Bidirectional scheduling for Wireless Sensor Network

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Abstract—Scheduling has recently acquired increased interest among researchers in the switching community. The premise is to replace the single switch, running at a speed Proportional to the number n of input and output ports (and to the line rate), by a scheduling switch consisting of k switches, each running at 1lk the speed.

Indeed, with such architecture, and for some classes of traffic patterns, simply spreading the traffic among the k switches achieves 100% throughput (thus the term load balancing). However, reordering among packets of the same flow may occur, which becomes a major concern. One way of avoiding this problem is to use a scheduling algorithm that does not split, i.e. that routes all packets of a given flow through exactly one of the k switches, without re-routing existing flows. We shall call such scheduling algorithm non-splitting algorithm. While In this paper, we present scheduling in Wireless Sensor Network through novel Forward backward Scheduling (FBS). Protocol for communication [21, 22] FBS defines a new metric for routing known as the degree of nodal activity to represent the load on a mobile node. In FBS routing information on all paths from source to destination are forwarded through setup messages to the destination. Setup messages include nodal activity information of all nodes on the traversed path. After collecting information on all possible paths, the destination then makes a selection of the path with the best-cost value and sends an acknowledgement to the source node.

Keyword: Wireless Ad hoc Networks, Wireless Sensor Network, Routing, scheduling algorithms, Performance Evaluation, Path Discovery, and Path Maintenance.

I. INTRODUCTION

A mobile ad hoc network is a collection of wireless sensor mobile hosts forming a temporary network without the aid of any centralized administration or standard support services regularly available in wide-area networks to which the hosts may normally be connected. In such an environment, it may be necessary for one mobile host to seek the aid of others in forwarding a packet to its destination, due to the limited propagation range of each mobile host's wireless transmissions A critical challenge in the design of ad hoc networks is the development of efficient routing protocols that can provide high-quality communication between two mobile nodes. Numerous routing protocols have been developed for ad hoc mobile net works. These protocols may generally be categorized as table-driven and on-demand routing.

Table driven routing protocols [1-5] attempt to maintain consistent, up-to-date routing information in each node by propagating updates throughout the network. Such protocols, and although a route to every other node is always available, incur substantial signaling traffic and power consumption. Since both bandwidth and battery power are scarce resources in mobile computers, this becomes a serious limitation to table-driven routing protocols.

On the other hand, on-demand routing protocols [6-10] overcome this limitation. This type of routing protocols does not maintain routing information at every node, but create routes only when desired by the source node. When a source has a packet to transmit, it invokes a route discovery mechanism to find the path to the destination. The route remains valid until the destination is reachable or until the route is no longer needed. In fact, on- demand routing is dominating the tendency for wireless ad hoc communication. Among all proposed wireless mobile ad hoc routing protocols, Dynamic Source Routing (DSR) [8, 9] and Ad hoc On-demand Distance Vector (AODV) [10] are the most prominent, and have been submitted to the Internet Engineering Task Force (IETF) Mobile Ad hoc NET working (MANET) working group [11] as candidates for standardization. DSR [8, 9] utilizes source routing in ad hoc networks to discover routes from source nodes to destination nodes. AODV [10] maintains routes as long as they are needed by the sources.

If a source node moves, or a hop on the route from the source node to the destination node becomes unreachable, route discovery from the source to the destination must be reinitiated if it still requires a route to the corresponding destination. It has been long believed that the performance of ad hoc networks routing protocols is enhanced when nodal mobility is reduced. This is true when considering performance measures such as packet delivery fraction and routing overhead. This may not be the case, however, when we consider packet delay. It was shown in [12] that the packet delay for both AODV and DSR increases as the nodal mobility is reduced. This is because there is a tendency in ad hoc networks routing protocols to use a few "centrally located" nodes in a large number of routes. This causes congestion at the medium access control (MAC) level, which in turn may lead to high packet delays, since few nodes have to carry excessive loads. Such sensor nodes may also suffer from high battery power consumption. This is an undesirable effect, which is compounded by the limited battery power of the mobile terminals. In fact, a major drawback of all existing ad hoc routing protocols is that they do not have provisions for conveying the load and/or quality of a path during route setup.

Hence they cannot balance the scheduling on the different routes. In this paper, we propose an efficient routing protocol, based on the concept of balancing traffic scheduling in wireless sensor network, namely, the Forward backward Scheduling (FBS) protocol. The proposed scheme is intended to route data packets circumventing congested paths so as to balance traffic load over the network and lower end-to-end delay. Additionally, the protocol demonstrates quick response to link failures incurred by topology changes in the ad hoc network and thereby improves data delivery reliability. Performance results indicate that FBS outperforms both AODV and DSR in terms of packet delivery fraction and average end- to-end delay, overload, Routing Load

II. FBS ROUTING

The proposed Forward backward Scheduling (FBS) is an on-demand routing protocol intended for delay-sensitive applications where users are most concerned with packet transmission delay. Hence, FBS focuses on how to find a path, which would reflect least traffic load so that data packets can be routed with least delay. The route discovery process is initiated whenever a source node needs to communicate with another node for which it does not have a known route. The process is divided into two stages: forward and backward. The forward stage starts at the source node by broadcasting setup messages to its neighbors. A setup message carries the cost seen from the source to the current node. A node that receives a setup message will forward it, in the same manner, to its neighbors after updating the cost based on its nodal activity value. In order to prevent looping when setup messages are routed, all setup messages are assumed to contain a route record, including a list of all node IDs used in establishing the path fragment form the source node to the current intermediate node.

