Best Parameter for Congestion Detection during Video Transmission in Wireless Sensor Networks

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Abstract- A Wireless Sensor Network (WSN) is a set of sensor nodes, whereby the nodes are equipped with multimedia devices such as cameras and microphones. Thus a WSN will have the capability to transmit multimedia data, such as still pictures, stream video, voice and monitoring data. In WSN during video transmission there is a chance of congestion occurrence. Congestion may cause multiple packet losses, which leads to the reduced quality of service (QoS) and waste of energy and increased delay. So it is very important to detect the congestion at once it occurs. So far many parameters are proposed for detecting the video congestion. In this paper we use dual queue scheduler algorithm for detecting congestion and finding the best parameter for video congestion detection. By comparing we conclude that AVERAGE DELAY is best parameter for detecting video congestion.

Keywords – Wireless Sensor Network, Congestion Control, Video Transmission

I. Introduction

A wireless sensor network is a collection of nodes organized into a cooperative network . Each node consists of processing capability (one or more microcontrollers, CPUs or DSP chips), 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 adhoc fashion.

Over the last few years, WSNs are being developed towards a large number of multimedia streaming applications, e.g., video surveillance, traffic control systems, health monitoring, and industrial process control. However, WSNs face important limitations in terms of energy and congestion occurrence in case of video transmission.Congestion occurs when the traffic load injected into the network exceeds available capacity at any point of the network. In wireless networks, packet losses can take place when more than one node is trying to access the channel simultaneously. The problem of buffer overflows is considered to be more critical in WSNs due to buffer size limitation. As a node waits for the channel, additional traffic may arrive filling up its buffer and further increasing packet delays.

Congestion may cause multiple packet losses, low link utilization (throughput reduction), increase of queuing delays, leading to the deterioration of the offered quality of service (QoS). Increasingly, congestion in WSNs is responsible for energy waste, decrease of network lifetime and even for the decomposition of network topology in multiple components energy waste, decrease of network lifetime and even for the decomposition of network topology in multiple components.Once congestion occurs, it should be detected in a timely way by the combination of buffer occupancy and channel utilization. The parameters for detecting video congestion so far proposed are Inter arrival time of packet, Average delay, Queue length, Retransmission time, Energy variance.

In this paper we compare various video congestion detection parameters. The metrics of comparison are speed, quality of video, and cost in terms of energy consumption.

II. PROPOSED ALGORITHM

A. DETECTING CONGESTION USING DUAL QUEUE SCHEDULER

A node in WSNs can act both as a source and forwarder. When the node act as a source it generates its own data called locally generated data. When the node acts as a forwarder it contains the data that is to be transmitted to other nodes. The data at any source node can be differentiated in to transmit data, which it receives from a downstream node and generated data, which is its own sensed data. In order to avoid congestion a flexible queue scheduler algorithm is used at the interface of client and server (interface may be a router or a node). It is implemented as a queue which contains the transit data coming from various nodes. A separate queue is used for the buffering of the generated data; the node generates the sensed data at a constant rate. Both queues are of the same length as shown in Fig 1.

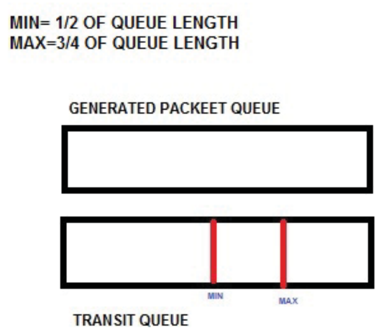

Fig 1. Dual Queue Scheduler

When the buffer size of the transit queue exceeds the minimum threshold value the nodes stops sending generating data to the generated queue. When the buffer size of the transit queue exceeds the maximum threshold value the node drops the packet send from other nodes. The dual queue scheduler algorithm is as follows.

Input: TP-> transit data packets
GP-> node generated packets

Variables: Qg =Queue for generated packets
Qt=Queue for transit packets
Qmin=minimum threshold of Qt
Qmax=maximum threshold of Qt
L=current length of Qt
Pin=incoming packet

Pseudo Code:

```
If (L < Qmin)
{
        Queue in Qg;
        Queue in Qt;
```

```
}
Else if (L > Qmin)
{
If (L < Qmax)
        {
        Node stops generating the packets
        }
Else
        {
        Discard the packet. Retransmit the packet
        after a   certain interval.
        }
}
```

B. PARAMETERS TO BE COMPARED AND THEIR EVALUATION

In this paper we compare inter packet arrival time, queue length; average delay to show that average delay is the best parameter to detect congestion in video transmission.

b.1 Inter Packet Arrival Time.

