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ESTIMATION OF ENERGY CONSUMPTION IN GRID BASED WIRELESS SENSOR NETWORKS

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SAHAURAN

ABSTRACT

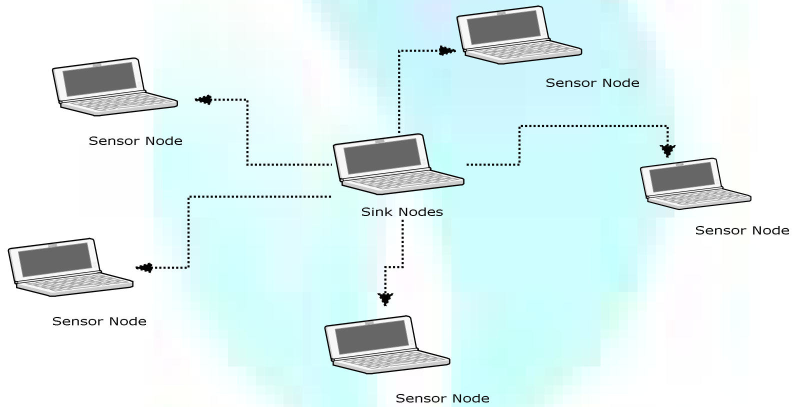
The wireless networking is the current technology where you can plug the power of the wireless device and then to share/connectthe device to the internet. The various technologies can be categorized are MANETs (Mobile Adhoc networks) and WSN (Wireless Sensor Networks).The main drawback of MANETs was that it consumed more power than WSN. The WSN saved the power consumption because transmission radius to limit the number of nodes in its transmission range. The wireless Sensor networks can be employed in different applications such as medical, military, environmental etc.The most powerful feature of this technology over other technologies is energy. This reduces overall energy consumptionof the fully connected wireless scenario. In this way it maximize the lifetime of whole the network. This paper consideredgrid based network to compute the energy and analyzed that by using the fully mesh grid based network consumed less energy when to compared other network topologies/scenarios. In this paper we planned a fully mesh networks and routed eachmessage to different sensor nodes.

KEYWORDS
WSN, AODV, sink node, coordinator, Transmission Power, Energy Consumption.

1. INTRODUCTION

In a wireless sensor networkis to evaluate the sensing field is monitored by sensors and also known as the coverage ofthe network. The coverage area of the network is directly related to the sensing capabilityof the network on monitoring phenomenon's occurring in the sensingarea for sensing other neighbouring nodes.Apartfrom the traditional wired or mobile ad hoc networks, there is always one ora set of special data collection nodes (the sink) that functions as a gatewaybetween the network and end users. The sink has reliable connections (e.g.,wired or satellite) to the Internet, powerful processing capabilities, and adequatepower supplies shown in figure 1.Sensor-actuator networks are heterogeneous networks that comprisenetworked sensor and actuator nodes that communicate among each otherusing wireless links to perform distributed sensing and actuation tasks.Actuators (called also actors) are resource-rich, usually mobile, and areinvolved in taking decisions and performing appropriate actions. Such networksare expected to operate autonomously in unattended environments.

FIGURE 1: ROUTING IN WSN

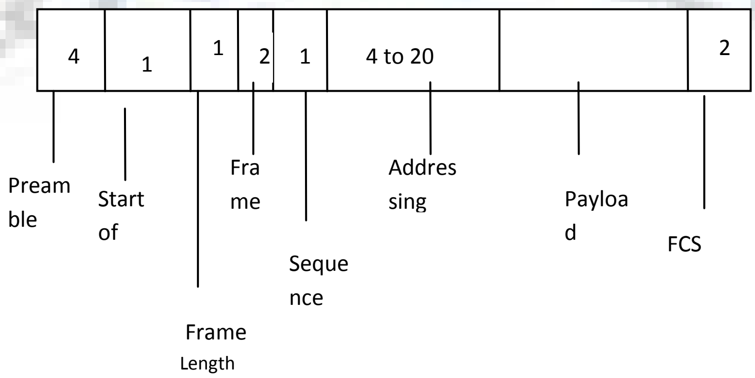


The sink node has been responsible for sending and receiving data to each node for effective routing in the entire network as shown in figure 1. Sensors provide new communication and networkingparadigms.They have small size, low battery capacity, nonrenewable power supply, small processing power, limited buffer capacity and a low-power radio, and lack unique identifiers.These nodes areautonomous devices with integrated sensing, processing, and communicationcapabilities.Mobile sensors, mobile sinks, and mobile actuators alsospend energy for moving around the network, and there is a tradeoffbetween energy spent on mobility and energy spent for communication.Further, energy needs to be saved not only by sensors, but potentially bysinks and actuators.

