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AN INNOVATIVE TECHNIQUE LINEAR CLUSTER HANDLING (LCH) FOR ENERGY EFFICIENCY IN LINEAR WSNs

ANJU RANI and AMIT BINDAL

Computer Science and Engineering
Maharishi Markandeshwar University (DU)
Ambala, India
E-mail: anjugahlot28@gmail
amitbindal@mmumullana.org

Abstract

For improving the network life of the sensor network i.e. wireless sensor networks (WSNs), the routing protocols which are based on topology rule are apparently important. When few WSN routing protocols allot uneven network visitors load to sensor nodes, as it is not superior anymore due to upgrading network longevity. This paper gives the proposal of an adaptable and energy proficient routing protocol which is differ from conventional WSN routing protocols. A New Linear Cluster Handling (LCH) Technique Genetic Algorithm (GA) to upgrade sensor hubs' vitality utilization for the Energy Efficiency in Linear WSNs with numerous static sinks in a straightly upgraded field to adjust vitality utilization of sensor hubs and to enhance WSN longevity.

The prudent technique for bringing down the energy utilization of a sensor hub alongside the expense concerning transmission is Clustering Technique. In this paper Genetic algorithm is suggested that produces a sensor clusters which is of negligible number with group heads and diminishes the expense of transmission. The simulation expresses the viability of the algorithm.

I. Introduction

Wireless Sensor Networks (WSN) can perform accumulation of information, summation and communication way from the surrounding by using radio communications through many conveyed singular sensor node. The nodes in the sensor gather the interest of data and transfer the information through the high nodes till the point that the information at long last arrive at the base station (BSs) for processing at last stage, when it

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detects the environmental events inside their particular ranges. WSNs hold becomes progressively helpful among a variety of fundamental applications, for example, natural observing, workplaces, surveillance in battlefield, and transport site guests limit. [6]. A standout feature in WSNs is that it is included in the restricted battery of the nodes of the sensor. In case, the battery-controlled remote sensor high nodes are kept in a particular field, replacing their batteries or supply of extra energy becomes tough. Moreover, if one node of the sensor intakes all it's totally energy, then some portion of the system may get disconnected [15].

For the transmission of the data which is generated to BS, all the nodes of sensor are eligible to transmit their generated information, yet this prompts more energy utilization and influences the lifespan of the network system [3]. The adjacent hubs or the hubs having similar attributes can be assembled together to make cluster which further helps in decreasing the total consumption of energy of the network system. To deal with the cluster activities, a cluster head (CH) will be chosen among the hubs. The responsibility with respect to the CHs is collection of the information alongside their member hubs, accumulating the gathered information, and transmitting the amassed records as indicated by BS. In any case, the CH hub expectation now not concerned about detecting activities as different hubs. When contrasted with member hubs (non-CH), generally a CH hub tends to spend more energy as a result of its information collection, summation, and transmission to BS [5]. The discussion of different such clustering algorithms in WSN are done in [1].

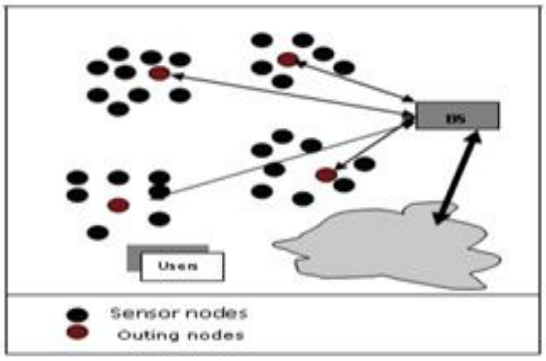

Figure 1. Wireless Sensor Network.

This paper, introduces a multi-sink protocol to linearly enhanced field. We cloven the network region in equal areas and amount range about nodes base equivalent aggregate concerning energy are deployed within every location which makes network homogeneous. Multi-sink strategy is presented in proposed protocol that is the reason CHs of each area send their information as per close-by sink. Subsequently, division with respect to network location of multiple areas yet more than one set sinks approach improve the network existence and throughput about the community.

By utilizing the previous clustering algorithms, the total consumption of energy of the system is lessen, however it comes at the expense of consumption of unbalanced energy that is among the sensor hubs. For particular cases, when we are endeavoring to adjust the energy which is spent among the hubs, the total consumption of energy may increase. To expand the WSNs lifespan, variety of computational intelligence techniques have been implemented [10]. GAECH stands for Genetic Algorithm based Energy environment friendly Clustering Hierarchy, is introduced for a trade-off among standard strength ruin or power pattern into the network, in this research paper. Albeit many clustering algorithms which are using genetic approach [11, 13] are introduced, these protocols get failed to expand the network stability period. The stability period is the duration that is till the First Node Die (FND) in the network. FND is consider as an essential parameter in calculating the network's dependability. Lifetime and stability period regarding the WSN each improved via GAECH using more suitable fitness function.

