ISSN (Online) 2278-1021
ISSN (Print) 2319-5940

IJARCCE

International Journal of Advanced Research in Computer and Communication Engineering
ISO 3297:2007 Certified
Vol. 7, Issue 6, June 2018

Optimization of Data Aggregation & Transmission in Wireless Sensor Network

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Abstract: Wireless Sensor Network is one of most common adhoc network with lot of problems related to congestion and routing. This work provides one of the solutions to optimize the transmission over the network by combing multiple route data from one path. In this work focusing on optimizing over both transmission and aggregation costs has been done, also develop an online algorithm capable of dynamically adjusting the route structure when sensor nodes join or leave the network. Furthermore, by only performing such reconstructions locally and maximally preserving existing routing structure, the purposed approach is the solution to reduce the traffic over the network by collecting multiple routes data in once combined route.

Keywords: WSN, AdHoc Network, MEMS, GSM, GPRS, SGSN

INTRODUCTION

WSN

The emerging field of wireless sensor networks combines sensing, computation, and communication into a single tiny device. Wireless networks are broadly divided into infrastructure and infrastructure less network where infrastructure network consists of wireless node with a network backbone and infrastructure less network consist with distributed ,independent, dynamic topology, low-power, task –oriented wireless node .cellular wireless network falls under the category of infrastructure network whereas ad-hoc and Wireless Sensor Network (WSN) are the part of infrastructure less network In adhoc mode, the wireless devices integrated and communicated to each other by making an on-support dynamic wireless link.

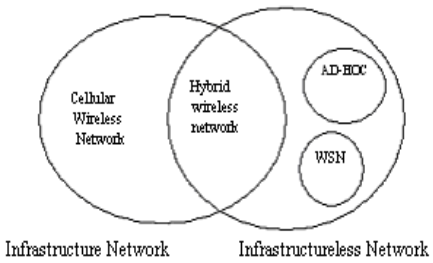

Fig1- Classification of wireless network

WSN consist with hundred/thousand wireless node distributed with geographical area; all wireless nodes collect information and supply towards central node for further processing Recent advances in micro-electro-mechanical systems (MEMS) technology, wireless communications, and digital electronics have enabled the development of low-cost, low-power, multifunctional sensor nodes that are small in size and communicate un tethered in short distances. These tiny sensor nodes, which consist of sensing, data processing, and communicating components, leverage the idea of sensor networks based on collaborative effort of a large number of nodes. Sensor networks represent a significant improvement Recent advances in micro-electro-mechanical systems (MEMS) technology, wireless communications, and digital electronics have enabled the development of low-cost, low-power, multifunctional sensor nodes that are small in size and communicate un tethered in short distances. These tiny sensor nodes, which consist of sensing, data processing, and communicating components, leverage the idea of sensor networks based on collaborative effort of a large number of nodes. Sensor networks represent a significant improvement wireless sensor networks use small, low-cost embedded devices for a wide range of applications and do not rely on any pre-existing infrastructure. The vision is that these devise will cost less than $1. Sensors can be positioned far from the actual phenomenon, i.e., something known by sense perception. In this approach, large sensors that use some complex techniques to distinguish the targets from environmental noise are required. Several sensors that perform only sensing can be deployed. The positions of the sensors and communications topology are carefully engineered. They transmit time series of the sensed phenomenon to the central nodes where computations are performed and data are fused. A sensor network is composed of a large number of sensor nodes, which are densely deployed either inside the phenomenon or very close to it.

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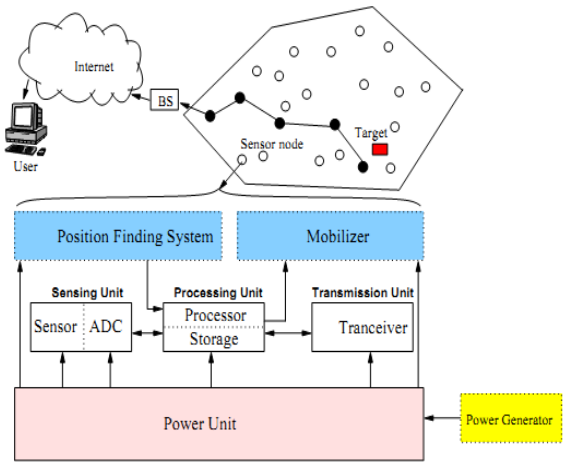

RESULTS AND CONCLUSION

Network Simulators

In simulation, we can construct a mathematical model to reproduce the characteristics of a phenomenon, system, or process often using a computer in order to information or solve problems. Nowadays, there are many network simulators that can simulate the MANET. In this section we will introduce the most commonly used simulators. We will compare their advantages and disadvantages and choose one to as platform to implement reactive/proactive protocol and conduct simulations in this thesis.

