ISSN (Online) 2393-8021
ISSN (Print) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology
Vol. 1, Issue 3, November 2014

ENERGY CONSUMPTION IN WIRELESS SENSOR NETWORKS USING BEACONLESS ROUTING

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Abstract: Wireless sensor networks are prevalent and cost-effective. However, they face RF interference from environmental noise and energy constraints. Routing protocols for such networks must overcome these problems to achieve reliability, energy efficiency and scalability in message delivery. Multi hop WSNs use shortest-path routing, since operation is often over long unattended periods so the protocol must be energy efficient.
An Enhanced Forward Aware Factor-Energy Balanced Routing Method (EFAF-EBRM) based on Data aggregation technique that has some key aspects such as a reduced number of messages for setting up a routing tree, maximized number of overlapping routes, high aggregation rate, and reliable data aggregation and transmission.
According to data transmission mechanism of WSN, we quantify the forward transmission area, define forward energy density which constitutes forward-aware factor with link weight. For energy efficient transmission in event-driven WSN, data should be reduced. It requires proper routing method for reliable transmission of aggregated data to sink from the source nodes. Propose a new communication protocol based on forward-aware factor in order to determine next-hop node and IEAR routing algorithm is to reduce the number of transmissions and thus balancing the energy consumption, prolonging the network function lifetime and to improve QoS of WSN.

Keywords: Wireless Sensor Networks, Efficient and Reliable Routing, Energy Consumption, Lifetime, Beaconless, Sensor Node, Link Score.

I INTRODUCTION

A wireless sensor network (WSN) consists of spatially distributed autonomous sensors to cooperatively monitor physical [1] [2] or environmental conditions, such as temperature, sound, vibration, pressure, motion or pollutants. The development of wireless sensor networks was motivated by military applications such as battlefield surveillance. They are now used in many industrial and civilian application areas, including industrial process monitoring and control, machine health monitoring, environment and habitat monitoring, healthcare applications, home automation, and traffic control.
In addition to one or more sensors, each node in a sensor network is typically equipped with a radio transceiver or other wireless communications device, a small microcontroller, and an energy source, usually a battery.
The forwarding scheme designed to be reactive to the network dynamics and to elect the next hop with extremely low overhead through online optimal strategies. For these reasons, integrate routing with a contention-based MAC [5] not requiring time synchronization (unscheduled and stateless). Moreover, the optimization performed in the present work is a nontrivial extension. In particular, the channel contention follows an optimization process over multiple access slots and, for each slot, over a two dimensional cost-token space, this considerably improves [6] the performance of the forwarding scheme.
Also, solution provides a method to locally and optimally elect the next hop for a given knowledge range transmission power). Finally, the proposed technique can be used in conjunction with advanced sleeping behavior algorithms. This is possible due to the stateless nature of our scheme, which makes it well adaptable to system dynamics.

II RELATED WORK

Several researchers in sensor networks have looked at ways of saving energy. The authors address the problem concerning the limits of energy efficiency. In [11] propose IGF routing protocol. IGF is targeting to the high-end sensor networks. Where each sensor node can obtain its location *(x, y)* through GPS or a position tracking technique. The IGF communication supports the location-address semantic, in which locations are specified as the routing destinations, instead of using a particular node ID.
Since the packet size in high-end sensor networks is relatively large, our main design uses [11] RTS-CTS handshaking to avoid the hidden and exposed terminal problems in wireless communication and an alternative solution for small-packet delivery.
CBF performs greedy forwarding without the help of beacons and without the maintenance of information about the direct neighbors of a node. Instead, all suitable neighbors of the forwarding node participate in the next hop selection [5] process and the forwarding decision is based on the actual position of the nodes at the time a packet is forwarded. This is in contrast to existing greedy forwarding algorithms that base their decision on the positions of the neighbors as they are perceived by the forwarding node. In order to escape from local optima, existing recovery strategies as mentioned in the section on

related work, can either be used directly or may be adapted to be used with CBF

We propose an energy efficient and reliable [8] routing protocol (EERR), which uses hierarchical clustering and to develop it we introduce a set of cluster heads and headset in which two phases namely election phase and data transfer phase are considered.

