ISSN:2229-6093

Ajay Shah et al ,Int.J.Computer Technology & Applications,Vol 3 (4), 1490-1495

Energy Efficient Routing Protocols in Mobile Ad hoc Networks

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Abstract

In wireless network can classified in two way one is infrastructure network and another is infrastructure less. Infrastructure less wireless network is known as Ad-hoc network. An ad-hoc network is a local area network (LAN) that is built spontaneously as devices connect. Instead of relying on a base station to coordinate the flow of messages to each node in the network, the individual network nodes forward packets to and from each other. "Adhoc" word is actually a Latin word its means "for this purpose." It is often used to describe solutions that are developed for a specific purpose. In computer networking, an ad-hoc networks all nodes are mobile and can be connected dynamically in an arbitrary manner. All nodes of these networks behave as routers and take part in discovery and maintenance of routes to other nodes in the network.In this paper, the three routing protocols are studied i.e. OSPF, TORA,OLSR

Key Words: Mobile ad hoc network, ad hoc network, OSPF, TORA, OLSR

1. Introduction

A mobile ad-hoc network (MANET) group has been formed within IETF. The primary focus of this working group is to develop and evolve MANET specifications and introduce them to the Internet standard track. The goal is to support mobile ad-hoc networks with hundreds of routers and solve challenges in this kind of network. Some challenges that ad-hoc networking faces are limited wireless transmission range, hidden terminal problems, packet losses due to transmission errors, mobility induced route changes, and battery constraints. Mobile ad-hoc networks could enhance the service area of access networks and provide wireless connectivity into areas with poor or previously no coverage Connectivity to wired infrastructure will be provided through multiple gateways with possibly different capabilities and utilization. To improve performance, the mobile host should have the ability to adapt to variation in performance and coverage and to switch gateways when beneficial. To enhance the prediction of the best overall performance, a network layer metric has a better overview of the network. Ad-hoc networking brings features like easy connection to access networks, dynamic multihop network structures, and direct peer-to-peer communication. The multihop property of an ad-hoc network needs to be bridged by a gateway to the wired backbone. The gateway must have a network interface on both types of networks and be a part of both the global routing and the local ad-hoc routing. Users could benefit from ubiquitous networks in several ways. User mobility enables users to switch between devices, migrate sessions, and still get the same personalized services. Host mobility enables the users' devices to move around the networks and maintain connectivity and reachability. Wireless networks can be classified in two types: First, infrastructure network which consists of a network with fixed and wired gateways. A mobile host communicates with a bridge in the network (called base station) within its communication radius. When it goes out of the range of one base station, it connects with a new fixed base station and starts communicating through it.

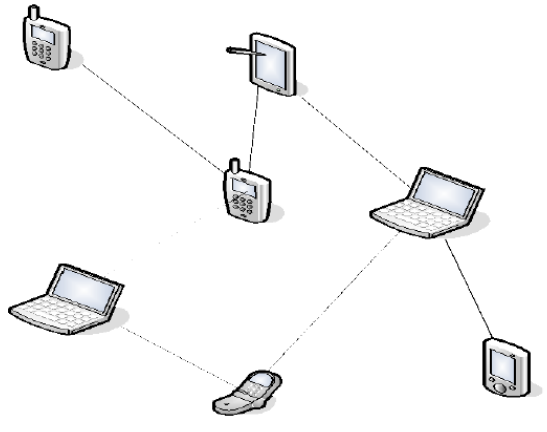

Fig 1. Infrastructure less Wireless Network

Second, infrastructure less (ad-hoc) networks fig. 1: In ad-hoc networks all nodes are mobile and can be connected dynamically in an arbitrary manner. All nodes of these networks behave as routers and take part in discovery and maintenance of routes to other nodes in the network.

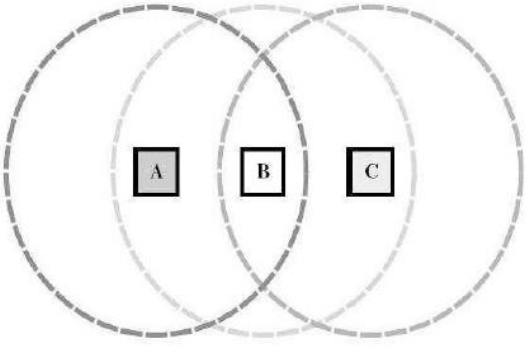

Fig 2. Simple ad hoc Network

In this simple ad hoc network in fig 2. We take three nodes A,B,C. In this they create adhoc network for some time for connecting to each other through this mobile adhoc network. They do not use any base station and router in this network. There are number of routing protocols for ad hoc networks, they are categorized into two: Proactive Routing and Reactive routing.

