T-TMAC: Energy Aware Sensor MAC Protocol for Health-care Monitoring

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I. SUMMARY

The paper discusses a newly developed MAC protocol T-TMAC designed to ensure a better lifetime for sensor nodes by minimizing their energy consumption and saving power. A health care tracking application is the most critical, since it must track every piece of information to keep people safe. The applications were used by a wide variety of people from young to old, and it's difficult for people to keep checking their sensors' batteries all the time. So, to resolve this issue, we need to save as much energy as we possibly can by ensuring continuous service. Therefore, it was necessary for us to implement a whole new MAC protocol that maximizes energy savings for sensors. And this motivated the authors to create a MAC protocol which combines the strengths of existing MAC protocols such as B-MAC, S-MAC and Wise-MAC and by taking consideration of both schedule-based and contention-based protocols they have implemented a multiple hop wireless communication protocol there by providing a clear ideology about how multi-tier architecture provides better capacity, coverage and reliability compared to single tier Ad hoc networks. In T-TMAC, sensors are organized in three tiers and interact with inter- and intra-tier nodes based on a dynamic scheduling of active/sleep, reducing collisions by utilizing slotted communication. By maintaining synchronization between the tiers, this architecture provides mobility services by allowing topology reconstruction.

II. GOOD THINGS ABOUT THE PAPER

Firstly, the idea of combining the strengths of multiple MAC protocols to produce one is a great idea. Scheduling-based and contention-based protocols minimize collisions and optimize resource utilization. The architecture consists of four nodes namely medical[M], coordinator[C], video[V], and sink[S] where these are connected as M->V->C->S. Where the S node is responsible for topology creation and data flow starts from the medical node. In addition, organizing nodes into groups will reduce collisions and make scheduling easier where nodes can sleep or wake up and reduce energy consumption for sensor nodes. As a result of the proposed protocol, nodes can enter sleep mode when not transmitting or receiving packets to reduce energy consumption. In addition, it uses an adaptive slot length allocation process to provide energy-efficient medium access scheduling. And the way network topology is initialized and reconfigured and sending Beacon messages periodically to provide mobility service and re-allocation of available slots.

III. MAJOR COMMENTS

It does not prioritize traffic based on application or priority. As this protocol does not explicitly consider different packet priorities, time-critical packets may not be transmitted on time as all data packets are treated equally. Real-time data is of the utmost importance and T-TMAC does not consider the possibility of data loss due to congestion or packet collisions. A priority-based scheduling scheme should be introduced to prioritize high priority data packets over less critical ones.

There are many security flaws in this protocol, including its vulnerability to malicious attacks. It does not provide any security features. As data from all the medical nodes are being sent to the coordinator node, this might lead to security issues and a single point of failure for transmitting the data. In order to avoid such security issues and access control mechanisms, the protocol must incorporate security measures.

The range and power of the nodes are not considered, resulting in inaccurate and unreliable data exchange. By reserving GTS for coordinator nodes in the Superframe, this protocol can experience unfairness, excessive interference, poor network performance, and inefficient resource utilization because nodes are able to use the channel frequently. It can affect the performance of other nodes, resulting in a waste of network resources on the same network. It can result in frequent disconnections and packet drops, the wasting of network resources. When dedicated slots are assigned to each medical node, will they be in active mode and send data, then sleep after sending that only node's data, or will they wait until all coordinator's data has been synced? If so wastage of energy for all nodes which are not actively sending the data to the coordinator. And while medical nodes reserving slot for data transmissions collisions will happen as all the nodes are trying to get a slot to transmit.

While network initialization everything works as expected as the sink starts initialization and sync responses with the lower nodes but when it comes to mobility and the medical nodes changes its locations after the sync is completed. Will the whole network be reconstructed and how the medical nodes will behave as they have dedicated slots to transmit data and the whole process just will be reinitialized if so, this wastes lots of time and data, as the nodes changes its location this results in an non scalable procedure as changing position will results in adding new nodes to the network. It is one of the benefits of this mechanism that it maintains synchronization, resynchronization prevents the clock drift, does it prevent it for sure? Sleep and active schedules can be affected by the clock drift mechanism.

Can beacons detect nodes outside their range? If the nodes were outside the range of the beacons establishing communication between them, how would communication and channeling be handled? When the devices are in a small range, the mechanism is efficient, but what if the nodes are farther apart?

Since the direct formulas are unclear, I believe a clear explanation of how they are derived could better explain the equation. In addition, images that illustrate the terms of the formula could be useful if a clear explanation is provided.

IV. Minor Comments

Overall, the paper was explained clearly along with an evaluation of the performance of the model using an analytical model. However, it missed multiple scenarios like performance evaluation due to topology reconfiguration. And security issues due to aggregation of data and single point of failure due to single node communication from one tier to another. Also, the paper didn't give much information about the synchronization and sleep schedules of the nodes when mobility is in action. In addition to these, the paper is very well structured and explains every aspect very clearly, which opens the door for more research on combining the strengths of multiple MAC protocols.