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Research Paper

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Multi path dynamic routing for data integrity and delay Minimization differentiated services in wireless sensor network

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Abstract— Wireless Sensor Network (WSN) is usually indicated as a network of devices. Devices are represented as nodes, which may sense the neighbouring and communicate the data gathered from the neighbouring in wireless way. In WSN, the QoS requirements can be determined as the performance measurements, such as, delay, reliability, throughput or jitter. The different applications which run on WSN can have distinct QoS requirements. The dynamic routing algorithm called Integrity and Delay Differentiated Routing (IDDR) is used to differentiate the packets with different QoS requirements. Low Energy Adaptive Clustering Hierarchy (LEACH) protocol has been used to make the clustering and cluster heads are chosen considering the highest energy. The cluster heads with minimum distance are used to transmit packets to the sink node. The routing algorithm differentiate the packet based on the weight present at header and sends the delay sensitive packet through shortest path and data integrity packets along sub optimal path. Data integrity packets are encrypted using homomorphic encryption technique to provide security. The performance metrics like energy consumption, average packet drop, packet delivery ratio, and queue length are examined. The simulation results show that suggested method is much efficient when compared with MinRoute protocol.

Keywords- *Wireless sensor networks, Quality of service, Routing, Performance*.

I. INTRODUCTION

Wireless Sensor Network (WSN), as the name conveys it's a network structure where each other nodes are connected to various other nodes without using any physical medium. Wireless Sensor Network has various huge applications such as the monitoring system, the environment monitoring system, the healthcare centre etc. Because of their simplicity and availability the WSNs has changed our general environment. They are getting to be basic part of our lives, more so than the present-day PCs as a result of their different focal points as said beneath. QoS in WSN can be interpreted as a measurement metrics that the network provides to the end user or application in terms of delay, integrity, bandwidth, accuracy, packet drop etc. User is concentrated only on the service that the network gives to advance the QoS of the application and not really bothered on how the network is going to provide. The QoS requirements can be application specific or network specific. For instance, for the event tracking application QoS requirements can be coverage, optimum number of sensor that are need to be active, exposure etc. From network perspective, the QoS requirement can be maximum usage of the sensors resources. While developing QoS provisioning protocol for WSN the challenges like resource constraint, mixed data, dynamic topology, scalability, multiple sinks or base station, redundant data etc must be addressed. In WSNs, two basic QoS requirements are low delay and the high data integrity. In most of the situation these two requirements cannot be satisfied at the same time. The paper mainly focus on how to design a routing protocol that provides data integrity and delay differentiated services over the same Wireless Sensor Networks at the same time without wasting much energy and must work well even the network is congested. WSNs, which are used to sense the physical world, will play an important role in the next generation networks. Due to the diversity and complexity of applications running over WSNs, the QoS guarantee in such networks gains increasing notice in the research community. As a part of an information infrastructure, WSNs should be able to support several applications over the same platform. Distinct applications might have distinct QoS requirements. For instance, in a fire monitoring application, the event of a fire alarm should be reported to the sink as soon as possible. Moreover, some applications require most of their packets to successfully arrive at the sink irrespective of when they arrive. For instance, in habitat monitoring applications, the arrival of packets is allowed to have a delay, but the sink should receive most of the packets. WSNs have two basic QoS requirements: low delay and high data integrity, leading

to what are called Delay-sensitive applications and high-integrity applications, subsequently.
Mainly, in a network with light load, both requirements can be readily pleased. Yet, a heavily loaded network will be affected by congestion, which increases the end-to-end delay. This work objective is to simultaneously improve the fidelity for high-integrity applications and decrease the end-to-end delay for delay-sensitive ones, even when the network is congested. We adopt the concept of potential field from the discipline of physics and design a novel potential-based routing algorithm, which is called integrity and delay differentiated routing (IDDR). IDDR is able to provide the following two functions:

1. Improve fidelity for high-integrity applications: The basic principal is to find as much buffer space as possible from the idle and/or under-loaded paths to cache the excessive packets that might be dropped on the shortest path. Therefore, the initial task is to find these idle and/or under- loaded paths, then the further task is to cache the packets efficiently for subsequent transmission. IDDR constructs a potential field according to the depth and queue length information to obtain the under-utilized paths. The packets with high integrity requirement will be forwarded to the next hop with smaller queue length. A mechanism called an Implicit Hop-by-Hop Rate Control is designed to make packet caching more efficient.

2. Decrease end-to-end delay for delay-sensitive applications: Individually an application is assigned a weight, which represents the degree of sensitivity to the delay. During building local dynamic potential fields with different slopes based on the weight values carried by packets, IDDR permits the packets with larger weight to choose shorter paths. Additionally, IDDR also utilizes the priority queue to further decrease the queuing delay of delay- sensitive packets.

