Design and Managing of Mac Protocol Using Wireless Sensor Network

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ABSTRACT:-We design a unified MAC and routing framework to exploit the temporal and frequency resources to significantly improve the throughput of wireless sensor networks. There are two things mainly concentrate of Network infrastructure and the MAC scheme must be establish the communication link between the sensor nodes and share the communication medium fairly and efficiently. First consider time scheduling on a single frequency channel with the aim of minimizing the number of time slots required (schedule length) to complete a converge cast. Next, we combine scheduling with transmission power control to mitigate the effects of interference, and show that while power control helps in reducing the schedule length under a single frequency, scheduling transmissions using multiple frequencies is more efficient. An efficient MAC protocol for low-traffic delay-tolerant wireless sensor networks. We defined a new routing metric that considers the difference in interface speeds, the delay due to retransmission, the impact of interface constraint, and the delay due to node competition for a limited number of channels. Simulations in NS2 (network simulator). In this paper, we discuss about the Energy Efficiency of the MAC (EEMAC) and improvising the MAC protocol (IMAC), based on simulation results we show that IMAC has smaller energy and delay compared to EEMAC.

I. INTRODUCTION

Wireless sensor networks are collection of sensor nodes connected via wireless LAN links. The information gathered at sensor node is propagates in the form of radio signal to control room via multi hop communication. In the networks, many sensors where lying in same channel to pass message, so as well as minimize the power efficient and delay for sensor networks. An Efficient Medium Access (MAC) protocol is critical for the performance of a Wireless Sensor Networks (WSN), especially in terms of energy consumption.

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IMAC is a Time Division Multiple Access (TDMA) scheme that extents the common single hop TDMA to a multi hop sensor network, Using a high-powered base station to synchronize the nodes and to schedule their transmission and receptions. The protocol first enables the base station together with topology (connectivity) information. A scheduling algorithm, then determines when each node should receive data and the access point announces the transmission schedule to the other nodes. The performance of EEMAC is compared to existing protocols based on simulations in NS2 (network simulator). In this paper, we discuss about the Energy Efficiency of the MAC (EEMAC) and improvising the MAC protocol (IMAC), based on simulation results we show that IMAC has smaller energy and delay compared to EEMAC.

A. Challenges and Design of Mac Protocol

The main challenges posed by the underwater environment for the development of efficient under water sensor networking solutions and propose a novel medium access control (MAC) protocol with power control to increase efficiency and save on energy. Underwater channel is characterized by high propagation delay, limited bandwidth capacity, variable delays, frequency dependent attenuation, noise, fading, and Doppler spread. New research at almost every level of the protocol suite is required. An efficient MAC protocol with power control for delay tolerant applications is analyzed and simulated. Proposed MAC protocol is different from those already existing as it encompasses power control mechanism to increase energy efficiency and save on power.

B. A Survey on Schedule-Based MAC Protocols for WSN

This paper discusses the properties of WSN-MAC protocols and the challenges of schedule-based MAC protocols. Then it surveys by describing several schedule-based MAC protocols for WSN which follows a comparison by emphasizing their strength and weaknesses with some other properties.

Finally open research issues on MAC layer of WSN are also discussed.

i) Energy Efficiency: The sensor nodes are battery powered and it is often very difficult to change or recharge batteries for these sensor nodes. Sometimes it is beneficial to replace the sensor nodes rather than recharging them.

ii) Latency: Latency requirement basically depends on the application. The detected events must be reported to the sink node in real time in the sensor network applications. So that the suitable action could be taken immediately.

iii) Throughput: Throughput requirement also varies with different applications. Some of the sensor network application requires sampling the information with fine temporal resolution.

iv) Fairness: In many sensor network applications when bandwidth is limited, it is necessary to ensure that the sink node receives information from all sensor nodes fairly. However among all of the above aspects the energy efficiency and throughput are the major aspects. Energy efficiency can be increased by minimizing the energy waste.

