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An Encoding Data Collection Based on Multi-Efficient Clustering for WSN

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ABSTRACT

In this project, the problem of cluster-based data gathering in Wireless Sensor Networks (WSNs) reduces the amount of data transmitted compared with the traditional acquisition Due to the dense nature of WSNs, reduces the amount of data transmitted compared with the traditional acquisition can be exploited to reduce the amount of data to be transmitted in the network and thus conserve energy. While much attention in recent years has been paid to analyzing and communication cluster-based WSNs from various perspectives, the problem of energy-efficient clustering of WSNs in presence of data correlation is not yet fully explored. For WSN with unevenly distributed nodes, an even clustering method based on node density is proposed, In this project, we model a single-cluster network and analytically characterize the optimal cluster data gathering methods of balanced projection nodes WSN with uniform distribution of nodes, an even clustering method where the clusters further from energy-efficient. We also propose the problem of energy-efficient clustering results confirm the effectiveness of having unevenly distributed nodes clusters in WSNs taking into account the location and density of nodes, balancing to both the network energy and prolonging the network lifetime. Other words Co-Clustering algorithm to find a solution to the problem of energy-efficient clustering. Simulation results confirm the effectiveness cluster-based WSNs from various perspectives in WSNs.

Index Terms: Cluster head, compressed sensing (CS), compressive data gathering (CDG), even clustering, random projection, sensor node, wireless sensor networks (WSN).

1. INTRODUCTION

A wireless sensor network (WSN**)** consist of partially distributed autonomous sensors and to monitor the both physical and environmental conditions, such as temperature, sound, vibration, pressure, motion or if the data passes in pollutants and to cooperatively through the network to a main location. In a modern networks are bi-directional, also enabling and to control the activity of the sensors. The WSN motivated by several application military application, industrial application and consumer application, military applications such as battlefield surveillance; Recently networks are used in many industrial application such as monitoring, control, and consumer applications.

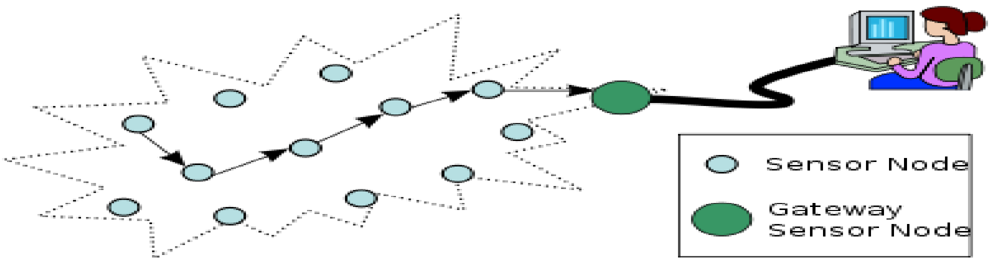

FIG 1: Typical Multi-Hop Wireless Sensor Network Architecture

The WSN is made up of "nodes" – from a few to several hundreds or even thousands, where each node is connected to one (or sometimes several) sensors. In an electronic circuit interfacing between the sensors and energy source, usually a battery or an embedded tends to the energy harvesting.

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The sensor node may vary in size both from shoebox down to the grain, although functioning "motes"(demo video) of genuine microscopic dimensions have yet to be created. The cost of sensor nodes is, ranging from hundreds of dollars to a few pennies, based on the complexity of the individual sensor nodes. Size and cost constraints from sensor nodes result is ideal to constraints on resources like energy, memory, computational speed and communications bandwidth. The topology WSNs vary different networks, from simple star network to advanced multi-hop wireless mesh network. The propagation technique introduced between the hops of the network can be routing and flooding.

If network Sensors is integrated into many parts namely structures, machinery, and the environment, If the couple is done with the efficient delivery of sensed information, it could provide tremendous benefits to the society. All Potential benefits are included: namely first is fewer catastrophic failure then second is conservation of natural resources ,third is improved manufacturing productivity, fourth is improved emergency response, finally enhanced homeland security. However, widespread use of sensors in structures and machines remain. In Bundles of lead wires and fiber optic “tails” are tends to breakage and connector failures.