A. Classification Of Routing Protocols:

The routing protocols can be classified into two parts: 1. Proactive (Table driven) and 2. Reactive (Source initiated) while depending on the network structure these are classified as flat routing, hierarchical routing and geographic position assisted routing. Flat routing covers both routing protocols based on routing strategy. The three ad hoc routing protocols are used, OSPF, TORA and OLSR. TORA is Reactive (On demand) and also Proactive(Table driven) so is called as Hybrid Routing Protocols whereas OSPF, OLSR is Proactive (Table driven) Routing protocol.

A.1. Proactive (Table- Driven) Routing Protocol

In Proactive, nodes maintain one or more routing tables about nodes in the network. These routing protocols update the routing table information either periodically or in response to change in the network topology. The advantage of these protocols is that a source node does not need route-discovery procedures to find a route to a destination node. On the other hand the drawback of these protocols is that maintaining a consistent and up-to-date routing table requires substantial messaging overhead, which consumes bandwidth and power, and decreases throughput, especially in the case of a large number of high node mobility. There are various types of Table Driven Protocols: Temporally-Ordered Routing Algorithm (TORA), Optimized Link State Routing protocol (OLSR), Open Shortest Path First (OSPF), Destination Sequenced Distance Vector routing (DSDV), Wireless routing protocol (WRP), Fish eye State Routing protocol (FSR), Cluster Gateway Switch Routing protocol (CGSR), Topology Dissemination Based on Reverse Path Forwarding (TBRPF) .

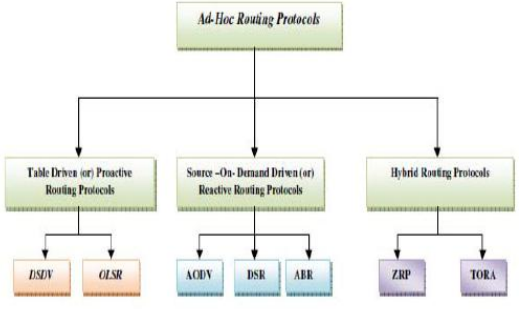

Fig 3. Adhoc Networking Protocols

A.2. REACTIVE (On-Demand) ROUTING PROTOCOL

Reactive routing is also known as on-demand routing protocol these protocols have no routing information at the network nodes if there is no communication. These protocols take a lazy approach to routing [3]. They do not maintain or constantly update their route tables with the latest route topology. If a node wants to send a packet to another node then this protocol searches for the route and establishes the connection in order to transmit and receive the packet. There are various types of On-demand protocols are the Temporally-Ordered Routing Algorithm (TORA), dynamic source Routing (DSR), ad hoc on-demand distance vector routing (AODV).

II. RELATED WORK

The problem of routing in MANETs has received attention among researchers, and many routing protocols devoted to MANETs have been proposed. According to their approaches for creating and maintaining routes, these protocols can be divided into two main categories; proactive protocols and reactive ones. The proactive protocols, also called table driven, establish routes in advance, and permanently maintain them, basing on the periodic routing table exchange.

Table 1: Comparison of Reactive and Proactive routing protocols

Reactive protocols	Proactive Protocols
A route is built only when required.	Attempt to maintain consistent, up-to-date Routing information from each node to every other node in the network.
No periodic updates. Control information is not propagated unless there is a change inthe topology	Constant propagation of routing information periodically even when topology change does not occur.
First-packet latency is more when compared with table-driven protocols because a route need to be built	First packet latency is less when comparedwith on-demand protocols
Not available	A route to every other node in ad-hocnetwork is always available

III. DESCRIPTION OF SELECTED ROUTING PROTOCOLS

A. Open Shortest Path First (OSPF)

Open Shortest Path First (OSPF) is a link state routing protocol. It is a mature proactive routing protocol widely used in today's wired networks. The basic idea in OSPF is to keep an identical topology database in all routers so that they can build routing tables locally. Because of the properties of the shortest path tree, a route provided by OSPF is loop-free and always the shortest one. OSPF continuously maintains routes to all possible destinations. Hence, it is beneficial for networks with traffic patterns where a large number of hosts in one subnet always communicate with hosts in other subnets. (This is a common advantage of proactive protocols.) OSPF is a complex routing algorithm. Another disadvantage of OSPF is the large overhead of control packets needed to maintain the link state database. An OSPF network is divided into several indexed areas. Area IDs are manually assigned to all subnets. Each area includes routers in one or more subnets, together with associated network interfaces. Every area maintains one copy of the link state database in that area. Area 0 is always assigned to the backbone network. Two areas are connected to each other when they share edge routers. Non-backbone areas have to attach to the backbone network. A separate copy of OSPF runs in each area. Hence, gateway routers with multiple interfaces in multiple areas run multiple copies of OSPF. There are two major operations in OSPF, determining adjacency and synchronizing the link state database. Fig 4. illustrates a network using the OSPF routing protocol.

