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INTER DOMAIN COMMUNICATION IN IEEE 802.15.4 USING NETWORK TIME STAMPING

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Abstract:

Wireless sensor network consists of spatially distributed autonomous sensors to monitor environmental conditions such as sound, temperature, pressure etc. Each sensor node senses and detects events in the area and communicates data back to the base station (BS). Restraining the transmission range and power consumption is significant restriction existing for communication and advantageous to put in order the sensors into clusters. Clustering in cross layer networks is one of the important mechanisms to improve the energy consumption of sensor network and thereby increase the network lifetime. In clustering, entire sensor network is divided into groups and each group called as cluster. The cluster heads are selected based on the energy level of a node. It collects and aggregates the data and sends it back to the BS.One of the major reasons for performance degradation in Wireless sensor network is the overhead due to control packet and packet delivery degradation. Clustering in cross layer network operation is an efficient way manages control packet overhead and which ultimately improve the lifetime of a network. All these overheads are crucial in scalable networks. But the clustering always suffers from the cluster head failure which needs to be solved effectively in a large network. As the focus is to improve the average lifetime of sensor networks the cluster head is selected based on the battery life of nodes. The cross-layer operation model optimize the overheads in multiple layer and eventually using clustering, reduces the most important overheads recognized.The proposed model operates on two layers of network ie., Network Layer and Transport Layer and Clustering is applied in the network layer . The simulation result shows that the integration of two layers reduces the energy consumption and increases the throughput of the wireless sensor networks.

Keywords – Base station, Clustering, Network and transport layer.

1. INTRODUCTION

Mobility in wireless sensor networks (WSNs), canhave a profound effect on the network operation. This effect is diverse according to several parameters thatinclude: application diversity, network topography (topology), network connectivity and deployed node(s) or sensed event(s) location estimation. Sensor node mobility can be divided into two categories: limited mobility where there are specific nodes that roam around the network to perform an exclusive task (e.g., mobile sink nodes) and random mobility where the nodes(sensor nodes) roam around the area of deployment to collectthe data needed for the application.

Mobility as a problemhas either advantageous effects or disadvantageous ones. mobility is a serious issue if introducedin WSNs operations. It has its advantages and disadvantageson diverse levels of the network operation. The focus of this paper is the random mobility of the deployed sensor nodesand how it has effects on the networks operation in terms of the connectivity and location estimation of the nodes. Theconnectivity issue is dealt with by using routing protocols andMAC protocols as both layers are responsible of insuring an available connection between one hop and another.

The locationinformation is an application layer attachment; however, it requires a specific mechanism to estimate the location of themobile node(s). The model operation leads the network to consume less energy while maintaining the network packet delivery ratio.The presented operational model with its simplicity has never been introduced. The simulation-based evaluations, the proposed model outperforms theconventional operation of IEEE 802.15.4-based network and the energy efficient and QoS aware multipath routing protocol in terms of energy consumption by roughly 10%. Twice less control packet overhead, on-par end-to-end delays and comparative packet delivery ratios.The proposed cross-layer assumes no clustering mechanism has been implemented. This makes the network more flexiblein terms of new nodes joining the network.

Advantages of introducing mobility to the network can be listed as below :1. Applications: introducing mobility to the network canenlarge the scope of applications to implement WSNs.Applications such as: social activity monitoring, cattlemonitoring, swarm bot actuated networks.2. Topography and network connectivity: since WSNstransfer their data in a multi-hop fashion, mobility canenhance the network operation by changing the locationof the nodes leading to create different links to the destination required.3. If mobility is limited to special nodes, e.g., sink node(s), the stationary nodes then can be relieved in terms of links generated to the destination node. The sinknode(s) can roam around through stationary nodes andgather the information sensed by sensor nodes. Mobilesink nodes can also enhance the network connectivity by minimizing the congestion that can happen during network traffic flow.Mobility can introduce a critical challenge to the operationof the deployed network:1. If mobility is limited to special node(s), then thosenodes can.

