Enrichment of MANET in Power Consuming and Broadcasting Data with the Progression of Ad-hoc Routing Protocols

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Abstract— Mobile Ad-hoc network be a set of mobile nodes that communicate via wireless links and communication is carried out without any centralized control or unchanging infrastructure. Each node participating in the network can act as router and host. In mobile ad-hoc network the nodes are free to move independently therefore topology changes frequently. Source to destination to route the packets, routing protocol is needed. Routing is the important issue in ad-hoc networks. Various routing protocols have been implemented. Ad-hoc network routing protocols can be broadly divided into two subparts reactive and proactive protocols. The main goal of this paper is to evaluate performance of Ad-hoc On Demand Distance Vector (ADOV), Adaptive Information Dissemination (AID), and Optimized Scheduling Algorithm in Mobile ad-hoc networks with different network parameters for improving network lifetime and power consumption parameters using NS2. Our basic goal is to present vast information related to AODV protocol and to analyze its performance using different metrics such as packet loss ratio, packet delivery ratio, throughput and packet drop rate.

Key words: Energy Efficiency, Mobile Ad hoc Networks, Routing Protocols, AODV, AID, Optimized Scheduling Algorithm

I. INTRODUCTION

Mobile ad hoc network [1] [2] is an independent system consisting of mobile hosts that do not rely on the presence of any unchanging network infrastructure. Depending on the nodes geographical positions, their transceiver coverage patterns, broadcast power levels, and co-channel interference levels, a network can be formed and unformed on the fly. This ad hoc network topology changes as mobile hosts travel around, "disappear" (failure or depletion of battery capacity), or adjust their broadcast and reception characteristics. The main characteristics of mobile ad hoc networks are:

- Dynamic topology: Nodes are free to move about arbitrarily. In addition, radio propagation conditions modify rapidly over time. Thus, the network topology may vary randomly and rapidly over unpredictable times.
- Bandwidth constraints and variable link capacity:
- Wireless links have considerably lower capacity than wired links. Due to the effects of multiple accesses, multipath fading, noise, and signal interfere, the capacity of a wireless link can be degraded over time and the effective throughput may be fewer than the radio's maximum transmission capacity.
- Energy constrained nodes: Mobile nodes rely on batteries for correct operation. Since an ad hoc network consists of several nodes, depletion of batteries in these nodes will contain a great influence on overall network performance. Therefore, one of the most important protocol design factors is associated to device energy conservation.
- Multi-hop communications: Due to signal spread characteristics of wireless transceivers, ad hoc networks require the support of multi hop communications; that is, mobile nodes that cannot attain the destination node directly will need to relay their messages through other nodes.

From the above mentioned characteristics a major concern in MANET is energy conservation due to the limited lifetime of mobile devices. Energy is a valuable resource in MANET. For many multi-hop scenarios, nodes are battery-operated, thus requiring competent energy management to ensure connectivity across the network. Numerous energy aware routing protocols have been proposed using various techniques such as transmission power adjustment, adaptive sleeping, topology control, directional antennas and multipath routing etc. But most of the methods take into account routing metrics such as delay or hop count. They don't deem about transmission energy cost and remaining battery energy. So energy efficiency is directly connected to network lifetime or network capacity. The main contribution of this paper is to provide an complete survey going on the energy-efficient routing protocols for MANETs as well as their classification based on its energy efficiency into three major categories: Power control metrics, Remaining battery power and multipath routing with reliability.

By focusing on the techniques these protocols use in order to route messages, taking into contemplation the energy they consume and how they achieve to reduce this consumption and extend the lifetime of the network. Moreover, by discussing the strengths and weaknesses of each protocol given that a comparison among them including a few metrics (scalability, power usage, route metric, periodic message type, mobility, robustness) in order for researchers and practitioners to understand the a variety of techniques and thus helping them to select the most appropriate one based on their needs.

