A Novel Approach of Minimizing Energy Utilization For Cross Layer Mobile WSN Based On IEEE 802.15.4

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***Abstract*— IEEE 802.15.4 mobile wireless sensor networks (MWSNs) defines the physical layer and MAC layer. One major problem of these networks is that they suffer from control packet overhead and delivery ratio degradation which increases the energy consumption of the network. So a cross-layer operation model which incorporates four layers in the system operation: 1) application layer; 2) network layer; 3) medium access control (MAC) layer; and 4) physical layers. At the system instatement, the location information of the mobile node is inserted into the routing operation after the route discovery process. At that point this data is utilized by the MAC layer to conform the transmission force of the nodes, which diminishes the node's energy consumption. Energy consumption of the network can be reduced by reducing the broadcasting of control packets between the nodes involved only in the active route. It likewise diminishes the occupation time of the wireless channel. To the best of our knowledge, the presented operational model has never been introduced and it improves the network's energy consumption and system throughput of these networks. The simulation results demonstrate that, the proposed model beats the ordinary operation of IEEE 802.15.4-based systems.**

***Index Terms*— Cross-layer scheme, Energy Proficiency, Hello packets, IEEE 802.15.4.**

I. INTRODUCTION

IEEE 802.15.4 is a standard made and kept up by specialists which indicates the physical layer and medium access control for low-rate wireless personal area networks (LRWPANs). The IEEE 802.15.4 protocol stack is shown in fig 1.

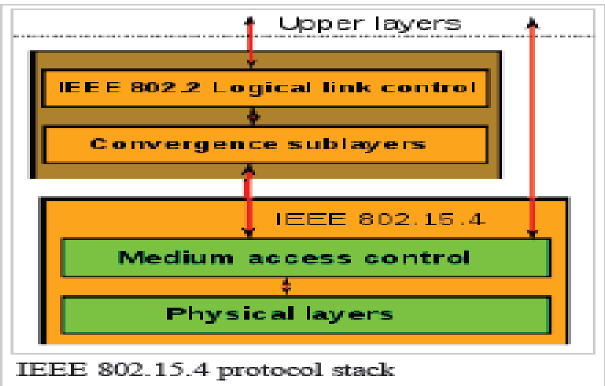

Fig 1: IEEE 802.15.4 convention stack.

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The IEEE 802.15.4 characterizes the physical layer (PHY) and medium access control sub-layer (MAC) for supporting gadgets that work in the individual working space (POS) of 10 m. wireless connections under 802.15.4 can work in three license free industrial scientific medical (ISM) frequency bands, as appeared in Fig. 2. These oblige over air data rates of 250 kbps in the 2.4 GHz band, 40 kbps in the 915 MHz band, and 20 kbps in the 868 MHZ. An aggregate of 27 channels are assigned in 802.15.4, incorporating 16 channels in the 2.4 GHz band, 10 channels in the 915 MHz band, and 1 channel in the 868 MHz band.

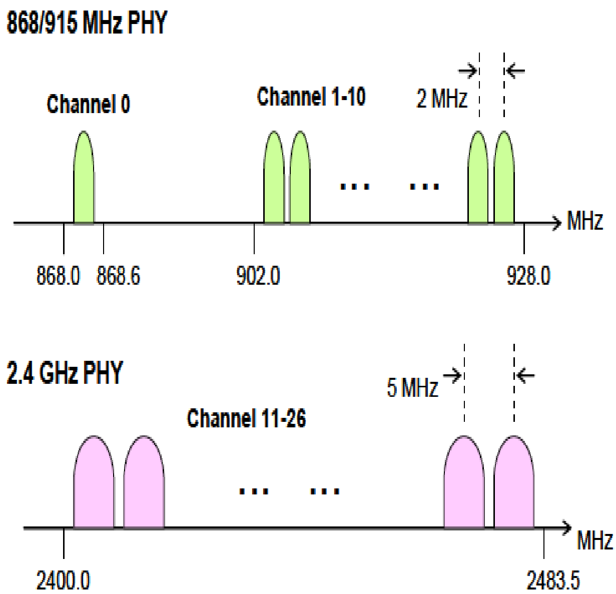

Fig 2: IEEE 802.15.4 channel structure.

