IJCSN International Journal of Computer Science and Network, Volume 3, Issue 1, February 2014
ISSN (Online) : 2277-5420
www.IJCSN.org

Traffic Analysis Tool for Wireless Sensor Node

[1]Harish H Kenchannavar,[2]Umakant P.Kulkarni

[1] Department of Computer Science and Engineering, Gogte Institute of Technology
Belgaum, Karnataka, 590008, India

[2] Department of Computer Science and Engineering, SDM College of Engineering
Dharwad, Karnataka, India

Abstract - Simulation is playing important role in design and test concepts in wireless sensor network. There are many simulators are available in research community, but problem is many researchers face flexibility in creating traffic flow for simulation of sensor network and associated energy consumption. This tool will generate traffic with given range of inter-arrival and service time. It generates simulation table, which consists of arrival, queue status, idle time, service time, number of packets stored in queue etc… It produces average energy consumption, life-time of node, average waiting time, average time between arrival and average waiting energy. This analysis will help to study behavior of traffic flow and average energy consumption at different interval. This paper deals with designing sensor node random event, which will help in simulating different random traffic flows and analysis of effect of intermediate component queue.

Keywords - *Simulation, Wireless sensor network, Simulation table, Traffic analysis*

1. Introduction

Experimentation has been carried out using the simulation environment developed for the wireless sensor network. Different stages of this environment are modeled using the available mathematical models [2]. This includes sensor deployment, defining the attributes of sensors and simulating the proposed algorithm. Simulations have been carried out taking into consideration the different scenarios encountered during the network operation and the data has been collected. For creating simulation environment the main ingredients required are random processes [10], input parameters, events and their scheduling. The experiments are carried out using the network simulator ns2.28 [1], which is popular among the research community. The simulink model is used to simulate real time scenarios of visual sensor network. Queuing models such as M/M/1 act as inputs to the simulation environments. Energy dissipation for every event is extracted from datasheets of different motes configuration. Every simulation event has a defined energy dissipation associated with it. An event includes idle status of the sensor node, data transmission and reception taking place within the network, data processing at the nodes and at the computing station as well along with the queuing operation. Data analysis related to every issue taken up with respect to the sensor network has been carried out. Some of the methods proposed have been investigated by creating a model similar to the real existing system.

Simulation mainly has three steps

1. Determine the characteristic of each of the inputs to the simulation. Sensor node consists of arrival, service and energy dissipation events needs to be evaluated. Theses may be modeled as random processes.
2. Construct a simulation table.
3. For each repetition i, generate a value for each of the p inputs; evaluate the function and calculating a value of the response.

2. Related Work

Ns-2 is robust network simulator used for simulate wired and wireless network [1]. It consists of many features, which can be used in simulation. It has energy models defined for wireless nodes. Because of complexity of network it is difficult to analyze and draw inference from log files. Similarly, OPNET [11], Net-simulator [12] and NCTUns [13] are different simulator mainly used for wired and wireless networks.

3. Activities Consuming Energy during Data Processing in Wireless Sensor Network

In wireless sensor network, energy parameter plays a very important role in sensing, processing, transmit, and receive, transient and sensor logging [3]. Different activities consume energy based on type of activity. Network life time is calculated based energy consumption of wireless sensor node. Following are sources of energy listed below:

i. Sensor Sensing
The sensing system links the sensor node to the physical world. Sources of sensor power consumption are: signal sampling and conversion of physical signals to electrical signals, signal conditioning, and analog to digital conversion (ADC).
ii. Logging
Sensor logging consumes energy used for reading *b* bit packet data and writing it into memory.
iii. Micro-Control
The energy for processing and aggregation of the data is mainly consumed by the micro-controller.
iv. Radio transmit and Receive
Communication of neighboring sensor nodes is enabled by a sensor radio. Energy dissipation by a sensor node can be attributed to transmitting and receiving data
v. Control packet overhead
These include energy dissipation from transmitting and receiving RTS, CTS, ACK packets and retransmissions.
vi. Transient
Radio and micro-controller units (MCU) support different operating modes including active, idle and sleep. Transitions between operating modes involve significant energy dissipation.
Figure 1 shows activities consuming energy.

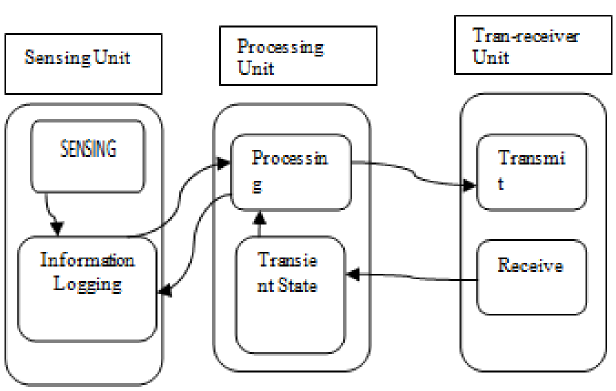

Fig. 1. Activities Consuming Energy

4. System Model for Sensor Node

We have considered a simple queue system model [10] in which packets arrive according to Poisson's model at rate λ, so the inter-arrival times are independent exponential random variable with mean 1/ λ.

4.1 Arrival Process

Typically, packets arrive to a queuing system at random times. The arrival rate for queuing system defines the stream of arrivals into a queue from some outside source. This rate is defined as an average rate which is derived from an arrival process.
The arrival pattern described in terms of the inter-arrival time. Inter-arrival time is defined as the interval between successive arrivals. i.e. defined the probability function of the inter-arrival time. A counting process A (t) is the number of arrivals that occurred by the time t.