During the election phase a head-set consisting of several nodes is selected and in the data transfer phase the headset member receives data from the neighboring nodes and transmits the aggregated results to the distant base station, which is done on a rotation basis. The results show that the energy consumption can be decreased and the lifetime of the network is also increased.

Several network layer protocols have [7] been proposed to improve the effective lifetime of a network with a limited energy supply. In this article we propose a centralized routing protocol called Base-Station Controlled Dynamic Clustering Protocol (BCDCP), which distributes the energy dissipation evenly among all sensor nodes to improve network lifetime and average energy savings. The performance of BCDCP is then compared to clustering-based schemes such as Low-Energy Adaptive Clustering Hierarchy (LEACH), LEACH-centralized (LEACH-C), and Power-Efficient Gatthering in Sensor Information Systems (PEGASIS).

III PROPOSED MODEL

Proposed model consists of three phases.

1. Setup Phase
2. Route Selection
3. Data Dissemination

3.1 Route Update

PHASE I

SETUP PHASE:

When a hub is powered on, it broadcasts an Advertisement (ADV) packet indicating that it wants to receive RPT packets. When a neighboring node around the hub [9] receives this ADV packet, it will store the route to the hub in its routing table. Nodes do not circulate the ADV packet received.

When a node is powered on, it delays for a random interval of time before starting an initialization process. A node starts the initialization process by broadcasting a Route [9] Request (RREQ) packet asking for a route to a hub. When a hub receives a RREQ packet, it will broadcast a Route Reply (RREP) packet.

Similarly, when a node gets a RREQ packet, it will broadcast a RREP packet if it has a route to a hub. Otherwise, it will ignore the RREQ packet. Nodes do not broadcast RREQ packets. When a node gets a RREP packet, it will store the route in its routing table.

When it has at least one route to the hub it skips the initialization process. By introducing random delay for each node to begin initialization process, a portion of nodes will receive a RREP packet before they have begun their initialization process.

PHASE II

ROUTE SELECTION PHASE:

Ideally, the best route is the shortest as it incurs the lowest latent and consumes the least energy. In an actual environment, the performance of an RF link varies with physical distance and the terrain between nodes and should be accounted for in routing decisions.

In IEAR, shortest routes are initially admitted into [9] the routing table based on hop-count. Some RF links are affected by temporary external disruption and if a link fails to relay all packets in the last N consecutive attempts, then it will be blacklisted and lost from the table. This allows for adaptiveness.

Path Selection by Calculating Link Score Value in Network:

Link Score is used when there are two links of different routes with the same hub distance competing to be admitted to the routing table.

When a new link is received and the routing table is full, link replacement is initiated. The search ignores blacklisted links and targets [6] the link with the lowest Link Score to be replaced. When there is more than one entry with the same Link Score, the entry with the longest length is chosen to be replaced. If there is a tie in route length, then the route with the higher Link Score is admitted. Link score will be calculated with a help of formula.

Link Score = (PE × WE +PT × WT)

Where, PE – energy level of the next hop node (0.0 to 100.0),

WE– assigned weight for PE (0.0 to 1.0),

PT – transmission success rate (0.0 to 100.0) and

WT – assigned weight for PT (0.0 to 1.0).

Packets at sender side will be received at destination side with a help of updating best path. Path will be updated by calculating link score. Link [9] score will be calculated with a help of formula. A best path should possess maximum of link score value and minimum of path length.

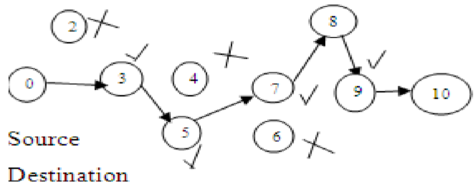

Fig. 3.1 Route selection by calculating link score values.

PHASE III

DATA DISSEMINATION:

Sensor nodes generate RPT packets at periodic intervals or sleep, waiting for some event to [4] [9] happen.