2. RELATED WORK

Advances in wireless multimedia communication technologies enable new types of pervasive and ubiquitous applications such as mobile health care, environmental monitoring, and facility monitoring and traffic surveillance. Among different factors concerned, energy efficiency is one of the most challenging issues in multimedia communication due to the resource constraints and the requirements for high bandwidth and low transmission delay. In this survey, we provide a broad picture of the state of- the-art energy efficient techniques that have been proposed in wireless multimedia communication for resource-constrained systems such as wireless sensor networks and mobile devices.

Service-oriented wireless sensor networks have recently been proposed to provide an integrated platform, where new applications can be rapidly developed through flexible service composition. In wireless sensor networks, sensors are periodically switched into the sleep mode for energy saving. This, however, will cause the unavailability of nodes, which, in turn, incurs disruptions to the service compositions requested by the applications. Thus, it is desirable to maintain enough active sensors in the system to provide each required service at any time in order to achieve dependable service compositions for various applications suffer from a bottleneck problem. A considerable plan and calculations are required to estimate theoptimum number and paths for the special node(s) to cover the deployed network. 2. If mobility is random. i.e., sensor nodes are also mobilein the network, the effect is greater as the network topology changes become rapid and that affects the connectivity of the nodes. Topology changes have an effect on the routing operation as the links need to berebuilt frequently; therefore, there is an increase energy consumption of the nodes. Mobility affects the MAC protocol operation because the connectivity can suffer from broken connections due to the transmission rangeof the wireless interface. The location of the sensor node(s) in random mobility is of importance because the sensed event is attached to the location of the sensor node. In a mobile scenario, a localization mechanism becomes a frequent operation leading to an increment in node(s) energy consumption.

Severe energy constraints of battery-powered sensor nodes necessitate energy-efficient communication in Wireless Sensor Networks (WSNs). However, the vast majority of the existing solutions are based on the classical layered protocol approach, which leads to significant overhead. It is much more efficient to have a unified scheme, which blends common protocol layer functionalities into a cross-layer module. In this paper, a Cross-Layer Protocol (XLP) is introduced, which achieves congestion control, routing, and medium access control in a cross-layer fashion. The design principle of XLP is based on the cross-layer concept of initiative determination, which enables receiver-based contention, initiative-based forwarding, local congestion control, and distributed duty cycle operation to realize efficient and reliable communication in WSNs.This result may be incorporated as a disadvantage of XLP when only the routing layer is taken into account. The overall performance of XLP reveals that maximizing the routing layer performance alone does not provide efficient communication in WSNs

Gathering correlated sensor data by a single sink node in a wireless sensor network. The sensor nodes are energy constrained and design efficient distributed protocols to maximize the network lifetime. Many existing approaches focus on optimizing the routing layer only, but in fact the routing strategy is often coupled with power control in the physical layer and link access in the MAC layer. This paper represents a first effort on network lifetime maximization that jointly considers the three layers. We first assume that link access probabilities are known and consider the joint optimal design of power control and routing. We show that the formulated optimization problem is convex and propose a distributed algorithm, JRPA, for the solution. We also discuss the convergence of JRPA. The problem cannot be converted into a convex optimization problem, but there exists a duality gap when the Lagrangian dual method is employed. Drawback of their work is that they do not fully consider the impact of the source rate allocation on the underlying communication layers.

Autonomous Mobile Robots (AMRs) operating in unknown environments face twin challenges: 1) localization and 2) efficient directed navigation. This paper describes a two-tiered approach to solving these challenges: 1) by developing novel Wireless-Sensor-Network (WSN)-based localization methods and 2) by using WSN–AMR interaction for navigation. The goal is to have an AMR travel from any point within a WSN-covered region to an identified target location without the aid of global sensing and position information. In this research, the target is reached.

Wireless Sensor and Actor Networks (WSANs), the collaborative operation of sensors enables the distributed sensing of a physical phenomenon, while actors collect and process sensor data and perform appropriate actions. WSANs can be thought of as a distributed control system that needs to timely react to sensor information with an effective action. In this paper, coordination and communication problems in WSANs with mobile actors are studied. First, a new location management scheme is proposed to handle the mobility of actors with minimal energy expenditure for the sensors, based on a hybrid strategy that includes location updating and location prediction.

