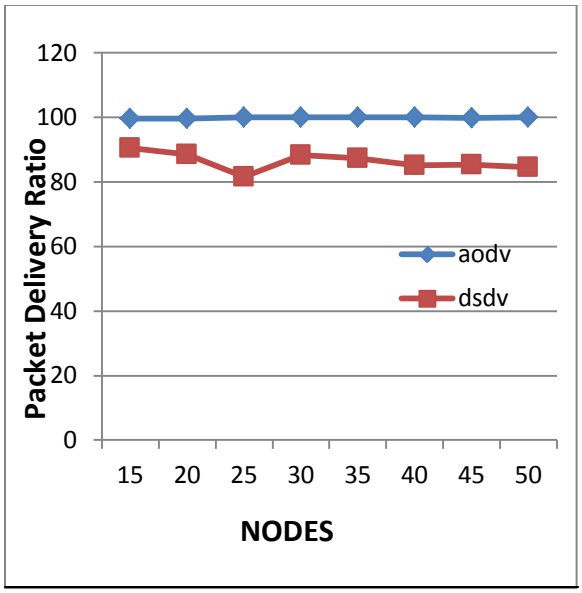

Figure7: Comparison of End To End Delay in AODV and DSDV

Conclusion:

We have compared a reactive routing protocol AODV and a proactive protocol DSDV through clustering using Network simulator-2. The simulation generates the performance evaluation of these two routing protocols. This would be interesting to note the behaviour of these protocols on a real world environment. Network parameters such as packet delivery ratio, End-to-End delay and throughput are taken into the consideration. We analyzed that Throughput and Packet Delivery ratio is high in AODV Protocol and low in DSDV Protocol where as coming to End-to-End delay; it is low in AODV protocol and high in DSDV protocol.

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