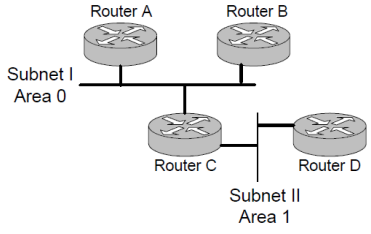

Fig 4. Example of OSPF routing protocol

Table 2. OSPF Network Types and Characteristics

	Broadcast	Nonbroadcast	Point-to-Point	Point-to-Multipoint
Characteristics	Default OSPF network type on LAN interfaces	Default OSPF network type on Frame Relay serial interfaces	Default OSPF network type on non-Frame Relay serial interfaces	Can be configured on any interface
	Neighbors automatically discovered	Neighbors statically configured	Routers at each end of a link form adjacencies	Neighbors automatically determined
	All routers on same subnet	All routers on same subnet	Each point-to-point link on a separate subnet	All routers on same subnet
	Has a designated router	Has a designated router	Does not have a designated router	Does not have a designated router

B. Temporally-Ordered Routing Algorithm (TORA)

The Temporally Ordered Routing Algorithm (TORA) is a highly adaptive, efficient and scalable distributed routing algorithm based on the concept of link reversal. TORA is proposed for highly dynamic mobile, multi-hop wireless networks. It is a source-initiated on-demand routing protocol. It finds multiple routes from a source node to a destination node. The main feature of TORA is that the control messages are localized to a very small set of nodes near the occurrence of a topological change. To achieve this, the nodes maintain routing information about adjacent nodes. The protocol has three basic functions: *Route creation*, *Route maintenance* and *Route erasure*. TORA can suffer from unbounded worst-case convergence time for very stressful scenarios. TORA has a unique feature of maintaining multiple routes to the destination so that topological changes do not require any reaction at all. The protocol reacts only when all routes to the destination are lost.

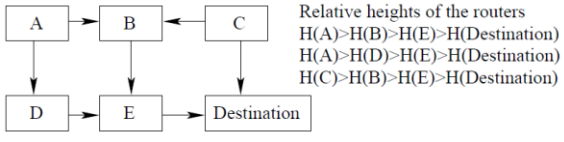

Fig 5. Example of TORA routing protocol

Advantages:
1)TORA supports multiple routes between source and destination. Hence, failure or removal of any of the nodes quickly resolved without source intervention by switching to an alternate route to improve congestion.
2) TORA does not require a periodic update, consequently communication overhead and bandwidth utilization is minimized.
3) TORA provides the supports of link status sensing and neighbor delivery, reliable, in-order control packet delivery and security authentication.

Disadvantages:
1)It depends on synchronized clocks among nodes in the ad hoc network.
2)The dependence of this protocol on intermediate lower layers for certain functionality presumes that the link status sensing, neighbor discovery, in order packet delivery and address resolution are all readily available. This solution is to run the Internet MANET Encapsulation Protocol at the layer immediately below TORA.
3)This will make the overhead for this protocol difficult to separate from that imposed by the lower layer.

C. Optimized Link State Routing Protocol (OLSR)

The Optimized Link State Routing (OLSR) protocol is a proactive link state routing protocol for MANETs. One key idea is to reduce control overhead by reducing the number of broadcasts as compared with pure flooding mechanisms. The basic concept to support this idea in OLSR is the use of multipoint relays (MPRs). MPRs refer to selected routers that can forward broadcast messages during the flooding process. To reduce the size of broadcast messages, every router declares only a small subset of all of its neighbors. "The protocol is particularly suitable for large and dense networks". MPRs act as intermediate routers in route discovery procedures. Hence, the path discovered by OLSR may not be the shortest path. This is a potential disadvantage of OLSR. OLSR has three functions: packet forwarding, neighbor sensing, and topology discovery. Packet forwarding and neighbor sensing mechanisms provide routers with information about neighbors and offer an optimized way to flood messages in the OLSR network using MPRs

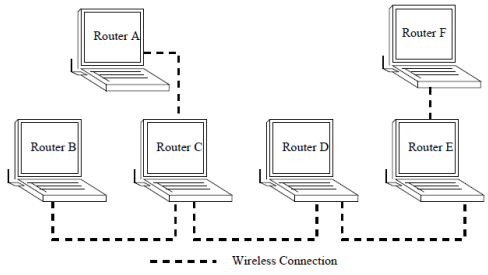

Fig 6. Example of OLSR routing protocol

Advantages:
1) OLSR does not need central administrative system to handle its routing process.
2)The link is reliable for the control messages, since the messages are sent periodically and the delivery does not have to be sequential.
3)OLSR is suitable for high density networks.
4)It does not allow long delays in the transmission of packets.

