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Study and Analysis of Multipath Routing Protocol for Mobile Ad Hoc Networks

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Abstract – A Mobile Ad-hoc Network (MANET) is a dynamic wireless network that can be formed without the need for any preexisting infrastructure in which each node can act as a router. One of the main challenges of MANET is the design of robust routing algorithms that adapt to the frequent and randomly changing network topology. A variety of routing protocols have been proposed and several of them have been extensively simulated or implemented as well. The common belief is that the same is true for ad hoc networks, i.e., multi-path routing balances the load significantly better than single-path routing. In addition route recovery & loop detection are implemented using simulation in order to improve quality of service regarding MANET. The MANET is suitable for mobile, large & dense network with large traffic & could satisfy critical multimedia applications with high on time constraints. While MANET is an efficient protocol which gives improved performance in large networks. In this paper, we have compare and analysis the performance of proactive multipath routing protocols for MANET under different scenarios & metrics using NS-2.

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1. INTRODUCTION

Multipath routing is a technique that exploits the underlying physical network resources by utilizing multiple source-destination paths. It is used for a number of purposes, including bandwidth aggregation, minimizing end-to-end delay, increasing fault-tolerance, enhancing reliability, load balancing, and so on. The idea of using multiple paths has existed for some time and it has been explored in different areas of networking (Bheemalingaiah, et. al., 2017).

In the traditional circuit-switching network, alternate path routing was used to decrease the probability of call blocking. In this scheme, the shortest path between two exchanges is used until it fails or reaches its capacity, when calls are routed through a longer, alternate path.

In data network the idea of using multiple paths for end-to-end transport first appeared in. One of the earliest distributed multipath algorithms was formulated by Gallager. Based on the assumption of stationary input traffic and unchanging network, the computation framework converges to minimize the overall delay in the network. The major drawback of in wireless networking, there are two main architectures: infrastructure (single-hop) networks and mobile ad hoc (multi-hop) networks (MANETs), Infrastructure networks include cellular networks and wireless local area networks. Users are connected via base stations/access points and backbone networks. Although users can handover between base stations or access points and roam among different networks, their mobility is limited within the coverage areas of the base stations or access points. Ad hoc networks exclude the use of a wired infra structure. Mobile nodes can form arbitrary networks "on the fly" to exchange information without the need of pre-existing network infrastructure. Ad hoc networks can extend communication beyond the limit of infrastructure-based networks.

A fundamental problem in ad hoc networking is how to deliver data packets among nodes efficiently without predetermined topology or centralized control, which is the main objective of ad hoc routing protocols. Each node in the network functions as both a host and a router, and changes of network topology are distributed among the nodes. Design of efficient and reliable routing protocols in such a network is a challenging issue (Hasan, et. al., 2017. Kumar, et. al., 2016. Jin, et. al., 2015. Hong, et. al., 2002).

On-demand routing protocols in particular, are widely studied because they consume less bandwidth than proactive protocols. Ad Hoc On-demand Distance Vector (AODV) and Dynamic Source Routing (DSR)

are the two most widely studied on-demand ad hoc routing protocols. Previous work has shown limitations of the two protocols. The main reason is that both of them build and rely on a unipath route for each data session. Whenever there is a link break on the active route, both of the two routing protocols have to invoke a route discovery process. On-demand multipath routing protocols can alleviate these problems by establishing multiple paths between a source and a destination in a single route discovery. A new route discovery is invoked only when all of its routing paths fail or when there only remains a single path available. In this research, a practical Node-Disjoint Multipath Routing Protocol (NDMR) is proposed. NDMR has two novel aspects compared to the other on-demand multipath protocols: it reduces routing overhead dramatically and achieves multiple node-disjoint routing paths (Radha, et. al., 2003. Beraldi & Baldoni, 2003. Seet, et. al., 2003).

2. MANET

MANET stands for "Mobile Ad-hoc Network System." A MANET is a kind of impromptu system that can change areas and design itself on the fly. Since MANETS are portable, they utilize remote associations with an interface with different methods. This can be a standard Wi-Fi association, or another medium, for example, a cell or satellite transmission. A few MANETs are limited to a neighborhood remote gadgets, (for example, a gathering of smartphones), others might be associated with the Web. For instance, A VANET (Vehicular Impromptu System), is a sort of MANET that enables vehicles to speak with roadside gear. While the vehicles might not have an immediate Web association, the remote roadside gear might be associated with the Web, enabling information from the vehicles to be sent over the Web. The vehicle information might be utilized to quantify activity conditions or monitor trucking armadas. Due to the effective idea of MANETs, they are ordinarily not extremely secure, so it is critical to be wary what information is sent over a MANET.

