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Effects of Scheduled Rendezvous Scheme on High Density of Sensor Nodes

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Abstract:

Wireless Sensor Network is made of a huge number of low cost and low power sensor nodes that are connected by means of wireless links. It has wide applications in the area of vehicle tracking, environment monitoring, target tracking. The main characteristic of Wireless Sensor Networks is limited bandwidth, computing capacity and limited battery power showing their design more challenging. A critical issue in WSNs is their limited power and much research has been done for tackling this critical issue. The scheduled Rendezvous Scheme has been applied for power management. It has showed some good results for power saving in WSNs.

Key words: WSN, sensor nodes, wireless links, bandwidth, battery power, limited power, Rendezvous Scheme.

1. Introduction:

Wireless sensor networks refer to a large number of distributed and lightweight sensor nodes deployed in large number to monitor physical phenomena such as industrial structures, pressure, humidity etc. The node has a microprocessor and a small memory for signal processing as well as task scheduling. The node is also equipped with one or more sensing devices i.e. acoustic microphone arrays, video or cameras, seismic, infrared

or magnetic sensors. A node communicates wirelessly with other nodes within its radio communication range [1].

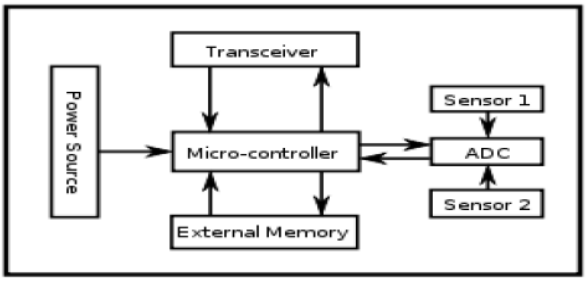


Figure 1: Structural view of WSNs

One of the most limiting factors in wireless sensor networks is their power limitations, most wireless sensor networks operating on batteries with a large amount of nodes scattered in the area. It is very hard to replace the batteries of nodes on a regular basis. To get longevity, it is good that nodes may operate at minimum power level to achieve good results [2].

2. Sources of power consumption

Idle monitoring: when a node carrier senses the channel in anticipation of packet arrivals. Even if it does not receive any packet, the power consumption in carrier sensing is high as compared to that of packet receiving.

Control Packet overhead: Control packets and receiving important data packets safely, sending and receiving these controlled packets cause power consumption.

Overhearing: When there is the packet transmission by a node's neighbors, even if the packet is not intended for this node, the header of the packet is still received by it. The power cost in terms of receiving this packet is another point for power consumption.

Collision: Collision wastes a lot of power. When it happens the node has to retransmit the packet and restart of communication, which is a cause of power wastage.

3. Applications of WSNs

Fire detection in forest:
WSNs can be used in forests to find the find the forest fire. The nodes can be equipped with sensors to determine temperature and gas produced as a result of fire. Early detection of fire is possible by installing sensors in the forest for the fire brigades to stop fire.

Agriculture:
WSNs have great applications in agriculture, using WSNs making the farmer free of maintaining wires in a hostile environment. Water tank levels can be determined by pressure transmitters, while with wireless I/O devices water pumps can be controlled.

Air Pollution Monitoring:
WSNs have been installed in various cities to find the various toxic gases in the air being hazard for human beings, also cause of air pollution.

Wastewater Monitoring:
Wireless Sensor Network has also been used in industries where there is ample quantity of wastewater; WSNs sensors monitor and take readings of waste water levels.

Machine Health Monitoring:
Wireless Sensor Networks can be used in industries where there is use of machinery for machine conditions and maintenance. Installed sensors can really report the weary and

rough conditions of machinery.

Structural Monitoring:

WSNs can be used within buildings to monitor the movement.

Green house Monitoring:

The Temperature and humidity in commercial greenhouses can be monitored by wireless sensor networks. The green house owner will be informed by email or text message regarding the temperature or humidity level drop; by receiving message, the conditions can be handled through fans or other proper arrangements to avoid big loss in greenhouses [3].

4. Wireless sensor implementation requirements

Wireless sensor networks are installed due to three reasons:

Low cost: wireless sensor networks are deployed on a large scale due to deployment being economically feasible, nodes being of low cost, so that scheme should be in low budget.

Small size: the size of the network should be small so that it will give good results for long time.

Low power: battery replacement is very hard in case of large network with many nodes; the battery issue in this case is critical. Nodes must have energy available for long time to give useful results [4].