Two distinctive device types can join in a LR-WPAN system: a full-function device (FFD) and a reduced-function device (RFD). The FFD can work in three modes serving as a PAN facilitator, an organizer, or a gadget. An FFD can communicate with RFDs or different FFDs, while a RFD can communicate just to a FFD. A RFD is proposed for applications that are very simple, for example, a light switch or a passive infrared sensor. They don't have to send a huge amount of information and would just relate with FFD at once. Therefore, the RFD can be actually utilizing insignificant assets and memory limit. Portability in remote sensor systems (WSNs), can profoundly affect the system operation [1]. This impact is differing as indicated by a few parameters that include: application differences, system geography (topology), system availability and conveyed node(s) or detected event(s) area estimation. Sensor node mobility can be isolated into two classes: limited mobility where there are particular hubs that meander around the system to perform a selective undertaking (e.g. , versatile sink hubs) and random mobility where the hubs (sensor hubs) wander around the region of arrangement to gather the information required for the application [2]. Portability as an issue has either worthwhile impacts or disadvantageous ones.

II. RELATED WORK

Cluster based routing protocol for mobile nodes in wireless sensor network [4]. Portable Wireless Sensor Network is having portable nodes in the system. Both the sensor nodes and portable sink can be versatile or there can be blended sensor hubs i.e. versatile and additionally static sensor hubs in the system in view of the application prerequisites. routing in portable wireless sensor system postures research issues as hubs are versatile, so it needs to send the information as per the routing protocol while it is moving. So the routing protocol have been proposed considering portable hubs in the system concentrating on exploration issues like packet loss, vitality utilization, and delay. In this paper, the group based steering conventions that have been proposed for versatile remote sensor system are talked about and correlation is done among them.

SAMAC: A cross-layer communication protocol for sensor networks with sectored antennas[11]. Wireless sensor networks have been used to gather data and information in many diverse application settings. The capacity of such networks remains a fundamental obstacle toward the adaptation of sensor network systems for advanced applications that require higher data rates and throughput. In this paper, we explore potential benefits of integrating directional antennas into wireless sensor networks. While the usage of directional antennas has been investigated in the past for ad hoc networks, their usage in sensor networks bring both opportunities as well as challenges. In this paper, Sectored-Antenna Medium Access Control (SAMAC), an integrated cross-layer protocol that provides the communication mechanisms for sensor network to fully utilize sectored antennas, is introduced. Simulation studies show that SAMAC delivers high energy efficiency and predictable delay performance with graceful degradation in performance with increased load.

Performance Evaluation of the IEEE 802.15.4 MAC for Low-Rate Wireless Networks[2]. IEEE 802.15.4 is a developing standard particularly intended for low-rate remote individual territory systems (LR-WPAN) with an attention on empowering the remote sensor systems. It endeavors to give a low information rate, low power, and ease remote systems administration on the gadget level correspondence. In this paper, performance evaluation of the IEEE 802.15.4 remote systems is performed. A few arrangements of down to earth examinations are led to study its different elements, including the impacts of 1) the direct and indirect information transmissions, 2) CSMA-CA system, 3) information payload size, and 4) guide empowered mode. The information throughput, conveyance proportion, and received signal strength indicator (RSSI) are examined as the execution measurements. The outcomes demonstrate that IEEE 802.15.4 has better execution in non-signal mode. Some issues that could debase the system execution are likewise talked about in this paper.