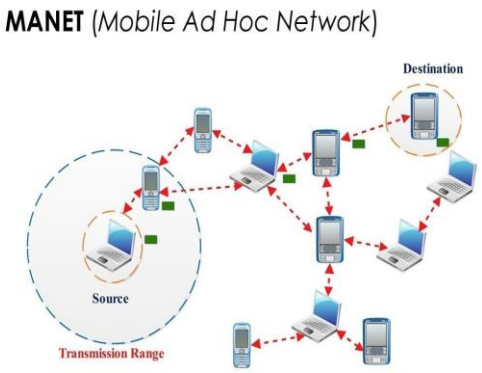

Figure 1.1: MANET Network

In the future, the work can be extended on the other categories of the routing protocols such as Reactive (on demand routing protocols) particularly Multipath routing protocols, proactive and hybrid routing protocols in order to find the appropriate protocol in their category on the basis of the varied simulation time. It can be further extended by implementing the scenario with the different mobility models, different network and traffic scenarios and observing the behavior of protocols by varying the simulated time. Also the behavior of the protocols can be studied further by carrying the simulations on different parameters like varying the number of mobile nodes, the topology area choice of the traffic type between the mobile nodes other than the simulation time.

The continuity of this work could be accomplished through the evaluation of others routing protocols (secure and not secure) particularly multipath routing protocols. It could be analyzed the impact caused in value of QoS metrics when using different mobility patterns, because due to the increasingly mobility, the tendency is a degradation in values of QoS metrics. Another interesting work that could be developed is to analyze the acting of security routing protocols in an Ad hoc network composed by malicious nodes. The research work focuses on three important aspects: node-disjoint multipath routing with low routing overhead, QoS routing for support and distributed Cross-Layer QoS in mobile ad hoc networks. Other important aspects, which need to be further investigated, are:

1. Multicast Routing - Multicast is the process of sending packets from a transmitter to multiple destinations identified by a single address. The packets of each multicast group are forwarded according to a multicast tree. Multicast routing in MANET is also hard since the network topology changes quite frequently.

2. Distributed Power Control - Most wireless devices are battery-powered and hence it is desirable that protocols for wireless networking should be energy-efficient. A distributed power control scheme should be taken into account to reduce energy consumption of nodes so that the battery life can be extended longer.

3. Effect of quality of wireless links - Because nodes move in and out of each other's range, the network topology changes frequently. The network's dynamic nature, combined with adverse wireless link's effects, raises issues that are difficult to address. In the physical layer, some techniques are needed to adapt to rapidly changing channel characteristics to make wireless link quality less sensitive to node performance.

3. RELATED WORKS

In wireless network routing protocol are categories into two kinds viz. proactive routing and reactive routing. A combination of both (proactive and reactive) routing is also potential this is known as hybrid routing. The current work concentrates (focus) reactive routing protocol for mobile ad hoc network. It aims to supply the better quality of services in area of routing protocol. Distinct routing method and comparison with other routing protocols employed in 'wireless networks' are described and discussed in this chapter. In ad hoc network routing is the top-tier targeted area.

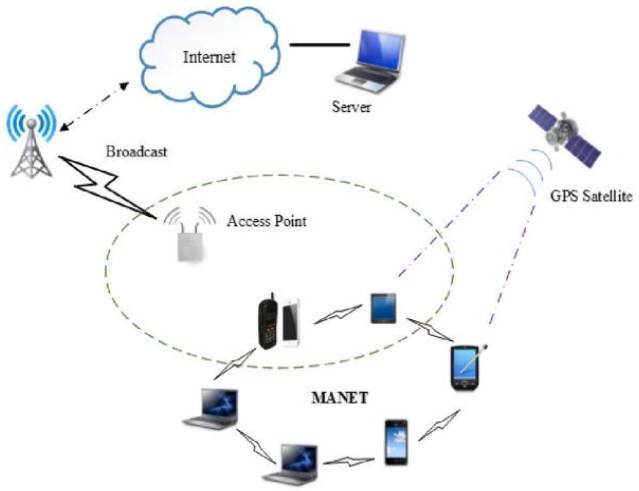

Fig 1.2 Architecture of MANET

The bandwidth in MANETs is assumed the most vital feature to enhance for effectiveness and efficiency. Reactive routing methods are built and rely on both single and multipath routing. They initiate the route locate task in case of link failure. However, multipath routing technique is adopted in wired network to provide quality of service. Power consumption is an important issue in mobile ad hoc network. To enhance the lifetime of ad hoc mobile network, the power consumption rate of every node must be evenly distributed and overall transmission of power for every connection request must be decreased. These two objectives concurrently cannot be satisfied simultaneously by employing existing routing algorithm.