C.COMMUNICATION PATTERNS

It is important to design and test the behavior of MAC protocols based on the kind of traffic they have to handle. We have identified two main communication patterns in sensor applications:

Local uni-/broadcast When a real-world event in the network occurs, we expect nodes to perform some in network processing. This will generally involve local messages being exchanged between neighbours. Nodes to sink reporting after processing a local event, or just periodically, nodes may want to report something. We expect messages to be directed to one or a few sink nodes, which are hooked up to a fixed network or a computer. Messages from different nodes may, or may not, be aggregated along the way. We do not specify an exact routing protocol, but we expect some random variation in message paths—messages flow 'roughly' in the correct direction. In this communication pattern, we see a more or less unidirectional flow of messages through the network. We explicitly exclude routed, multi-hop communication between random nodes in the network, although this pattern is frequently used to study MAC protocols. After identifying several realistic wireless sensor applications, we have determined that this communication pattern does not occur.

The two basic communication patterns imply that the message rate in the network may vary, both in time and location: events trigger periods of increased activity, and, around sink nodes, the message rate will be higher than at the edge of the network, even when aggregation is used.

II. RELATED WORK

There are several solutions addressing the problem of energy waste due to idle listening. In general, some kind of duty cycle is involved, which lets each node sleep periodically. For example, TDMA-based protocols are naturally energy preserving, because they have a duty cycle built-in, and do not suffer from collisions [2]. However, maintaining a TDMA schedule in an ad-hoc network is not an easy task and requires much complexity in the nodes. Keeping a list of neighbor's schedules takes valuable memory capacity. Allocating TDMA slots is a complex problem that requires coordination. Furthermore, as TDMA divides time into very small slots, the effect of clock drift can be disastrous; exact timing is critical. Another way of energy saving is to use an extra radio— the so-called wake-up radio—, which operates on a different frequency than the radio used for communication [7]. As the wake-up radio is only for waking up other nodes, it needs no data processing and therefore uses much less energy. It does, however, require an extra component on the node and most wireless sensor nodes currently used in research only have a single radio that operates on a single frequency.

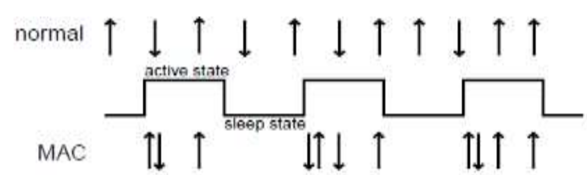

Figure 1: The MAC duty cycle; the arrows indicate transmitted and received messages; note that messages come closer together.

Can communicate with its neighbours and send any messages queued during the sleeping part, as shown in Figure 1. Since all messages are packed into the active part, instead of being 'spread out' over the whole frame, the time between messages, and therefore the energy wasted on idle listening, is reduced.

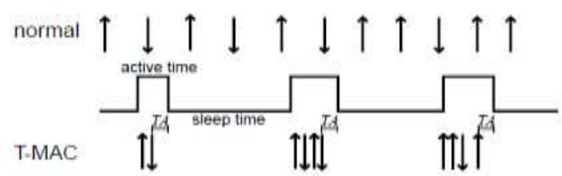

Figure 2: The basic T-MAC protocol scheme, with adaptive active times.

The problem is that, while latency requirements and buffer space are generally fixed, the message rate will usually vary (Section 1.1). If important messages are not to be missed– and unimportant messages should not have been sent in any case–, the nodes must be deployed with an active time that can handle the highest expected load. Whenever the load is lower than that, the active time is not optimally used and energy will be wasted on idle listening. The novel idea of the T-MAC protocol is to reduce idle listening by transmitting all messages in bursts of variable length, and sleeping between bursts. To maintain an optimal active time under variable load, we dynamically determine its length. We end the active time in an intuitive way: we simply time out on hearing nothing.

A. BASIC PROTOCOL

Figure 2 shows the basic scheme of the T-MAC protocol. Every node periodically wakes up to communicate with its neighbors, and then goes to sleep again until the next frame. Meanwhile, new messages are queued. Nodes communicate with each other using a Request-To-Send (RTS), Clear- To-Send (CTS), Data, Acknowledgement (ACK) scheme, which provides both collision avoidance and reliable transmission [1]. This scheme is well known and used, for example, in the IEEE 802.11 standard [4]. A node will keep listening and potentially transmitting, as long as it is in an active period. An active period ends when no activation event has occurred for a time TA. An activation event is:

- The firing of a periodic frame timer;
- The reception of any data on the radio;
- The sensing of communication1 on the radio, e.g. during a collision;
- The end-of-transmission of a node’s own data packet or acknowledgement;
- the knowledge, through overhearing prior RTS and
- CTS packets that a data exchange of a neighbour has ended.