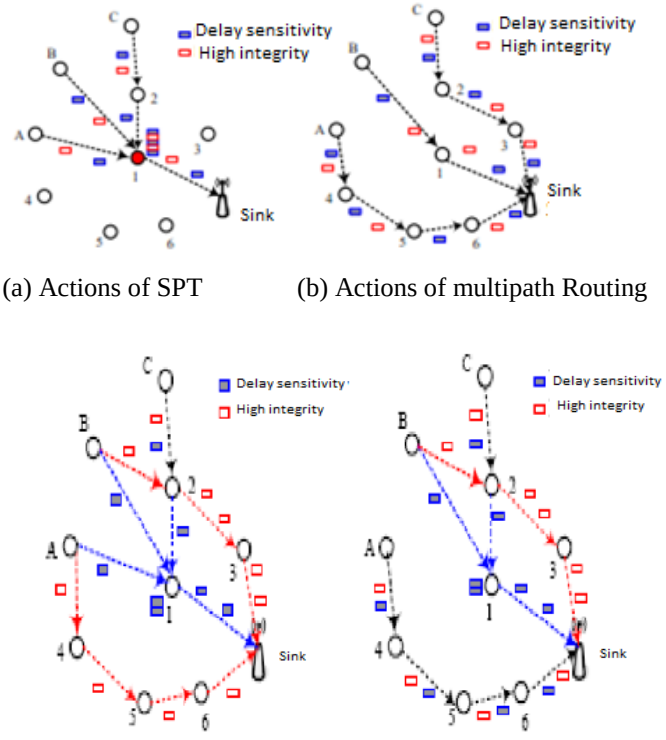
II. MOTIVATION

There are lot of techniques that are suggested to handle the QoS necessities in WSN. Existing systems cannot satisfy low delay and high integrity services in the mean time. Since delay sensitive packets occupy restricted bandwidth and buffer. High integrity packets block the shortest path thus delay sensitive packets to travel additional hops and these packets occupy buffers that will increase the queuing delay for the delay sensitivity packets

Figure 1 illustrates a small part of a WSN. Suppose node 1 is a hotspot and there are both high-integrity packets (hollow rectangles) and delay-sensitive packets (solid rectangles) from source nodes such as path 2 → 3 → Sink and 4 → 5 → 6 → Sink, are used to cache and route these packets efficiently so as to protect them from being dropped in the hotspot.

On the other hand, IDDR gives delay-sensitive packets priority to go ahead in the shortest path to achieve low delay. Furthermore, if the traffic on the shortest path is heavy, IDDR can also select other paths for the delay-sensitive packets, such as path: A → 4 → 5 → 6 → Sink shown in Figure 1(d), the link from node 1 to the sink is so busy that node A or B will bypass node 1 and send packets to the sink along other under-utilized paths to avoid packets being dropped.

IDDR distinguishes different types of packets using the weight values inserted into the header of packets, and then performs different actions on them. Its cornerstone is to construct proper potential fields to make right routing decisions for different types of packets.



(a) Actions of SPT (b) Actions of multipath Routing

(c) IDDR without hotspots (d) IDDR with hotspots

Figure 1. Motivation of IDDR

III. RELATED WORK

So many algorithms have been suggested to improve the quality of service in wireless sensor networking.
Algorithm may look at single QoS parameter or more than that. There are routing protocols like RAP, SPEED and EDF which are suggested to deliver real-time service and Protocols like AFS, ReInforM and LIEMRO are suggested to improve the reliability [1].

The SPEED is QoS conscious protocol in WSN that make sure end to end QoS. Every individual hub holds the details of the surrounding hubs and "Stateless Geographic Nondeterministic Forwarding (SNGF)" is used as a routing procedure to find the path [2]. It handles selected shipping speed to all the packets. By dividing length to sink by speed an end to end delay is measured. Last Mile course of action is used to produces communication service. Congestion can be minimized using this. Yet packet miss ratio is high when network is congested [3].

MMSPEED an extension of SPEED and this protocol produces multi route and multi speed for data. The QoS prerequisites like reliability and timeliness are examined. Because of possibility multi-route packet forwarding, packet can select shipping speed. Here routing is localized which permits distinct types of packet to go through network. By doing decision at each intermediate node it achieves both QoS prerequisites examined. But it consumes lot of power in doing so. The protocol suffers from wastage of the energy and data reputation problem [4].

ReInForM, a routing algorithm which supplies wanted dependability at proportional cost. Protocol makes copies of the packet and transfers them through multiple paths [5]. Reliability is achieved by doing this. ReInForM make utilize of randomized forwarding mechanism which obtains result in load balancing. But scares resources like energy and bandwidth usage is more and the global topology of the network should be known [6].

EQSR protocol for wireless sensor networks to improve from node failure. The protocol splits the traffic and routed through node disjoint paths across the network to get an efficient load balancing. The real time and non real time queuing model is used to differentiate between real time and non-real time data traffic. "XOR-centered Forward Error Correction (FEC)" has been utilized to increase the reliability. But this protocol suffers from control overhead [7].