M. Bheemalingaiah et.al. (2017), they choose power aware node disjoint Multi-route Source Routing (PNDMSR) to construct and then compared the its performance with respective to the Multipath Dynamic Source Routing (MDSR) by the using several quantitative performance metric as like, routing handle the overhead, throughput, packet delivery ratio, packet loss and energy efficiency is by changing several parameters like networks load etc.

Mohammed Zaki Hasan et.al (2017), creator composed numerical model for a novel Quality of Service (QoS) directing assurance technique. Their plan empowers deciding the ideal way to give proper shared radio fulfilling the QoS for a vast scope of the constant concentrated media. The numerical model depended on the Lagrangian Relaxation strategy (LR).

Rajeev Kumar et.al (2016), designed the novel algorithm called, Exponential Ant Colony Optimization (EACO) to and locates the issue in WSN after searching the cluster heads using Fractional Artificial Bee Colony (FABC) algorithm. In first step, cluster head and find out using FABC algorithm with fitness method considering distance, energy and delay.

Junwei Jin et.al. (2015), author proposed node disjoint multipath routing protocol which form opportunistic disjoint node or path for data transmission and support packet salvaging. This protocol routing overhead in forming the multiple routes and achieve the efficient recovery of route break.

Xiaoyan Hong et al. (2002) survey the routing protocols that address scalability. The routing protocols involved in survey fall into three classifieds: flat routing protocol, hierarchical routing approaches and GPS augmented geographical routing facility. Developing the dynamic routing protocol is a challenging task in mobile ad hoc networks. The dynamic routing protocol efficiently finds the path during mobile nodes.

Radha et al (2003) proposed a Node Transition Probability (NTP) based routing algorithm, which determines stable paths using the received power from every other neighboring nodes. Node Transition Probability based on the routing algorithm is designed and implemented using Glo-Mo-Sim (Global Mobile Simulator).

R. Beraldi et al. (2003) address the issue of designing a proactive cache scheme that does not rely on the any timer-based mechanism. This facility guarantees that valid cached routes are never eliminates while stale paths are removed aggressively. This proactive cache scheme has been embedded in Zone Routing Protocol (ZRP) framework and evaluated by the extensive simulation analysis. The performance of this routing algorithm is analyzed for several mobility models and throughput, control overhead the average end-to-end delay and percentage of packet dropped are compared with existing routing protocol. This algorithm shows the acceptable performance under all mobility situations. The result displays that this algorithm maximizes the bandwidth organization between heavy traffic with lesser overhead.

Boon-Chong Seet et al. (2003) analyze the efficacy of UNIQUE by applying it to the route discovery of Dynamic Source Routing (DSR) protocol. In addition, a comparative analysis is made with the DSR protocol optimized with only LAR. The results display that UNIQUE could additional minimized the overall routing overhead by as much as 58% under highly mobile condition. One important feature of MANET is that mobile hosts may communicate with every other through the sequence of wireless link. While many routing protocols have been proposed for MANET by assuming the criteria such as length, quality, bandwidth and signal strength the problem of route lifetime has not been addressed formally.

You-Chee Tseng et al. (2003) present the formal model to predict the lifetime of a routing path based on random walk model. Route lifetime is derived based on a probabilistic model.

Aristotelis Tsirigos et al (2004) develop the analytical framework for an evaluating multipath routing in mobile ad hoc network. The unpredictability of topology varies viz. failure of nodes due to moving of nodes in the distinct direction. To combat the intrinsic unpredictability of these networks they used a routing technique with more routes that distribute simultaneously the data between large amounts of route. As a result there was a delay in destination receiving the potential section of packet. Despite the delay causing overhead since the packet were fragmented into the smaller blocks and disseminated over available routes, the packet dropping possibility was minimized in numbers some mobile ad hoc network nodes are in the role to interconnect with another node in another network with help of the internet. These links may use the gateway nodes and neighbor nodes used to meet the gateway over multiple routes. On-demand routing techniques are best suitable for gateway communication because their minimum routing overhead in lower bandwidth. Their routing handles overhead raises exponentially with node density.

Joo-Han Song et al. (2004) presents method to control overhead without sacrificing performance. This was naive advanced of ad hoc on-demand distance vector (AODV) routing protocol called load-balancing ad hoc on-demand distance vector (LB-AODV), which absorb the conception of load-balancing (LB). The LB-AODV routing protocol has the significant higher packet delivery fraction a lower end-to-end delay and minimized routing overhead when compared with both AODV.

