Performance Analysis of Delay in Wireless Sensor Networks

Jayashree C. Pasalkar
pasalkarj@yahoo.com

Vivek S. Deshpande,
vsd.deshpande@gmail.com

Dattatary Waghole
dattawaghole10@gmail.com

Abstract: A transport handles the congestion and reliability. In wireless sensor network (WSN), applications require a congestion control mechanism to regulate the large amount of traffic to inject within WSN to avoid packet loss and to assurance E2E reliable packet delivery. WSN researchers thus argue the presence of a transport layer for WSN similar to the Internet. Because of the resource constraint nature of sensor devices, researchers however admit that an Internet-scale transport layer will indeed be a matter of challenge. Invented story exposes detailed analysis of the requirements and constraints of a WSN transport layer. The advancements in microprocessor technology, high speed and large memories, high speed networks, Ultra Wide Band frequency spectrums, very efficient sensor network Operating Systems and miniaturization of many heterogeneous sensor devices, to name a few, have led to the development of many transport layer protocols. This seminar addresses the unique characteristics of a WSN at transport layer, classifies the attributes that characterize different functionalities offered by a transport layer.

Keywords **— Delay, Random access network, Optimal MAC, Wireless Sensor Network, Transport layer.**

I. INTRODUCTION

A wireless sensor network is a group of nodes organized into an obliging network. Each node consists of processing capability (one or more microcontrollers, CPUs or DSP chips), it may contain multiple types of memory (program, data and flash memories), have a RF transceiver (usually with a single omni directional antenna), have a power source (e.g., batteries and solar cells), and accommodate various sensors and actuators. The nodes communicate wirelessly and often self-organize after being deployed in an ad hoc fashion.

As shown in the in the Figure 1, users can retrieve information of interest from a WSN by inserting queries and assembling results from the base stations (or sink nodes), which behave as an boundary between users and the network. In this way, WSNs can be considered as a distributed database. It is also envisioned that the sensor networks will eventually be connected to the Internet, through which global information sharing becomes realistic

Delay can take a long time for a packet to be delivered across intervening networks. In reliable protocols where a receiver acknowledges delivery of each chunk of data, it is possible to measure this as round-trip time. Due to congestion problem some time traffic will be occurs in the network. So delay will be increases and reliability of data transmission also decreases. Delay factor directly affect on network performance.

AODV facilitates dynamic, multihop routing between mobile nodes desire to establish and maintain an ad hoc network. This protocol allows mobile nodes to find routes rapidly for new destination and does not require node to maintain routes to destinations that are not in active communication. AODV allows mobile nodes to respond to link breakages and changes in network topology in a timely manner. DSR is a simple and capable routing protocol designed specifically for use in multi-hop wireless ad hoc networks of mobile nodes. DSDV broadcast every change in the network to every node. When two neighbours enter into communication range of each other, this result in a wide network broadcast. Local movements have global effects [1].

The modern networks are bi-directional, enabling them to *control* the activity of the sensors. The growth of wireless sensor networks was encouraged by military applications such as battlefield surveillance; today such networks are used in many industrial and end user applications, such as industrial process monitoring and control, machine health monitoring, and so on.

Size and cost constraints on sensor nodes result in corresponding constraints on resources such as energy, memory, computational speed and communications bandwidth. The topology of the WSNs can vary from a simple star network to an advanced multi-hop wireless mesh network. The transmission technique between the hops of the network can be routing or flooding.

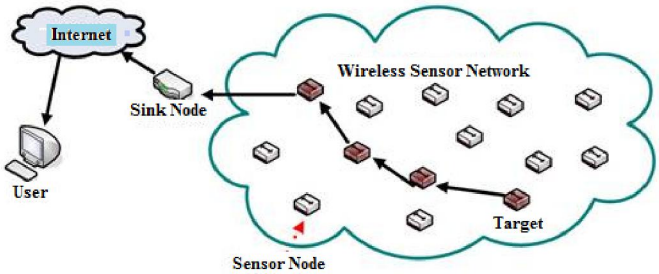

Figure 1: Accessing WSN through Internet.

WSN networks have been useful in a variety of domains such as healthcare, environmental observations, military applications, and many more. Healthcare, sensors can be used in biomedical applications to improve the quality of the provided care. In this type of applications, sensors are surrounded in the human body to observe medical problems like cancer and help patients maintain their health.

