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Enhanced Hybrid Services in Sensor Networks Using Routing Techniques

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Abstract: In WSN, routing protocols play an important role in network performance. This paper mainly deals with quality of service which consists of two parameters namely low delay and data integrity. These parameters are difficult to achieve simultaneously but using IDDR these can be achieved simultaneously. By constructing a virtual hybrid potential field, IDDR separates packets of applications with different QoS requirements according to the weight assigned to each packet, and routes them towards the sink through different paths to improve the data fidelity for integrity-sensitive applications as well as reduce the end-to-end delay for delay-sensitive ones. Using the Lyapunov drift technique, we prove that IDDR is stable. Simulation results demonstrate that IDDR provides data integrity and delay differentiated services.

Keywords: WSN, Data integrity, delay differentiated services, Dynamic routing

I INTRODUCTION

A WSN is composed of large number of sensor nodes which are distributed in the wireless environment. This feature allows a random distribution of the nodes in the disaster relief operations or inaccessible terrains and several other applications. The emergence of wireless sensor networks (WSN) as one of the dominant technology trends in the coming decades has posed numerous unique challenges to researchers. The sensing technology combined with processing power and wireless communication makes it lucrative for being exploited in abundance in future. Wireless Sensor Networks, 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 attention in the research community. As a part of an information infrastructure, WSNs should be able to support various applications over the same platform. Different applications might have different 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. On the other hand, some applications require most of their packets to successfully arrive at the sink irrespective of when they arrive. For example, 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, respectively. Generally, in a network with light load, both requirements can be readily satisfied. However, a heavily loaded network will suffer congestion, which increases the end-to-end delay.

This work aims 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. 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) is used.. IDDR is able to provide the following two functions.

1) Improve fidelity for high-integrity applications. The basic idea 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 first task is to find these idle and/or under loaded paths, then the second task is to cache the packets efficiently for subsequent transmission. IDDR constructs a potential field according to the depth and queue length information to find the under-utilized paths. The packets with high integrity requirement will be forwarded to the next hop with smaller queue length. A mechanism called Implicit Hop-by-Hop Rate Control is designed to make packet caching more efficient.

2) Decrease end-to-end delay for delay-sensitive applications. Each application is assigned a weight, which represents the degree of sensitivity to the delay. Through building local dynamic potential fields with different slopes according to the weight values carried by packets, IDDR allows the packets with larger weight to choose shorter paths. In addition, IDDR also employs the priority queue to further decrease the queuing delay of delay-sensitive packets.

IDDR inherently avoids the conflict between high integrity and low delay: the high-integrity packets are cached on the under loaded paths along which packets will suffer a large end-to-end delay because of more hops, and the delay-sensitive packets travel along shorter paths to approach the sink as soon as possible. Using the Lyapunov drift theory, it is proved that IDDR is stable. Furthermore, the results on a transmission graph demonstrate the efficiency and feasibility of the IDDR scheme.

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II RELATED WORK

This paper[10] proposes gradient routing with two-hop information for industrial wireless sensor networks to enhance real-time performance with energy efficiency. Two-hop information routing is adopted from the two-hop velocity-based routing, and the proposed routing algorithm is based on the number of hops to the sink instead of distance. Additionally, an acknowledgment control scheme reduces energy consumption and computational complexity. The simulation results show a reduction in end-to-end delay and enhanced energy efficiency.

In paper[13], The existing multipath routing protocols for wireless sensor networks demonstrate the efficacy of traffic distribution over multiple paths to fulfill the Quality of Service (QoS) requirements of different applications. However, the performance of these protocols is highly affected by the characteristics of the wireless channel and may be even inferior to the performance of single-path approaches. Specifically, when multiple adjacent paths are being used concurrently, the broadcast nature of wireless channels results in inter-path interference which significantly degrades end-to-end throughput. In this paper, a Low-Interference Energy-efficient Multipath Routing protocol (LIEMRO) is proposed to improve the QoS requirements of event-driven applications. In addition, in order to optimize resource utilization over the established paths, LIEMRO employs a quality-based load balancing algorithm to regulate the amount of traffic injected into the paths. The performance gain of LIEMRO compared to the ETX-based single-path routing protocol is 85%, 80%, and 25% in terms of data delivery ratio, end-to-end throughput, and network lifetime, respectively. Furthermore, the end-to-end latency is improved more than 60%.