B. clustering and synchronization

Frame synchronization is inspired by virtual clustering, as described by the authors of the S-MAC protocol [12]. When a node comes to life, it starts by waiting and listening. If it hears nothing for a certain amount of time, it chooses a frame schedule and transmits a SYNC packet, which contains the time until the next frame starts. If the node, during start up, hears a SYNC packet from another node, it follows the schedule in that SYNC packet and transmits its own SYNC accordingly.

Nodes retransmit their SYNC once in a while. Nodes must also listen for a complete frame sporadically, so they can detect the existence of different schedules. This allows new and mobile nodes to adapt to an existing group. If a node has a schedule and hears a SYNC with a different schedule from another node, it must adopt both schedules.
It must also transmit a SYNC with its own schedule to the other node, to let the other node know about the presence of another schedule. Adopting both schedules means that the node will have an activation event at the start of both frames.

C. DETAILED PROBLEM DEFINITION

The way of Directed diffusion is an on-demand routing approach; it was designed for energy efficiency so it only sets up a path if there is data between a source and a sink. However, the major disadvantage of the scheme, in terms of energy efficiency, is the periodic flooding of data. In order to avoid the flooding overhead, proposes the setup and maintenance of alternate paths in advance using a localized path setup technique based upon the notion of path reinforcement.

The goal of a localized reinforcement-based mechanism is for individual nodes to measure short term traffic characteristics and choose a primary path as well as a number of alternate paths based upon their empirical measurements. An alternate path is intended to be used when the primary fails. ”Keep-alive” data is sent through the alternate paths even when the primary path is in use. Because of this continuous “keep-alive” data stream, nodes can rapidly switch to an alternate path without going\ through a potentially energy-depleting discovery process for a new alternate path.

A multipath routing technique which uses braided multipath is also proposed. Braided multipath relax the requirement for node disjoint. Multiple paths in a braid are only partially disjoint from each other and are not completely node-disjoint. These paths are usually shorter than node disjoint multipath and thus consume less energy resources; alternate paths should consume an amount of energy comparable to the primary path. A simple localized technique for constructing braids is as follows. The sink unifies the query results from multiple storage nodes into the final answer and sends it back to the user. Sink can detect compromised storage nodes when they misbehave. Instead of using two nodes we can use many number of nodes to increase the efficiency and even we can decrease the delay time.

III. EXPERIMENTAL EVALUATION OF POWER AWARE PATH MULTICASTING

A. Integrity

The sink needs to detect whether a query result from a storage node includes forged data items or does not include all the data that satisfy the query. There are two key challenges in solving the privacy and integrity-preserving range query problem. First, a storage node needs to correctly process encoded queries over encoded data without knowing their actual values. Second, a sink needs to verify that the result of a query contains all the data items that satisfy the query and does not contain any forged data.

B. Privacy

To preserve privacy, SafeQ uses a novel technique to encode both data and queries such that a storage node can correctly process encoded queries over encoded data without knowing their actual values.

C. Range Queries

The queries from the sink are range queries. A range query “finding all the data items collected at time-slot in the range ” is denoted as . Note that the queries in most sensor network applications can be easily modeled as range queries.

D. Sink

The sink is the point of contact for users of the sensor network. Each time the sink receives a question from a user, it first translates the question into multiple queries and then disseminates the queries to the corresponding storage nodes, which process the queries based on their data and return the query results to the sink. The sink unifies the query results from multiple storage nodes into the final answer and sends it back to the user. Sink can detect compromised storage nodes when they misbehave.

E. Storage Node

Storage nodes are powerful wireless devices that are equipped with much more storage capacity and computing power than sensors. The storage node collects all data from the sensor nodes. The storage node can’t view the actual value of sensor node data.

