ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 3, March 2015

A Simulation Study of Joint Power Controling, Scheduling and Routing In Wireless Sensor Network

Nirubama , R. Renita Rexy

Assistant Professor, Department of ECE, Bharath University, Chennai, Tamil Nadu, India

Assistant Professor, Bharath University, Chennai, Tamil Nadu, India

ABSTRACT: In recent years, we have witnessed an increased interest in using wireless sensor networks (WSNs) in a wide range of military and civilian applications. To lower the cost, in these networks sensors are typically powered by non-rechargeable batteries. Once deployed, the sensors in the field are usually left unattended, making the replacement of the batteries impractical (if not impossible). To provide long-lasting operation time, energy efficient system architecture and communication protocols are crucial to the successful deployment of WSNs.

In this paper we improved the energy efficiency of a large-scale WSN that may contain thousands of nodes. Systems at this scale are expensive, and thus it is more desirable to make their operation last long. Due to the extremely large amount of nodes in the network, the collision between nodes becomes more severe, making the interference and delay between simultaneous transmissions a major factor in deteriorating the system's energy- efficiency. Thus a good medium access control (MAC) schedule algorithm and routing protocal is needed to coordinate the transmissions of different nodes in such a way that the interference and delay between nodes can be minimized. Here TDMA scheduling was used and three different algorithms are compared and concluded which of them will give us the best power saving by minimizing the delay and interference.

I. INTRUDUCTION

A wireless sensor network (WSN) is a distributed sensing network comprised of thousands, or even tens of thousands small devices. Wireless sensor networks require a new set of protocol stacks because of new features of wireless sensor networks. Most nodes in sensor networks are likely to be battery powered and it is not feasible to recharge or replace the batteries and the traffic pattern in sensor networks varies with different sensor network applications. Major traffic could be in-network local communication or from sensors to a common sink in a tree topology. Measurements have shown that the best way to save energy is to put a node to sleep. Putting nodes to sleep affects another important communication layer: the network layer. A node in sleep is no longer part of the network. [1-3]Therefore, by the sleep scheduling, the topology of the network keeps changing at different times. A link between two neighbouring nodes is available only if both of them are scheduled to be active at the same time slot. The paths selected by the routing algorithm affect power consumption. Thus, given certain source nodes and base stations in a sensor network, there are two key design considerations: one is the scheduling, the other is routing. Those two are closely coupled together and will affect each other.

Possible approches to setup scheduling and routing for flow in WSN are
1) *Scheduling first*: Determine the schedules of the sensor nodes first. Based on the schedules, using a routing algorithm to find an energy efficient and low latency path.
2) *Routing first*: Using a routing algorithm to find a path first. Given the path, find the schedules of the nodes on the path.
3) *Joint scheduling and routing*: find the schedule and routing solution jointly. [4]

Both scheduling first and routing first scheme have their disadvantages. Scheduling first schemes may cause routing scheme hard to find short paths while routing first schemes may cause low latency schedule impossible.
The scheme can be decoupled into two distinct phases for each flow in the network:
- The setup and reconfiguration phase :First a route from the node originating the flow to the

base station is selected, and then the schedules are set up along the chosen route.

➢ Steady state phase:If a schedule can not be set up along the chosen route, the routing protocol will find an alternative route.

Broadly speaking, there are two kinds of applications in sensor networks:

1. *Event driven*: In event driver sensor network, most of the time the sensor nodes are off until certain interesting event happens. Then the nodes begin to send data to base station periodically until the event disappear.

2. *Continuous monitoring* :In a continuous monitoring sensor networks, sensor nodes sample and transmit data at regular intervals requested by the base station

Our goal is to find paths from sources to sinks, and schedules of the nodes on the paths, with the objective to minimize the average delay .[6-8]

II. DISTRIBUTED JOINT POWER CONTROL, SCHEDULING AND REAL-TIME ROUTING IN WSN

The distributed execution strategy implements the dynamic distributed query integration from the query processing model. The inputs are the same as the central algorithm except that each child agent must be given a name. This is needed so that agents can communicate to the correct child agent during execution. Initially it computes the best plan with which to begin execution. After each phase, the child agents broadcast their results to the other child agents. If the current strategy should be changed, all child agents produce the same identical new plan to execute the remaining queries. A distributed algorithm is an algorithm designed to run on computer hardware constructed from interconnected processors. Distributed algorithms are used in many varied application areas of distributed computing, such as telecommunications, scientific computing, distributed information processing, and real-time process control. Standard problems solved by distributed algorithms include leader election, consensus, distributed search, spanning tree generation, mutual exclusion, and resource allocation. [5]

We propose the *Real-time Power-Aware Routing (RPAR)* protocol, which supports energy-efficient real-time communication in WSNs. RPAR achieves this by dynamically adapting transmission power and routing decisions based on packet deadlines. RPAR has several salient features.

- It improves the number of packets meeting their deadlines at low energy cost.
- It has an efficient neighborhood manager that quickly discovers forwarding choices that meet packet deadlines while introducing low communication and energy overhead.

Moreover, RPAR addresses important practical issues in WSNs, including lossy links, scalability, and severe memory and bandwidth constraints. Due to the unreliable and dynamic nature of WSNs, it is unrealistic to provide hard delay guarantees. RPAR assumes that each packet is assigned a soft deadline by the application, which specifies the desired bound on the end-to-end delay of a packet. The primary goal of RPAR is to increase the number of packets that meet their deadlines while minimizing the energy consumed for transmitting packets under their deadline constraints. RPAR focuses on minimizing the energy consumed in packet transmissions.