1.1 IEEE 802.15 STANDARD

The IEEE 802.15 standard shown in figure2, and is therefore able to support a wide variety of network topologies and routing algorithms. The IEEE 802.15 standard incorporates many features designed to minimize power consumption of the network nodes. In addition to the use of long beacon periods and the battery life extension mode, the active period of a beaconing node can be reduced (again by powers of two), allowing the node to sleep between beacons.

FIGURE 2: IEEE 802.15 STANDARD



ThePreamble is a spread spectrum signal, which signals the start of the delimiter. The length field describes the total length of the frame fields which follow, but precede theframe check sequence.The frame check sequence (FCS) used by ethernet is a 4 byte (32 bit) cyclic redundancycheck (CRC) code.The payload is padded (PAD) to bring it to standard length.

1.2 AODV PROTOCOL

ADOV come under the category of Reactive routing protocolsare designed to reduce the overheads associatedwith proactive routing protocols. They do this by only maintaining informationfor active routes. Reactive routing protocols do not proactively maintain routesto all nodes; therefore, they must perform route discovery when a route to adestination node is required. Route discovery requires that a route request (RREQ) packet be flooded throughout the network.When the destination(or a node with an active route to the intended destination) receives the RREQ aroute reply (RREP) is sent back to the source of the route request. The RREPmay either be flooded back to the source or it may be unicast back along thepath followed by the RREQ.

2. MOTIVATION OF THE WORK

The motivation for such restriction is thatsensors otherwise may not learn their hop distance for reporting to thenearest actuator because of asymmetric links.Therefore, it may be safer to restrict actuatorsto the same transmission radius that the sensors are using. This also allowsfor immediate construction of backward paths from sensors to actuators,also including alternative neighbors with the same hop count distance incase the first choice fails at reporting time.Each sensor is able to recursivelydetermine its hop distance to the nearest actuator based on recenthello messages received from other sensors. Each sensor associates itself with a parent sensor, and forwards the field reports to it. The parent sensormay collect reports from several associated sensors.

Although many schemes with WSN design have beenproposed for wireless networks, there are stillsome open issues that need to be addressed. First, thepotential complexity brought by the WSN design with IEEE 802.15needs to be analyzed. Moreover, the performance gain thatcan be achieved by the WSN design needs tobe studied. Secondly, with the evolvement of emerging wireless technologies, such as cooperative communicationand networking, as well as opportunistic networking, oneneeds to investigate their impact to efficient the WSN with MAC Layerdesign. Lastly but not least important, more real-systemdevelopment is needed to evaluate the real value of theWSN design.

3. NETWORK MODEL

The monitoring area is divided into regions, one per each actuator. Allsensors within a region, when event occurs, are reporting, each one to itsnearest actuator.Positions of all theactuators can be learned by broadcasting from each one of them. Actuatorsnormally have larger transmission radii than sensors, which enables themto communicate among themselves, either via a common sink or in a multihopfashion. They may transmit therefore with larger transmission radiithan the one available to sensors, possibly even large enough to reach allthe sensors with one transmission. Only sensors on the border of transmissionradius need to retransmit: these are exactly the sensors that haveneighbors which did not receive the message directly from the actuator.The received power only depends on the transmittedpower Pt, the antenna's gains (Gt and Gr), and on the distance between thesender and the receiver. It accounts mainly for the fact that a radio wave whichmoves away from the sender has to cover a larger area. So the received powerdecreases with the square of the distance. In this formula L is an additional lossfactor independent of the propagation.