In [8] suggested Reliable energy aware routing in wireless sensor networks. It usually tries to minimize energy wastage. The reliability is attained by sending packets along with the multiple paths and acknowledgement. Source node initiates the routing methodology in this protocol. In the path discovery process packets are flooded by sink node [9]. The energy is reserved based on different energy requirement. It is used to reduce buffering and data loss in case of broken connection. This is not used under normal operation but used only when no path exist [10]. End to end capability is reduced to capability of single path.

In [11] suggested a localized QoS aware routing for Wireless Sensor Network. In network having distinct data traffic types, it is used to differentiating QoS essentials financial in based on the data type, which empowers to give diverse furthermore customized QoS metrics for per barter type. Among per bundle, the protocol undertakings to satisfy the compulsory information related QoS metrics during considering energy efficiency.

For the link quality estimation, the suggested method uses distributed, mind moreover computation effective devices. Multi-link single route is used in order to maximize reliability. The protocol is the initial that forces wear of the different data types whereas considering latency, reliability, remainder battery power in sensor nodes. Packet drop occurs frequently [12].

IV. DESIGN OF PROPOSED METHOD

There are various algorithms which have been suggested to direct the QoS requirements in WSN. The routing protocol can examine single QoS constraints or more. Due to the restricted bandwidth and buffer size the existing system cannot examine two primary QoS parameters delay and data integrity. In the highly congested network these requirements cannot be satisfied at the same time. Hence there is a need of new protocol which directs both these parameters and should be scalable. In [2] suggested on novel potential based routing protocol, integrity and delay differentiated routing (IDDR) to enhance fidelity for data integrity applications and to minimize end to end delay for delay-sensitive applications. The data integrity packets are cached on under loaded path which suffers from large end to end delay where as delay sensitive packets will route along the shortest path. It has following disadvantages. Energy consumption to transmit a packet is high. There can be the routing loops. Data integrity can be destroyed by internal or external attacks. To deal with the issues of existing system here IDDR routing protocol is combined with LEACH protocol and homomorphic encryption. The primary step is to create potential field by calculating the potential depth for each node. Clusters are formed by using LEACH which examines the energy and position. Based energy and potential depth value cluster head is selected for each cluster formed. Cluster head will be used to route the packets from one cluster to another until it reaches the sink node. The packets are given weight which indicates the degree of delay sensitivity. Packets with zero weights are examined as data integrity packets and they are encrypted by using homomorphic encryption technique to ensure the integrity. Packets whose weights are not zero are delay sensitive packets which should travel shortest path to avoid end to end delay. The integrity and delay differentiated routing (IDDR), potential based on routing algorithm is used to differentiate distinct packets according to their weight and route them accordingly. Energy consumption is reduced by using the leach protocol. Security is provided by encrypting packets and has acceptable above.

1) LEACH Clustering algorithm Here LEACH protocol based on current energy of the node is examined. The node with highest energy is examined as the cluster head. Cluster head uses energy more than any other non cluster node. Each cluster includes one cluster head to transmit data from neighbors to another cluster.

$$T(n) = p/1 - p * (rmod\ 1/p) * Ecur/E0 \quad (1)$$

1.) Where T (n) is the threshold, $Ecur$ represents current energy and $E0$ represents initial energy. p represents percentage of cluster head. The clustering helps to save the energy and prolongs the network lifetime.

2) Potential depth Potential depth is calculated by Euclidean distance formula for two dimensions. Since nodes are deployed in 2D the x and y co ordinates are examined. If p is examined as any node in the network and q is examined as another node, the distance between them is measured as follows.

$$d(p,q) = \sqrt{(x1 - x2)^2 + (y1 - y2)^2} \quad (2)$$

Where p($x1$, $y1$) is the position of the node and q($x2$,$y2$) is position of the sink node and d(p,q) is the distance between node p and node q.

3) IDDR algorithm Let c be the weight of the packet. The weight of the packet is represented in the packet header. Let p be the packet. Before applying IDDR algorithm clustering is done and the cluster head is selected.

Step 1: if (c! =0) // delay sensitive packet
Step 2: if (CH= mini distance && q!= full) Send packet p to next CH having minimum distance and having empty queue else
Send packet p to next CH minimum distance and pre-empt, detour other packets
Step 3: if(c==0) // data integrity packet.
Do the step 4 and step5.
Step 4: Encrypt the packet p using homomorphic encryption and Store it in the buffer
Step 5: Send the encrypted packet p to next CH having optimal distance.
Step 6: end

V. CONCLUSION

In Wireless Sensor Network (WSN) QoS aware routing is a vast area of exploration with growing set of research results. The proposed system implements a combination routing algorithm called integrity and delay differentiated routing (IDDR) and clustering protocol LEACH to improve fidelity for data integrity packets and reduce delay for delay sensitive packets. Encryption is done for the data integrity packet using homomorphic encryption technique to maintain integrity of the packet. The simulation was carried on NS-2 and the simulation results were compared with MinRoute protocol. The obtained results show that energy consumption, packet delivery ratio, packet drop and queue length are improved in proposed system. The future work can focus on improvement of the proposed system by considering different parameters like priority of packets, multiple sink etc. and still more efficient encryption algorithm can be combined.

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