Disadvantages:
1) OLSR protocol periodically sends the updated topology information throughout the entire network.
2) It allows high protocol bandwidth usage.

IV. SIMULATION BASED ANALYSIS USING NETWORK SIMULATOR (NS-2.34)

A. Simulation Tool

The simulation tool used for analysis is NS-2.34 which is highly preferred by research communities. NS is a discrete event simulator targeted at networking research. NS provides substantial support for simulation of TCP, routing, and multicast protocols over wired and wireless (local and satellite) networks. NS2 is an object oriented simulator, written in C++, with an OTcl interpreter as a frontend. This means that most of the simulation scripts are created in Tcl (Tool Command Language). If the components have to be developed for ns2, then both Tcl and C++ have to be used.

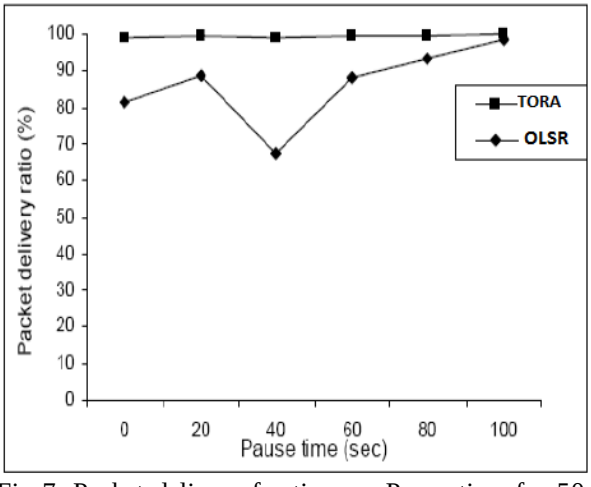

Fig 7. Packet delivery fraction vs. Pause time for 50-node model with 15 sources.

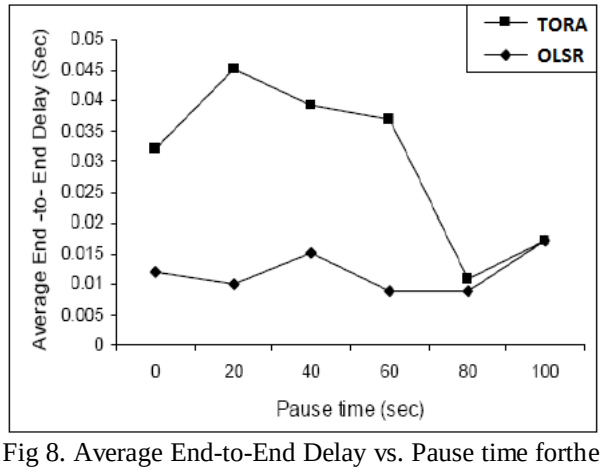

Fig 8. Average End-to-End Delay vs. Pause time forthe 50-node model with 15 sources.

V. CONCLUSION

It is difficult for the quantitative comparison of the most of the ad hoc routing protocols due to the fact that simulations have been done independent of one another using different metrics and using different simulators. This paper does the realistic comparison of three routing protocols OSPF, TORA and OLSR. The significant observation is, simulation results agree with expected results based on theoretical analysis. As expected, proactive routing protocol OSPF performance is the best considering its ability to maintain connection by periodic exchange of information, which is required for TORA, based traffic. OSPF performs predictably. Meanwhile OLSR was very good at all mobility rates and movement speeds. Compared the hybrid routing protocol (TORA) and Table-Driven (OSPF and OLSR) routing protocols by varying the number of nodes and measured the metrics like end-end delay, dropped packets, As far as packet delay and dropped packets ratio are concerned.

VI. FUTURE SCOPE

The application developed can be further enhanced to include some new features that changes with time and new technologies some of them includes the following features:

1. It can be used to transfer the larger packets, length by fragmenting at the sender side and de-fragmenting at the receiver side.
2. The protocols which are having poor behaviors and correcting it is not simple. It is more than complex that of writing a new protocol so in future the performance, quality gets enhanced.

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