A. Energy Efficient Route Selection Policies

Energy efficiency is a critical problem in MANETs [3] [4] [5]. The existing energy-efficient routing protocols often use remaining energy, transmission power or link distance as metrics to select an optimal path. In this section, the spotlight is on energy efficiency in MANETs and the route selection policies with novel metrics in order to increase path survivability of MANETs. The new metrics result in stable network connectivity and less additional route discovery operation. The nodes used in a MANET are resource constrained, they have a low processing speed, a low storage capacity and a limited communication bandwidth. Furthermore, the network has to operate for long periods of time, but the nodes are battery powered, so the available energy resources boundary their overall operation.

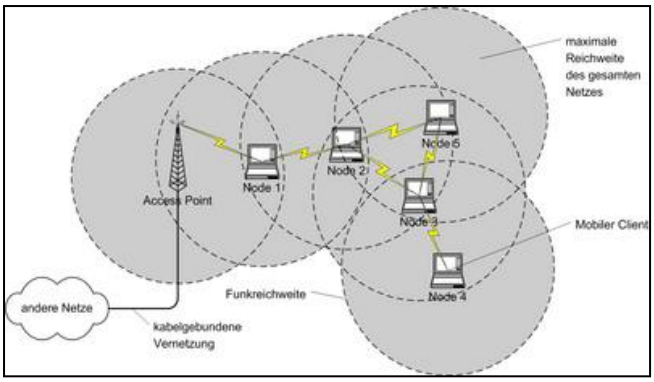

Fig. 1: MANET Architecture

To minimize energy consumption, most of the device components should be switched off most of the time. Another important characteristic is that nodes have noteworthy processing capabilities in the ensemble, but not individually. Nodes have to arrange themselves, administering and managing the network all together, and this is much harder than controlling individual devices. However, the operation of the protocol can affect the energy spent for the transmission of the data. There are some terms associated to the energy efficiency on MANETs [6] that are used to evaluate the performance of the routing protocols are as following below:

- Energy per Packet: This phrase is referred to the amount of the energy that is used up while sending a packet from a source to a destination.
- Reliability and Energy: It refers to the way that a tradeoff between different application necessities is achieved. In some applications, emergency events may validate an increased energy cost to speed up the reporting of such events to raise the redundancy of the transmission by using a number of paths.
- Network Lifetime: In MANETs, it is important to maximize the network lifetime, which means to increase the network survivability or to extend the battery lifetime of nodes. Moreover, the lifetime of a node is efficiently determined by its battery life. The major drainage of battery is due to transmitting and receiving data the processing elements and among nodes.
- Average Energy Scatter: This metric is associated to the network lifetime and shows the average dissipation of power per node over time in the network as it performs diverse functions such as transmitting, sensing, receiving and aggregation of data.
- Low Energy Consumption: A low energy protocol has to consume less energy than traditional protocols. This means that a protocol that takes into consideration the remaining energy level of the nodes and selects routes that make the most of the network's lifetime is considered as low energy protocol.
- Distance: The distance between the transmitter and receiver can impinge on the energy that is required to send and receive packets.

B. Challenging Factors Affecting the Energy-Efficient Routing Protocols design Issues

MANETs, despite their innumerable applications, suffer from a number of restrictions concerning, mainly limited energy deposits, limited processing power, and some degree of bandwidth of the wireless links connecting mobile nodes. The design of energy-efficient routing protocols in MANETs [7] is influenced by several factors. These factors must get over before efficient communication can be achieved in MANETs. Here is a list of the most common factors affecting the routing protocols design:

- Node Deployment
- Node/Link Heterogeneity
- Scalability
- Network Dynamics
- Fault Tolerance
- Energy Consumption without Losing Accuracy
- Connectivity
- Transmission Media
- Quality of Service