III. SYSTEM ARCHITECTURE

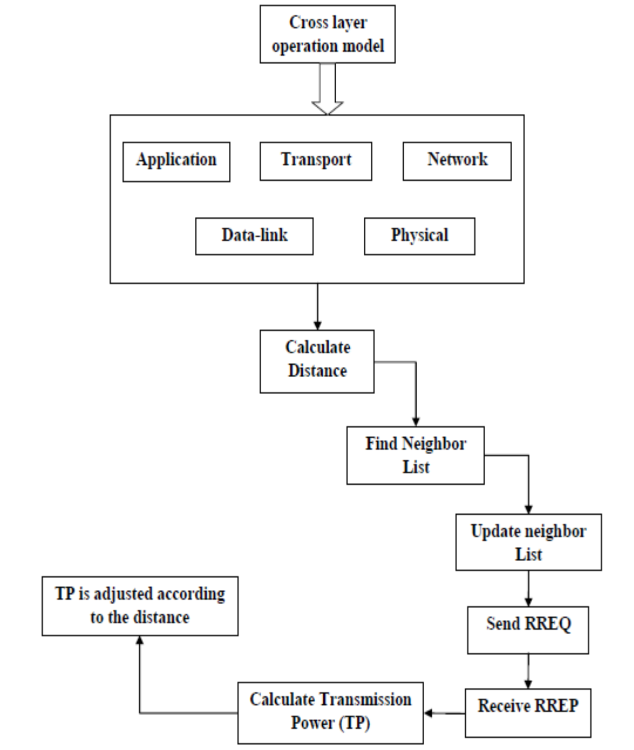

Fig 3: system architecture

At system instatement, the portable nodes began to telecast a neighbor discovery message to start neighbor(s) data accumulation and store it in a neighbors' list (NB-List). After the instatement procedure, if a hub in the system had information important to send, appended with this information was the area data of the portable hub. The area data in the hub is given by either a GPS module joined to the hub or some other strategies where the hubs can assess their individual areas. This hub then began sending route request(RREQ) packets to set up a link to the destination hub. The routing protocol used in the operation model uses an occasional neighbor upkeep message which is a hello packets. Hello packets are telecast bundles; subsequently, it was conceivable to use the neighbor list in the MAC layer. This killed the requirement for neighbor disclosure messages to be sent by the MAC layer. After the destination hub got the RREQ bundles, it answered by sending a unicast route reply (RREP) parcel. The destination hub implanted its own area data in the RREP message and sent it back to the following jump hub in the opposite course. Fig. 3 outlines the RREP bundle structure subsequent to installing the area data. The following jump hub in the converse course ascertained the separation amongst it and the destination hub and sent out this data to the data link layer. The MAC convention used the transmission power control-in light of the separation data and computed the obliged energy to utilize when sending information parcels back to the destination hub. The transmission power and range is ascertained by executing the radio engendering model as indicated by the separation figured by the hubs. The separation between two hubs is computed as the Euclidian separation between two focuses. To minimize the telecasting of the control bundles, the hubs that were just in the active route(s) were permitted to intermittently telecast hi parcels to their neighbors. active link is the link that has been built up to transmit information from source hub to destination hub after the route disclosure operation.

IV. Methodology

The network energy utilization model can be portrayed as takes after: Let Fig. 4 speak to the case system at time stamp ts The used system model is depicted as an undirected network chart G (V, E), where V is a limited arrangement of hubs, and (i, j) ∈ E speaks to a remote connection between hub i and hub j. The portable node'(s') speed, position, moving course and transmission extent can be spoken to as a capacity to demonstrate a sensor hub's condition in the system in a Cartesian arrange, that is:

$$\Phi i(t) = f((x(i, t), y(i, t)), v(i, t), \theta(i, t), Ri)$$

where f speaks to the hub's state at time, (x(i, t), y(i, t)) is the position, v(i, t) is the rate, θ(i, t) is the moving heading of hub i at time t and Ri is the communication range of hub i. If node j is a neighbor of node i , the relative function can be expressed as:

$$\Phi\, j{-}i\,(t) = g((x(\,j\_i, t), y(\,j\_i, t)), v(\,j\_i, t), \theta(\,j\_i, t), Ri, Rj)$$

where g represents the neighboring nodes i and j states, (x(j_i, t), y(j_i, t)) is the relative position, v(j_i, t) is the relative speed, θ(j_i, t) is the relative moving direction of node j to node i at time t and Ri, Rj are the communication range of node i, j, respectively.