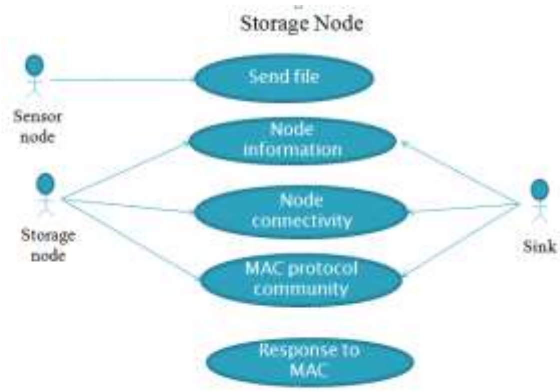

Figure 3. Use case Model

As seen the life of the network depends on various factors, which include the initial threshold, density of the network and range of the transmitters. These parameters need to be adjusted for each network. This is still work in progress. The project presented here studied the various power saving techniques employed by mobile devices. The initial results show that the various parameters affect the lifetime of the network. This is still work in progress. At this point, we are not taking into consideration the nodes’ personal tasks. In the future, we can take into account the power consumed by these activities, to see its impact on the lifetime of the network.

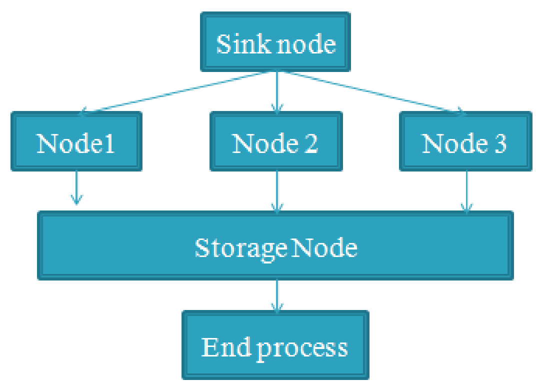

Figure 4: Flow Chart

The two S-MAC variants, namely, T-MAC and DSMAC, have the same features with S-MAC given in Table I. The cross-layer protocols include additional layers other than the MAC layer, and are not considered in this comparison.

	Time Synch. Needed	*Comm. Pattern Support*	*Type*	*Adaptivity to Changes*
S-MAC / T-MAC / DSMAC	No	All	CSMA	Good
WiseMAC	No	All	np-CSMA	Good
TRAMA	Yes	All	TDMA / CSMA	Good
SIFT	No	All	CSMA/CA	Good
DMAC	Yes	Convergecast	TDMA / Slotted Aloha	Weak

Table1: Mac Layer Comparison

Although there are various MAC layer protocols proposed for sensor networks, there is no protocol accepted as a standard. One of the reasons behind this is the MAC protocol choice will, in general, be application-dependent, which means that there will not be one standard MAC for Common wireless networking experience also suggests that link-level performance alone may provide misleading conclusions about the system performance. Similar conclusion can be drawn for upper layers as well. Hence, the more layers contributing to the decision, the more efficient the system can be. For instance, the routing path could be chosen depending on the collision information from the medium access layer. Moreover, layering of the network protocols creates overheads for each layer which causes more energy consumption for each packet. Therefore, integration of the layers is also a promising research area which has to be studied more extensively.

IV . RESULT ANALYSIS MULTI-PATH MULTICAST POWER MODEL

Experiments are conducted with the intra domain network topology. It is a close approximation to analyze how our routing algorithm performs under these conditions since; recent findings suggest that many ISPs are in the process of increasing the node connectivity of their networks. Each link has a bandwidth of 20 Mbps. The topology has 3 sources that simultaneously send multicast traffic, where each source has 18 receivers and nodes 10 and 23 are selected as additional overlay nodes. Each source-destination pair has three paths including the min-hop path starting at the source node and each source generates Poisson traffic with an average rate of 10 Mbps. The routing algorithm starts from the setting that all overlay rates other than the source nodes are set to model, the algorithm starts with basic unicast routing to reach each destination. It starts with a single shortest path multicast tree rooted at each source node and gradually shifts traffic to alternative trees rooted at overlay nodes 10 and 23. For the proposed algorithm simulated an ad-hoc network with varying densities and transmission ranges. Each node had a random location in a 1000 x 1000 area. They also had a random amount of initial power within a range of 70 joules 150 joules. The thresholds were varied from 70joules to 100 joules.

Graph. As seen from the graph, the life of the network depends on various factors, which include the initial threshold, density of the network and range of the transmitters. These parameters need to be adjusted for each network. This is still work in progress. The project presented here studied the various power saving techniques employed by mobile devices. The initial results show that the various parameters affect the lifetime of the network. This is still work in progress. At this point, we are not taking into consideration the nodes' personal tasks. In the future, we can take into account the power consumed by these activities, to see its impact on the lifetime of the network.

