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Minimize Energy Cost in Internet of Things Using Quadratic Algorithm

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***Abstract*: Internet of Things has become a part of normal life. An major issue in running this IoT devices is its energy cost. One of the energy saving way is to co-locate several services on one device in order to reduce the computing and communication energy. A single starting node (eg. Switch) is connected to a multiple destination nodes (eg. Home appliances). These multiple nodes are connected not only to the starting node but also it is connected among themselves.**

The packets are transferred among these nodes. Since the packet is emerged from the starting node it travels through all the nodes which are connected to the starting node. For example, if the different home appliances are connected to the single switch when the switch is on all the appliance tend to work. This produce a high energy cost. To reduce this, The problem is formulated as a quadratic programming. And this is solved using the integer programming.

***Keywords:* Service mapping; Energy optimization; Sensor selection.**

1. INTRODUCTION

The idea of **Internet of Things** (IoT) has recently brought many new and smart products to the market. Sensors and communication abilities have been installed into many traditional devices, controllers, and infrastructures so that systems can make their own smart decisions. New applications have been developed using various IoT platforms, for sensing and collecting information in order to identify our needs and comfort, and then by composing and deploying smart services to make our lives simple and safe.

One of the major issues of perpetually running IoT services on distributed system is its communication energy cost. Running more than 50 billion devices and communicating between them will needs a lot of energy.

Many researchers have proposed various sleep scheduling algorithms to keep some devices power off or running at a low-power mode. Another approach to conserve energy is to reduce network communication traffic. In this researc ,we investigate how to minimize the communication energy cost among devices.

1.1 NETWORK SIMULATOR:

Network Simulator (Version 2), widely known as NS2, is simply an event-driven simulation tool that has proved useful in studying the dynamic nature of commu- nication networks. Simulation of wired as well as wireless network functions and protocols (e.g., routing algorithms, TCP, UDP) can be done using NS2. In general, NS2 provides users with a way of specifying such network protocols and simulating their corresponding behaviors. Due to its flexibility and modular nature, NS2 has gained constant popularity in the networking research community since its birth in 1989. Ever since, several revolutions and revisions have marked the growing maturity of the tool, thanks to substantial contributions from the players in the field. Among these are the University of California and Cornell University who developed the REAL network simulator,1 the foundation on which NS is invented. Since 1995 the Defense Advanced Research Projects

Agency (DARPA) supported the development of NS through the Virtual InterNetworkTestbed (VINT) project Currently the National Science Foundation (NSF) has joined the ride in development. Last but not the least, the group of researchers and developers in the community are constantly working to keep NS2 strong and versatile. Again, the main objective of this book is to provide the readers with insights into the NS2 architecture. This chapter gives a brief introduction to NS2. NS2 Beginners are recommended to go thorough the detailed introductory online resources. For example, NS2 official website provides NS2 source code as well as detailed installation instruction.

1.2 NODE CREATION:

Node is created using TCL scripting language in feroda with the help of VMware virtualization. Multiple nodes are connected to a single switch and the packets are transferred between the nodes. And the traffic occur during the transfer of packets from starting node to the ending node is calculated in order to define the efficiency.

1.3 PACKET FLOW:

Packets are transferred between the different nodes. Different paths are choosed for the flow of the packets between the nodes and the bandwith of the node connection can be specified according to our need. Since the packets move between the different nodes it chooses different path to reach the destination. And the path with the best efficiency and less traffic is chosen in this module to calculate the efficiency.

Finally, complete content and organizational editing before formatting. Please take note of the following items when proofreading spelling and grammar.