At system introduction (or when a hub has information of interest), the hubs begin to show ND bundles to set up their neighbor tables where the neighbor hubs {NR} ∈ {N}. In this way, the energy utilized is the energy consumed for sending and ND packets.

$$P_{initialization} = \sum_{i \in N_R}^{n} P_{ND}(\Phi i(t_s + t_{ND}))$$

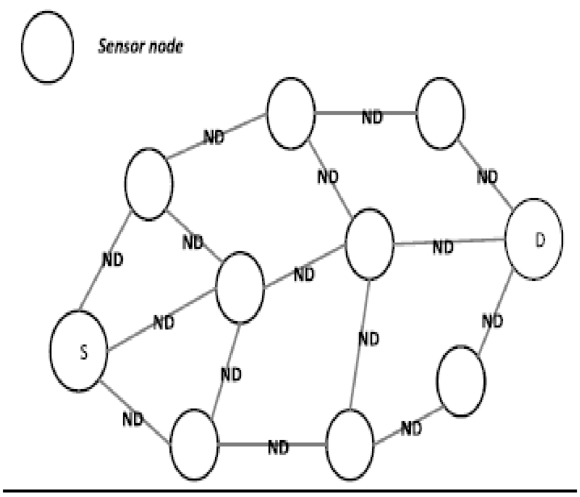

Fig 4: Network movement state at time stamp ts.

where PND speaks to the force consumed by one for sending one ND parcel, ts speaks to the time stamp of system introduction and tND speaks to the time required to transmit and get ND bundles by every hub. The second step is to hunt down a link to the destination hub by television hi parcels to keep the RREQ messages between the hubs. The force devoured by the hubs at this state is the force expended for sending hi parcels in addition to the force devoured by sending RREQ messages as depicted in:

$$P_{route1} = \sum_{i \in N_R}^{n} P_{RREQ}(\Phi i(t_{RREQ})) + \sum_{i \in N_R}^{n} P_{Hello}(\Phi i(t_H))$$

Where PRREQ speaks to the force devoured by the hubs for sending and accepting RREQ parcels, tH speaks to the time required to transmit a welcome bundle and PHello is the force required for the intermittent transmission of hi parcels. The destination hub then begins sending back RREP messages. RREP messages incorporate the data of the hub's area that has sent the RREP message. This will make an alternate arrangement of hubs {K} where (K ∈ N) as the RREP message is a unicast message. A hub is incorporated into set {K} if the hub gets a RREP parcel. The proposed operation restricts the intermittent show of hi bundles to the hubs just required in the active link. Therefore, the energy consumption at this state is represented by:

$$P_{route2} = \sum_{i \in K}^{n} P_{RREP}(\Phi i(t_{RREP})) + \sum_{i \in K}^{n} P_{Hello}(\Phi i(t_H))$$

Where PRREP speaks to the vitality devoured by the hub to transmit and get RREP bundles. The welcome bundles are just show between the hubs in the event that i ∈ {K}. The last stage is spoken to by sending information parcels from the source hub. Since the source hub and the hubs involved in the route know the separation from them to the following jump in the course, these hubs will modify their transmission energy to the required separation. This makes the force expended within the information transmission express a component of both separation and time devoured for transmitting full information packet(s). Beneath Equation speaks to the force expended at information transmission state.

$$P_{DATA-State} = \sum_{i \in K}^{n} P_{DATA}(\Phi i(t_{DATA}, R_{Distance})) + \sum_{i \in K}^{n} P_{Hello}(\Phi i(t_H))$$

where *PDAT A* represents the power consumed by the transmission of data packets between the nodes, *tDATA* represents the time required to send data packet(s) and *Rdistance* represents the distance between node *i* and node *j* (*i* is the sender node and *j* is the receiver node). The hello packets' broadcasting power consumption is bounded by the lifetime of the route established.
The final network power consumption model can be represented by :