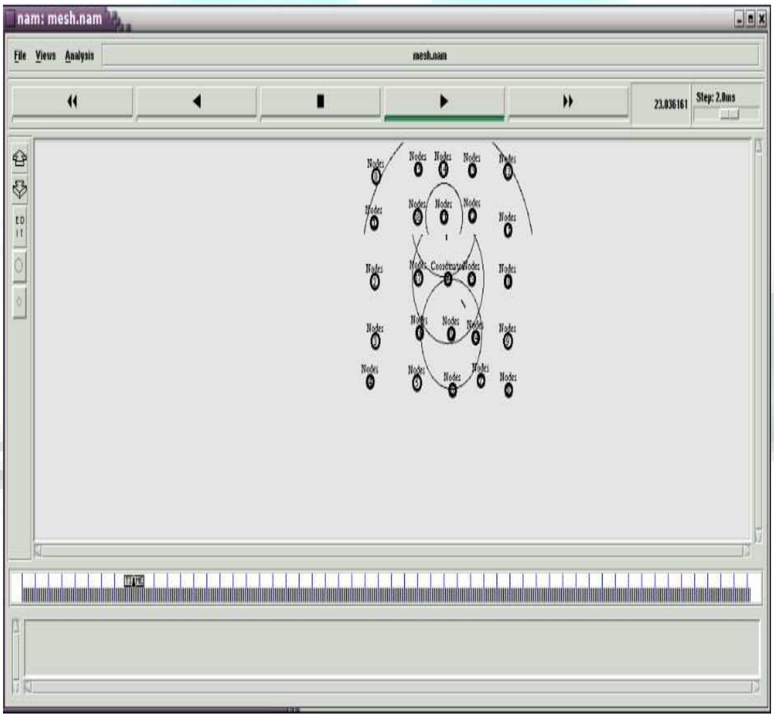
$P_r = P_t G_t G_r \lambda^2 / (4\pi)^2 d^2 L$ (1)

4. EVALUATION AND IMPLEMENTATION

We study the grid topology and choose to place 25 nodes in a grid. Each row (column) contains 5 nodes equally spaced with distance 789x480 m apart shown in figure 3. There is a single broadcast source located at the left top corner. It continuously sends CBR traffic at the rate of a packet every 1.5 ms.

Each Sensor node begins the simulation by selecting a random destination in the defined area and moves to that destination at a random speed.Each time a mobile node transmits a frame in asimulation, ns-2 uses a propagation model to calculatethe receive power of the radio signal for everypotential receiving node.All frames with a power below the carriersense threshold are ignored by the receiver.The ''free space'' model was used in this paper with equation shown in thesection "Network Model". We first characterize theTransmission Power and energy consumption per flow insensor networks, based on the heterogeneous transmission rangesthat we have obtained. We then summarize these results andexplore the insights and implications that they may provide us.Simulation results are shown in Figures 4–5 and Simulation Statistics has shown in Table1.

FIGURE 3: SCENARIO OF GRID BASED NETWORK ALONG WITH COORDINATOR



The positions of nodessignificantly impact the network lifetime therefore we used grid based mesh networks.from the figure 3 to achieve maximal coverage withthe least number of sensors, a square grid hasbeen used.The coordinator usedto find a placement of nodes that achieves thecoverage goals using the least number of sensorsand also maintain a strongly connected networktopology even if one node fails. The objective of this paperis to minimize energy consumption at the individual sensors whilemaximize the network lifetime.

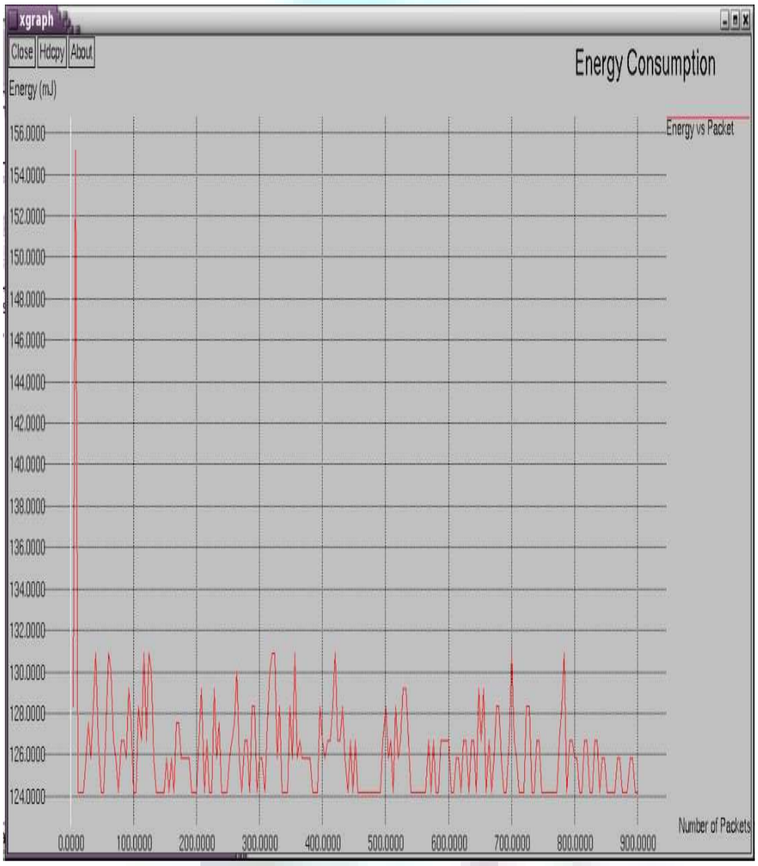
TABLE 1: SUMMARY OF SIMULATION STATISTICS

