Survey of Routing Algorithms for Power Consumption in Ad-Hoc Networks

R. Srividhya
Assistant Professor
Department of Computer Engineering
School of IT & Science, Dr. G. R. D College of Science, Coimbatore, India

Abstract— In mobile Ad-hoc network (MANET), a node communicates directly with the cluster head within the wireless range and indirectly with the nodes inside the cluster. In order to efficiently communicate with the nodes and to save excess power in the network routing algorithm is used. The primary goal of such a network is to save excess network in the nodes by making the nodes inactive while not in use and also establish an efficient path for safe and secure message transfer. This article surveys different routing mechanisms proposed for MANETs.

Key words: MANETs, Routing Algorithms for Power Consumption

I. Introduction

Recently, Wireless Technology has been one of the hottest topics in computing and communications. Since the late 1970s, consumer wireless applications such as mobile phones began to take off, and presently people are beginning to activate fourth-generation (4G) networks for commercial purposes. Wireless networking technology offering high data rates for mobile users will flourish which will enable the handling of multimedia Web content, video conferencing, and e-commerce, etc. Routing is one of the key issues for supporting these demanding applications in a rather unstable and resource limited wireless networking environment.

There are two ways to implement mobile wireless networks – infra-structured network and infra-structure-less (ad-hoc) network. With an infra-structured network, mobile nodes communicate only with the base stations providing internode routing and fixed network connectivity. With the infra-structure-less mobile network, each node communicates with other nodes directly or indirectly through intermediate nodes. Thus, all nodes are virtually routers participating in some protocol required for deciding and maintaining the routes.

A large number of routing protocols have been developed for mobile ad-hoc networks which are characterized by unpredictable network topology changes, high-degree of mobility, energy-constrained mobile nodes, bandwidth-constrained, intermittent connection, and memory-constrained. The routing problem has been well researched in infra-structured wireless networks, where the goals are efficient detection and adaptation to the network topology, scalability, and convergence.

Even though these are equally valid for MANETs, the solutions are more difficult to find since MANETs are inherently more dynamic. In particular, energy efficiency may be the most important design criteria for mobile networks since a critical limiting factor for a mobile node is its operation time, restricted by battery capacity. In infra-structured wireless networks, where a wireless link is limited to one hop between an energy-rich base station and a mobile node, the goal of energy conservation can be largely achieved by relocating power intensive network operations to the base station.

II. Routing Protocols for Ad Hoc Networks

The routing protocols proposed for MANETs are generally categorized as table-driven, source-initiated on-demand driven, and hybrid based on the timing when the routes are updated. With the table-driven routing protocols, each node attempts to maintain consistent, up-to-date routing information to every other node in the network. With source-initiated on demand routing, route discovery and maintenance are performed only when a source node desires them. The hybrid approach combines the two approaches to minimize the overhead incurred during route discovery and maintenance. In this section, the protocols belonging to each of the three aforementioned categories are discussed.

A. Table-Driven Routing Protocols

In table-driven routing protocols, each node maintains up-to-date routing table by responding to the changes in network topology and propagating the updates. Thus, it is proactive in the sense that when a packet needs to be forwarded the route is already known and can be immediately used. As is the case for wired networks, each node in a MANET maintains a routing table containing a list of all the destinations, next hop, and the number of hops to each destination. The routing table is constructed using either link-state or distance vector algorithms.

In ZHLS, the network is divided into non-overlapping zones without any zone-head. It defines two levels of topologies - node level and zone level. If any two nodes are within the communication range, a physical link exists. A virtual link exists between two zones if at least one node of a zone is physically connected to some nodes of the other zone. The node (zone) level topology provides the information on how the nodes (zones) are connected together by the physical (virtual) links. Thus, given the zone and node ID of a destination, the packet is routed based on the zone ID until it reaches the correct zone. Then, within that zone, it is routed based on node ID.

Fisheye State Routing (FSR) protocol is another hierarchical routing scheme where information exchange is more frequent with closer nodes than that with far away nodes. FSR is an improvement over GSR to minimize the bandwidth overhead due to update messages. The FSR protocol scales well to large networks since the overhead is controlled.

All rights reserved by www.ijsrd.com

B. Source-Initiated On-Demand Driven Protocols

These are reactive protocols where routes are created only when desired by the source node. The two basic procedures of source-initiated on-demand driven protocols are route discovery process and route maintenance process. The route discovery process involves sending route-request packets to neighbour nodes, which then forward the request to their neighbours, and so on. Once the route-request reaches the destination or the intermediate node with a "fresh enough" route, the destination/intermediate node responds by unicasting a route-reply packet back to the neighbour from which it first received the route-request. Once the route is established, it is maintained by some form of route maintenance process until either the destination becomes inaccessible along any path from the source or the route is no longer desired.