An RPT packet contains information of interest to network users and has two fields in its header: ExpPathLen and NumHopTraversed. The first field is the expected number of hops the packet will have to traverse before it reaches the hub.

To prevent potential deadlocks from occurring, a variable BufUtilLvl is used at each node to store the current utilization level of the packet output buffer. A threshold

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International Advanced Research Journal in Science, Engineering and Technology
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value, BLThreshold, is defined where BLThreshold < Bmax (max size of buffer).

If Buffer Utilization Level BufUtilLvl is greater than BLThreshold (Buffer Level), the packet will be relayed on the shortest route to the hub. This buffer control mechanism [7] ensures that new packets will not be injected when the buffer is almost full and there will always be at least one buffer space for transit packets to be routed.

Route Update:

Sensor nodes continually update "best" routes in the routing table. Instead of explicit control packets, Improved Efficient and Reliability Routing [9] [10] Protocol (IEAR) uses the handshaking mechanism at the MAC layer. Route information is piggybacked onto both RTS (Ready-to-Send) and CTS (Clear-to-Sent) packets.

IV EXPERIMENTAL RESULTS

The simulation results have been obtained using the quantitative analysis. NS-2 has been used to simulate the results. The energy consumption IEAR routing protocol designed is being compared and the results are shown.

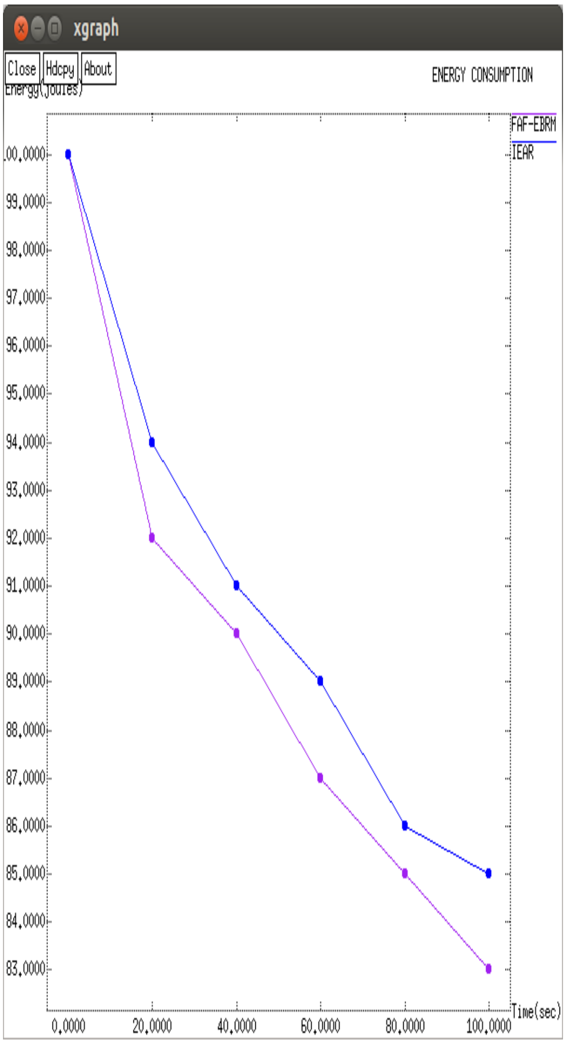

Fig 4.1 Energy Consumption

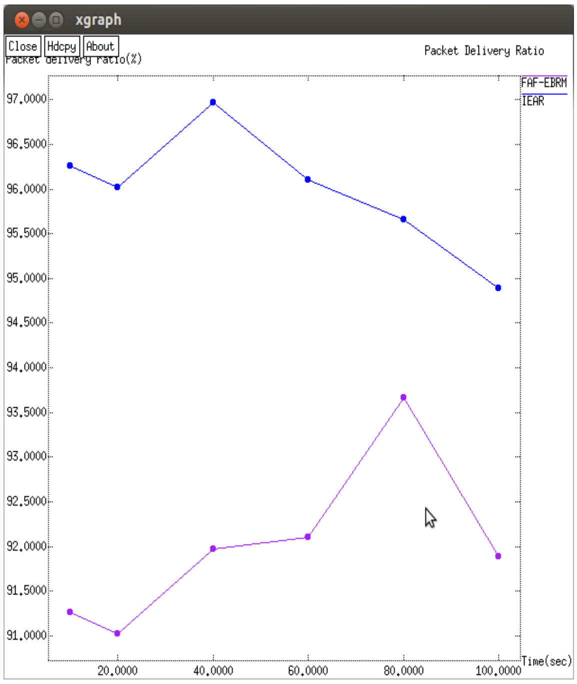

Fig 4.3 Packet Delivery Ratio

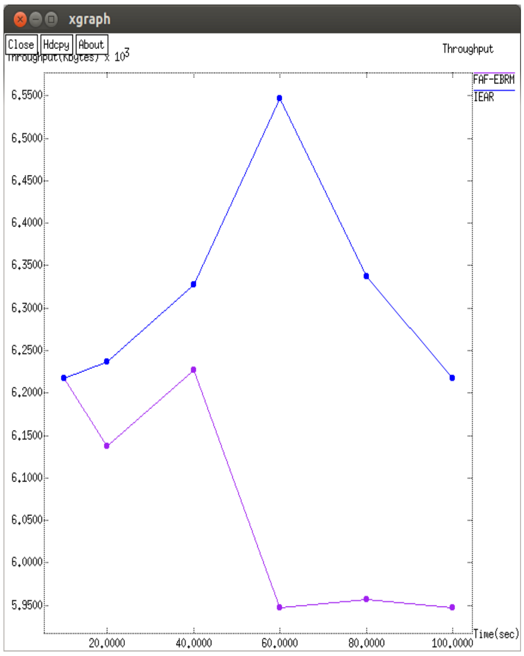

Fig 4.4 Throughput

In the experiment, we evaluate the performance of the routing protocols as the area of the sensor field is increased. IEAR is organized into rounds, where each of them begins with a set-up phase, and is followed by data transfer [8] phase. Usually, the latter phase is longer than the former phase. Their sub-phases include advertisement, cluster set-up, schedule creation, and data transmission phases.