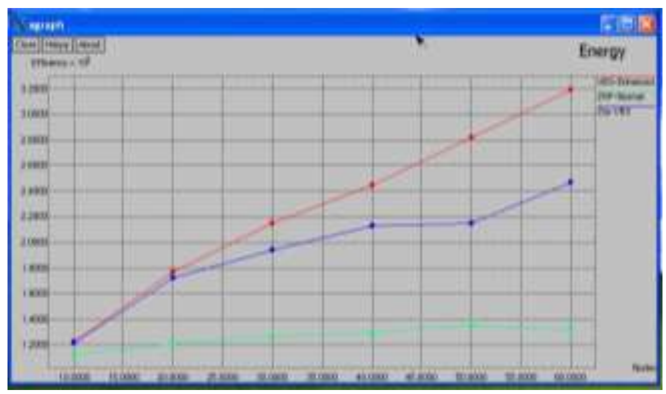

Figure 5. Energy comparisons

In this proposed method the video can be split into five parts and transmitted in multipath based on the availability of the nodes. The source and the destination for the transmission are visible. The five paths taken are shown below. Eventually the video is multicast from destination 24 to all nodes. Throughput is the number of useful bits per unit of time forwarded by the network from a certain source address to a certain destination, excluding protocol overhead, and excluding retransmitted data packets. Throughput is the amount of digital data per time unit that is delivered over a physical or logical link, or that is passing through a certain network node. Pause-time is the time for which a packet stops in when it reached a destination after a travel from the place of origination. The unit of pause-time is seconds. Mobility is the velocity with which a node moves from the source to destination.

It is usually specified in m/s. Dropped packets are number of packets dropped due to the effect of link breaks. The dropped packets may be a control packets or data packets.

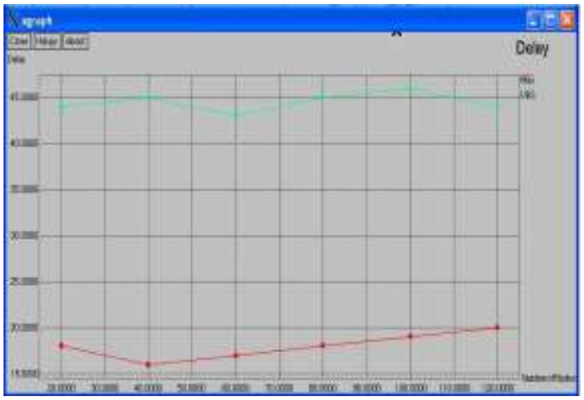

Figure 6. Delay comparisons

V. CONCLUSION

The proposed power aware multicast identifies the characteristics of the proposed routing algorithm. It evaluates its performance under various network conditions. Each plot presented illustrates the average of 10 independent runs that are initiated with different random seeds. For the optimization algorithm, the link cost function is selected, and defined. In all simulations, the period of link state measurements is selected as one second. As a consequence, source nodes can update their rates at best approximately every two seconds since it require two measurements for estimating the gradient vector according to the modified power algorithm. For simplicity set the rate of redundancy due to source coding, to zero.

The optimal values suggest that the complexity of having smart routers that are able to forward packets onto each branch at a different rate offers only a marginal benefit in this scenario. However, it is hard to draw any further conclusions as this result may depend on the specific topology and source-destination pair selections. Also, our algorithm does better than tradition power algorithm as a consequence of the availability of multiple trees to distribute the traffic load. However, while under network topology model the algorithm is able to minimize the cost to a certain level, it cannot eliminate the packet losses and has a much higher overall cost compared to traditional ones. The reason behind this result is the lack of multicast functionality. Since we cannot create multicast trees, the only savings due to multicasting occurs between the sources and overlay nodes. Once multicast packets reach the overlays, overlay nodes need to create independent unicast sessions for each destination ignoring the multicast nature of the traffic, and this creates a high level of link stress as multiple copies of the same packets are generated. One important observation is that the algorithm is able to converge faster in network model NM-IIb than all other models. This is due to the fact that, it is only need to optimize the overlay rates instead of individual receiver rates. Hence, the number of parameters to be calculated is much smaller than the other two cases.

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