In paper[12], The increasing demand for real-time applications in Wireless Sensor Networks (WSNs) has made the Quality of Service (QoS) based communication protocols an interesting and hot research topic. Satisfying Quality of Service (QoS) requirements (e.g. bandwidth and delay constraints) for the different QoS based applications of WSNs raises significant challenges. More precisely, the networking protocols need to cope up with energy constraints, while providing precise QoS guarantee. Therefore, enabling QoS applications in sensor networks requires energy and QoS awareness in different layers of the protocol stack. In many of these applications (such as multimedia applications, or real-time and mission critical applications), the network traffic is mixed of delay sensitive and delay tolerant traffic. Hence, QoS routing becomes an important issue. In this paper, an Energy Efficient and QoS aware multipath routing protocol (abbreviated shortly as EQSR) is proposed that maximizes the network lifetime through balancing energy consumption across multiple nodes, uses the concept of service differentiation to allow delay sensitive traffic to reach the sink node within an acceptable delay, reduces the end to end delay through spreading out the traffic across multiple paths, and increases the throughput through introducing data redundancy. EQSR uses the residual energy, node available buffer size, and Signal-to-Noise Ratio (SNR) to predict the best next hop through the paths construction phase. Based on the concept of service differentiation, EQSR protocol employs a queuing model to handle both real-time and non-real-time traffic.

By means of simulations, the performance of the routing protocol can be evaluated and compared with the MCMP (Multi-Constraint Multi-Path) routing protocol. Simulation results have shown that the protocol achieves lower average delay, more energy savings, and higher packet delivery ratio than the MCMP protocol.

In this paper, author[6] proposes a new localized quality of service (QoS) routing protocol for wireless sensor networks (WSN) is proposed in this paper. The proposed protocol targets WSN's applications having different types of data traffic. It is based on differentiating QoS requirements according to the data type, which enables to provide several and customized QoS metrics for each traffic category. With each packet, the protocol attempts to fulfill the required data-related QoS metric(s) while considering power efficiency. It is modular and uses geographical information, which eliminates the need of propagating routing information. For link quality estimation, the protocol employs distributed, memory and computation efficient mechanisms. It uses a multilink single-path approach to increase reliability. This protocol is the first that makes use of the diversity in data traffic while considering latency, reliability, residual energy in sensor nodes, and transmission power between nodes to cast QoS metrics as a multi-objective problem. The proposed protocol can operate with any medium access control (MAC) protocol, provided that it employs an acknowledgment (ACK) mechanism. Extensive simulation study with scenarios of 900 nodes shows the proposed protocol outperforms all comparable state-of-the-art QoS and localized routing protocols. Moreover, the protocol has been implemented on sensor motes and tested in a sensor network test bed.

In paper[14] Event-driven sensor networks operate under an idle or light load and then suddenly become active in response to a detected or monitored event. The transport of event impulses is likely to lead to varying degrees of congestion in the network depending on the sensing application. It is during these periods of event impulses that the likelihood of congestion is greatest and the information in transit of most importance to users. To address this challenge an energy efficient congestion control scheme for sensor networks called CODA (Congestion Detection and Avoidance) is proposed that comprises three mechanisms: (i) receiver-based congestion detection; (ii) open-loop hop-by-hop backpressure; and (iii) closed-loop multi-source regulation. The detailed design, implementation, and evaluation of CODA are presented using simulation and experimentation. Two important performance metrics (i.e., energy tax and fidelity penalty) are defined to evaluate the impact of CODA on the performance of sensing applications. The performance benefits and practical engineering challenges of implementing CODA in an experimental sensor network test bed based on Berkeley motes using CSMA

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are discussed. Simulation results indicate that CODA significantly improves the performance of data dissemination applications such as directed diffusion by mitigating hotspots, and reducing the energy tax with low fidelity penalty on sensing applications. CODA is capable of responding to a number of congestion scenarios are demonstrated that is believed will be prevalent as the deployment of these networks accelerates.

III PROPOSED METHODOLOGY

A System Architecture

Figure 1 illustrates a small part of WSN. If node1 is a hotspot there are both high- integrity packets and delay-sensitive packets from source nodes A, B, C. The standard shortest path tree (SPT) routing will forward all to node1 as shown in fig 1a.This will cause congestion and thus lead to many high integrity packet loss and large end to end delay for delay sensitive packets.