The remaining part of the paper is organized in away as following: the description of related research then explanation of the motivation and also detail about the deprivations of the latest research after that details of the proposed work are given and then discussion about simulation and analysis of different parameters with their plots and at last proposed technique conclusion.

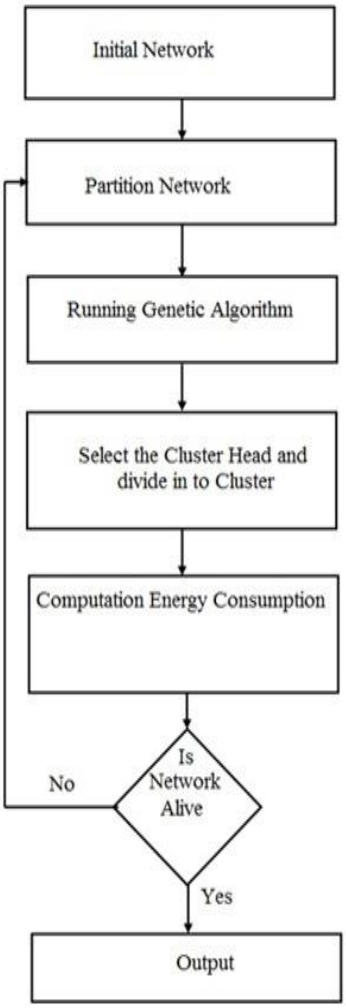

Figure 2. Network Construction.

II. Related Work

Khanna et al. [9] proposed a technique that requires to choose a head for the cluster which may limit the distance between the intra-cluster which is maximum and the cluster members. Henceforth, it reduced the consumption of the energy of the system.

W. B. Heinzelman et al. in [14], proposed a dispensed routing protocol, Low-Energy Adaptive Clustering Hierarchy (LEACH), inside that the node of

the sensor together with equal amount of energy are randomly deployed in the field CH is select randomly for unique rounds along with some probability. The other nodes join the CH as lies at minimal distance. LEACH utilizes single-hop routing the place every node transmits facts directly in conformity with the CH then CH in front its statistics in accordance with the stationary sink.

In the HEED protocol [8], the most essential parameter for selection of stochastic of CHs is the energy which is left of the sensor nodes. Degree of node or the average separation distance to neighbors is utilized for the conclusion of the CH when there is a tie between two sensor nodes. When HEED and LEACH are compared, it is found that the HEED performance is much better than LEACH due to HEED energy level is considered during CH election.

In [7], authors introduced first reactive protocol Threshold Sensitive Energy practicable sensor network protocol (TEEN). The detected component is temperature, which is further categorize in to two parts; HT that stands for Hard Threshold and ST that stands for Soft Threshold. HT is the charge of the quality that is beyond as the node senses it charge have to switch about its transmitter or record in accordance with its CH. ST is the small sensed value afterward HT which similarly decrease the energy consumption.

Zhang et al. [4] proposed an algorithm that is novel clustering algorithm which results in enhancing the intensity of information accumulated in the system, by keeping it ensure that the nodes which has sufficient amount of energy are considered as cluster heads and they incredibly diminished the energy which is consumed.

Seo et al. [2] considered that the separation between the transmission of the information and sensor nodes assesses the wellness of the system. According to this review, the real energy consumption of the sensor node was changed by characterizing cluster heads and battery status of nodes of the sensor GCA i.e. Genetic clustering algorithm [12], accomplishes an expand of lifespan through two parameters. The aggregate transmission distance inside a cluster is the first parameter. It is calculated by including the separation of individual member hubs to its CH. The aggregate number of CHs in the hub is the second parameter. As nodes of CH intake higher energy in comparison

to other member nodes, the decrease in number of CHs will significantly improve the lifetime of the system.

III. The Proposed Protocol

In our research, we introduced a Genetic Algorithm to expand the lifespan and throughput of WSN. Detailed description of GA_LCH is given in the following flowchart (figure 2) and steps are described:

A. Deployment of nodes and sinks position

When sub-region formation is completed, the main objective is to set up nodes into the region in such a way greatest territory incorporated the number of nodes that is the sensor node. Same number of nodes is conveyed in all the subarea. Three sinks are put among the system, two at the two corners concerning the field or sure at the inside on the field. By utilizing this way, CH gets detected realities concerning the nodes and moves it in imitation of its closest sink in the field.