3.2.1.1 Real-time power aware roting protocol

- RPAR has four components:

1. A dynamic velocity assignment policy
2. A delay estimator,
3. A forwarding policy
4. A neighbourhood manager.

RPAR uses the velocity assignment policy to map a packet's deadline to a required velocity. The delay estimator evaluates the one-hop delay of each forwarding choice (N, p) in the neighbor table, i.e. the time it takes a node to deliver a packet to neighbor N at power level p. Based on the velocity requirement and the information provided by the delay estimator, RPAR forwards the packet using the most energy efficient forwarding choice in its neighborhood table that meets the required velocity. When the forwarding policy cannot find a forwarding choice that meets the required velocity in the neighbor table, the neighborhood manager attempts to find a new forwarding choice that meets the required velocity through power adaptation and neighbor discovery.

3.2.2 Centralized algorithm

Under a centralized architecture, recently collected data from node measurements to the next access

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point (AP), which in turns reports it to the central location. Node can also use the exchange to request route updates. The centralized location makes routing decisions, upon request, based on the reports from all other nodes . Both the frequency at which node report collected measurements and obtain updated routes is limited by the availability of APs.[10]
Step 1: Beacon Every AP in the system periodically sends a beacon message. AP beaconing allows surrounding nodes to learn of the presence of APs and to estimate how many of them are in communication range. To improve scalability under high node density, a node receiving a beacon probabilistically decides whether to respond or not, according to the inverse of the number of beacons received in the last beacon interval.

Step 2: Segment Status Report and Route Request If a node decides to respond to a beacon, it sends to the beaconing AP all recently collected information that it has not yet reported as a Segment Status Report. A node can also send a Route Request that includes its current location and destination.[9]

Step 3: Central Location Asks and Route Updates the central location responds to a node via the AP from which it sent the messages. The centralized server sends Acknowledgment messages for Segment Status Reports, which signal that the node can remove those reports from its local buffer. In the case of a Route Request, the centralized location uses its global view to transfer the data to the receiver node or to sink by this method we can avoid the interference

Our basic distributed algorithm has three steps. Every node beacons to advertise its presence. Any node can request (pull) data information from a nearby node. Node respond to data update requests the most recent transformation for the requested sections of the map. Hereafter, we use nodes when referring to the instrumented vehicles participating in our system. [11]

Step 1: Beacon. Every node in the system periodically sends a beacon message. Node beaconing allows surrounding nodes to learn of the presence of others and to estimate how many of them are within communication range. A node receiving a beacon probabilistically determines whether or not to respond according to the inverse of the number of beacons received in the last beacon interval. This improves system scalability under high node density by limiting the number of nodes responding to a beacon.

Step 2: Area of Interest Request. If a node decides to respond to a beacon, it sends an Area of Interest (AOI) Request message to the beaconing node which includes a list of path segments for which it requests updated state information.[12-15

Step 3: Area of Interest Reply. When a node receives an AOI Request, it compiles a reply (an AOI Reply) with the most recent data for each path segment requested. The actual data included will depend on the routing algorithm in use, but it is extracted from the responding node's local estimation of global traffic conditions. A node's local view of conditions is derived from the data reported by all nodes with which it has previously been in contact.

III. SIMULATION RESULT AND DISCUSSIONS

Simulation was carried out by using network simulator version 2 . Here I compared all the three protocols where to find which protocol will help us in saving energy in node .This compration was taken place between the delay bound ,end to end delay simulation time , node residual energy and miss ratio for finding which protocol is best for minimizing the delay and interference .

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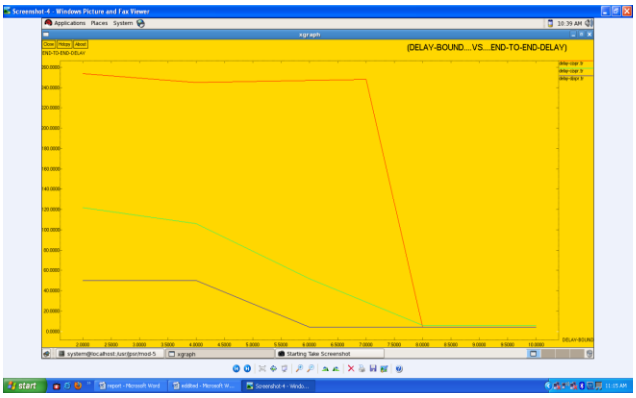

comparing the delay bound with end to end delay for three different real-time protocols

IV. CONCLUSION

In a wireless sensor network Increase in transmission power is an effective way to improve real-time data delivery in wireless sensor networks .On the other hand, increased power will also incur more interference though it can improve the link quality to increase real-time communication. So there is a tradeoffs between interference and delay.

So I consider a joint power control, scheduling and real-time routing problem, try to find a converged transmission power that can satisfy the on-line real-time data packet delivery. Preliminary simulation results using NS-2 shows that the real-time routing protocols like RPAR which shows an excellent results in transforming the data in dead line with out any delay and gives an effective energy saving in node but a problem with interference .where as in CJPSR shows reduction in interference by frequently checking all the nodes while data was transforming in the slot but checking all the nodes gives us a delay where a lot of power was consumed in this process .over coming the disadvantages of both protocol I introduced DJPSR (Distributed joint power control, scheduling and real-time routing in wireless sensor network) which helps the node to save energy by minimizing the delay time and interference .we can know this by comparing the results of the three protocol .[11]

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