$$P_{Network} = P_{initialization} + P_{route1} + P_{route2} + P_{DATA-State}$$

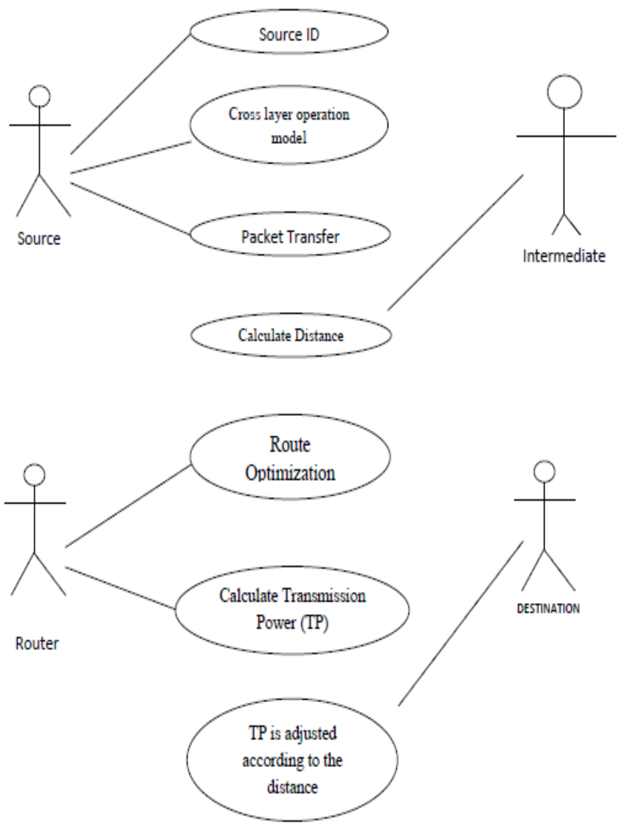

Fig 5: Use case diagram

In the above use case diagram source, router, intermediate and destination are the actors. The source sends the RREQ parcels to make a link to the destination hub. The router will optimize the route and calculates the distance between the nodes. By conforming the transmission power as per the separation the information is sent from source to the destination hub.

V. Results and Discussion

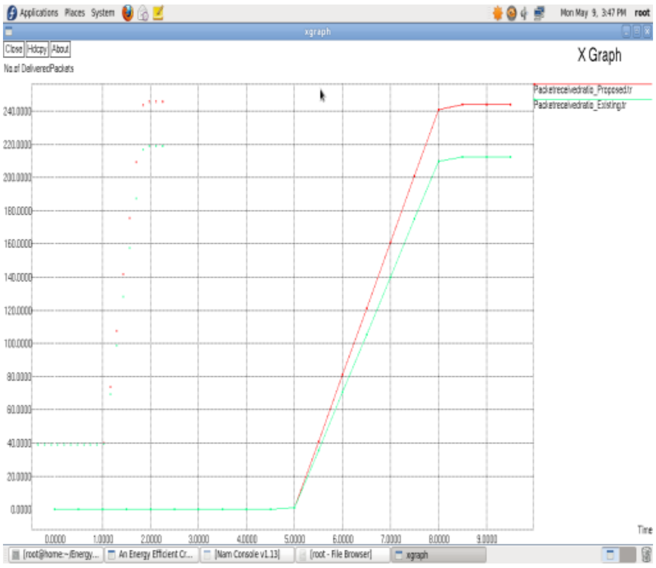

Fig 6: Packet conveyance proportion.

In Fig 6 the packet delivery ratio of proposed system is high as compared to existing system.

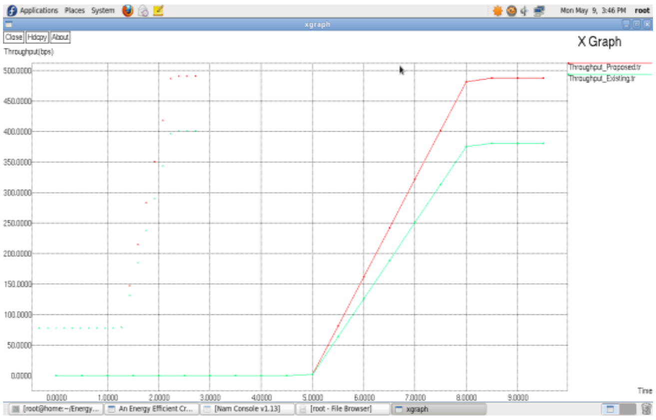

Fig 7: Throughput of the network

In Fig 7 the throughput of the network in proposed is high as compared to existing one. Since the welcome parcels are constrained just to the hubs required in the dynamic course.

