Survey on Data Routing for In-Network Aggregation: A Lightweight and Reliable Routing Approach for In-Network Aggregation in Wireless Sensor Networks

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***Abstract*— In a huge sensor network, in-network aggregation considerably reduces the amount of communication and energy consumption. Newly, the research group of people has proposed a robust aggregation structure called synopsis diffusion that unites multipath routing schemes with duplicate-insensitive algorithms to precisely compute aggregates (e.g, predicate count, sum) in spite of message losses resulting from node and transmission failures. However, this aggregation framework does not attend to the problem of false sub cumulative values contributed by compromised nodes resulting in large errors in the collective computed at the base station, which is the root node in the aggregation hierarchy, This is an important problem since sensor networks are extremely vulnerable to node compromises due to the unattached nature of sensor nodes and lack of tamper-resistant hardware. In this paper we have presented introduction about wireless sensor network, data aggregation, application of wireless network, routing protocol, aggregation network and we have also proposed data aggregation in WSN.**

Keywords-; Routing Protocol; Data Aggregation; WSN

I. INTRODUCTION

Wireless sensor network is a collection of specialized transducers with a communications infrastructure for monitoring and recording conditions at diverse locations. Commonly monitored parameters are temperature, humidity, pressure, wind direction and speed, illumination intensity, vibration intensity, sound intensity, power-line voltage, chemical concentrations, pollutant levels and vital body functions.

A sensor network consists of multipath direction stations called sensor node, each of which is small, lightweight and portable. Every sensor node is equipped with a transducer, microcomputer, transceiver and power source. The transducer generates electrical signals based on sensed physical effects and phenomena. The microcomputer processes and stores the sensor output. The transceiver receives commands from a central computer and transmits data to that computer. The power for each sensor node is derived from a battery. Potential applications of sensor networks include:

- Industrial application
- Automated and Smart Homes
- Video Surveillance
- Traffic Monitoring
- Medical Device Monitoring
- Monitoring of Weather Conditions
- Air Traffic Control
- Robot Control

In data Aggregation, value is derived from the aggregation of two or more contributing data characteristics. Aggregation can be made from different data occurrences within the same data subject, business transactions and a de normalized database and between the real world and detailed data resource design within the common data architecture. Reporting and data analysis applications that work closely to tie together company data users and data warehouses need to overcome problem on database performance. Every single day, the amount of data collected increases at exponential properties. Along with the increase, the demands for more detailed reporting and analysis tool also increases. In a competitive business environment, the areas that are given more focus to gain competitive edge over other companies include the need for timely financial reporting, real time disclosure so that the company can meet compliance regulations and accurate sales and marketing data so the company can grow a larger customer base and thus increase profitability.

Data aggregation helps company data warehouses try to piece together different kinds of data within the data warehouses so that they can have meaning that will be useful as statistical basis for company reporting and analysis.

But data aggregation, when not implemented well using good algorithm and tools can lead data reporting inaccuracy. Ineffective way of data aggregation is one of the major components that can limit performance of database queries. Statistics have shown that 90 percent of all business related reports contain aggregate information making it essential to have proactive implementation of data aggregation solutions so that the data warehouse can substantially generate data for significant performance benefits and subsequently open many opportunities for the company to have enhanced analysis and reporting capabilities.

II. SAMPLE APPLICATION FOR WSN

- Habitat and Ecosystem Monitoring
- Seismic Monitoring
- Civil Structural Health Monitoring
- Monitoring Groundwater Contamination
- Rapid Emergency Response
- Industrial Process Monitoring
- Perimeter Security and Surveillance
- Automated Building Climate Control

A. Basic component for WSN

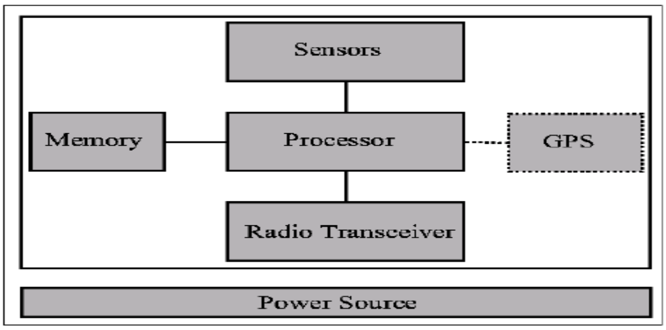

Figure.1: Component of Wireless Sensor Network

III. ROUTING PROTOCOL

A routing protocol identifies how routers communicate with each other, disseminating information which enables them to pick routes between any two nodes on a computer network. Routing algorithms decide the specific choice of route. Each router has a priori knowledge only of networks attached to it directly. A routing protocol shares this information first among instant neighbors, and knowledge of the topology of the network.