Network Simulator – NS-2

Ns-2 is a discrete event simulator targeted at networking research. It provides substantial support for simulation of TCP, routing and multicast protocols over wired and wireless networks. It consists of two simulation tools. The network simulator (ns) contains all commonly used IP protocols. The network animator (nam) is use to visualize the simulations. Ns-2 fully simulates a layered network from the physical radio transmission channel to high-level applications. Version 2 is the most recent version of ns (ns-2). The simulator was originally developed by the University of California at Berkeley and VINT project the simulator was recently extended to provide simulation support for ad hoc network by Carnegie Mellon University (CMU Monarch Project homepage, 1999). The ns-2 simulator has several features that make it suitable for our simulations.

- A network environment for ad-hoc networks,
- Wireless channel modules (e.g.802.11),
- Routing along multiple paths,
- Mobile hosts for wireless cellular networks.

Ns-2 is an object-oriented simulator written in C++ and OTcl. The simulator supports a 28 class hierarchy in C++ and a similar class hierarchy within the OTcl interpreter. There is a one-to-one correspondence between a class in the interpreted hierarchy and one in the compile hierarchy. The reason to use two different programming languages is that OTcl is suitable for the programs and configurations that demand frequent and fast change while C++ is suitable for the programs that have high demand in speed. Ns-2 is highly extensible. It not only supports most commonly used IP protocols but also allows the users to extend or implement their own protocols. It also provides powerful trace functionalities, which are very important in our project since various information need to be logged for analysis. The full source code of ns-2 can be downloaded and compiled for multiple platforms such as UNIX, Windows and Cygwin.

GlOMOSIM

GlOMOSIM is a scalable simulation environment for wired and wireless network systems. Currently it only supports protocols for a purely wireless network. It is also built in a layered approach; such as OSI layer network architecture. GlOMOSIM is designed as a set of library modules, each of which simulates a specific wireless communication protocol in the protocol stack. The library has been developed using PARSEC, a C-based parallel simulation language. New protocols and modules can be programmed and added to the library using this language. The latest version of GlOMOSIM has implemented DSR. GlOMOSIM ‘s source and binary code can be downloaded only by academic institutions for research purposes. Commercial users must use Qual Net, the commercial version of GlOMOSIM.

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OPNET Modeler

OPNET Modeler is commercial network simulation environment for network modelling and simulation. It allows the users to design and study communication networks, devices, protocols, and applications with flexibility and scalability. It simulates the network graphically and its graphical editors mirror the structure of actual networks and network components. The users can design the network model visually. The modeler uses object-oriented modelling approach. The nodes and protocols are modelled as classes with inheritance and specialization. The development language is C.

Comparison

When choosing a network simulator, we normally consider the accuracy of the simulator. Unfortunately, there is no conclusion on which of the above three simulators is the most accurate one. David Cavin et al. has conducted experiments to compare the accuracy of the simulators and it finds out that the results are barely comparable. Furthermore, it warns that no standalone simulations can fit all the needs of the wireless developers. It is more realistic to consider a hybrid approach in which only the lowest layers (MAC and physical layers) and the mobility model are simulated and all the upper layers (from transport to application layers) are executed on a dedicated host (e.g. cluster of machines). Although there is no definite conclusion about the accuracy of the three network simulators, we have to choose one of them as our simulation environment.

After comparing the three simulators, we decide to choose NS-2 as network simulator for our thesis because: -
1. Ns-2 is open source free software. It can be easily downloaded and installed.
2. Programming language C++ is compatible

Simulation Environment

Here the basic parameters of the proposed work are presented respective to the simulation environment. The system is implemented on Cygwin Environment with NS2 simulator and X Graph is used as the tool for graph analysis.

Parameter	Value
Number of Nodes	50
Topography Dimension	670 m x 670 m
Traffic Type	CBR
Radio Propagation Model	Two-Ray Ground Model
MAC Type	802.11. Mac Layer
Packet Size	512 bytes
Mobility Model	Random Way Point
Antenna Type	Omni directional
Protocol	AODV

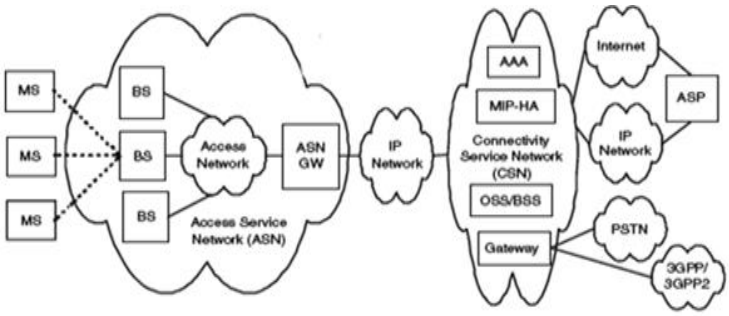

Figure: Basic Architecture

In fig, the mobile adhoc network comprising of 50 mobile nodes is constructed in the NS-2 simulator with the use of TCL script in the topological boundary area of 670 m x 670 m. The position of the mobile nodes is defined in terms of X and Y coordinates values and it is written in the movement scenario file. A NS2 application will be used to generate sample data. Care will be taken to make sure that the approach is tested for performance considerations under similar hardware and software environments. To test the performance of all of the above stated approaches, a program is written in tcl and tested in real environment. The architecture framework allows for the flexible decomposition and/or combination of functional entities when building the physical entities. For example, the ASN may be decomposed into Base Station Transceivers (BST), base station controllers (BSC), and an ASNGW analogous to the GSM model of BTS, BSC, and Serving GPRS Support Node (SGSN).

