A Survey on Performance Comparison of Virtual Structure based Data Dissemination Schemes in WSN

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Abstract –Wireless sensor network are highly distributed network of small, lightweight wireless node to interact with the physical world. Each node in the network is capable of sensing, processing and communicating. In the present scenario, sensor networks are used in a variety of applications such as military, commercial, industrial etc, which require constant monitoring and detection of specific event. In WSN we may exploiting mobility of sink to increase the network lifetime and balance the node energy dissipation. For efficient working of sensor network, by minimizing the route reconstruction cost and energy level, survey highlights variety of data collection and data dissemination schemes. Survey highlights many routed schemes to be named few novel routing schemes like Virtual Grid based Dynamic Route Adjustment (VGDRA), Virtual Circle Combined Straight Routing (VCCSR).But each scheme has its own advantages and disadvantages.

Index Terms - WSN, TTDD, LBDD, VGDRA, VCCSR.

1. INTRODUCTION

Wireless sensor network is a deployment of large amount of sensor nodes. . The heart of any WSN lies in the sensors. The past decade has seen rapid advancement in multiple sensing technologies such as Micro electromechanical systems (MEMS), CMOS based sensors, LED sensors etc and wireless technology [1]. This development makes sensor become a technology that is suitable for collecting contexts from real world. The node may be static or mobile which are capable of communicate with each other to collect data accurately. Each node in the network is capable of sensing, processing and communicating. The most important application of wireless sensor network is the monitoring and tracking. The application of wireless sensor network is extended to other field such as battle field, volcano monitoring, industry monitoring, traffic monitoring etc.

The main characteristics of wireless sensor networks are power consumption, ability to cope with node failures, mobility of nodes, heterogeneity of nodes, ease of use etc. The base stations are one or more components of the wireless sensor network with much more computational, energy and communication resources. They act as a gateway between senor nodes and the end user as they typically forward data from the WSN on to a server.

The two important elements in the wireless sensor network is the source and sink, in which sink may be static or mobile. Static sink does not scale network size and it will increases network congestion. These problems can be avoided by introducing mobile sink. Sensor nodes are constrained in energy and bandwidth, network lifetime is depend upon the energy efficiency.

In wireless sensor network different kinds of routing protocols exists for the purpose of data dissemination and data gathering. Mobility of sink has more advantages when compared with static sink, sink mobility improves the network connectivity as well as network life time. For mobile sink based wireless sensor network virtual infrastructure strategy are most efficient. Virtual infrastructure can achieve better scalability and energy efficiency [2]. Virtual infrastructure can be classified in to two types such as rendezvous based and backbone based. Backbone based approach is a kind of self-organizing scheme but in rendezvous structure a localized rendezvous area defined within the sensor field [2]. In the present scenario lots of rendezvous or backbone based virtual infrastructure routing schemes are available.

Virtual Grid Based Dynamic Routes Adjustment Scheme (VGDRA) and Virtual Circle Combined Straight Routing (VCCSR) are two data dissemination protocol used in a mobile sink based wireless sensor network [3]. Both the scheme consists of a structure based routing with virtual backbone. But individually each scheme has its own advantages and disadvantages.

The remaining part of this paper organized as follows: Section II describes various existing data dissemination schemes Section III presents VGDRA scheme. Section IV presents VCCSR scheme. Section V represents the performance comparison of VCCSR and VGDRA scheme. Finally, Section VI concludes the paper.

2. OVERVIEW OF DATA DISSEMINATION SCHEMES

Data dissemination is the process of broadcasting data throughout the network, is two steps process in which in first step interest of nodes is broadcasted in network and in second step nodes after receiving the request sends data having requested data. Various data dissemination schemes have been proposed over the years to reduce the energy consumption in Wireless Sensor Networks. Data dissemination protocol can be classified based on different criteria, according to the nature of the data disseminated it may be meta data dissemination and sink location dissemination [2].Data dissemination in the case of multiple sink consumes lots of energy. Energy consumption is an important constraint for efficient data delivery, virtual infrastructure based data dissemination scheme reduces the energy consumption [3].Virtual infrastructures can be divided into rendezvous-based approaches and Backbone based approaches. In rendezvous based approach each node is aware of its location through the use of Global positioning System or some virtual coordinate system [2].In backbone based approach use a self-organizing scheme to build a virtual infrastructure over the network[2].