In advertisement phase, the self-selected cluster-heads [1] broadcast advertisement messages in their clusters, and the non-cluster-head nodes decide which clusters they belong to based on the received signal strength. In data transmission phase, each node waits for its turn to send data if needed. IEAR protocol provides sensor networks with many good features, such as clustering architecture, localized coordination and randomized rotation of cluster-heads. In data transmission phase, each node waits for its turn to send data if needed.

COMPARATIVE TABLE

Parameters	FAF-EBRM	EAR
Throughput (kbytes)	5.9	6.2
Energy consumption (milli joules)	92	90
Packet delivery ratio (%)	91	96

V CONCLUSION

This research work was motivated for data aggregation in fixed-power WSNs. Routes are managed based on expected path length and a weighted combination of distance traveled, energy level and RF link performance history.

Simulation results have shown that it performs competitively against existing routing protocols in terms of packet delivery ratio, packet latency, scalability, and energy consumption while operating in a noisy wireless environment where network traffic, link disruptions and node failure rates are high. Future work includes studying the open issues and investigating the security aspects of EAR, especially in clustered WSNs.

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BIOGRAPHIES

Dr. D. Francis Xavier Christopher received his B.Sc., in 1996, M.Sc., in 1998 from Bharathiar University, Coimbatore. He obtained his M.Phil in the area of Networking from Bharathiar University, Coimbatore in 2002. He obtained his Ph.D in the area of software engineering from Bharathiar University, Coimbatore in 2014. At present he is working as a Director, School of Computer Studies in RVS College of Arts and Science, Coimbatore. His research interest lies in the area of Software Engineering.

Jayapriya P completed her undergraduate degree from Navarasam College for Women, and has also completed her post graduate level course MCA at Kongu Arts & Science College, and is currently pursuing her M.Phil in Computer Science at RVS College of Arts &Science, Coimbatore, India. Her area of interest is Advanced Networking.