The Cluster Based Routing Protocol (CBRP) is an extension of CGSR where nodes are divided into clusters. When a source has data to send, it floods route request packets only to the neighbouring cluster-heads. Upon receiving the request, a cluster-head checks to see if the destination is in its cluster. If so, the request sent directly to the destination; otherwise, the request is sent to all its adjacent cluster-heads.

Temporally Ordered Routing (TORA) is a highly adaptive protocol that provides multiple routes for any desired source-destination pair, and localizes the control messages to a very small set of nodes near the occurrence of a topological change. To accomplish this, nodes maintain routing information on adjacent (1-hop) nodes and use a "height" metric to establish a directed acyclic graph (DAG) rooted at the destination. When the DAG route is broken during node mobility, route maintenance is necessary to re-establish a DAG rooted at the same destination. This is achieved using a link reversal algorithm at the site of the link failure to re-establish the path. The algorithm tries to localize the effect and gives many alternate paths to the destination. Thus, they not only save bandwidth in updates, but also provide alternate paths on case of path failures.

C. Hybrid Routing Protocols

The hybrid approach combines the table-driven and source-initiated on-demand driven approaches such that the overhead incurred in route discovery and maintenance is minimized while the efficiency maximized.

Zone Routing Protocol (ZRP) partitions the network implicitly into zones, where a zone of a node includes all nearby nodes within the zone radius defined in hops. It applies proactive strategy inside the zone and reactive strategy outside the local zone. Each node may potentially be located in many zones. ZRP consists of two sub-protocols. The proactive intra-zone routing protocol (IARP) is an adapted distance-vector algorithm. When a source has no IARP route to a destination, it invokes a reactive inter-zone routing protocol (IERP), which is very similar to DSR

The Location-Aided Routing (LAR) protocol assumes that the sender has advanced knowledge of the location and velocity of the destination node using the GPS. Based on the location and velocity of the destination node, the expected zone can be defined. Thus, LAR limits the search for a new route to a small zone resulting in fewer route discovery messages. The request zone is the smallest rectangle that encompasses the expected zone. The sender explicitly specifies the request zone in its route-request message to limit the boundary on the propagation of the route-request messages.

D. Routing Protocols for Balanced Energy Consumption

This section surveys energy efficient routing protocols developed for MANETs. It is noted that direct comparison of these protocols is extremely difficult because these approaches have different goals with different assumptions and implementation levels. Nevertheless, there are three major issues involved in energy aware routing protocols. First, the goal is to find the path that either minimizes the absolute power consumed or balances the energy consumption of all mobile nodes. Balanced energy consumption does not necessarily lead to minimized energy consumption, but it keeps a certain node from being overloaded and thus, ensures longer network lifetime. Since the energy balance can be achieved indirectly by distributing network traffic, one such routing protocol is also discussed in this section. Second, energy awareness has been either implemented at purely routing layer or routing layer with the help from other layers such as MAC or application layer. For example, information from the MAC layer is beneficial because it usually supports power saving features which the routing protocol can exploit to provide better energy efficiency. Third, some routing protocols assume that the transmission power is controllable and nodes' location information is available (e.g., via GPS). Under these assumptions, the problem of finding a path with the least consumed power becomes a conventional optimization problem on a graph where the weighted link cost corresponds to the transmission power required for transmitting a packet between the two nodes of the link.

SPAN Protocol Unlike other aforementioned routing protocols, the SPAN operate between the routing layer and the MAC layer. This is because SPAN tries to exploit the MAC layer's power saving features in its routing decision. The basic idea of the MAC layer's power saving mechanism is to power down (sleep) the radio device when it has no data to transmit or receive. This allows substantial energy savings since sleep operation consumes less power. For example, Lucent's Wave LAN-II based on the IEEE 802.11 wireless LAN standard consumes 250 mA and 300 mA when receiving and transmitting, respectively, while consumes only 9 mA when it is in sleep mode .In order to coordinate the sleep period operation in IEEE 802.11, one mobile node is selected as the master. The master node must be awake all the time and periodically sends a beacon packet to its slave nodes followed by TIM (Traffic Indication Map) that indicates the desired receivers. Each slave wakes up at the beacon times and checks if it is addressed or not. If the node is not addressed it sleeps again; otherwise, it stays awake to receive data.

The SPAN protocol makes the information on master nodes available to the network layer and lets them constitute a routing backbone to route most of traffic in the MANET. All slave nodes need not wake up to forward traffic on behalf of other nodes and conserve energy by sleeping most of time. On the other hand, master nodes must be awake all the time for routing. However, this does not

All rights reserved by www.ijsrd.com

spend any extra energy because they need to be up anyway for MAC layer's sleep period coordination. To prevent overloading the masters and to ensure fairness, each master periodically checks if it should withdraw as a master and give other neighbours a chance to become a master.