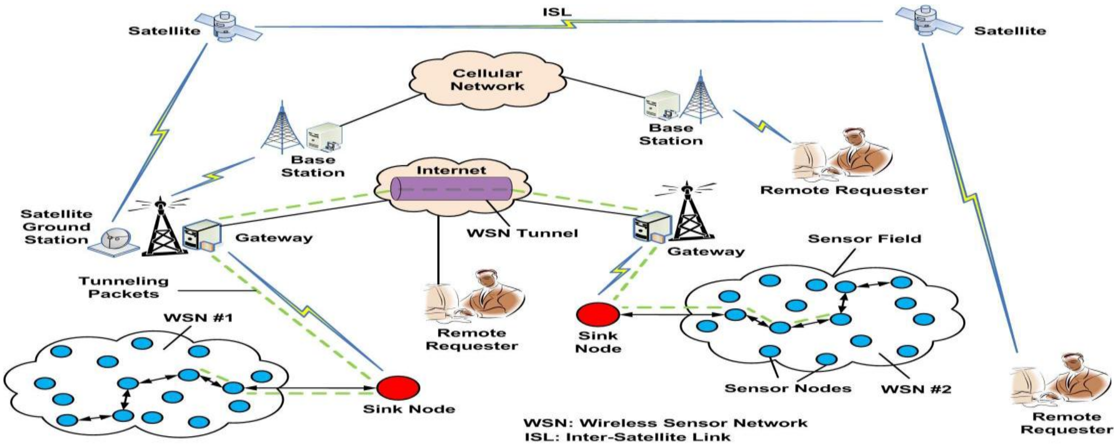

FIG 2: Wireless Sensor Network Architecture

In a Long wire bundles are denoted into a significant installation and the long term maintenance cost, as well as limiting the number of sensors that may be deployed, and therefore reducing the overall quality of the data reported. Wireless sensor networks can eliminate the costs, and easing installation and connectors would eliminate. In an ideal wireless has advance both the networked and scalable, It consumes very little power, is smart and software programmable, and capable of fast data acquisition, reliable and accurate over the long term, costs little to purchase and install, and requires no real maintenance. The sink node relays the collected data to the remote requester (user) through an arbitrary computer communication network like gateway network as well as associated communication network. If many applications need to different communication as well as network infrastructures for efficiently transfer the sensed data, WSN designers can optimize the communication architecture by determining the appropriate topology (all number of sensor and distribution of sensors consist of WSN) and communication infrastructure (e.g., gateway nodes) to meet the application’s requirements. An infrastructure-level optimization known as bridging facilitates from transfer the sensed data to remote requesters residing at different locations help of connecting the WSN to external networks(i.e) Internet, cellular, and satellite networks Selecting the both optimum sensors and wireless communications link requires knowledge of the application and problem definition. In real time Battery intimate life sensor update rates, and also size all major design considerations.

Nowadays advances sensor resulted in the ability to integrate sensors, and radio communications, and digital electronics in built a single integrated circuit (IC) package. At this capability enable the networks in very low cost sensors and able to communicate with each other by using low power wireless data routing protocols. A Wireless sensor network (WSN) can generally contains of a base station and gateway that can communicate with a number of wireless sensors via a radio link. After collecting the data it will compressed with the help of wireless sensor network after compressed the data will transmitted to the gateway directly or, if any other sensor required, at the time uses the wireless sensor nodes helps forward the data to the gateway. The transmitted data is then presented to the system by the gateway connection, on the other hand the recent development of high-performance microprocessors and novel sensing materials has stimulated great interest in the development of smart sensors – physical, chemical, or biological sensors combined with integrated circuits. It is not uncommon to place multiple sensors on a single chip, with the integrated circuitry of the chip controlling all these sensors