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NAM Results

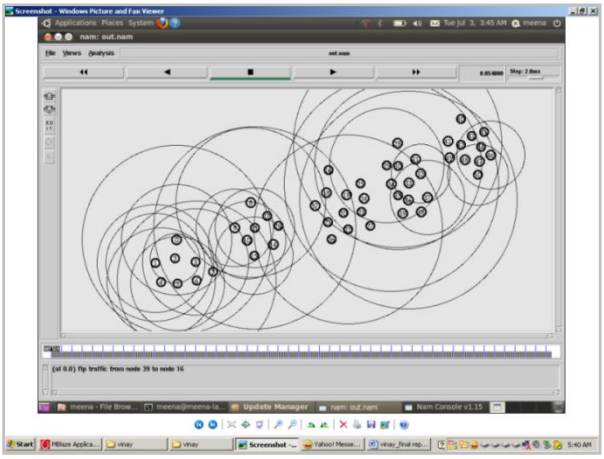
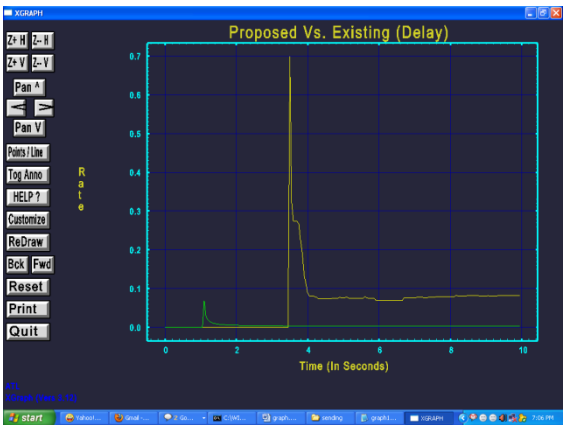


Figure: Shows the position of base station and mobile station

As in figure 5.2 show that the complete work is divided in 5 clusters. Each cluster is having n nodes. Each cluster having a base station. As the transmission each node generates a public and private key pair and share it with neighbouring nodes. The nodes start out initially at two opposite ends of the boundary. Then they move towards each other in the first half of the simulation and again move away for the second half. A TCP connection is setup between the two mobile nodes. Packets are exchanged between the nodes as they come within hearing range of one another. As they move away, packets start getting dropped.

Analysis Results



In this figure the comparison between the Existing and proposed approach is defined. The existing approach defines the system with aggregation and Proposed is the solution with authentication system. In this figure the Delay Rate is presented. As we can see the Delay Rate is decreased after the implementation of algorithm in the system

CONCLUSION

A Wireless Sensor Network (WSN) is a set of sensors that are integrated with a physical environment. These sensors are small in size, and capable of sensing physical phenomena and processing them. They communicate in a multi hop manner, due to a short radio range, to form an Ad Hoc network capable of reporting network activities to a data collection sink. Recent advances in WSNs have led to several new promising applications, including habitat monitoring, military target tracking, natural disaster relief, and health monitoring. The current version of sensor node, such as MICA2, uses a 16 bit, 8 MHz Texas Instruments MSP430 micro-controller with only 10 KB RAM, 128 KB program space, 512 KB external ash memory to store measurement data, and is powered by two AA batteries. Due to these unique specifications and a lack of tamper-resistant hardware, devising security protocols for WSNs is complex. Previous studies show that data transmission consumes much more energy than computation. Data aggregation can greatly help to reduce this consumption by eliminating redundant data. However, aggregators are under the threat of various types of attacks. Security is one of the major Concern to achieve the secure communication. This approach will combine the concept of data verification and user authentication along with data aggregation. The approach is driven to both the integrity as well as the security to transfer data

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FUTURE SCOPE

Improve the Robustness of the proposed scheme:
Proposed scheme is able to defend against the active attacks, however not included the passive attack. so it would be interesting to extend the approach to the other security attacks. then the feasibility of making the improved scheme for the WSN could be the another direction for the future research

Improve the data availability and the life time of the network:
Battery consumption poses one of the challenging issue in the wsn network designing. one solution to increase the life time is to decrease the transmission over the network with the help of data a aggregation approach. But as during the performing of the data aggregation the node will require more power than the rest of the nodes .so energy of the aggregator will deplete more rapidly than the other nodes .so it will be interesting to develop the aggregation selector and rotator mechanism that enable the load sharing.

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