2. RELATED WORKS

In service-oriented computing (SOA) research, QoS aware service composition and service selection are two important topics. However, most SOA research concentrates on performance and QoS issues, rather than energy cost. Moreover ,the communication overhead usually is not considered .Our research adopts the composition ideas from SOA to build IoT applications, but also takes energy consumption into consideration since IoT systems must be energy efficient in order to run constantly. In wireless sensor network research, energy efficiency has been well studied. Earlier projects have focused on minimizing energy consumption on individual sensor nodes, whereas more recent studies have suggested that the energy efficiency for the whole system is actually more important to extend network lifetime . A common technique to achieve energy efficiency is to put as many sensors in the sleep mode as possible, and keep only enough sensors in the active mode for sensing, communicating and processing .Wang et al. propose a cross-layer sleep scheduling design in a service-oriented WSN while meeting the system requirement on the number of active service nodes for each service at any time interval. Another approach to prolong then et work lifetime is energy consumption balancing. studies the uneven energy depletion phenomenon in sink-based wireless sensor networks. considers an energy efficient layout with a good coverage by using a multi-objective particles warm optimization algorithm. propose two node deployment schemes, namely, distance-based and density based ,to balance each sensor node’s energy consumption and to prolong network lifetime. In , we show how to use quadratic programming model to balance the energy usage .Nevertheless, since the quality of sensor data is an important factor on how intelligent a system can be, we also use the QoS oriented mapping .To build energy efficient IoT systems, our earlier work has proposed a simple greedy algorithm that iteratively collocates ,if possible, two connected components with the largest communication cost on the same device to reduce energy consumption. In this work, we model the problem as the Maximum Weighted Independent Set (MWIS) problem .MWIS has been used to solve many large data clustering problems. The Maximum Independent Set (MIS) problem, which is a special case of MWIS in that the weight of each vertex is 1, has been studied in using the GMAX and GMIN greedy algorithms. Extending the result, proposes several greedy algorithms, including GWMAX, GWMIN, and GWMIN2 , for MWIS. We use these algorithms to solve the service colocation problem in this paper.

3. PROPOSED SYSTEM

In this proposed system, In large IoT application scenarios like smart factory or smart building, an FBP will be mapped to devices whose communication to other devices may go through multiple hops. In this section, we present the energy model for multi-hop networks.We show how to formulate the problem as a quadratic programming problem, and how to solve it by integer programming.

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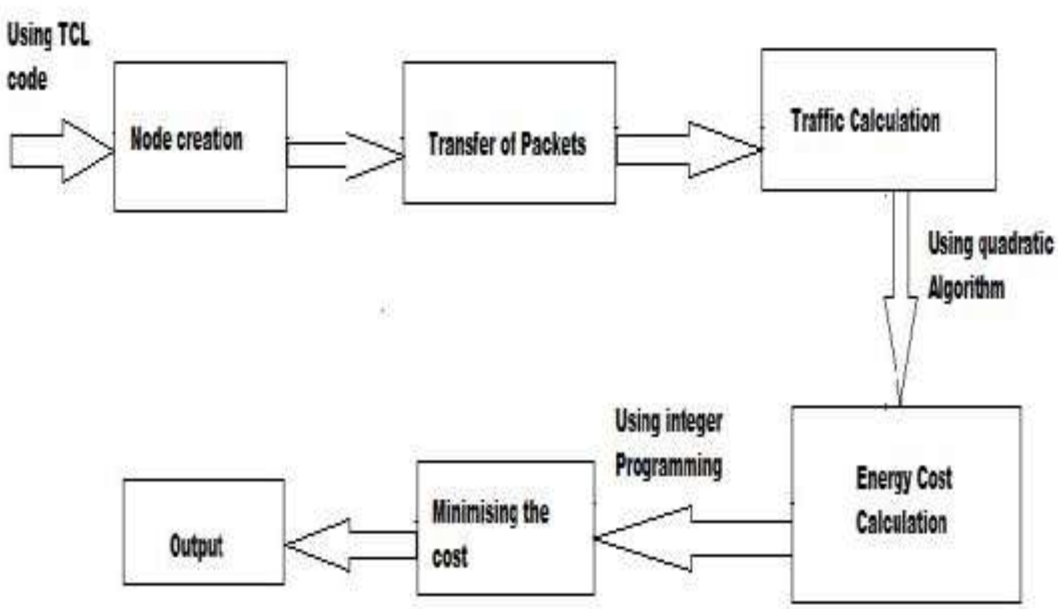
* In this paper, we consider the multi-hop network with a static routing table, in that each device always routes messages to the same destination using the same path. Usually, devices use a static path AnmAnm between any two devices DnDn and DmDm by the shortest path between them.

* Given an FBP and an IoT system, we denote the data volume of an FBP link, the routing path between two devices in the static routing table.

* In smaller scale IoT systems, devices are installed close to each other and communicate with each other in a single hop network. In this section, we study the energy parameters for such systems. We present the problem definition and the analysis on the computation complexity of the problem.