2. WORKING PRINCIPLE OF EXISTING SYSTEM

The random selection of projection nodes can induces the overall energy consumption of the network to be unstable and unbalanced. In this project, we existing two compressive data gathering methods of balanced projection nodes. For WSN with uniform distribution of nodes, an even clustering method based on spatial locations is existing to distribute the projection nodes evenly and balance the network energy consumption. For WSN unevenly distributed nodes, and even clustering method based on node density was existing, taking into account the location and density of nodes together, balancing the network energy and prolonging the network lifetime. The simulation results show that compared with the random projection node method and the random walk method, our proposed methods have better network connectivity and more significantly increased overall network lifetime.

DISADVANTAGES

Due to random selection of projection nodes induce the overall energy consumption Network to be unstable as well as unbalanced. The location and density of nodes together, and to maintain the balancing network

3. WORKING PRINCIPLE OF PROPOSED SYSTEM

The proposed work describes an efficient communication paradigm has been adopted in the bottleneck zone by combining duty cycle and network coding. Studies carried out to justify the upper bounds of the network lifetime based on this below consideration (i) duty cycle, (ii) network coding (iii) combinations of duty cycle and network coding. The sensor nodes in the bottleneck zone is splitted into two groups: namely simple relay sensors and network coder sensors.

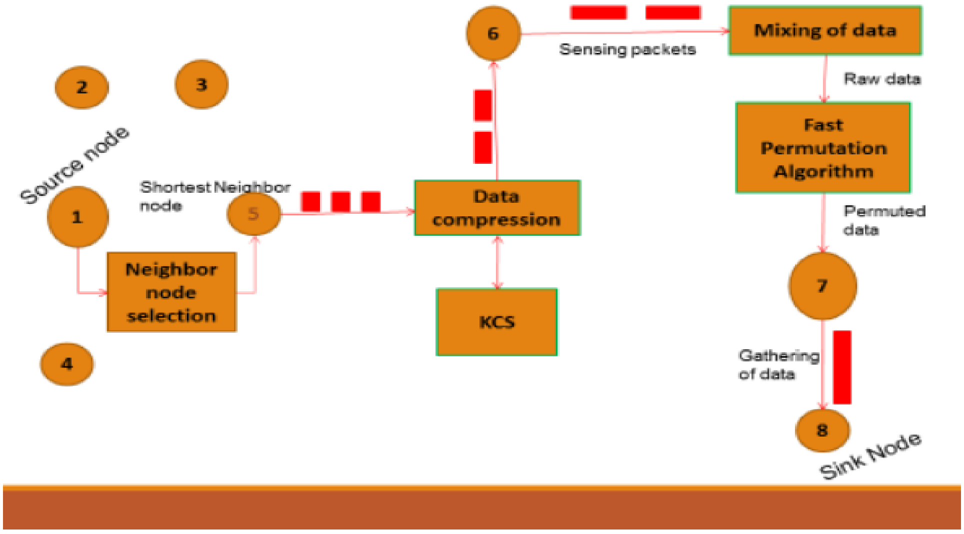

FIG 3: Block Diagram

The relay nodes is used to forward the received data, whereas, the network coder nodes is transmit by help of proposed network coding based algorithm. The Energy efficiency of the bottleneck zone is increases because of the more volume of data would be transmitted to the Sink and also the same number of transmissions. In this process improves the overall lifetime of the networks.

ADVANTAGES

The network coding technique improves the capacity of an information network with better utilization of bandwidth and the reliability of the network.

Energy savings is done at the node level based on switching between active and sleep states.
There is a reduction in energy consumption in the bottleneck zone with the proposed approach. In this turn will lead to increase the network lifetime.