2.1. Two tier data dissemination scheme

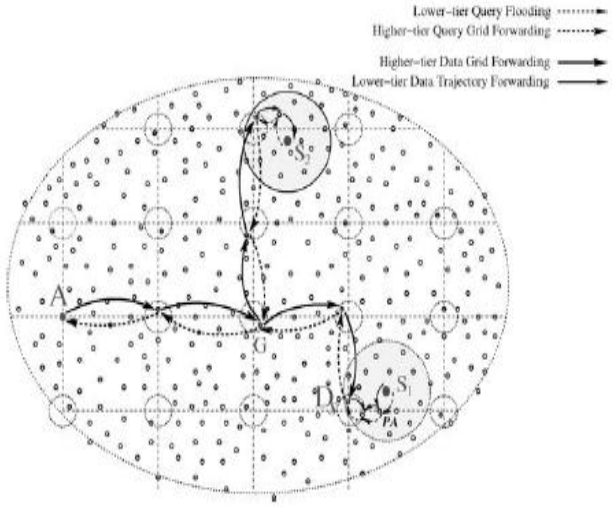

Fig 1: Two-tier query and data forwarding between source A and sink in TTDD [8]

The Two Tier Data Dissemination TTDD scheme proactively maintains a grid-based propagation structure over the whole network in spite of the actual locations of the sinks, and the structure should be updated whenever the source location changes [5].The source node selected as the start crossing point on the grid and send notification to the adjacent crossing points [5].The process is continues until the entire grid structure is formed. Queries can easily propagate throughout the grid and data reports are directly transmitted from source to sink. This scheme cannot support mobile sink and source, when the sink are mobile it limit the network lifetime [2][5]. In TTDD building of virtual grid structure support efficient data dissemination in large-scale sensor fields. TTDD can effectively deliver data from multiple sources to multiple, mobile sinks with performance comparable with that of stationary sinks [8]

2.2. Energy Efficient Data Dissemination Scheme

Energy efficient Data Dissemination EGDD scheme uses virtual grid based structure for data transmission [4].EGDD reduces energy consumption due to query flooding by multiple sinks located at different geographical locations [4].Energy aware grid based data dissemination scheme provides a shortest path between source and sink for query and data forwarding. Energy efficiency is the major concern in EGDD scheme and it is more energy efficient for multiple sink and multiple source in large wireless sensor networks [9].

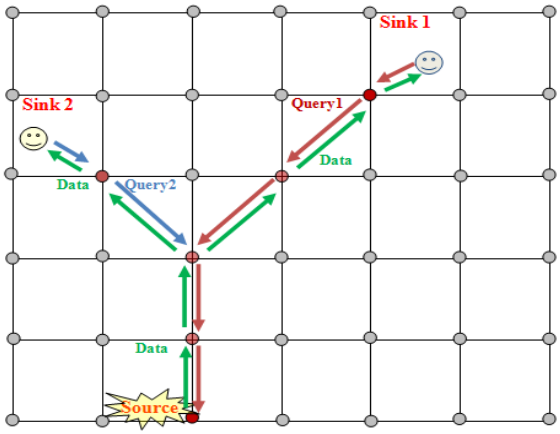

Fig 2: Query and data forwarding in EGDD [9]

Comparison	TTDD	EGDD
Grid Construction	Separate grid for each source i.e. each source starts grid construction.	Source constructs a grid only when no valid grid is present in the sensor field.
Query Forwarding	Query is forwarded along the sides of the grid-cell.	Query is forwarded diagonally in the grid-cell

Sink Mobility	Immediate dissemination nodes are selected for handling sink mobility.	The dissemination node common to the original cell and the new cell is selected as sink manager
Dissemination node failure	No dissemination node failure as separate grid is constructed by each source.	No dissemination node failure.Alternate dissemination nodes are selected in advance during the grid construction process.
Energy Efficiency	Consumes a lot of energy in separate grid construction for each source.	Energy-efficient,no dissemination node failure and saves energy in grid construction.

Table 1: Comparison of TTDD and EGDD [9]

2.3. Line based data dissemination scheme

In Line Based Data Dissemination LBDD scheme sensor field is divided in to two equal parts by using a strip [2].The node within the strip are called inline nodes and this act as an important region for data storage and forwarding. The line is placed in the centre of the sensor field so that each node can easily access it. Nodes within the boundaries of this wide line are called inline-nodes, while the other nodes are referred to as ordinary nodes. This line acts as a rendezvous region for data storage and lookup [12]

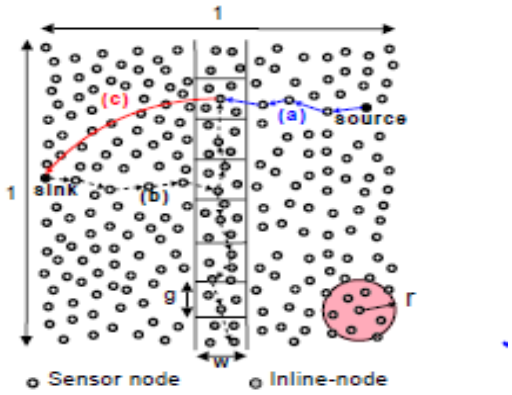

Fig 3: Virtual infrastructure of LBDD [12]