3.1 BASIC ARCHITECTURE:



4. MODULES

4.1 TOPOLOGY FORMATION:

Fixing the nodes in a network region with the help of TCL scripting language and showing the deployed nodes sensible range. The sensible range can be fixed using the default keyword “sense power value” in TCL scripting Language. The maximum sensible range for a node is 500MX500M.

Constructing the network by the nodes and share the packets between the nodes with the help of TCL scripting language. The code for creating the node is “$ns duplex_link_op”. The base station is the switch which acts as an intermediate to connect the nodes outside the network to the nodes presents inside the network. The base station will find the corresponding node to reach the destination.

4.2 MULTIPLE DESTINATIONS:

Here there will be one source node which acts as a switch and has a multiple destination which may be some electronic devices like living room, kitchen, etc. To minimize the energy cost between the source and the destination nodes we use various algorithms like quadratic programming, integer programming. In existing system, they have proposed greedy algorithm to minimize the energy cost which has a major disadvantage. That is it takes long time to compute the minimum path to reach the destination. To overcome this disadvantage we have proposed quadratic programming to formulate the problem and integer programming to solve the problem.

The integer algorithm will minimize the energy cost by rounding of the floating values which is easy to compute the energy cost

4.3 ENERGY CONSUMPTION:

After this process, a file called ENERGY.TXT will be automatically created such that we can able to see how much energy is getting drained with the help of transmission and receiving power

5. LITERATURE SURVEY

5.1 GREEN COMPUTING AND COMMUNICATIONS:

The world is seeing more sensing and actuating devices deployed in our environment as part of the global digital ecosystem. One issue for perpetually running Internet of Things (IoT) devices is the energy efficiency. Many new IoT devices are running on powerful platforms that have ample computing and memory capacities to support multiple services. One energy saving strategy is therefore to co-locate several services on one device in order to reduce the computing and communication energy cost. Our research proposes the service merging approach for mapping and co-locating many services on one device. The service co-location problem is modeled as the Maximum Weighted Independent Set (MWIS) problem. We study the algorithms to transform a service flow to a co-location graph, and then use heuristic algorithms to find the maximum independent set which will be used for the service co-location decisions. The performance of different co-location algorithms are evaluated by simulation in this study.

5.2 MIDDLEWARE FOR IOT-CLOUD INTEGRATION ACROSS APPLICATION DOMAINS:

Profile-based protocols such as Bluetooth 4.0 Low Energy (BLE) Technology have enabled very low-power devices to efficiently participate across multiple application domains in the Internet of Things (IoT). We propose a middleware layer called rimware to enable today’s profile-based IoT nodes to realize the full potential of inter-application participation. First, the nodes need to be able to establish authenticated, secure connections to the cloud through trusted gateways using an adapter structure when the smartphone or tablet is not available. Second, a knowledge base in the cloud is needed to establish mapping between profiles on the device side and application semantics on the cloud side. Results show our rimware to provide a modular, extensible structure for integration across three applications while incurring minimal code size and communication overhead on BLE devices.

5.3 CROSS-LAYER SLEEP SCHEDULING DESIGN IN SERVICE-ORIENTED WIRELESS SENSOR NETWORKS:

Service-oriented wireless sensor networks have recently been proposed to provide an integrated platform, where new applications can be rapidly developed through flexible service composition. In wireless sensor networks, sensors are periodically switched into the sleep mode for energy saving. This, however, will cause the unavailability of nodes, which, in turn, incurs disruptions to the service compositions requested by the applications. Thus, it is desirable to maintain enough active sensors in the system to provide each required service at any time in order to achieve dependable service compositions for various applications. In this paper, we study the cross-layer sleep scheduling design, which aims to prolong the network lifetime while satisfying the service availability requirement at the application layer. We formally define the problem, prove that the problem is NP-hard, and develop two approximation algorithms based on the LP relaxation and one efficient reordering heuristic algorithm. The proposed work will enhance the dependability of the service composition in service-oriented wireless sensor networks.

5.4 BUILDING ENERGY EFFICIENT INTERNET OF THINGS BY CO-LOCATING SERVICES TO MINIMIZE COMMUNICATION:

Systems built for future Internet of Things (IoT) may have a large number of intelligent objects with sensing, actuating, and computing capabilities. In a specific context, a smart application deployed in a sytem needs to meet the QoS requirement in order to provide a good experience for users. We are building the WuKong middleware which adopts the service oriented paradigm to help application developers define the logical functionalities using Flow Based Programs (FBP). WuKong then maps an FBP onto physical smart devices and actuators, and deploys the codes for executions. In this paper, we study the QoS oriented mapping algorithm for applications with a set of QoS definitions. After developers specify how each attribute contributes to the overall QoS, WuKong will find the best mapping solution according to the user QoS specification. We formalize the problem as a maximum weighted bipartite problem, and present the algorithm based on the Integer Linear Programming. We study the algorithm performance by simulation.