4. RELATED WORKS FOR IMPLEMENTATION

In Successfully the new system and to giving the user, and to keep confidence the new system will work and to be effective. This implementation involves many stages i)careful planning,2) Mainly investigation of the existing system 3)It's constraints on implementation, mainly this method design for achieve changeover method and evolution method

4.1 MODULES

- Cluster Setup
- Calculating the End-to-End Delay
- Inter-Cluster Multi-Hop Routing Algorithm
- Network coding

A) MODULE1: CLUSTER SETUP

The algorithm begins with the neighbor discovery phase, which is initiated by the sink by broadcasting an advertisement (ADV) message to all nodes at a certain power level. Each node computes its approximate distance to the sink (dtoSink) according to the received signal strength.

Each node waits for an amount of time $\tau = 1/E$ before broadcasting an ADV(ID,E) message to its neighbors and collecting data from the neighbors, where ID is a nodal identifier and E is the nodal remaining energy. Each node compares its energy level with the energy level of the nodes from which it has received ADV messages. If a sensor node has less energy, it will cancel its timer and decide to be a cluster member (i.e., a non-cluster head).

The cluster head candidates are the set of sensor nodes that send ADV messages and then either do not receive any ADV messages or have higher energy than the energy in the ADV messages they receive. It is possible for two nodes with the same energy level to be in communication range of each other.

To address this situation, a trade-off for energy and delay (TED) is used to establish a balance between energy consumption and end-to-end delay by adjusting the value of the parameter α based on the remaining energy of the cluster head and the value of the parameter β based on distance from the cluster head to the sink. The TED is calculated for sensor i from (4) for the remaining energy of the cluster head candidates, and β is used to adjust the distance between the cluster head candidates and the sink.

In (4), Ei is the remaining energy of cluster head candidate i, Etotal is the cumulative energy of the other cluster head candidates received from ADV messages, and d (i,s) is the distance from cluster head candidate i to the sink.

Each cluster head candidate i waits for an amount of time $\omega = 1/TEDi$ before making an announcement that it is a final cluster head. All cluster head candidates that receive a final cluster head announcement cancel their TED timers to become the member nodes for the current round. After the cluster setup procedure is finished, all clusterheads broadcast time division multiple access (TDMA) message to allocate time slots to their cluster members.

B) MODULE 2: CALCULATING THE END-TO-END DELAY

The link delay D(i, j) is a measure of the delay a packet experiences when traversing a link from node i to node j. By definition, a link delay D(i, j) includes the queuing delay dQ per node, the transmission delay dT , and the propagation delay dP . In other words:

$$D(i, j) = (dQ + dT + dP) \quad (5)$$

where $dT = l/\psi$ and $dP = dij/\gamma$; l is the packet size (bits), ψ is the link bandwidth (bps), dij is the length of physical link from cluster head i to cluster head j, and γ is the propagation speed in the medium (m/s).

The value of dQ can be calculated using rules related to queue theory. The nodal queue is considered to be of type M/M/1. In this type of queue, the input is of Poisson type, the output is an exponential random variable, and the amount of service is 1. The queuing delay dQ in this queue is calculated based on the following equation:

$dQ = 1 / \mu - \lambda$ (6)

where μ is the service rate, which is an exponential stochastic variable, and λ is the rate of entry for new packets, which is a Poisson stochastic variable.

An end-to-end delay, denoted by Dete(x, s), is the time elapsed between the departure of a collected data packet from a source x and its arrival at the sink s. By definition, the end-toend delay Dete(x, s) of the route from clusterhead x to sink s is defined as:

where μ, λ, ψ, and γ are constants that are assumed to be the same for all clusterheads; l is the packet size (bits); ψ is the link bandwidth (bps); dij is the length of the physical link from clusterhead i to clusterhead j; γ is the propagation speed in the medium (m/s); and U is the set of intermediate nodes from clusterhead x to sink s.