The inter packet arrival time is how much time elapses from when the last bit of the first packet arrives until the last bit of the second packet arrives. Let us assume that server sends data to the client as packets. Then the inter packet arrival time of the client is calculated as follows.

$$\text{Inter Packet Arrival Time} = L/R_s$$

Where, L= size of the packets in bits

R_s=rate of transmission in bits/sec.

b.2 Queue Length

The length of the queue is the buffer size allocated to each node in the network. Queue can store data that are generated by the node and also the data from the other nodes. Buffer size depends on the capacity of the node.

b.3 Average Delay

In a packet-switched network, the average delay is the sum of the delays encountered by a packet between the time of insertion into the network and the time of delivery to the addressee. This term is most often used in reference to routers. When packets arrive at a router, they have to be processed and transmitted. A router can only process one packet at a time. If packets arrive faster than the router can process them the router puts them into the queue (also called the buffer) until it can get around to transmitting them. Delay can also vary from packet to packet so averages and statistics are usually generated when measuring and evaluating queuing delay. Suppose all packets are L bits, the transmission rate is R bps, and that N packets simultaneously arrive at the buffer every LN/R seconds.

The average delay is given by the formulae.

$$L/R + 2L/R + ... + (n - 1) L/R = L (n - 1)/2R.$$

C. COMPARISON OF THE PARAMETERS

There are various metrics used for the comparison of above parameters. The metrics used for the comparison in this paper are

- Cost of Congestion detection.
- Quality of video received
- Parameters Locality
- Congestion Misdetection

c.1 Cost of Congestion detection

One of the comparison metrics in congestion detection is the cost. Some methods have overhead cost. Method with lower cost is most convenient in sensor networks.

- The parameters that are involved in nodes such as queue length have more processing overhead because of large amount of load on intermediate nodes.
- Calculating inter packet arrival time of dropped packets includes not only retransmission request but also transmission of dropped packet. These methods waste a great amount of energy.

c.2 Quality of video received

The parameters such as queue length, service time of packets or inter-arrival time of packets are indirectly affect the quality of service. Reducing these parameters causes the decrease of delay and as a result enhancement of the quality of received video.

c.3 Parameters Locality

Among the parameters used for the congestion detection the parameters such as queue length detects the congestion local information that is available in the node. It detects the congestion only based on its own node queue length. But the delay parameters use the sum of delay of all nodes in the path. Needless to say those parameters that use global information are better than those using local information.

c.4 Congestion Misdetection:

Another criterion for congestion detection parameter assessment is that how accurately that parameter detects congestion. More the parameter detects the congestion more we use them for this task. Consider a video is transferred each format of a video file has different types of frame format and division. So dividing these video into equal frame in a network is impossible and rate of transmission is high. In order to detect congestion in this case we have to know the traffic pattern which is not possible in calculation inter arrival time of the packets. From the above scenario we conclude that inter arrival time is not best parameter for detecting congestion.

c.5 Comparison Table

METRICS OF COMPARISION	AVERAGE DELAY	QUEUE LENGTH	INTER PACKET ARRIVAL TIME
Cost	Has power overhead	Has processing overhead	Lower cost
Quality of video received	Indirectly affects	Indirectly affects	Directly affects
Parameters Locality	Calculated using local value	Calculated using local value	Calculated by considering all the nodes
Congestion misdetetion	NA	Traffic pattern is not known	Detects congestion with speed and accuracy

We use Microsoft Visual Studio 2008 and C# in our simulation. Five nodes are considered in our simulation arrangement and in that Node 5 is sink. Initially consider that node 1 sends packets of a video file with MPEG format. Average service time and queue length for node 3 is also shown in Figures 2 and 3. We assume that our network can tolerate one single burst and applications would not be affected in such a burst. But our network will not be respondent if two or more flows simultaneously go to a burst. So packets will be late in sink or will be discarded. Thus congestion will occur and we must detect it. We want to use the parameter that detects it quicker and with more probability. We start the simulation from scratch. this time both server nodes 1 and 2 are sending simultaneously and because they use the same coding format they go burst together. average delay of node 5, average service time and queue length for node 4 is depicted in figures 4 and 5. in these figures we see the change in value of parameters with the increase of a simultaneous flows and occurrence of congestion. We observe that average delay only in a single congestion case does not violate its threshold. but queue length passes its threshold only 3 times and this threshold passing for service time is only 5 times. both service time and queue length have similar change. but delay of the network in occurrence of congestion have further change and so better detects congestion in terms of both speed and accuracy.