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3. SYSTEM MODEL

The abstract illustration of the cross-layer operational modelis detailed in Fig. 1. To show the activity of each layer,an abstract TCP/IP model was placed beside the operational model. At network initialization, the mobile node started to broadcasta neighbor discovery message to initiate neighbor(s) information collection and store it in a neighbors' list (NB-List).After the initialization process, if a node in the network had data of interest to send, attached with this data was the locationinformation of the mobile node. The location information in the node is provided by either a GPS module attached to thenode or any other methods where the nodes are able to estimatetheir individual locations. This node then started sending route request (RREQ) packets to establish a route to the destinationnode. The routing protocol utilized in the operation model utilizes a periodic neighbor maintenance message which is ahello packet. Hello packets are broadcast packets; therefore, it was possible to utilize the neighbor list from the network layerin the data-link layer. This eliminated the need for neighbour discovery messages to be sent by the MAC protocol. After the destination node received the RREQ packets, it replied bysending a unicast route reply (RREP) packet. The destination node embedded its own location information in the RREPmessage and sent it back to the next hop node in the reverse route.

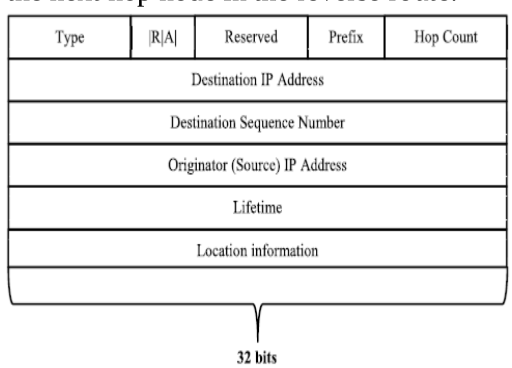

Fig. 2. RREP Message structure after embedding the location information. A 32-bit field is required for the location information as it is relevant to the implemented simulations. 16 bits for the X-axis and 16 bits for the Y-axis. It is possible to store the location information (Latitude and longitude) in a 32 bit integer number by using Virtual Earth's tiling system method

Fig. 2 illustrates the RREP packet structure after embeddingthe location information. The next hop node in the reverse route calculated the distance between it and the destination node and exported this information to the data-link layer. TheMAC protocol utilized the transmission power control-based on the distance information and calculated the required power to use when sending data packets back to the destination node. The transmission power and range is calculated byimplementing the radio propagation model according to the distance calculated by the nodes. The distance between two nodes is calculated as the Euclidian distance between twopoints.

To minimize the broadcast of the control packets, the nodes that were only in the active route(s) were allowed toperiodically broadcast hello packets to their neighbors. Active route is the route that has been established to transmit datafrom source node to destination node after the route discovery operation.This operation was repeated through all nodes until thesource node. After the established route passed its

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lifetimeand there was no data of interest to send, the nodes engaged in the operation went into sleep state. Nodes which were stillinvolved in another route were active as the operation required.

The proposed model has been compared against the EQSR protocol and the standard model of IEEE 802.15.4. Thescenarios had a deployment area of 200 × 200 meters. The nodes deployed were all mobile with a stationary sink nodeplaced in the middle of the simulation area. There were seven data sources randomly chosen for all of the scenarios. Allof the sources transmitted their data to the sink node. The applications started consecutively for each source node with10 seconds difference between each source application start time. The mobile nodes had random mobility directions. Thetransmission power and reception power considered mimicked an IEEE 802.15.4 cc2420 model. The mobile nodeshave randomly timed mobility pauses. The period of each pause was 50 seconds. The transport protocol used was UDP.

The simulation period was 500 seconds. The minimum node mobility speed was 1 m/s and the maximum was 3 m/s. Theproposed cross-layer model was compared against a model proposed for WSNs. Table I illustrates the parametersfor the simulations. The transmission range and the carrier sense range were the same 40 meters. This means that if anode left another node's(s') transmission range there was no possible overhearing from the nodes beyond the transmissionrange.