5. Literature Review:

On-demand

There is a vital role of on-demand protocol in power management. It is based on the idea that whether a node should wake up when other nodes want to communicate with it. It reduces power consumption and due to this approach a node remains active for a long time. It also has fewer effects on latency because a node wakes up quickly when there is a pending message. The disadvantage of on-demand protocols is

that how to make aware the sleeping node when other node wants correspondence with it. Usually this method uses two different radio channels. One channel is used for normal packet exchange while the other is used for awaking a node when there is a message for it. The data radio is usually off and it is on when a signal is received through wake up radio. Wake up radio has less impact on power consumption. Different on-demand schemes behave variously in the way they use the wake up radio. The power consumption of wake up radio is not different from data radio. Duty cycling is used on the wake up radio. It can be assumed from many works that the wake up radio is low power and it can be kept on. Wake up radio has less communication range as compared to data radio. It is serious limitation that two adjacent nodes may be in data radio transmission out of wake up radio ranges. Whenever the second wake up radio is not available, an approach called rendezvous can be scheduled[5].

TDMA-based

Time division multiple access schemes enables a duty cycle on sensor nodes as the channel access is possible through slot –by –slot basis. The time is slotted and slots are being arranged in frames. Slots are assigned in each each frame to individual nodes and can be used to transmit and receive packets to and from other nodes. Nodes are needed to run on their radio only during their assigned slots and can sleep during slots to other nodes.this permits the power consumption to the minimum limit required for transmitting and receiving of data.TDMA-based protocols have disadvantages that compensate the benefits in terms of power saving. There is the lack of flexibility, having less scalability and needed strong synchronization among network nodes. It is very hard to find a slot assignment that tries to be avoided of interference among adjacent nodes because the interference range is higher as compared to that of transmission range. In addition, TDMA-

based protocols perform worse than contention-based protocols in low traffic conditions. Due to these limitations and bottle necks they are not used frequently as stand-alone protocols for duty cycling phenomenon [6].

6. Detailed Analysis of Scheduled Rendezvous Scheme

Scheduled Rendezvous

Rendezvous scheme is based on the idea that both nodes should wake up simultaneously as its neighbors. Usually the nodes wake up according to a certain policy and they remain active for a short period for communication with their neighbors. They go to sleep until their rendezvous time. Nodes follow different wake up/sleep pattern.

- The disadvantage of this scheme is that power saving is achieved through latency due to travel of message to different hops.
- Another drawback is that nodes must be synchronized.

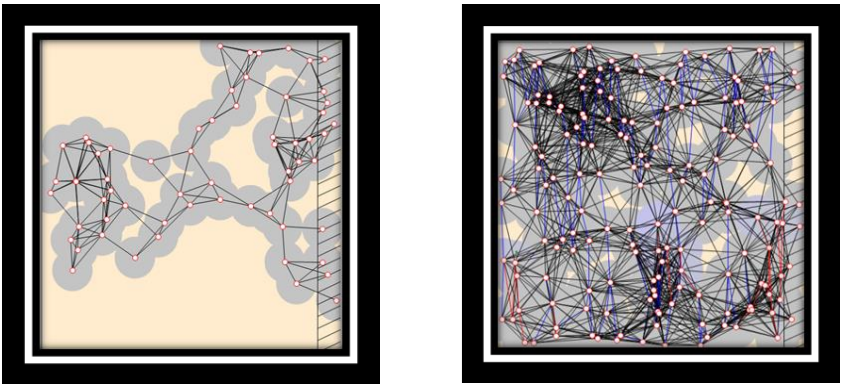
Maintaining strong synchronization among nodes requires a high overhead of exchanged control messages and it causes power consumption. The power consumption for synchronizing nodes is highly compensated by power management.

Energy Saving in case of large number of sensor nodes vs scheduled rendezvous scheme

If a large number of sensor nodes has been installed then there will be a large number of wireless links. Due to the large number of wireless links and high density of nodes, battery condition will become critical within a short period of time. There are also many factors causing more energy wastage as collision, signal loss, idle listening, overhead etc.

An experiment was performed on a simulator. First the number of nodes deployed was 62 and battery energy was at 30000 degrees; when simulation was performed the network life

was achieved as 300 seconds. On the other hand, when the number of nodes was increased to 169 and then battery energy was 166851 degree and when it was simulated, the network life achieved was just 120 seconds. During this simulation the sensor radius, transmitter period and transmission radius were fixed.



(A) (B)

Figure 2: (A) small number of nodes (B) large number of nodes

Applying Scheduled rendezvous scheme is a good technique for power saving, but it has limitations and draw backs in case of large networks. Wireless sensor networks have also energy consumption problems, in case of activating sensors at the same time as described in the case of rendezvous scheme, causing more consumption. This technique gives good results if some sysnchronization protocols have been applied.

7. Conclusion

Sensor nodes are equipped with battery, these nodes are deployed at large numbers where there is the access problem for human beings, and it is very hard to replace the battery. Some good techniques are required to apply to enhance the lifetime of network. Scheduled rendezvous scheme was the aim to apply on large networks to achieve high level of achievement but this scheme should be applied on some small scale

networks.

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