B. Protocol Operation

The protocol operation is categories into different phases given as;

- Cluster setup phase:
- Steady-state Phase:

- **Setting-up Phase of Cluster**

Setting-up phase of cluster is one time procedure and it is the first stage. In this stage, head of the cluster are selected as the pre-defined sensor node numbers. The CH number also demonstrates number of clusters in the system. According to the distance of nodes of Non CH to the CHs, nodes of the non CH are appointed to clusters. The nodes of the non CH are joined the clusters.

- **Steady State Phase**

At this point, all the nodes begin communication with the respective CHs. Time Division Multiple Access (TDMA) is utilized by every node to schedule communication with CH. TDMA is a technique which enables different approach to stake similar radio channel and then divide separate channel towards time space for enabling the transmissions of data. Later on, all

members of the nodes sends to the CH, it combines all data collection into one slot and then transmit packet to base station (BS). At the same time all CHs transmit its data to BS, one round is finished. After finishing of every round, BS reviews the CHs energies and the nodes member. In case if CH energy is below the normal energy of cluster node member, a neighboring CH will be selected from member of cluster nodes. The node member with largest energy is chosen as new CH and old one again turn into a node member. The clusters don't seem to be reproduced. Every cluster members not to be changed, they are situated in same cluster.

Lifespan of the system can be increased by methods for rounds in GA. Binary representation is utilized in the network and every sensor of the node relates a bit. 1 represents the CHs and 0 represents the nodes of the non-CH. Chromosome or Genome, bits collection is the network representation. At first the GA begins with a populace, the pre-characterized chromosomes composed of individuals which are generated randomly. At that point GA assesses every chromosome by computing its fitness. Some parameter of fitness defines the fitness of a chromosome which are explained in Section 3.2. After the evaluation of the every chromosome fitness in population, GA chooses the chromosomes, which is greatest fit with the help of specific selection method that is depend upon the fitness cost and afterwards deals two operators, crossover as well as mutation, separately. For the production of new population which is better than the earlier one for the coming generation is carried out by utilizing these operations.

C. Fitness Function

Fitness Function play important role to increase the lifespan of network system. Fitness function contains following 3 parameters and is given below:

RFND: indicates round that beginning (first) nodes die,

RLND: indicates round that final (last) node dies,

C: indicates cluster distance.

The cluster distance is equivalent to the distance between the member hubs and the cluster head in addition to the separation from cluster to Base Station.

The distance of cluster for the cluster which has k member hubs is represented as below:

$$C = \sum_{i=1}^{k} d_{ih} + d_{hs}. \tag{1}$$

Where d_{ih} = distance between node, (i) and cluster head, (h)

d_{hs} distance between the cluster head, (h) and the BS node, (s).

Fitness function, (F), is function of all parameters which are explained above and also utilized in genetic algorithm, can be represented as follows:

$$F = \sum_{i} (f_i \times w_i), \forall f_i \in (R_{FND}, R_{LND} - C) \tag{2}$$

w is the value of application reliant weight of parameter of the fitness, demonstrates the parameter which shows higher effective results for function. We are able to generate fitness parameter much imperative than other either by varying weight or give them parallel significance by keeping equal weights.

D. Selection

To figure out that which chromosomes from present populace will make new chromosomes child by acting crossover and transformation with help of this process. The new youngster chromosomes unite the current populace. The populace with new youngster chromosomes would be cause for following determination. The chromosomes, have great fitness cost have greater opportunity to be chosen. The determination techniques which can be used are Roulette-Wheel selection method, selection of Rank and Tournament.

E. Crossover

A genetic operator i.e. Crossover which generates two other modern child chromosome by the two originator (parent) chromosome. The most straightforward approach that is required to make this to pick a irregular crossover point and two originator (parent) chromosomes transfer data after that particular point. An example is appeared in Figure (1):

$$Parent\ 1 - 1110 \mid 0101$$

$$Parent\ 1 - 1011 \mid 1110$$

$$Child\ 1 - 11101110$$

$$Child\ 2 - 10110101$$

Figure 3. A Cross-over Illustration.

When crossover process is completed after selection process and relies upon a probability which is defined an initially prior to beginning of GA. The occurrence probability of crossover relies upon the crossover rate.