4.2 Service Process

The service times are random because they depend on the amount of work required by each task. S (t) is the function where service time randomly generated. The service rate parameter is defined similar to arrival process. Service rate is also average rate, which defines how many packets are processed per unit time when server is busy.

4.3 Queue

It is the buffer space depending on availability of server; packet is stored in the queue and it is processed. The prime motivation for performing queuing analysis is assess local system behavior under a variety of assumption, initial condition and operational scenarios.

In sensor node, server may be the CPU, I/O channel, memory, or a communication port. Awaiting line (Queue) is a place where packets queue for service. To make queue a queuing model work, message packets requires the sort of processing provided by the server.

5. Simulation Environments

It has three different tasks. Following are components for simulation:

5.1 Generate arrival and service time

Figure2 shows graphical user interface for generating inter-arrival and service time system. This is the initial step for simulation.

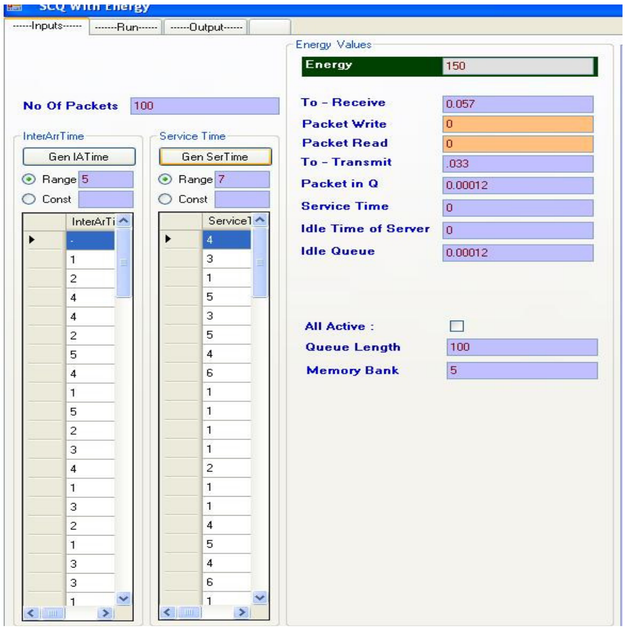

Fig. 2 Generate arrival and Service time

5.2 Simulation Sheet

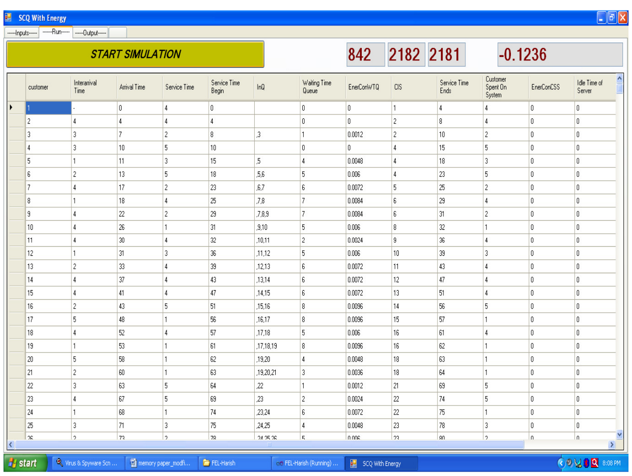

Fig. 3 Simulation sheet

Figure 3 shows simulation sheet which provides simulation scenarios for specified number of iteration. Simulation scenario consists of inter-arrival time, arrival-time, service time begins, queued packet, service time end and energy consumption for arrival, service and queue.

5.3 Results Sheet

Figure 4 provides result sheet for simulation, it consists of average waiting time, service time, waiting energy and average energy consumption.

Fig. 4. Result sheet

6. Conclusion

This traffic tool can be used to generate traffic flow with varied inter-arrival and service time as per the user requirement. Simulate the scenarios and produce performance parameters such as average energy consumption, life-time of node, average waiting time, average time between arrival and average waiting energy. These results will help researchers to analyze results and draw inferences in design of the sensor node architecture.

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Asst. Prof. Harish H. Kenchannavar received his Master's degree (M.E) from Shivaji University, Walchand College of Engineering & Tech, Sangli,Maharashtra. He has registered for Ph.D degree under Visvesvaraya Technological University, Belgaum. Research Center:- SDMCET, Dharwad, Karnataka under the guidance of Prof. Umakant P. Kulkarni. He is currently working as Assistant Professor in Computer Science Department, Gogte Institute of Technology, Belgaum, and Karnataka. He has presented and published papers at national and IEEE International conferences. His research interests include computer networking, simulation and modeling, visual sensor networks and queuing algorithms.

Prof. Umakant P. Kulkarni received his Ph.D degree from Shivaji University, Kolhapur. Research Center Walchand College of Engineering & Tech, Sangli, Maharashtra in Nov 2007. He has completed his Masters degree (M.E) from PSG, Coimbatore. He is currently working as Professor in Computer Science Department, SDMCET, Dharwad, and Karnataka. He has published and presented a number of papers in many reputed journals and International IEEE conferences as well. He also has presented technical talks and tutorials on various aspects of Mobile Agents. His research interest includes mobile-agent, computer networking, and distributed networking.