2.4. Novel Energy Aware Data Dissemination Scheme

Novel Energy Aware Data Dissemination NEADD is a novel grid-based data dissemination scheme uses virtual grid infrastructure for query and data forwarding. NEADD is an energy-efficient scheme for addressing the issues of dissemination node failure and excessive flooding of packets in WSNs [6].It is very useful for the large scale wireless sensor network with multiple mobile sinks.

3. PROPOSED SCHEMES

3.1. Virtual Grid Based Dynamic Route Adjustment Scheme

Virtual Grid based Dynamic Route Adjustment scheme [3] is novel data dissemination scheme for energy efficient data delivery in a wireless sensor network. This scheme will reduce the route reconstruction cost and improves the network life time. For a mobile sink based wireless sensor network, novel scheme will maintain the optimal route to the latest location updates. Sensor fields are divided into equal number of cells, each cell contain cell header for data transmission. The neighboring cell headers are communicates through the help of gateway nodes. The gateway nodes and cluster heads are combined to form virtual backbone structure. In dynamic network latest route update should sync with the mobile sink. For dynamic route adjustment only a set of cluster head are involved so it will reduces the network overhead. The route readjustment process is effectively done and the scheme should minimize the route reconstruction cost.

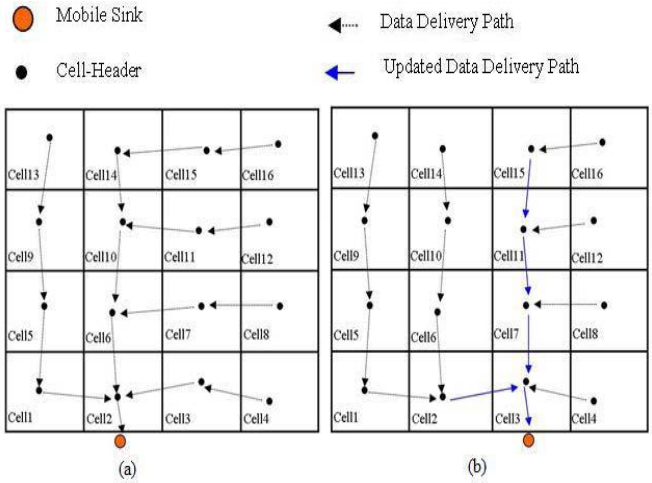

Fig 4: Route readjustment in VGDRA [3]

3.2. Virtual Circle Combined Straight Routing (vccsr) Scheme

The novel VCCSR scheme is a virtual infrastructure based data dissemination scheme used for mobile sink based wireless sensor network. The scheme is a structure based routing with virtual backbone [1].The scheme will make an efficient virtual structure to route the data effectively and leads to save energy in wireless sensor networks [1].The algorithm reduces overall maintenance cost of continues data collection for mobile sink in wireless sensor networks [1].In VCCSR, virtual structure consist of combination of virtual circles and straight lines. This makes route readjustment is easy when compared with dynamic tree adjustment scheme. Novel scheme will be decreases the energy consumption and increases the network life time [7].

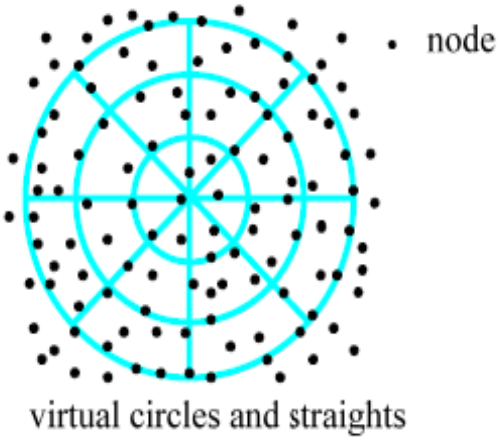

Fig 5: Virtual infrastructure of VCCSR[7][1]

4. PERFORMANCE COMPARISON OF VIRTUAL INFRASTRUCTURE SCHEME

Virtual infrastructure schemes are most efficient for data collection in large wireless sensor networks. The schemes are highly supported in the case of mobile sink based wireless sensor networks. By using virtual infrastructure schemes it reduces the dissemination cost. The novel schemes VGDRA and VCCSR both support multiple mobile sink based wireless sensor network, they differ only in the structure of virtual backbone. Based upon the virtual backbone structure it gives various performances. The schemes are compared based on the parameters such as network convergence time, route reconstruction cost, packet delivery ratio etc. At different network size virtual structure construction cost is very less in VGDRA when compared with VCCSR. In terms of rounds in the sensor field network lifetime is higher in VCCSR.