Parameter	Value
Number of Nodes	25
Topography Dimension	789 m x 480 m
Radio Propagation Model	Two-Ray Ground Model
MAC Type	802.15Mac Layer
Packet Size	1024 bytes
Protocol	AODV

4.1 ENERGY CONSUMPTION

The energy consumption metrics used for the routing algorithm should be adjusted based on application specific and or even site-specific data. This energy metric used to evaluate a specific path incorporates the cost of using the path, the energy health of the nodes along the path, the lifecycle of the nodes, and topology of the network. In the Network scenario, the packets used the primary path about half the time but in order to meet the expected lifecycle; a communication will use the other sub-optimal paths at different times. In this manner, the overall energy consumption of the network is reasonably minimized without burning the energy of any single nodes along the optimal paths.

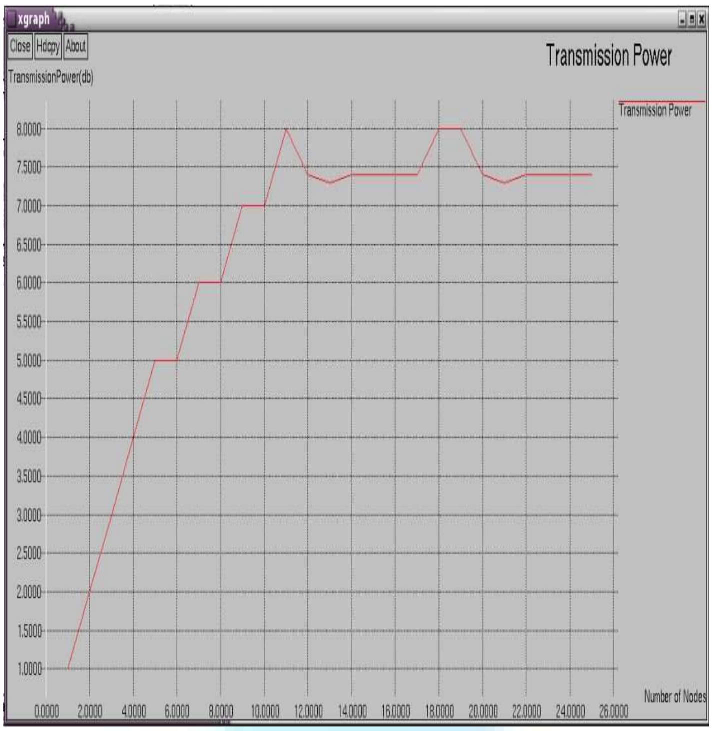
FIGURE 4: ENERGY CONSUMPTION OF WSN



4.2 TRANSMISSION POWER

Power is a valuable resource in wireless networking especially for routing, power is highly needed.The nodes may have the ability to vary theirtransmission power. This is important, since at a higher power, nodes havemore direct neighbors and hence connectivity increases, but the interference between nodes does as well. Transmission power control can also result inunidirectional links between nodes, which can affect the performance ofrouting protocols.Energy reduction for each node occurs for every transmission or reception made. Hence, the probability of choosing the same node as the next hop is reduced. Thereby, the energy has been balanced and fairly used. The less area a sensor covers, the lower the amount of energy it consumes. The application determines the frequency of the sensing activity, but there is still an opportunity to reduce power consumption by the sensing task by decreasing the coverage area of a particular sensor.

FIGURE 5: TRANSMISSION POWER OF WSN



CONCLUSION

This study has presented a broad overview ofthe research work conducted in the field of Wireless Sensor Networks(WSN) with respect to MAC Layer.The real issue with regard to such arrangementis whether it actually improves the energy consumption.We have developed the heterogeneous transmission range forthe WSN network under the random walk mobility model with nontrivial velocities respectively.In addition, results of the Transmission Power and Energy Consumption areconsequently derived for mobility sensorynetworks.Besides, in comparison to existing works weclearly show that we save energy and also properly managed during this network scenario and life time ofthe whole network was increased.

FUTURE WORK

Future sensor network systems will bemore heterogeneous and radically distributed, potentially with millionsof nodes. They will respond to multiple tasks, to multiple and potentiallymobile sinks, and multiple sensor networks will be integrated into a single network.

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