Load-Balanced Opportunistic Routing for Duty-Cycled Wireless Sensor Networks

Ramaya S. Pure1 Pooja2
1Research Scholar 2M.Tech Student
1,2Department of Computer Science & Engineering
1,2GNDEC, Bidar, Karnata, India

Abstract— In duty-cycled wireless sensor networks running asynchronous MAC protocols, the time when a sender waits for its receiver to wake up and receive the packet is the major source of energy consumption. Opportunistic routing can reduce the sender wait time by allowing multiple candidate receivers, but by doing that it suffers from redundant packet forwarding due to multiple receivers waking up at the same time. Thus, the number of forwarders should be controlled in a way that overall forwarding cost is minimized considering both sender wait time and cost of redundant packet forwarding. Also, in order to prolong network lifetime, candidate forwarders should be selected so that load is balanced among nodes. We propose ORR, an opportunistic routing protocol that addresses the two issues. First, the optimal number of forwarders is calculated based on forwarding cost estimation, which is derived from duty cycle and network topology. Second, the metric used for selecting forwarders considers residual energy so that more traffic is guided through nodes with larger remaining energy. The resulting routing protocol is proven to avoid loops and shown to achieve longer network lifetime compared to other protocols regardless of duty cycle and network topology.

Key words: Opportunistic Routing, Wireless Sensor Networks

I. INTRODUCTION

Energy efficiency is one of the most important factors to consider when designing protocols for wireless sensor networks (WSNs). Energy is important not only because it can be costly to exchange batteries or add new sensor nodes in the target area, but because sometimes it is very difficult or even impossible to maintain control over the nodes, such as networks deployed deep inside ocean, near an active volcano, or a battlefield. Medium access control (MAC) and routing protocols designed for WSNs try to achieve long network lifetime while supporting application requirements. Duty-cycling is a method commonly used in WSNs to trade packet delay with network lifetime. When duty-cycling is used, nodes switch between active and sleep modes according to a predefined wake-up interval. While in sleep mode nodes cannot send or receive packets, but spend much less energy compared to the active mode [1]. When a pair of nodes want to communicate, they both have to be in the active mode. To coordinate node states, a MAC protocol can follow one of the two approaches: synchronous and asynchronous. In a synchronous MAC protocol, wake-up time of nodes is synchronized so that multiple nodes wake up at the same time. Since active period is synchronized, a sender can assume that the receiver is also active and is ready to receive a packet. Problem with synchronized protocols is that message overhead is needed in order to maintain time synchronization among nodes. Also, a mechanism such as random backoff is needed to resolve packet collisions, since multiple nodes may start transmission at the beginning of an active period. On the other hand, nodes wake up at different times in an asynchronous protocol.

So either sender or receiver needs to wait in the active mode until the counterpart wakes up, and this wait time is the major source of energy consumption in asynchronous protocols. Compared to synchronized protocols, asynchronous protocols are simple and easy to implement.

II. LITERATURE SURVEY

O.Gnanwali et al proposed a paper on “Collection tree protocol” which describes the method proposed to examine the data path and it is divided in two ways. The first way is the data path approval and second is versatile beaconing. According to the author there are two principles for wireless routing protocols [1]. These principles include data path validation and quickly identifying data traffic and fixing the routing inconsistencies. There are certain goals to inspire the necessity for data path validation and „adaptive beaconing” which are discussed below. Reliability: When a route exists in the network a protocol must supply end-to-end packet transmission. Robustness: It must yield enough capability to function without tuning else even configuring in network conditions, workloads & environmental conditions.

Suresh Nandikol and Udaya Rani Under wireless sensor network, the nodes are aligned and reconfigured according to the purpose of design and working environment; certain nodes are not successfully configured and thus termed as transfaulty [2] nodes. The mode updating the information is via single node path or via multi node path. Reliable and efficient mode of node connectivity for transfaulty detection in network data fusion is performed to get actual information from the redundant information received from the radiation-affected area.

III. SYSTEM ARCHITECTURE

This segment provides an excessive-stage review of how the capability and the duties of the device were portioned and then assigned to subgroups or the components or the modules accurately.

A. Design Considerations

The layout manner is restrained with the aid of the assumptions made previous to the development of the machine. It includes choosing the kind of approach used for the improvement of each portion of the machine with the rational for the choice of the equal.

B. Assumptions & Dependencies

Several assumptions regarding the hardware required and the operating surroundings of the system influence design
selections. The assumptions have been made after giant consultation with the cease user and are greater or much less affordable. The gadget might be applied at the Ubuntu working gadget, using C++ and TCL Script.

This design scheme is iterative and requires attention of various options at each stage.

C. Topology Design

Topology design gives the information about how the network topology is set, how to set the strength of the module, identifying the nodes, specifying the source and destination and how to start and stop the simulation.

IV. IMPLEMENTATION

Implementation phase is a process of knowing a technical specification or an algorithm as a program & it is important phase as it provides the concluding solution at the end. This phase focuses on converting the design to feasible solution with the use of programming languages. In our project two programming languages are used. Also this phase gives detailed information about the coding language and the development platform used.

A. Implementation Modules

1) Topology Module

This can also be referred as network module. It describes about the functionality of the scripts used for building network topology.

The steps involved in this module are as follows:

a) Wireless Network Topology Setup

This considers setting up of node configuration, topology creation and environmental settings.

b) Transmission Parameters Setup

This includes the parameters that are being used such as node functions, its range and channels assigned are defined.

The pseudocode for initialization of nodes randomly is as follows:

a) for i=0 to num_of_nodes

b) Initialize mobile nodes

c) Enable random motion

d) Nodes Energy.

e) Define initial node position

f) Initialize agent

g) Attach agent to node.

h) End for

The following pseudo code is to create random node position.

a) Start the process.

b) Calculate the nodes primary energy in joules.

c) Initialize i=1 and N number of nodes.

d) Calculate the amount of energy taken by node.

e) The residual energy of the node is calculated.

f) Increment the value of i once and repeat from step c.

g) End for process.

Fig. 2: Network with Node Range

Fig. 2 shows the number of nodes deployed in a network with the node range defined to each node.

Fig. 3 show the delay taken by the network to transfer data to the destination node.

Fig. 4 Shows throughput of the network when data is transferred from source node to destination node.

Fig: 3 Delay Comparison Graph
We have demonstrated on achieving increased lifetime of network, also to achieve high scalability and even very low latency for data gathering. In this system an energy efficient path is created to find the best optimal path to reach destination. The Opportunistic routes are calculated for the nodes with high residual energy to increase the network lifetime.

In future, combination of genetic and ACO algorithm can be used to find the best fit nodes which can reduce the energy consumption of the overall network and security parameters with advanced network protocols can be used to increase network security.

ACKNOWLEDGEMENT

We are indebted to the management of GNDEC, Bidar, for excellent support in completing this work at the right time. A special thanks to the authors mentioned in the references.

REFERENCES