II. RELATED WORK

Minimum Total Transmission Power Routing [8] finds [MTPR] the path with the minimum power consumption. MTPR considers the signal to noise ratio [SNR] and sets a threshold (BER, Bit Error Rate) in order to select a path in which each link in the chosen path satisfies, where SNR is the signal-to-noise ratio; i and j are the sending and the receiving nodes, respectively; Pi is the transmitting authority of the sending node; Gij is the enhancement of the link between nodes i and j; μj is the noise detected by the receiving node; k is a neighboring node of the receiving node; and βj is the threshold BER. The Minimum Battery Cost Routing (MBCR) [9] takes into account the remaining power of nodes to prolong network lifetime by selecting one path with the maximum remaining power from all available paths. To find the path with the highest remaining power, MBCR calculates the sum of the remaining power of each node in a path, using Equations.

Viragoes et al. proposed x MBCR [10], which is an improved version of MBCR and MMBCR, to have higher network lifetime than MBCR and MMBCR. X MBCR modifies the battery cost function of MBCR, as shown in

$fi\,(t) = (\,1 / Ci\,(t)\,)p$

Where Ci(t) is the remaining power of node i at time t and p is a constant. When p is 1, the battery cost function of x MBCR is equal to the one of MBCR. In addition, when p is equal to zero, x MBCR can find the shortest routing path. When p grows, the behavior of x MBCR is more and more similar to MMBCR.

To solve this problem, Condition Min–Max Battery Capacity Routing (CMMBCR) [12] which considers both the power consumption during data transmission and the remaining energy of nodes, was proposed. Taking into account the transmission power and the remaining power, CMMBCR combines MBCR and MMBCR. CMMBCR has a pre-defined threshold used for the remaining power of nodes. When the remaining power of a node is greater than the threshold, the MTPR protocol is used to shrink power consumption.

The Minimizing the Maximum used Power Routing (MMPR) [13] selects the path that has minimum power consumption for data transmission by finding all the routing paths from a source to a destination node and calculating the power consumed by each path. In addition, MMPR also takes into account the power consumption of

each node to balance the total power consumption, so the result is network lifetime is increased.

Gomez et al. Proposed [14] the PARO protocol which evaluates the distance between two nodes to determine the transmission power needed to decrease power consumption. In PARO, it is assumed that each node can directly communicate with all the other nodes in the network (a one-hop network). A sending node uses the maximum power to transmit the first packet to the destination node. After the source node transmits the first packet to the destination node and receives the ACK packet effectively, the source node can use d4 and Tmin to determine the distance from itself to the destination node, as well as the smallest amount of power needed for data transmission to the destination node.

Wang et al., proposes ES-AODV [15] to reduce power consumption, it uses the relationship between the distance and signal strength to determine the smallest amount of power for data transmission. To prevent transmission failure due to signal decay, ES-AODV takes the most wanted received power strength P0 and divides it by the signal decay ratio to obtain the minimum data transmission power Pmin. Accordingly, to transmit data, ES-AODV selects from all available paths the one path that consumes lowest amount of power, as shown in Eq., where P(i,j) is the power consumed in transmitting data from node i to node j, n is the several of nodes in path l, and P(l,n) is the power consumed in transmitting a packet along path l.

III. EXISTING WORK

Mobile Ad Hoc Networks (MANETs) contain of nodes that adjust position frequently. To accommodate the changing topology particular routing algorithms are needed. For relatively small networks flat routing protocols may be sufficient. However, in bigger networks either geographic or hierarchical routing protocols are needed. There is no single protocol that fits all networks perfectly. The protocols have to be selected according to network characteristics, such as density, size and the mobility of the nodes. Wireless local area network based on IEEE 802.11 technology is the most prevalent infra-structured mobile network, where a mobile node communicates with a fixed base station, and thus a wireless link is limited to one hop between the node and the base station maintaining an optimized lifetime of a routing path in a network is a very difficult task because the power or energy of the nodes depends on the size, model, property, and capacity of the battery. Energy in batteries continuously drains due to node activities such as transmission, reception and overhearing. Depletion of power in nodes especially the intermediate ones disrupt communication and results in changes to the network topology.