Environmental observation, sensor networks can be used to monitor environmental changes. An example could be water pollution detection in a lake that is located near a factory that uses chemical substances. Sensor nodes could be randomly deployed in unknown and hostile areas and relay the exact origin of a pollutant to a centralized authority to take appropriate measures to limit the spreading of pollution. Other examples include forest fire detection, air pollution and rainfall observation in agriculture. Military monitoring, Military uses sensor networks for battlefield surveillance; sensors could monitor vehicular traffic, track the position of the enemy or even safeguard the equipment of the side deploying sensors. Building monitoring, Sensors can also be used in large buildings or factories monitoring climate changes. Thermostats and temperature sensor nodes are deployed all over the building's area. In addition, sensors could be used to monitor vibration that could damage the structure of a building.

II. Literature Survey

As we know, a multihop random accesses network is distributed in nature, which arranges many applications on the sensor networks. To optimize the performance of network it, can apply maximization framework, but it will results algorithm into huge amount of delay. When we combine energy cost and effectiveness of rate, we can solve two problems: finest MAC with link delay constraint and optimal congestion and contention control with E2E delay restriction [2].

The basic aim of the random access network is to protect ac cess to channel in order to achieve the entire network performance. The arrival rate is a parameter which affects on the traffic at each node that should be controlled properly in order to avoid increasing queue sizes and packet delays. The speed control may be performed either at each node or only at the source of the traffic. Such parameters can affect on whole network performance including the delay, energy consumption, and transmission rates of the packets.

The main advantage of the non-iterative suboptimal algorithm is to reduce message passing. Based on the scrutiny and by essential the network usefulness as a function of rate and energy, two related problems are devising: 'optimal MAC with link delay constraint' and 'optimal contention and congestion control with end-to-end delay constraint'. Both of the problems are devised as standard convex problems.

Protocol restricted for WSNs place a high accent on energy preservation, as the nodes run on limited battery power. Data which is generated by the nodes are transmitted to the sink over a multihop wireless network. In this type of network a node may use its power for communicate with other nodes. As nodes depart its life out, the networks are responsible to get disconnected, leading to loss of reporting and connectivity [3].

One way to decide this problem is to commence mobility in the WSN. Tradition of a mobile sink is one such come up to that has been studied. The advantage of this is that it reduces the load on the "hotspot" nodes near the sink. Another approach is to use mobile data collection agents. The mobile agent called a Mobile Data Collector (MDC) that travels through entire network and collects the data from the nodes. The mobile data collector also helps in data processing, data aggregation and other functions if needed [4].

New architecture for MDC, it controls two different methods to reduce the data latency. First, gives the node locations priority, which proposes the Range Constrained Clustering (RCC) algorithm to determine a set of stop points for the mobile agents. It tries to reduce the number of stops, while guarantee that all nodes are covered. Second, it proposes the usage of long range wireless communication between the MDC and the sink/gateway to transmit the buffered data pro-actively. This is in contract with previous approaches having assumed that the MDC unload the data at the sink after a tour. We can analyse that the performance of a sensor network that utilize both these approaches using a discrete event simulation model [5].

Mobile entities are also called as MULEs which elect to choose up data from sensors in close range, buffer it and drop it at wired access points. The MDC tour is mould as a TSP and the mobile agent periodically traverses the network to collect the data and dump it on the sink. A similar architecture was proposed in, where the network is divided into clusters by a k-means clustering based mechanism and a cluster head is placed in each cluster [6].

A Multipath transmission is one of the processes for make certain QoS routing in both wires and wireless environment. WSN protocol, the working of this is to just routes the packets through a single path, which hardly meets the throughput requirement of multimedia data. It proposes a multipath algorithm based on directed transmissions that add force to multiple routes with high link quality and low latency. It maintains the merits of the original directed diffusion algorithms, including its energy efficiency and scalability [7].

Real-time multimedia data have strict QoS needs such as bandwidth, delay, jitter and loss ratio. To gathering these QoS requirements, it requires well-organized sensor network routing protocols. Multipath transport provides higher available bandwidth for a session by splitting traffic and achieving better load balancing. This technique has long been used in wired networks. Heuristics-based solutions to find the set of paths which minimizes the cost or maximizes throughput [8][9][10]. For ad hoc networks, DSR and AODV are customized to maintain multiple paths by sending back multiple REPLYs from the destination [11].

The goal of multiple disjoint paths can achieve high throughput and desirable delay and it meets the QoS

requirement of multimedia streaming. The protocol does not consume much energy or routing transparency. If more paths are found, both the throughput and delay performance can be improved even further.

III. RESULT ANALYSIS

In this simulation scenario includes 50 sensor nodes with 1 sink node. Through the network initialization, 50 nodes are formed in the distribution of 2000 *500 m^2 region. Media access control protocol is used as IEEE 802.11, size of queue is 30 packets for storage. Radio propogation model is two ray ground. Ad-hoc on demand routing protocol is used. 50 byte is a packet size. Packet generation rate is variable. Reporting rate 5 is allocate to node one hop left from sink, then 6 is allocate to two hop away node, like wise 10 is assign to node which is 6 hop away from sink.