Calculating the Link and Route Costs :

We define the following cost function for a link between clusterhead nodes i and j.

where Ei Rx, given by (1), is the energy that clusterhead i spends receiving data from members; EiFu, given by (2), is the energy that clusterhead i spends in fusing data from m members; Eij Tx, given by (3), is the energy spends transmitting data from clusterhead i to clusterhead j; and ρ is the nodal remaining energy factor.The cost(Ei Re) is cost function that takes into consideration the remaining energy of sensors for the energy balance among sensors. Therefore, the function cost(Ei Re) is based on the principle in which small changes in remaining energy of sensors can result in large changes in value of cost Exponential function f(x) = exp (1/x2) is the type of function that can satisfy this principle. Replacing x by Ei Re(the remaining energy of sensor i), we have the following cost function:

C) MODULE 3:INTER-CLUSTER MULTI-HOP ROUTING ALGORITHM

Our optimization problem is finding the lowest cost route (most energy efficient) from a cluster head node x to the sink s such that the end-to-end delay along that route does not exceed a delay constraint Δ. The constrained minimization problem is: where Rk is the kth route, R (x, s) is the set of routes from cluster head node x to the sink s for which the end-to-end delay is bounded by Δ, given by:

By considering the optimization problem above, we propose the algorithm shown in Algorithm 1 to find k-least cost routes that meet the end-to-end delay constraint.

The algorithm calculates the costij (line 3) for each link from cluster head i to cluster head or sink j based on the cost function. Then, it calculates the number of probable routes from cluster head node x to the sink s (line 4) using depth-first search (DFS) algorithm. In line 5, the algorithm uses the k-shortest path to find k-least cost route. After determining the least-cost route Rk (initial k=1), the algorithm calculates the end-to-end delay Dete (Rk) for that route. Then, it checks whether this end-to-end delay can satisfy specified threshold value Δ or not. If so, Rk is chosen (SeR, lines 9 and 10), and if not, Rk will be removed and added to the NoSa (lines 7 and 13). Line 7 will remove least cost routes that do not satisfy the delay bound Δ.

D) MODULE 4: NETWORK CODING

Network coding is a technique which allows the intermediate nodes to encode data packets received from its neighboring nodes in a network .The encoding and decoding methods of linear network coding are described below.

Encoding operation: A node, that wants to transmit encoded packets, chooses a sequence of coefficients q = (q1, q2, ..., qn), called encoding vector, from GF(2s). A set of n packet Gi(i = 1, 2, 3, 4, ..., n) received at the node are linearly encoded into a single output packet. The output encoded packet is given by the coded packets are transmitted with the n coefficients in the network. The encoding vector is used at the receiver to decode the encoded data packets.

Decoding operation: At the receiver side the receiver node solves a set of linear equations and to retrieve the original packets from the received coded packets. The encoding vector q is received by the receiver sensor nodes with help of the encoded data. Let, a set (q1, Y1),….(qm, Ym) has been received by a sensor node. The symbols Yi and qj represent the information symbol and coding vector for the jth received packet respectively. A sensor node solves the based following set of linear equations (2) with mth equations and nth unknowns for decoding operation.

At least n linearly independent coded packets must be received by the recipients for proper decode of the original packets. The only unknown, Gi, contains the original packets that are transmitted in the network. The n number of original packets can be retrieved by solving the linear system in above equation after getting n linearly independent packets.

The XOR network coding, a special case of linear network coding .has been used in this work. The coded packets that are transmitted in the network are elements in GF(2) = {0, 1} and bitwise XOR in GF(2) is used as an operation. Cluster head candidates only. α and β are controlling parameters

Algorithm1:

DataPacketProcess(Pi) : DataPacket processing
at a node inside the network coding layer
Require: DataPacket transmission and reception starts, received DataPackets inserted
into the RecvDataQueue()
Ensure: Encoded DataPacket transmitted or discarded
1. Pick a DataPacket Pi from RecvDataQueue(Pi)
2. If DataPacket Pi ∈ ForwardDataPacketSet(Pi) exit;
3. If Node n ∈ EncoderNodeSet() continue;
4. If native(Pi) then
5. CN =ExorEncoding();
6. Node n transmits the coded DataPacket CN to Sink
7. Insert the processed DataPacket Pi to ForwardDataPacketSet();