A.Tsirigos et al. (2004) implement analytical framework for evaluating multipath routing in the mobile ad hoc networks. The unreliability of topology in this kind of network due to nodal mobility and vary in wireless propagation situations made the transmission of time-sensitive information and challenging issue. And they also proposed the routing facility that uses the multiple routes concurrently by splitting the information during a multitude of route so as to enhance the probability that essential section of information is received at destination without incurring excessive delay. To dynamically generate a pre-routing area during every source-destination pair and limit the propagations of path request packets only within this area. The pre-routing region effectively restricts route discovery activities to the nodes that most likely constitute the optimal or near-optimal routes.

Yong Liu et al. (2004) initiate REGR (region-based routing) protocol. This protocol, consequently not the only decrease significantly path implementation overhead, but also guarantees the path optimality. The links in an ad hoc wireless network are typically powered by batteries with the limited energy provide. One of most vital and challenging issue in ad hoc wireless network is how to preserve energy, increasing the lifetime of its nodes and thus of network itself. Since routing is the imperative method in this network, constructing the power-aware routing protocols for ad hoc wireless networks has been an intensive analysis area in current years.

Jiageng Li et al. (2005) presented the review of recent state of power-aware routing protocols in the ad hoc wireless network. The minimum energy need to transfer the one bit of information through the network characterizes most economical route to interconnect in network. The less energy-per-bit for multicasting with routing is finding by an integer linear program.

Y.Wu et al. (2005) introduced the relaxation of this integer linear program, analysis earlier in Steiner tree literature, can now be interpreted as optimization for minimum energy multicasting with network coding.

Xiao-Hui Lin et al. (2005) introduced two of the channel adaptive routing protocols which work by using the adaptive channel coding and modulation facilities that allow the mobile terminal to dynamically manage data throughput via varying amount of bug protection incorporated. They proposed the qualitative and quantitative comparison of two classes of ad hoc routing protocols.

Sun Baolin et al. (2006) presents Multi-cast Ad hoc on need Distance Vector (MAODV) routing protocol supplied fast and efficient path establishment during mobile nodes that demand to communicate with every another which is demonstrate by. MAODV has minimal handle overhead and route acquisition latency. In addition to unicast routing, MAODV support multicast and broadcast as well. The multicast routing issue with multiple QoS constraint, which may deal with delay, bandwidth and packet loss computations, is discussed and network model

for analyzing the ad hoc network QoS multicast routing issue is reported.

Georgios Parissidis et al. (2006) evaluate performance of the multipath routing protocol. These protocol showed reached lesser routing overhead, lesser end-to-end delay and low congestion in evaluation analysis with the single path routing protocol. In current times, various multi-path routing protocols have been proposed for MANETs. However, a quantitative comparison of multi-path routing protocols has not been conducted. The simulation out-come of three multi-path routing protocols like Split multipath routing (SMR), Ad hoc On-Demand Multipath Distance Vector (AOMDV) Routing and Ad hoc On-Demand Distance Vector Multipath (AODVM) were gained with NS-2 simulator. The simulation outcome demonstrates that AOMDV protocol achieves the greatest performance in a high mobility environment, while AODVM Multipath performs the better with low mobility and high node density.

4. CONCLUSION

For MANET, routing techniques play the very important position in sequence to gain the Q-o-S solutions. Traditional MANET is the routing protocols are suffering from more routing overhead and reduced the packet delivery ratio due to the single path intercommunications in MANET. We analyzed the number of existing single route and multipath techniques by assuming the distinct network condition and parameters such as mobility speed, energy consumption, load etc. But there is lack efficient multipath routing method which achieves more improved Q-o-S performance by considering the varying mobility speed of mobile nodes. To address these research problems, this research proposed new algorithm for MANET multipath routing protocol with goal of scalability and efficiency. This new approach is based on recently presented existing disjoint based multipath routing protocol DAOMDV, hence new protocol is called as MDAOMDV.

The simulation is designed with two different objectives such as 1) QoS Evaluation: we designed new algorithm for achieving and enhanced QoS performance as compared to the existing AODV, AOMDV and DAOMDV routing protocols. The results are compared by assuming three vital performance metrics of any routing protocol as throughput, end to end delay and packet delivery ratio. In all cases, proposed routing protocols showing increased the performance as compared to existing methods. 2) Scalability Evaluation, in which we designed different networks to claim the scalability of proposed multipath routing protocol. From the experimental results it showing the throughput performance of proposed method is improved by 37 % as compared to existing multipath routing method.

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