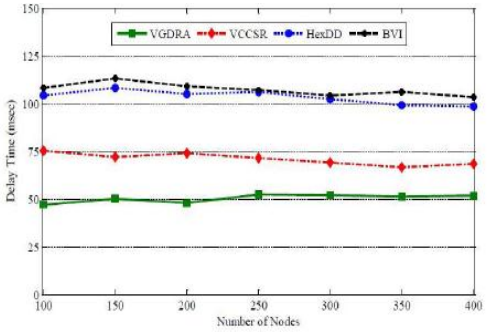

Fig 6: Network convergence time of different schemes [3]

From the figure VGDRA scheme have faster convergence time than other scheme like VCCSR. In the VGDRA scheme only a part of cell header is involved in the route readjustment process it will reduces the overall network overhead and easily adjust the route towards latest location of mobile sink.

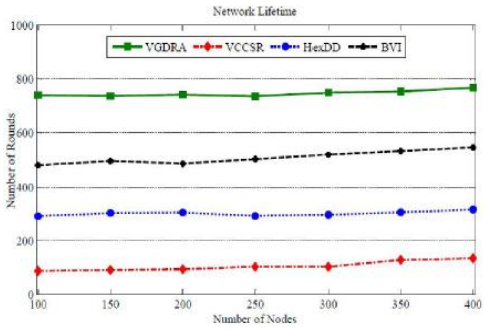

Fig 7: Compairing network lifetime in terms of number of rounds[3]

Network life time is the amount of time that a wireless sensor network would be fully operative.This matric commonly used in WSN to reflect the time span from the ntwork's initial deployment to the first loss of coverage.The data dissemination

scheme in a virtual infrasructure minimizes the maximum node is that one will ensure the maximum networklife time.

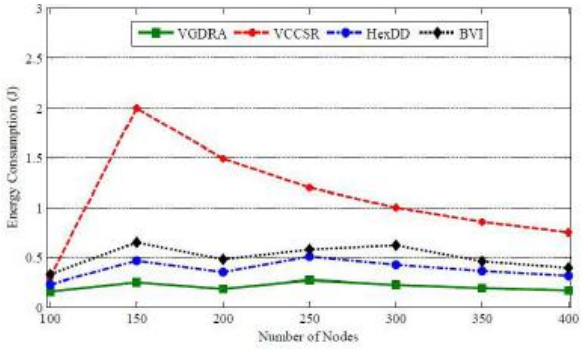

Fig 7: Comparing per round route reconstruction cost for different network sizes [3][1]

Per round route reconstruction cost determines the amount of node energy for readjusting the routes to the latest location of the mobile sink. In the case of VGDRA scheme, it wills always providing the optimal routes towards v latest location of the mobile sink. Using VGDRA scheme reduces the per round route reconstruction cost when compared with other schemes.

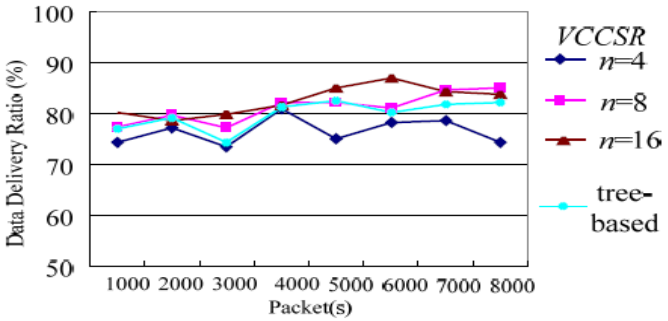

Fig 8: Comparison of Data Delivery Ratio [1]

Data delivery ratio defined as the ratio of data packets received by the destinations to those generated by the sources .VCCSR scheme provides better data delivery ratio compared with other schemes. Using VCCSR scheme it effectively collect data in wireless sensor networks.

5. CONCLUSION

This paper proposed a survey of various virtual infrastructure data dissemination schemes and out of them two novel schemes is described. Virtual infrastructure over the physical network is considered as an efficient approach. The survey study show that two novel virtual infra-structure based data dissemination schemes like Virtual Grid Based Dynamic Routes Adjustment Scheme for mobile sink based wireless sensor network and Geographic converge cast in Wireless sensor network have better performance when compared with other existing novel schemes.

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