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8. else
9 Discard(Pi);
10 endif
10. else
11. Node n acts as relay and transmits the DataPacket Pi to the Sink;
12. endif
13. endif

Algorithm 2:

ExorEncoding() : Encoding algorithm
Require:A received queue RecvdataQueue() and a sensed queue SenstheQueue()
is maintained at an encoder node
Ensure: Generation of network coded packet CN
1. If SenstheQueue() is not empty then continue;
2. Pick a packet Pi from head of the RecvdataQueue();
3. Pick a packet Pj from head of the SenstheQueue();
4. CN = Pi ⊕ Pj ;
5. else
6. Pick next packet Pi+1 from the RecvdataQueue();
7. CN = Pi ⊕ Pi+1;
10. endif;
11. return CN

5. CONCLUSION

Collaborative data collection scheme is based on optimal clustering for wireless sensor networks. By justifying the intra-cluster energy consumption and the inter-cluster energy consumption are individually, The clustering method is implemented with the same size of the grids, which ensures the positional balance of the projected nodes. For the WSN with uneven distributed nodes, a node density-based even clustering method is proposed. we abstracted the optimal clustering problem as a separable convex optimization problem and then solved it to obtain the optimal network parameters. A cluster heads-linking based on designed to realize the accumulative inter-cluster data collection. Furthermore, a distributed cluster-constructing was also designed to construct the intra-cluster data collection structure. Experimental results showed that the proposed scheme outperformed some existing data collection schemes in terms of energy consumption, network lifetime and load balance. The analysis and simulation of the relevant parameters affecting the network energy consumption were analyzed. Compared with the random projection node method and the random walk method, the proposed method performs well and the network lifetime is significantly extended. In the next step, we will consider the application of artificial intelligence to further optimize the routing topology of the network and make more in-depth research on signal reconstruction to obtain better compressed data collection results.