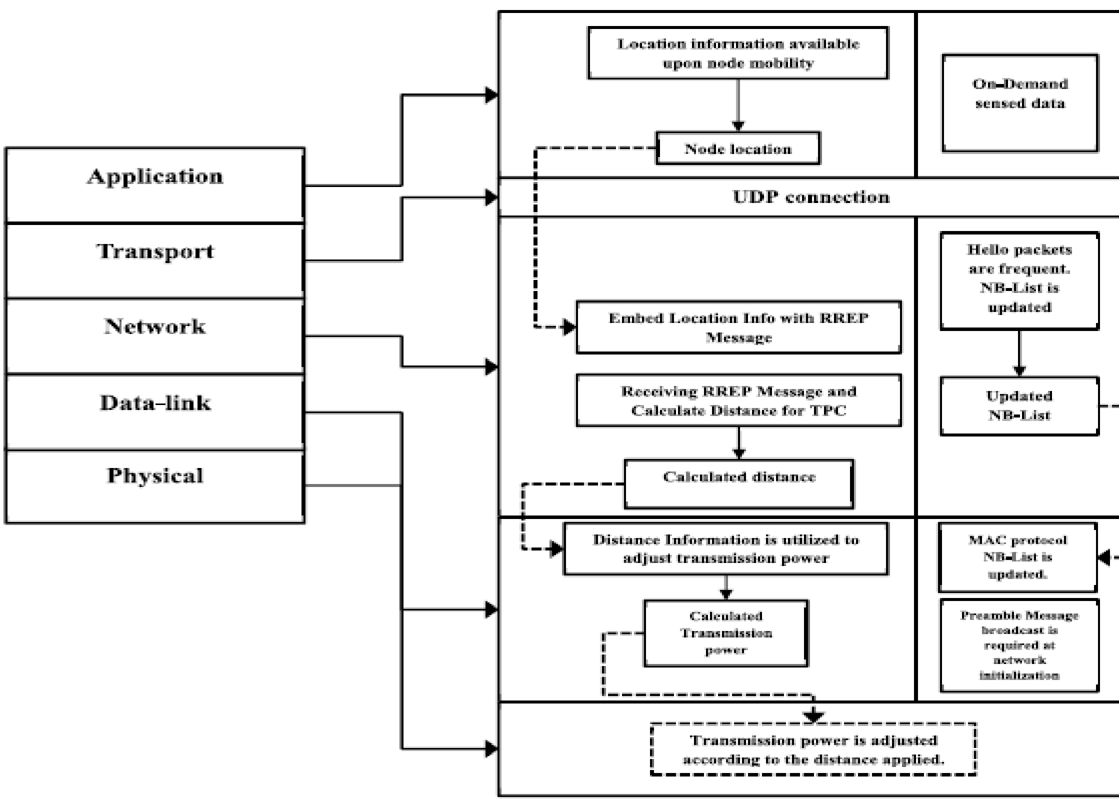

Fig. 1 Operational model detailed process diagram

network energyconsumption. The proposed operational model consumedenergy lower than the standard IEEE 802.15.4 model. The energy consumption per packet was also lower for the crosslayermodel than the standard model. The low energy consumed per packet was because the packet delivery ratio forthe cross-layer model was higher than the standard model and the network energy consumption was lower.The network energy consumption was lower because the cross-layer employs both transmission power control andcontrol packet minimization.

The cross-layer operational model improved the packet delivery ratio (PDR) of the standard model by almost 2%. The trend of the throughput was thesame as in the PDR results. The cross-layer model minimized control packet overhead which resulted in less channel occupationduring packet transmission.The channel occupation was aneffective parameter on the hop-to-hop message propagation delay. The mobile nodes were required to check for themedium if it was available or not. Controlling the number of broadcast control packets deployed in the network controlledthe wireless channel occupation and lowered the link(s) congestion.

Minimizing the channel occupation improved theoverall end-to-end delays. The multi-path mechanism of EQSR improved the average end-to-end delays. EQSR utilized thenetwork interface buffer size as one of the metrics of choosing the next hop in the active route.The control packet overheadhas been immensely decreased. The order of the improvement was about two times less than the standard model. The cross-layer model improved the number ofcontrol packets by limiting them after network convergence tothe nodes that were involved in active routes.