Selecting and replacing masters must be done in a distributed way. In SPAN, each node periodically determines if it should become a master or not based on the following master eligibility rule: If two of its neighbours cannot reach each other either directly or via one or two masters, it should become a master.

PEN (Prototype Embedded Network) Protocol is designed for embedded networks where the rate of interaction is fairly low. It is thus more suited for control applications rather than data applications. Low power consumption is a key design criterion, which renders existing de-facto protocols replaced by low power ad hoc protocol stack from the physical layer to the transport layer. As in SPAN and GAF, this protocol exploits the low duty cycle of communication activities and powers down the radio device when it is idle. Like SPAN, the PEN system has an additional layer between the MAC and the routing layer, called the Rendezvous layer, which is responsible for scheduling and forecasting times of inactivity.

However, unlike SPAN, nodes interact asynchronously without master nodes and thus, costly master selection and cluster formation procedures can be avoided at the cost of extended delay. This asynchronous protocol is based on "server beaconing" mechanism where each node periodically wakes up, broadcasts its routing capability as a server, and listens for replies before powering down again. Any node wishing to send would wake up and listen for beacons from such nodes. Route discovery and route maintenance procedures are similar to those in AODV On-demand route search and routing table exchange between neighbour nodes. Due to its asynchronous operation, the PEN protocol minimizes the amount of active time and thus saves substantial energy

III. CONCLUSION

A MANET consists of autonomous, self-organizing and self-operating nodes. It is characterized by links with less bandwidth, nodes with energy constraints, nodes with less memory and processing power and more prone to security threats than the fixed networks. However, it has many advantages and different application areas from the fixed networks or the infra-structured mobile networks. The field of ad-hoc mobile networks is rapidly growing and changing, day by day.

Routing is one of the main problems in MANETs. Numerous solutions to routing have been proposed, but energy efficient routing decision is more important than simple shortest path routing. In this chapter, I have provided descriptions of a number of energy aware routing schemes proposed for MANETs. While it is not clear that any particular algorithm or a class of algorithms is the best for all scenarios, each protocol has definite advantages/ disadvantages and is well-suited for certain situations.

REFERENCES

[1] Ali Broumandnia, Ehsan Sharifi and Milad Ghahari Bidgoli, "Reducing Energy Consumption in Mobile ad hoc Networks Using Energy-aware Routing Algorithm Based on Multiple Routes", ACSIJ Advances in Computer Science: an International Journal, Vol. 3, Issue 2, No.8 , March 2014.

[2] P. Dhaval, R. Arpit, "Power Aware Routing Protocol to Extend Life-Time of MANET", International Journal of Engineering Research & Technology (IJERT), Vol. 1 Issue 10, 2012.

[3] S.Suganya, S.Palanimmal, "An Optimized Energy Consumption Algorithm For Magnet", Published Bu Elsevier Ltd.Procedig Engineering, 2012.

[4] W. Jiang, Li. Zhaojing, Zeng. Chunqiang and Jin.Hai, "Load Balancing Routing Algorithm for Ad Hoc Networks", International Conference on Mobile Ad-hoc & Sensor Networks, 2009.

[5] M. Iqbal, I. Gondal and L. Dooley, "A novel load balancing technique for proactive energy loss mitigation in ubiquitous networks", IEEE International Conference on Consumer Communications & Networks, Vol. 1, pp.157–167, 2006.

[6] K. Woo and C. Yu, "Localized Routing Algorithm for Balanced Energy Consumption in Mobile Ad Hoc Networks", Proc. of Int'l Symp on Modeling, Analysis and Simulation of Computer and Telecommunication Systems, 2001.

[7] C-K. Toh, "Maximum Battery Life Routing to Support Ubiquitous Mobile Computing in Wireless Ad hoc Networks", IEEE Communications Magazine, vol. 39, no. 6, pp. 138-147, 2001.

[8] Q. Li, J. Aslam and D. Rus, "Online Power-aware Routing in Wireless Ad-hoc Networks", Proceedings of Int'l Conf. on Mobile Computing and Networking, 2001.

[9] J-H. Chang and L. Tassiulas, "Energy Conserving Routing in Wireless Ad-hoc Networks", Proceedings of the Conference on Computer Communications, pp3-22, 2000.

[10] Y. Qin, Y. Y and H.Y, "A routing protocol with energy and traffic balance awareness in wireless ad hoc networks", Proceeding of the 6th International Conference on Information, Communication Signal Processing, 2010.

All rights reserved by *www.ijsrd.com*