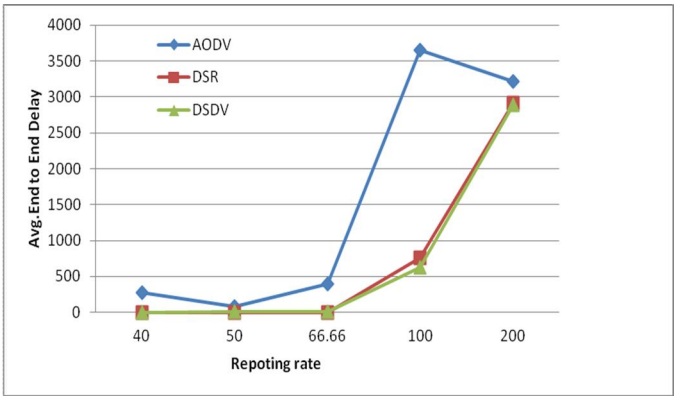

Figure 2: Average End to end delay function of reporting rate for MAC as 802.11.

Above graph shows random 802.11 Ad hoc On-Demand Distance Vector (AODV) Routing Protocol's performance analysis for reporting rate vs. average end-to end delay. As shown in the graph when reporting rate increases, there may be possibility of congestion in the network and because of that end-to-end delay may get increases.

The scenario of 50 nodes which shows that, when the no of nodes increases (consider after 50 to 70), the average end to end delay get increases drastically because in AODV when reporting rate increases end to end delay also increases. AODV, it packs and unpacks the data so it requires more processing time so that's why when no. of nodes increases, the average end to end delay also increases.

Above graph shows random 802.11 Destination-Sequenced Distance-Vector Routing (DSDV) performance analysis for reporting rate vs. average end-to end delay. As shown in the graph when reporting rate increases, there may be possibility of congestion in the network and because of that end-to-end delay may get increases.

The scenario of 50 nodes which shows that, when the no of nodes increases (consider after 90 to 100), the average end to end delay get increases significantly because in DSDV every time it add its own id in header, so packet size is also increases. When no. of nodes increases packet header size increases. And when packet size increases delay may get increases significantly.

Above graph shows random 802.11 Dynamic Source Routing (DSR) performance analysis for reporting rate vs. average end-to end delay. As shown in the graph when reporting rate increases, there may be possibility of congestion in the network and because of that end-to-end delay may get increases.

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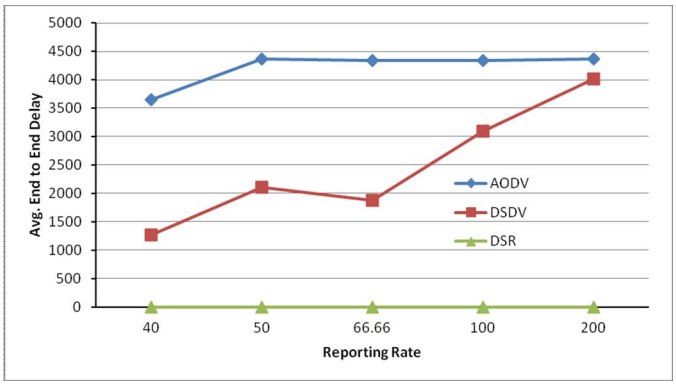

Figure 3: Average End to end delay function of reporting rate for MAC as 802.15.4.

DSR out performs fro end to need delay as compare with AODV and DSDV (Refer figure 3). As static routes are defined we get minimum delay for DSR. As reporting rate changes AODV degrades its performance for end to end delay. Every time when packet receives at the node, it checks the routing table and forwards it logically. Hence routing overheads are larger as compare to DSDV and DSR. DSDV performs midway as compare to AODV and DSR. As reporting rate increases, end to end delay also increases. This is mainly because of the packet size increases drastically as no of hop increases.

IV. CONCLUSION AND FUTURE WORK

AODV performs very poorly irrespective of MAC protocol. DSDV and DSR behaves equally for MAC 802.11. DSR outperforms for 802.15.4 and DSDV increase the end to end delay as reporting rate increase. To develop an anycast packet-forwarding scheme to reduce the event-reporting delay and to extend the lifetime of wireless sensor networks employing asynchronous sleep-wake scheduling. A new stop point computation and tour planning algorithm based on clustering

and a new wireless communication based data collection mechanism reduces the delay which required for communication in the wireless sensor network.

Enhanced work will be achieving in bounded delay delivery with light weight protocol.
Aim to develop wireless multi-media protocols that will perform well in networks with congestion. And we will focus on developing wireless multi-media protocols that will well in networks with congestion.

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