The other nodes went to the dormant state if they hadno data for transmission. The EQSR protocol had a higher normalized routing load since it produced lower packet transmitted. As for the number of control packets, it was generatinga lower number of packets than the standard model. However, the number of generated control packets by the EQSR was higher than the cross-layer model since the protocol did not employ any control packet minimization or control.

Wireless Network Configure Setting

Wireless Networks to create the no of nodes. The packets to send and receiving through the source to destination. It’s based the scheme of packets delivered for ACK packet drop on the nodes. In this network to creating the source and destination node of the network and transmit the data to processing on their whole networking.

Topology Design

This module is developed to Topology design all node place particular distance. Without using any cables then fully wireless mobile equipment based transmission and received packet data. Node and wireless between calculate sending and receiving packets. The cluster head is at the center of the circular sensing area. Intermediate the sender and receiver of this networking performance on this topology.

Node Creation

This module is developed to node creation and more than 30 nodes placed particular distance. Wireless node placed intermediate area. Each node knows its location relative to the sink. The access point has to receive transmit packets then send acknowledge to transmitter.

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Voting Based Mechanism

The voting based allows all nodes in the network to vote together. As Certification Authority (CA) exists in the network and instead each node monitors the behavior of its neighbors. The weight of a node is calculated in terms of the reliability and trustworthiness of the node that is derived from its past behaviors, like the number of accusations against other nodes and that against itself from others. The stronger its reliability, the greater the weight will be acquired. The certificate of an accused node is revoked when the weighted sum from voters against the node exceeds a predefined threshold.

Cluster Head Selection

The fuzzy relevance clustering algorithm protocol, consider both the residual energy and the current speed of each mobile node in cluster head election in order to avoid that low-energy nodes are selected as cluster heads and balance the energy consumption among all nodes. After a cluster head is selected, it broadcasts an advertisement message as well as its location, velocity to the mobile nodes within its transmission range using a Carrier Sense Multiple Access with Collision Avoidance (CSMA/CA) Media Access Control (MAC) protocol. Each node in the cluster has a cluster id and node id for its authentication process.

QoS Routing Through Gateway Node

If the source and destination are in different clusters then the data from source is transmitted to destination of other cluster through the gate way nodes present in the intermediate cluster. The local cluster gateway node that has the shortest distance to the external network node includes that external node in its control message. Due to the FSR mechanics, the gateway node closest to the external network node will be the first gateway to receive the external node’s link state update. It is responsible for providing this information to the cluster.

Graph Design Based Result

Graph is an essential part of display a result, so we plot a graph to show a various result comparison with packets, throughput, energy efficient and etc.

CONCLUSION

This paper has proposed a simple, intuitive yet highly effective cross-layer network operational model for MWSNs.The network model employs two major mechanisms: the first is controlling the amount of control packets being broadcast inthe network to provide a relief for the communication channel between the nodes. The control packet minimization processfocuses on the broadcast packets, mainly neighbor, discovery mechanism at the MAC layer and the neighbor discoverypackets (hello packets) at the routing layer. The second mechanismis transmission power control that is dependent on thenode’(s’) location. The transmission power control mechanismis only active when the route is established; therefore, its effect is guaranteed at the data transmission state. Combined togetherresults in energy efficiency, higher throughput and lower end-to- end delays than the standard model. To our knowledge,such a combination in the cross-layer operation with four layercooperation has not been introduced before and is unique. Future directions for the proposed model is to minimize more control packets especially RREQ packets as they arealso broadcast packets. A possible mechanism is to program the mobile so that they know where the sink node is.Therefore, by implementing a directional broadcast flooding, this should minimize the number of control packets beingbroadcast and improve the channel quality. Another possible improvement over the proposed model is to have heuristiccalculated information about the active route life-time. By merging the information of the mobile node(s) movementdirection and speed, the active route can be programmed to have a life-time equal to when the first node of this activemight leave the connectivity range. Such mechanism can minimize the link error handling messages between the nodes. Applications that can benefit from such implementation canbe related to elder care centers or social activity monitoring, e.g., kindergarten monitoring related applications.

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