A. Types of Routing

There are two types in routing namely

- Static routing
- Dynamic routing

The router learns about remote networks from neighbor routers or from an administrator. The router then builds a routing table. If the network is directly connected then the router already knows how to get to the network. If the networks are not attached to the remote network with either static routing (administrator manually enters the routes in the router's table) or dynamically routing (happens automatically using routing protocols). The routers then update each other about all the networks they know. If a change example a router goes down, the dynamic routing protocols automatically inform all routers about the change. If static routing into routers and therefore no routing protocol is used.

Only dynamic routing uses routing protocols, which enable router to:

- Dynamically discover and maintain routes
- Calculate routes
- Distribute routing updates to other routers
- Reach agreement with other routers about the network topology

Statically programmed routers are unable to discover routes, or send routing information to other routes. They send data over routes defined by the network administrator.

IV. AGGREGATION NETWORK

Aggregation network collect traffic from distribution networks and concentrate it onto high bandwidth facilities before they terminate on core or backbone networks. Access networks tend to be specialized for reasons of cost or mobility. VDSL, FTTH and mobility (radio) distribution networks are examples. Aggregation networks terminate the various technologies onto an all IP infrastructure, usually with VLANs. As the terminus of distribution, aggregation networks also are logical points for AAA management (Authentication, Authorization and Accounting). In DSL networks Broadband Remote Access Servers (BRAS) terminate point to point Ethernet over DSL (PPoE) and work in concert with Remote Authentication Dial-up User Service (RADIUS) service for AAA validation. QoS, traffic shaping and policy management are often designed into aggregation networks as well.

Mobility aggregation networks are very complex, implementing mobility management, policy and charging, and device specific media servers and Access Point Name (APN), which identifies the type of network the device can access, and the type of service.

Voice over IP (VoIP) aggregation networks is also complex. Legacy VoIP technologies, such as MGCP, Megaco and H.323 must be converted to a common protocol set, typically SIP, to enable interworking across the range of devices and IP-PBXs. Session Border Controllers (SBCs) and back to back user-agents, or proxies populate the aggregation networks to enable interworking. Media gateways and media servers may also be distributed in the aggregation networks, or may be concentrated in data center served by the common backbone.

Aggregation networks have two general types of connection to common backbones, private and public. Private connections are used for enterprise customers or by specialized common virtual networks, such as those used for VoIP of IPTV. Public connections provide Internet services.

V. DATA AGGREGATION IN WIRELESS SENSOR NETWORK

Data aggregation is any process in which information is expressed in a summary form for purpose such as reporting or analysis. Ineffective data aggregation is currently a major component that limits query performance. And, with up to 90 percent of all reports containing aggregate information, it becomes clear why proactively implementing an aggregation solution can generate significant performance benefits, opening up the opportunity for companies to enhance their organizations analysis and reporting capabilities.

A Wireless Sensor Network (WSN) typically consists of a sink node sometimes referred to as a Base Station and a number of small wireless sensor nodes. The base station is assumed to be secure with unlimited available energy while the sensor nodes are assumed to be unsecured with limited available energy. The sensor nodes monitor a geographical area and collect sensory information. Sensory information is communicated to the Base Station through Wireless hop by hop transmissions. To conserve energy this information is aggregated at intermediate sensor nodes by applying a suitable aggregation function on the received data. Aggregation reduces the amount of network traffic which helps to reduce energy consumption on sensor nodes. It however complicates the already existing security challenges for wireless sensor networks and requires new security techniques tailored specifically for this scenario. Providing security to aggregate data in Wireless Sensor Networks is known as Secure Data Aggregation in WSN. Were the first few works discussing techniques for secure data aggregation in Wireless Sensor Networks.

Two main security challenges in secure data aggregation are confidentiality and integrity of data. While traditionally encryption is used to provide end to end confidentiality in Wireless Sensor Network(WSN), the aggregators in a secure data aggregation scenario need to decrypt the encrypted data to perform aggregation. This exposes the plaintext at the aggregators, making the aggregator can inject false data into the aggregate and make the base station accept false data. Thus, while data aggregate improves energy efficiency of a network, it complicates the existing security challenges.

VI. RELATED WORK

This section presents some of the prior research work that has been introduced for the purpose of to address the in-network data aggregation in Wireless Sensor Network.

The survey was conducted by Akyildiz et al [1] of sensor networks which has been made viable by the convergence of micro electro-mechanical systems technology, wireless communications and digital electronics. First, the sensing tasks and the potential sensor networks applications are explored, and a review of factors influencing the design of sensor networks is provided. Then, the communication architecture for sensor networks is outlined, and the algorithms and protocols developed for each layer in the literature are explored. The paper was demonstrated by Romer and Mattern [2] of this fact with regard to the design space of wireless sensor networks by considering its various dimensions. They justify their view by demonstrating that specific existing applications occupy different points in the design space.

The review was illustrated by Anastasi et al [3] a systematic and comprehensive taxonomy of the energy conservation schemes, which are subsequently discussed in depth. Special attention has been devoted to promising solutions which have not yet obtained a wide attention in the literature, such as techniques for energy efficient data acquisition. Finally they conclude the paper with insights for research directions about energy conservation in WSNs.