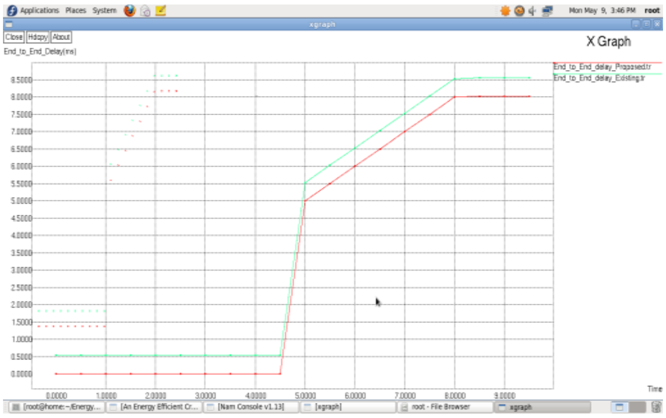

Fig 8: End-to-end delay

In Fig 8 end-to-end delay of the proposed system is low as compared to existing system. This means that there is no congestion in the network and no overhead of hello packets. So the deferral will be less and parcels will be sent soon.

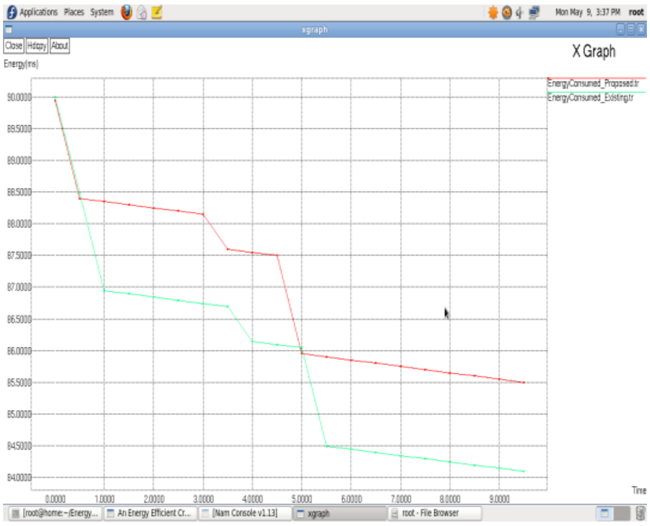

Fig 9: Energy consumed

Fig 9 vitality utilization of the system is appeared. Here the proposed framework will devour less vitality when contrasted with existing framework. The energy graph depends on the distance between the nodes.

VI. CONCLUSION AND FUTURE SCOPE

The conclusion is drawn from the above dialog that, the paper introduces a straightforward, natural yet very compelling cross-layer system operational model for MWSNs. The system model utilizes two noteworthy components: the first is controlling the measure of control bundles being telecast in the system to give a help to the correspondence station between the hubs. The second component is transmission power control which relies on upon the hub's area. The transmission power control instrument is just dynamic when the course is built up; in this way, its impact is ensured at the information transmission state. Joined together results in vitality proficiency, higher throughput and lower end-to-end delays than the standard model. As far as anyone is concerned, such a mix in the cross-layer operation with four layer collaboration has not been presented before and is unique.

Future bearings for the proposed model is to minimize more control bundles particularly RREQ parcels as they are additionally telecast parcels. A conceivable system is to program the versatile with the goal that they know where the sink hub is. In this way, by actualizing a directional telecast flooding, this ought to minimize the quantity of control parcels being show and enhance the station quality.