I. APPENDIX

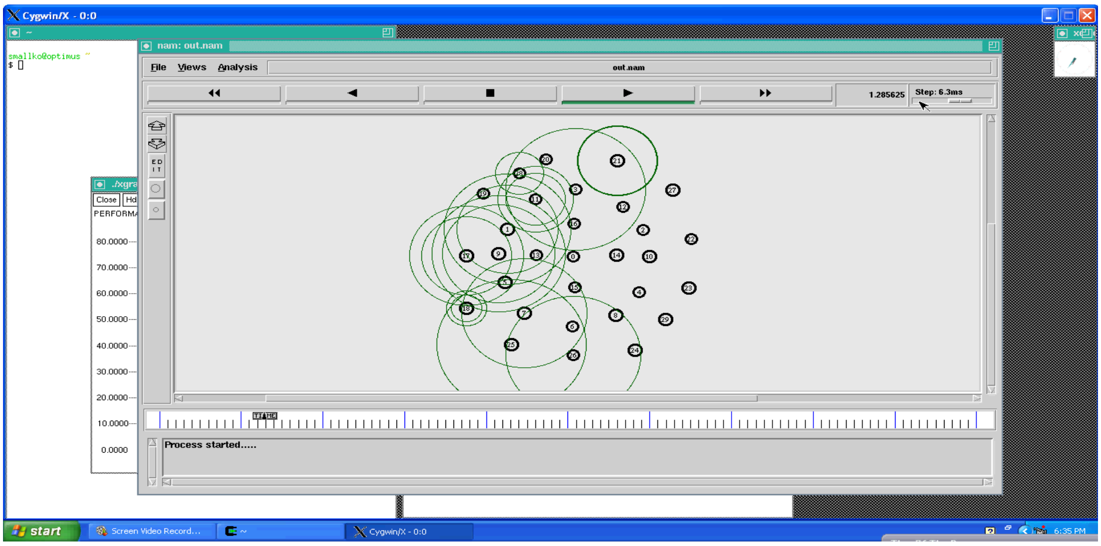

FIG A: DYNAMIC NODES DEPOLYMENT

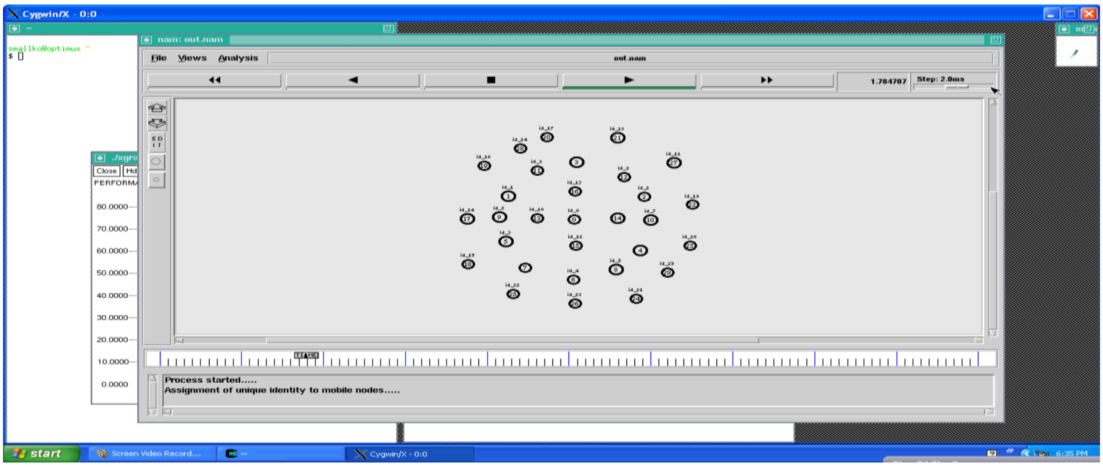

FIG B: SIMULATION PROCESS STARTED WINDOW

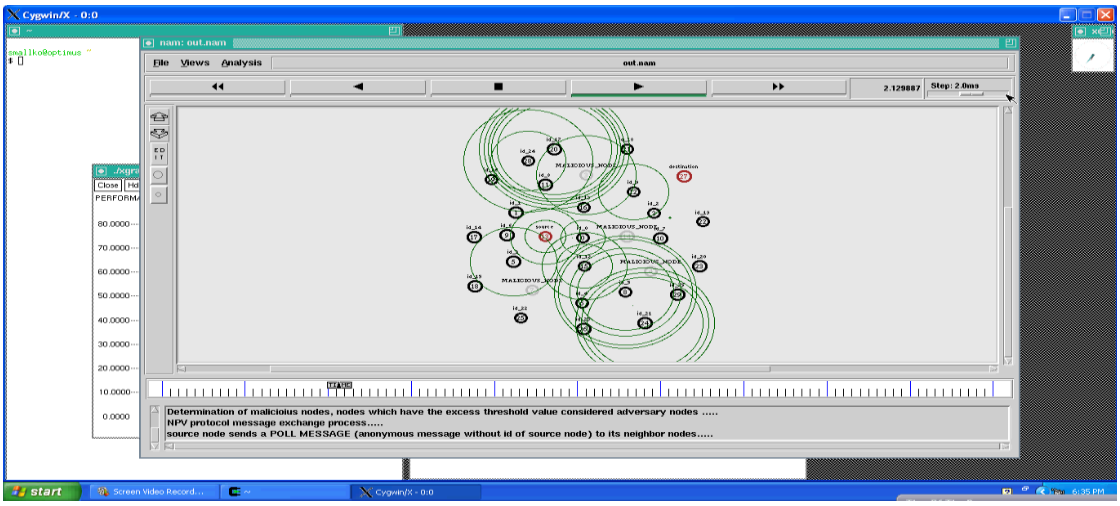

FIG C: ASSIGNMENT UNIQUE IDETITIES FOR ALL NODES

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