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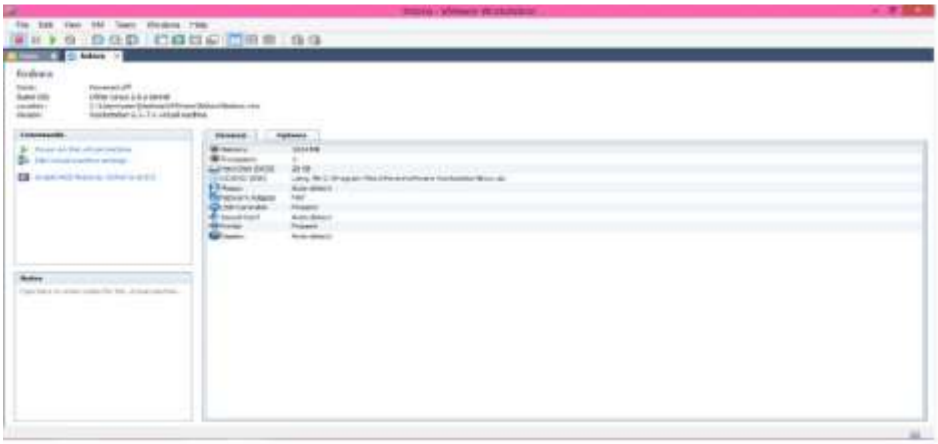
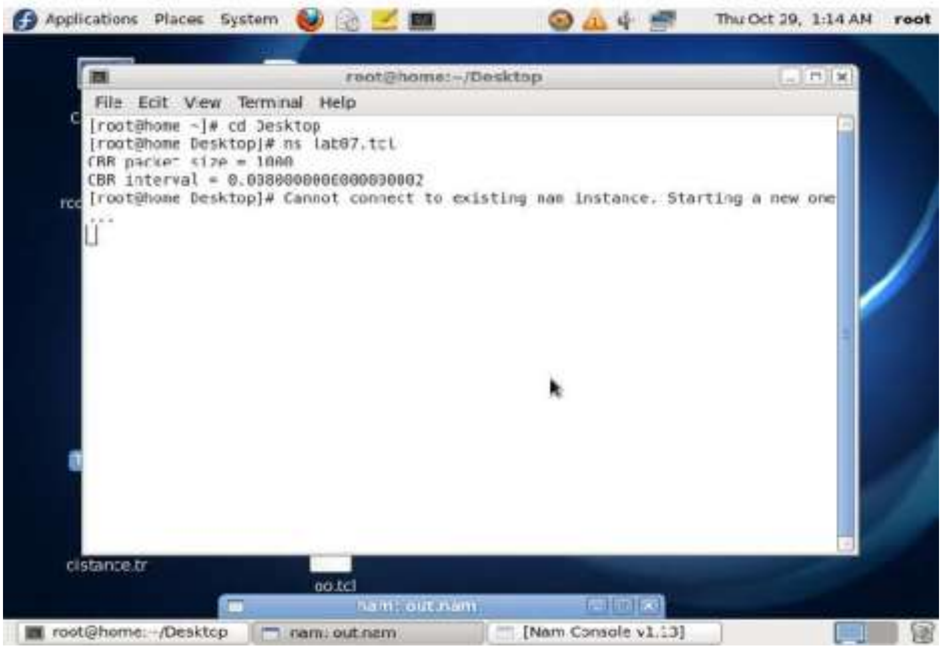
5.5 AN APPLICATION-SPECIFIC PROTOCOL ARCHITECTURE FOR WIRELESS MICROSENSOR NETWORKS:

WSNs (Wireless Sensor Networks) can collect reliable and accurate information in distant and hazardous environments, and can be used in National Defence, Military Affairs, Industrial Control, Environmental Monitor, Traffic Management, Medical Care, Smart Home, etc. The sensor whose resources are limited is cheap, and depends on battery to supply electricity, so it's important for routing to efficiently utilize its power. In this paper, an energy-efficient Single-Hop Active Clustering (SHAC) algorithm is proposed for wireless sensor networks. The core of SHAC has three parts. Firstly, a timer mechanism is introduced to select tentative cluster-heads. By analyzing relation between time of timer and residual energy, it is known that time of timer is inversely proportional to residual energy of nodes so a timer mechanism can balance the residual energy of the whole network nodes which improves the network energy efficiency. Secondly, a cost function is proposed to balance energy-efficient of each node. Finally, an active clustering algorithm is proposed for single-hop homogeneous networks. Through both theoretical analysis and numerical results, it is shown that SHAC prolongs the network lifetime significantly against the other clustering protocols such as LEACH-C and EECS. Under general instance, SHAC may prolong the lifetime by up to 50% against EECS.

6. SAMPLE RESULT

VMWARE:





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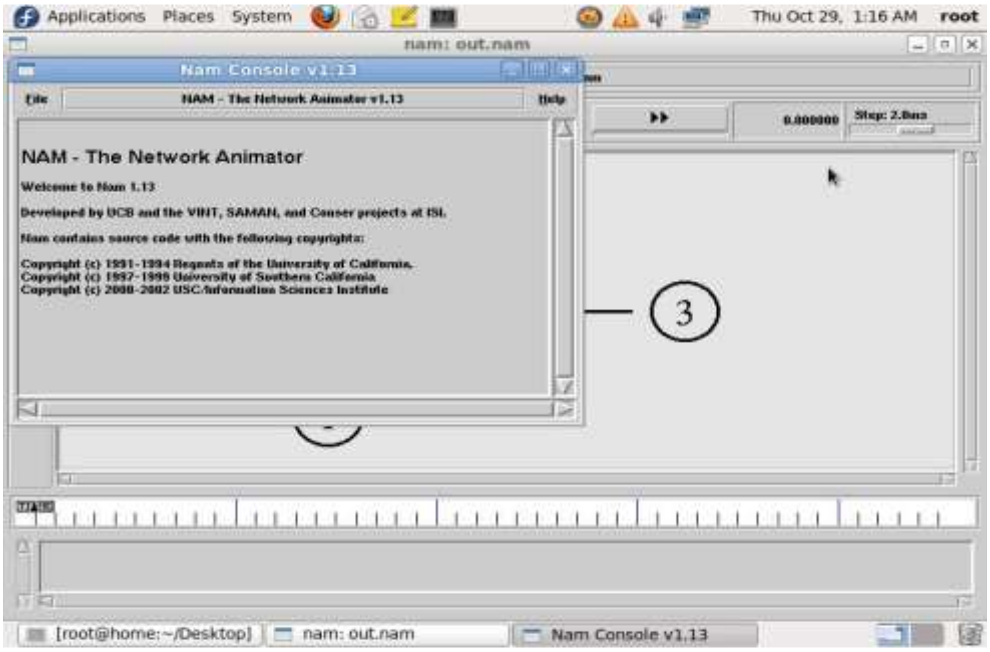