The destination node collects arriving setup messages within a route-select waiting period, which is a predefined timer for selecting the best-cost path. The backward stage begins with an ACK message forwarded backward towards the source node along the selected path, which we call the active path. If a link on the selected path breaks, the ACK message is discarded and an error message is sent backward along the path fragment to the destination. The destination node will then choose another path, which does not contain any of the previous broken links. When the source node receives an ACK message, it knows that a path has been established to the destination and then starts transmission. When either the destination node or some intermediate node moves outside the active path, path maintenance will be initiated to correct the broken path. Once the next hop becomes unreachable, the node upstream of the broken hop propagates an error message to the destination node. Upon receiving notification of a broken link, the destination node picks up an alternative best-cost partial route passing through the node propagating the error message and then sends an ACK message to the initiator of the error message. If the destination has no alternative path passing through the node sending the error message, the destination picks up another route and sends an ACK message to the source. The source will use this new route to send data packets if it still has data to send. By then, a new active path is defined. In the worst case, where the destination has no alternate paths, it propagates an error message to the source and lets it restart route discovery.

Nodes learn about their neighbors in one of two ways. Whenever a node receives a broadcast from a neighbor, it updates its local connectivity information in its Neighborhood table to ensure that it includes this neighbor. In the event that a node has not sent data packets to any of its active neighbors within a predefined timeout, hello interval, it broadcasts a hello message to its neighbors, containing its identity and activity. This hello message is prevented from being rebroadcast outside the neighborhood of the node. Neighbors that receive this packet update their local connectivity information in their Neighborhood tables.

Receiving a broadcast or a hello from a new neighbor, or failing to receive consecutive hello messages from a node previously in the neighborhood, is an indication that the local connectivity has changed. If hello messages are not received from the next hop along an active path, the upstream active neighbors using that next hop send notification of link failure and the path maintenance protocol is invoked. A cost function is used to find a path with the least traffic so that data packets can be transmitted to the destination as fast as possible while achieving the goal of balancing load over the network. The following definitions are used:

• *Active path:* a path from a source to a destination, which is followed by packets along this selected route.

• *Active node:* a node is considered *active* if it originates or relays data packets or is a destination.

• *Activity:* The number of active pa ths through a node is defined as a metric measuring the activity of the node.

• *Cost:* Minimum traffic interference is proposed as the metric for best cost.

a) The beginning of the forward stage, where a request to establish a path is initiated. The source node begins to forward this request to its neighbors. Therefore, the source can begin transmitting data. if it does not receive acknowledgement from destination that a path has been established. When the source node receives an error notification indicating that destination cannot find alternate paths, it must restart route discovery.

b) Where the node forwards setup message to its neighbors, avoiding already visited nodes. in which acknowledgement is sent backward to upstream nodes if next link is not broken. Otherwise, an error notification is sent from the node along the path fragment to indicate the failure of the candidate path. Error notification is relayed downstream until it reaches the destination to pick an alternate path. Upon receiving new partial route from destination, packets are redirected on this new partial route

c) The forward stage and the start of the backward stage. The route and cost information is stored at the destination routing table. I f the route-select time period enforced at the destination node is reached; the path with the minimum cost is selected to begin the backward stage. The case when destination node receives error notification of link breakage. The destination node removes all the invalid paths associated with broken links. I f an alternate path passing through the node detecting link breakage exists; the destination node selects this path to notify the error.

III. RESULTS

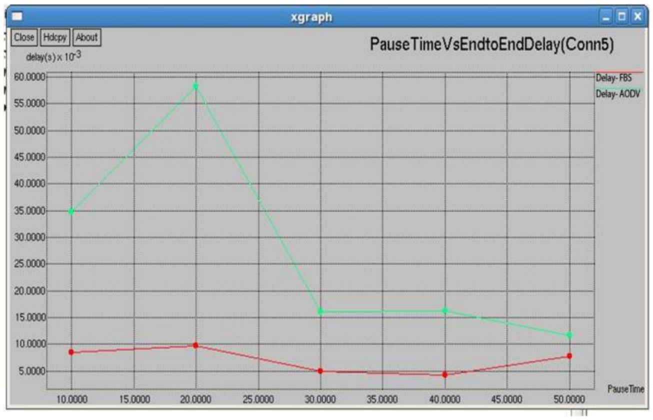

Figure 1: Pause time Vs End to End Delay

Figure1: show that in end to end Forward backward Scheduling performance is much better than AODV Protocol

Figure 2: Pause time Vs overhead

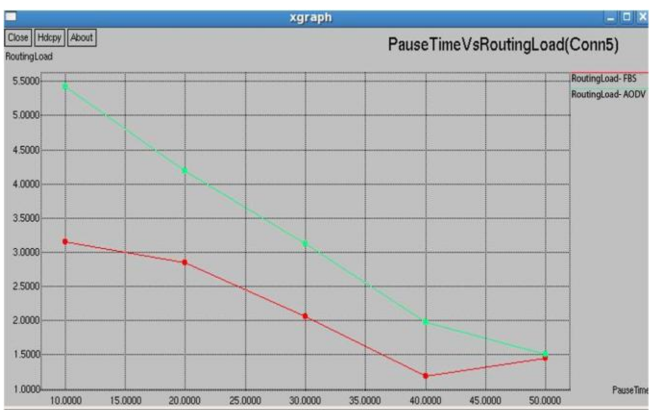

Figure 3: Pause time Vs routing load

IV. CONCLUSION

Proposed Forward backward Scheduling performance better than AODV protocol in concerns with End to end delay, Overhead and routing load, which will help us for improving the load balancing in wireless sensor network

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