A multipath routing algorithm can utilize more paths to avoid hotspots as shown in fig 1b.But low delay and high throughput are hardly met simultaneously because of high integrity packets blocking the shortest paths and delay sensitive packets occupying the limited bandwidth and buffers.

To overcome the above drawbacks a multi-path dynamic routing algorithm called IDDR-Integrity and Delay Differentiated Routing is defined in this project which allows the delay-sensitive packets to move along the shortest path and packets packets with fidelity requirements to avoid possible dropping on the hotspots. In this way the data integrity and delay differentiated services can be provided in the same network.

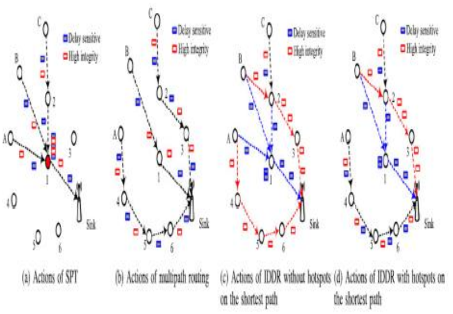

Fig 1: System Architecture

B IDDR Algorithm

Step 1: [START]

Step 2: [Node Deployment]

It is a process of placing nodes in a network.

Step 3: [Node Configuration]

It's a process in which nodes are configured in specific environmental conditions like:

- Channel
- Bandwidth Allocation
- Setting Up Paths
- Identifying Routers
- Verifying source and destination

Step 4: [DDR Protocol]

It works in 3 steps :

- Nodes are bound based on other nodes in a network.
- It uses both static and dynamic methods for finding distance from reference point.
- It selects minimum distance with hybrid services like delay and integrity.

Step 5: [Services]

1) High Integrity services
- Resource
- Discovery(memory, hardware, software),,(shortest path)
- Hop by hop rate control.

2) Delay Differentiated Services
- Transmission delay and path length
- Queuing delay
- Channel (link , path)

3) Packet Weight

Step 6: [Stop]

IV PERFORMANCE EVALUATION AND RESULTS

For comparing performance existing system and proposed system, one simulator is used. It's based on java based tool. The focus is on reducing the delay and providing high data integrity

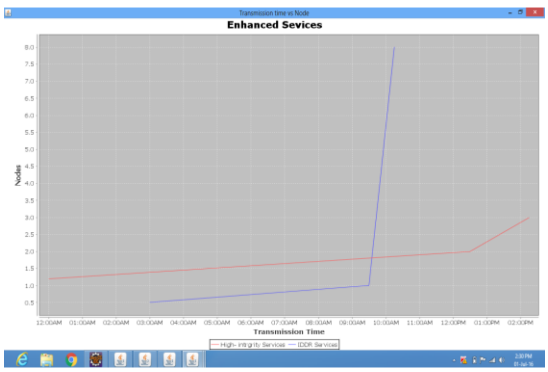

Fig 2: This shows the comparison of delay and data integrity of existing system and proposed system. In proposed system the data integrity is high and delay is low

V CONCLUSION AND FUTURE ENHANCEMENT

In this paper, a dynamic multipath routing algorithm IDDR is defined based on the concept of potential in physics to satisfy the two different QoS requirements, high data fidelity and low end-to-end delay, over the same WSN simultaneously. The IDDR algorithm is proved stable using the Lyapunov drift theory. Moreover, the result shown using display content graph and transmission graph demonstrate that IDDR can significantly improve the throughput of the high-integrity applications and decrease the end-to-end delay of delay sensitive applications through scattering different packets from different applications spatially and temporally. IDDR can also provide good scalability because only local information is required, which simplifies the implementation. In addition, IDDR has acceptable communication overhead. It may be needed to extend the present system into a both distributed and other different types of networks by including different parameters like routing techniques, any intermediate acknowledgement service to verify the services like both delay and integrity in an efficient and effective manner.

This thesis deals with deployment of integrated services, differentiated services and quality of services there by meeting the needs of routing for QoS requirements of flows better, and improved network utilization. However, some problems remain open for research. There is a need for better protocols/algorithms in the area of delay and high integrity services, duplication of data and transaction management. Better interfaces that exploit locality to shape the answers to queries.

As the study does not have dealt with network security, it can be taken up as a scope for improvement, network security issues have to be addressed. Further, the future work analyzing all the threats for our proposed system and build necessary security resources for the system to keep the data secured during the communication between the nodes by extending the preliminary work to secure the data fetched from server as well as delivered to source/service node by applying cryptography algorithms.

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