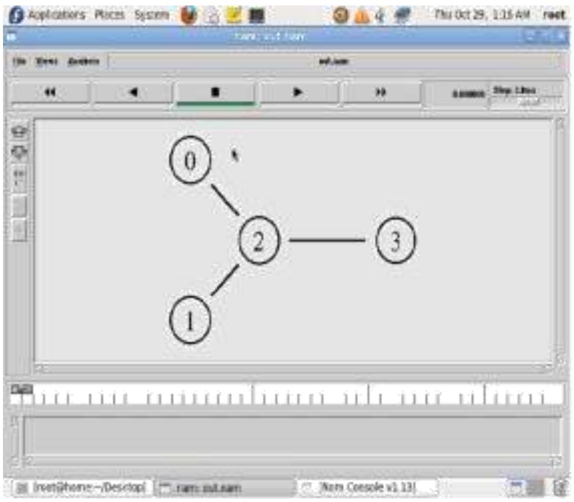

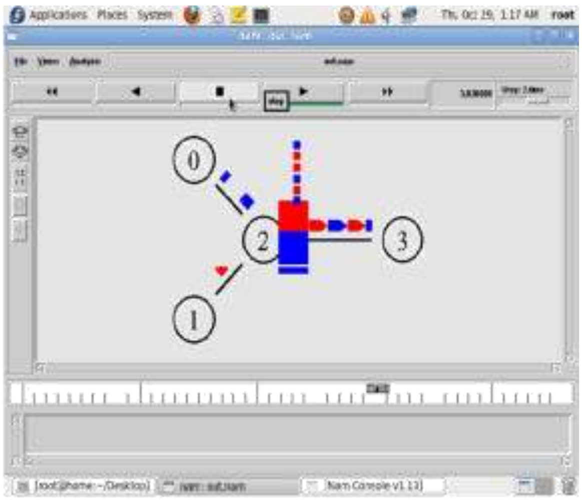

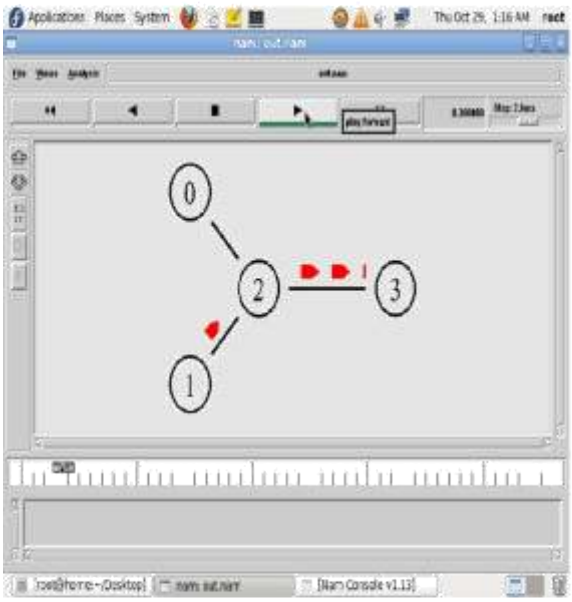

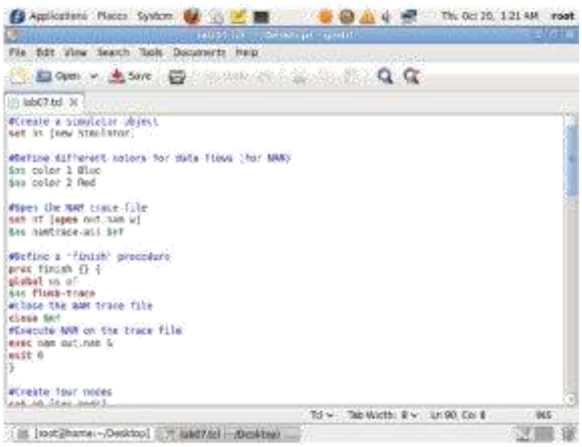

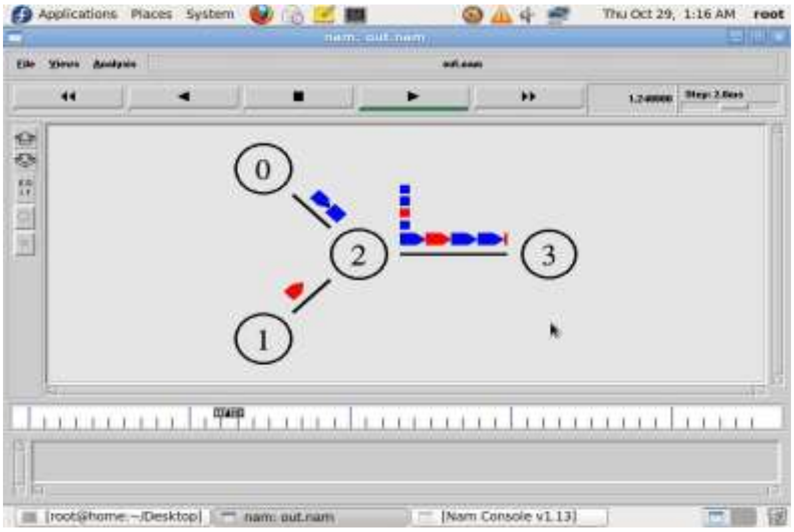

7. CONCLUSION

In above related work multiple nodes have been created and the packets are sent between different nodes and the time taken for the packets to reach the destination is calculated and the total traffic occur during the transfer is calculated. If the traffic occurs at maximum range during the transfer of the packets, the packets are discarded.

The efficiency of the packets and the time taken for the packets reach the destination through multiple nodes is calculated through which cost is being calculated and the node which occupies minimum cost is chosen.

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