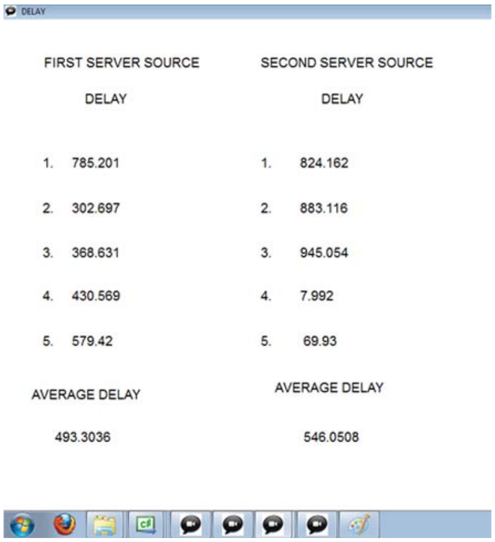

Fig 2. Average Delay of Server 1 and Server2

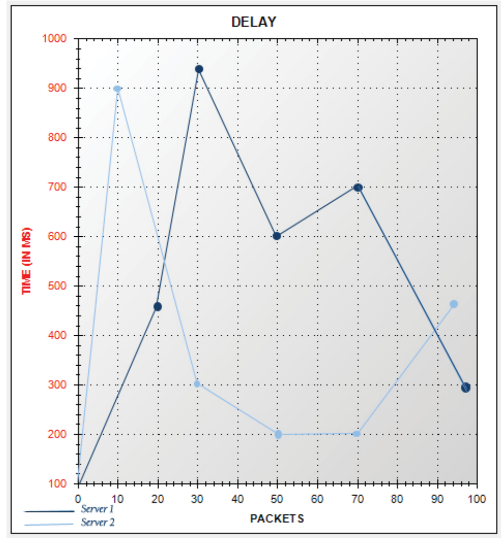

Fig 3. Average Delay Graph

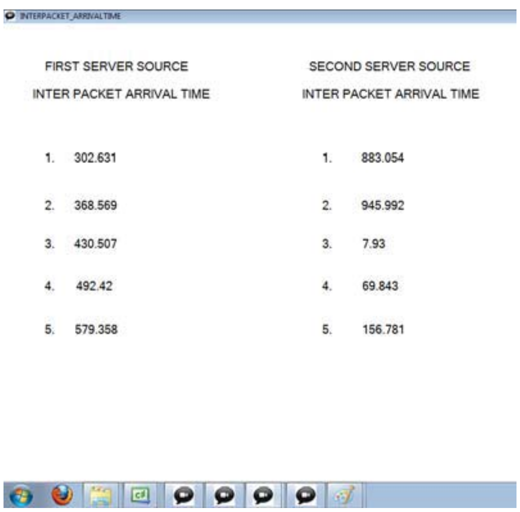

Fig 4.Interpacket Arrival Time of Server 1 and Server2

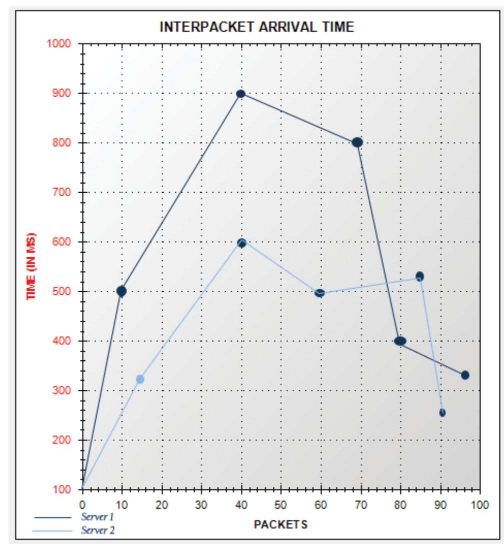

Fig 5. Inter Packet Arrival Time Graph

IV.CONCLUSION

In this paper we proceed by implementing all three parameters using Dual Queue Scheduler algorithm and compare these parameter in terms of cost, quality of video and congestion misdetection. It has lower cost for congestion detection and besides has a direct effect on quality of received video. Delay parameter not only uses local information but also it considers the whole network status. Furthermore it is accurate in congestion detection and it quickly detects congestion in network. Since average delay has advantages over the metric we compared. From the results of this comparison we conclude that Average delay is the best parameter to detect the video congestion in wireless multimedia sensor networks.

REFERENCES

[1] Hemmat Sheikhi, Mousa Dashti, Mehdi Dehghan,” Congestion Detection for Video Traffic in Wireless Sensor Networks”,IEEE 2011.

[2] C. Wang, K. Sohraby, V. Lawrence, B. Li, Y. Hu, "Priority-based congestion control in wireless sensor networks," IEEE International Conference on Sensor Networks, Ubiquitous, and Trustworthy Computing (SUTC) 2006 Karlsruhe 22-29.

[3] B. Hull, K. Jamieson, H. Balakrishnan, "Mitigating congestion in wireless sensor networks ," In Proc. of the First International Conference on Embedded Networked Sensor Systems (Sensys) 2004 Baltimore 266-279.

[4] Meera.S, R.Beulah Jayakumari, V.Jawahar Senthilkumar," Congestion Control in Wireless Sensor Networks using Prioritized Interface Queue" In Proc. International Conference on Recent Trends in Computational Methods, Communication and Controls (ICON3C 2012).

[5] P. Sankar and C. Chellamuthu, 2011. Study on the Effect of Video Traffic on Responsive Flows Using Queue Management Algorithms. *Asian Journal of Information Technology, 10: 42-46.*

[6] http:// cboard.cprogramming.com/ brief-history-cprogramming-com/ 69342-networking- queuing-delay –avg -packet-loss.html

[7] http://en.wikipedia.org/wiki/Queuing_delay

[8] http://www.chegg.com/ homework-help/ questions-and-answers /assume-know-bottleneck -link-path-server -client-link-rate-rs-bits-sec-suppose-send-pair-pac-q954568