The paper was demonstrated by Younis et al [4] in clustering a WSN , discuss the design rationale of the different clustering approaches, and classify the proposed approaches based on their objectives and design principles. They further discuss several key issues that affect the practical deployment of clustering techniques in sensor network applications.

The paper was focused by Chatzgiannakis et al [5] a new protocol for data propagation towards a control center (.sink.) that avoids flooding by probabilistically favoring certain (.close to optimal.) data transmissions. Motivated by certain applications and also as a starting point for a rigorous analysis, they study here lattice-shaped sensor networks. They however show that this lattice shape emerges even in randomly deployed sensor networks of sufficient sensor density.

The review was conducted by Chatzigiannakis et al [6] a model for Smart Dust and three basic protocols(and their average case performance) for local detection and propagation. They plan to investigate protocols that trade-off hops efficiency and time, as well as study te fault tolerance of protocols as a function of smart dust parameters (such as density of the cloud, the energy saving characteristics, etc). The review was proposed by Nakmura et al [7] of the background necessary to answer some questions about information fusion, such as: (1) What is information fusion? (2) Why should a designer use it? (3) What are the available techniques? And (4) how should a designer use such techniques?

The paper was conducted by Hu et al [8] to use an intelligent timer and some high-level knowledge of the network to implement an efficient aggregation timing control protocol. Their protocol aims to dynamically change the data aggregation period according to the aggregation quality. The review was demonstrated by Solis and Obraczka [9] of timing in data aggregation algorithms. In-network aggregatin achieves energy-efficient data propagation by processing data as it flows from information sources to sinks. Their goal is to show that decision of when to “clock out” data as it is processed by nodes have significant performance impact in terms of data accuracy and freshness.

The review was examined by Krishnamachari et al [10] of source-destination placement and communication network density on the energy costs and delay associated with data aggregation. They show that data-centric routing offers significant performance gains across a wide range of operational scenarios. The paper was introduced by boukerche et al [11] of ad hoc routing protocols. They have divided the adhoc routing protocols into nine categories: 1) source-initiated (reactive or on-demand), 2) table-driven (pro-active), 3) hybrid, 4) location-aware (geographical), 5) multipath, 6) multicast, 7) geographical multicast, 8) hierarchical, and 9) power-aware.

The review was conducted by Al-Karaki et al [12] of the design tradeoffs between energy and communication overhead savings in every routing paradigm. They also highlight the advantages and performance issues of each routing technique. The paper was provided by Fasolo et al [13] a comprehensive review of the existing literature on techniques and protocols for in network aggregation in wireless sensor networks. They first define suitable criteria to classify existing solutions, and then describe them by separately addressing the different layers of the protocol stack while highlighting the role of a cross-layer design approach, which is likely to be needed for optional performance.

The review was explored by Intanagonwiwat et al [14] of directed diffusion for a simple remote- surveillance sensor network analytically and experimentally. Their evaluation indicates that directed diffusion can achieve significant energy savings and can outperform idealized traditional schemes (e.g., omniscient multicast) under the investigated scenarios.

The paper demonstrated by Intanagonwiwan et al [15] a novel approach that adjusts aggregation points to increase the amount of path sharing, reducing energy consumption. Their preliminary results suggest that, under investigated scenarios, greedy aggregation can achieve up to 45% energy savings over opportunistic aggregation in high-density networks without adversely impacting latency or robustness. The review was discussed by Madden et al [16] a various generic properties of aggregates, and show how those properties affect the performance of their in network approach. They include a performance study demonstrating the advantages of their approach over traditional centralized, out-of-network methods, and discuss a variety of optimizations for improving the performance and fault tolerance of the basic solution.

The paper was presented by Maden et al [17] a variety of techniques to improve the reliability and performance of their solution. They also show how grouped aggregates can be efficiently computed and offer a comparison to related systems and database projects. The survey was proposed by Fan et al [18] a techniques for data aggregation that do not use any explicit structures. Efficient aggregation requires packets to meet at the same node (spatial convergence) at the same time (temporal convergence). For spatial convergence they proposed a MAC layer any cast based approach called Data-Aware ay cast (DAA).

The paper was presented by Hill et al [19] an identity key requirements, develop a small device that is representative of the class, design a tiny event-driven operating system, and show that it provides support for efficient modularity and concurrency-intensive operation. Their operating system fits in 178 bytes of memory, propagates events in the time it takes to copy 1.25 bytes of memory, context switches in the time it takes to copy 6bytes of memory and supports two level scheduling. Hence, it can be seen that there are abundant set of research work in the past; however, majority of the research work carried out in the past are explored with significant issues in data aggregation process.

CONCLUSION

There are two most important parts, data aggregation and wireless sensor network. Wireless sensor networks are energy constrained network. Since most of the energy consumed for transmitting and receiving data, the process of data aggregation becomes an important issue and optimization is needed. Efficient data aggregations not only provide energy conservation but also remove redundancy data and hence provide useful data only.

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