IV. PROPOSED WORK

Mobile Ad-Hoc Networks (MANETs) is collection of mobile nodes, dynamically forming a temporary network without centralized administration or preexisting network infrastructure. DSR (Dynamic Source Routing) is on-demand, simple and efficient routing protocol used for multi-hop wireless ad-hoc networks of mobile nodes. DSR uses source routing and protocol composed of two most important mechanisms-"Route Maintenance" and "Route Discovery", which works together entirely, on demand. The AODV protocol allows multiple routes to destination, loop-free routing, support for unidirectional links, use of only "soft state" in routing, quick discovery when routes in the network change, designed for mobile ad hoc networks of up to about two hundred nodes and to work healthy even with high rates of mobility. Each Mobile Host operates as a specialized router and routes are obtained as necessary i.e. on demand with little or no reliance on periodic advertisements. Our novel routing algorithm is quite suitable for a dynamic self-starting networks required by users wishing to utilize ad-hoc networks AODV. AODV provides loop free routes even while repairing broken links because the protocol does not require global periodic routing advertisements the needed on the overall bandwidth available to the mobile nodes is substantially fewer than in those protocols that do necessitate such advertisements.

A. Optimized Scheduling Algorithm

The proposed algorithm assigns several nodes along a path to manage steps at once. This local assignment is realized by solving the matching between operations and control steps optimally. Each operation-control step similar within this solution is related with a corresponding weight/gain. The local solution is optimal for the given set of operations in the sagacity that the summation of the weights of the matching generated for those operations is maximized. This distinguishes new algorithm from other heuristics such as list scheduling, force directed scheduling, etc., which generally make a scheduling decision regarding a single operation at a time. In our algorithm generate a solution for a collection of operations while maximizing the scheduling purpose for this set of operations. While the quality guarantee remains local, this helps to grant a good solution at each step for the operations along each path at hand. Moreover, by manipulating the weight function related with the matching between control steps and operations, a wide variety of objectives can be combined within a solution. Hence, this algorithm provides a flexible way of defining and changing our scheduling objective function.

B. Ad hoc on demand Distance Vector Routing Protocol (AODV)

The (Ad hoc on demand Distance Vector) AODV protocol tries to remove the main disadvantage of the DSR protocol by eliminating source routes from data packets and its control. Moreover, AODV was the first protocol to carry multicasting in a MANET. In multicasting, a source node may want to send the same packet to a number of destination nodes. Broadcasting is a special case of multicasting, when a source node wants to send the same packet to all the nodes in the network. It is possible to support multicasting through finding unit-cast routes from the source to all the nodes in a multicast group. AODV is in sagacity a table-driven as well as a reactive protocol. AODV has two phases, route maintenance and route discovery, like DSR. AODV uses a mechanism where every node along a route sets up reverse and forward paths during the route discovery phase.

C. Adaptive Dissemination Protocol

AID (AID) algorithm with other MANETs transmission protocols with respect to the energy effectiveness. In AID,

each node can dynamically amend the values of its local parameters using information from neighboring nodes without requiring any extra effort, such as exact location-determination or distance measurements of nodes.

V. CONCLUSION

In recent days the MANETs have greatly expanded playing an important role for the efficient data communication selection and their delivery. The energy efficiency is a very significant issue for the networks especially for MANETs which are characterized by some degree of battery capabilities. The complexity and reliance of corporate operations on MANETs require the use of energy efficient routing protocols and techniques, which will guarantee the network connectivity and routing of information with the less required energy. Therefore, the application of the proper routing protocol will increase the network lifetime and at the same time it will ensure the network connectivity and efficient data delivery. This survey addresses the important key factors to selecting energy efficient routing schemes to prolong the lifetime of the node and network.

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