REFERENCES

[1] M. Cattani, S. Guna, and G. P. Picco, “Group monitoring in mobile wireless sensor networks,” in *Proc. Int. Conf. Distrib. Comput. Sensor Syst. Workshops (DCOSS)*, Jun. 2011

[2] K. Zen, D. Habibi, A. Rassau, and I. Ahmad, “Performance evaluation of IEEE 802.15.4 for mobile sensor networks,” in *Proc. 5th IFIP Int. Conf. Wireless Opt. Commun. Netw. (WOCN)*, 2008, pp. 1–5.

[3] X. Wang, X. Lin, Q. Wang, and W. Luan, “Mobility increases the connectivity of wireless networks,” *IEEE/ACM Trans. Netw.*, vol. 21, no. 2, pp. 440–454, Apr. 2013.

[4] S. A. B. Awwad, C. K. Ng, N. K. Noordin, and M. F. A. Rasid, “Cluster based routing protocol for mobile nodes in wireless sensor network,” in *Proc. Int. Symp. Collaborative Technol. Syst. (CTS)*, 2009, pp. 233–241.

[5] T. Yang, T. Oda, L. Barolli, J. Iwashige, A. Durresi, and F. Xhafa, “Investigation of packet loss in mobile WSNs for AODV protocol and different radio models,” in *Proc. IEEE 26th Int. Conf. Adv. Inf. Netw. Appl. (AINA)*, Mar. 2012, pp. 709–715.

[6] T. Melodia, D. Pompili, and I. F. Akyldiz, “Handling mobility in wireless sensor and actor networks,” *IEEE Trans. Mobile Comput.*, vol. 9, no. 2, pp. 160–173, Feb. 2010.

[7] W.-Y. Lee, K. Hur, K.-I. Hwang, D.-S. Eom, and J.-O. Kim, “Mobile robot navigation using wireless sensor networks without localization procedure,” *Wireless Pers. Commun.*, vol. 62, no. 2, pp. 257–275, 2012.

[8] S. He, J. Chen, D. K. Y. Yau, and Y. Sun, “Cross-layer optimization of correlated data gathering in wireless sensor networks,” in *Proc. 7th Annu. IEEE Commun. Soc. Conf. Sensor Mesh Ad Hoc Commun. Netw. (SECON)*, Jun. 2010, pp. 1–9.

[9] M. C. Vuran and I. F. Akyildiz, “XLP: A cross-layer protocol for efficient communication in wireless sensor networks,” *IEEE Trans. Mobile Comput.*, vol. 9, no. 11, pp. 1578–1591, Nov. 2010.

[10] J. Wang, D. Li, G. Xing, and H. Du, “Cross-layer sleep scheduling design in service-oriented wireless sensor networks,” *IEEE Trans. Mobile Comput.*, vol. 9, no. 11, pp. 1622–1633, Nov. 2010.

[11] E. Felemban *et al.*, “SAMAC: A cross-layer communication protocol for sensor networks with sectored antennas,” *IEEE Trans. Mobile Comput.*,vol. 9, no. 8, pp. 1072–1088, Aug. 2010.

[12] P. Park, C. Fischione, A. Bonivento, K. H. Johansson, and A. Sangiovanni-Vincent, “Breath: An adaptive protocol for industrial control applications using wireless sensor networks,” *IEEE Trans. Mobile Comput.*, vol. 10, no. 6, pp. 821–838, Jun. 2011.

[13] L. Shi and A. Fapojuwo, “TDMA scheduling with optimized energy efficiency and minimum delay in clustered wireless sensor networks,” *IEEE Trans. Mobile Comput.*, vol. 9, no. 7, pp. 927–940, Jul. 2010.

[14] H.-W. Tseng, S.-C. Yang, P.-C. Yeh, and A.-C. Pang, “A cross-layer scheme for solving hidden device problem in IEEE 802.15.4 wireless sensor networks,” *IEEE Sensors J.*, vol. 11, no. 2, pp. 493–504, Feb. 2011.

[15] F. Yu, S. Park, E. Lee, and S.-H. Kim, “Elastic routing: A novel geographic routing for mobile sinks in wireless sensor networks,” *IET Commun.*, vol. 4, no. 6, pp. 716–727, Apr. 2010.