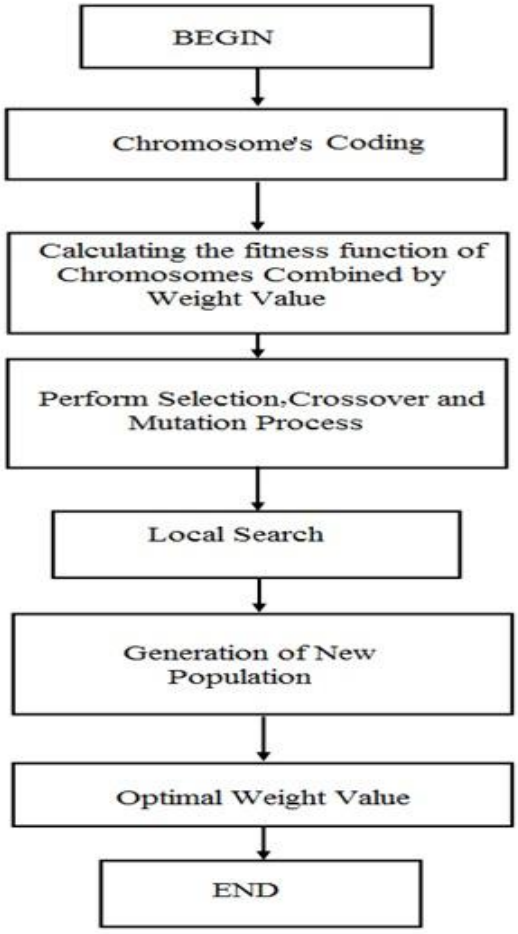

Figure 4. Wireless Sensor Network.

F. Mutation

The transformation takes place, when a crossover process is performed. To avert entire solutions in populace into locally optimized solved problem.

Alteration of transformation all of new youngster chromosome along with probability is called rate of mutation as appeared in Figure (2).

IV. Results and Disscussion

The performance parameters which are generally used to evaluate the WSN clustering protocols are as follows:

- Data Packets at base station.
- Number of alive nodes.
- Number of dead nodes.
- Throughput of Network

The metrics which is previously mentioned, provide us the plan to finish up about the period of stability of the network system which is the time period from the beginning of system task till the main sensor hub is dead, period of unstable of the network system that is the time period between when the first node is dead till the last node is dead, utilization of energy, the information send that are gotten by the base station and the throughput of the system which is the measure of information moved effectively starting with one place then onto the next in a given period of time.

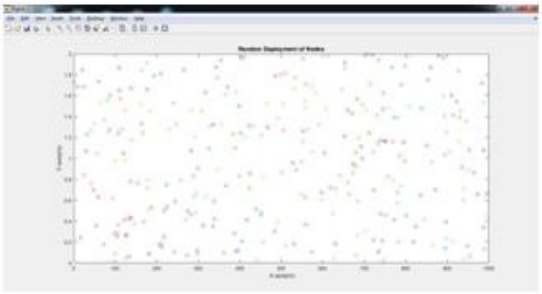

Figure 5. Random Deployments of Nodes.

Placement of nodes in the Network shows in the figure no. 5. The given graph shows the aggregate Number of Nodes present in the Network.

Figure 6 illustrates the Alive Nodes number in the Network Area using TEEN and TEEN-LCH Protocol where the rounds of Data Transmission are represented by *X*-axis and the number of alive nodes represented by *Y*-axis.

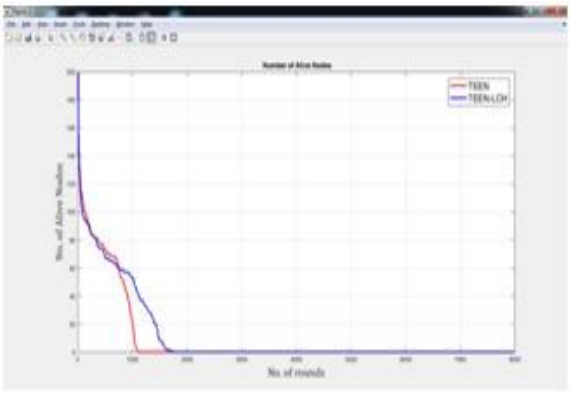

Figure 6. Number of Alive Nodes in WSN using TEEN and TEEN-LCH Protocol.

Figure 7 represents the count of dead Nodes in the Network Area using TEEN and TEEN-LCH Protocol, where *X*-axis represents the rounds of Data Transmission and *Y*-axis represents the count of dead nodes.

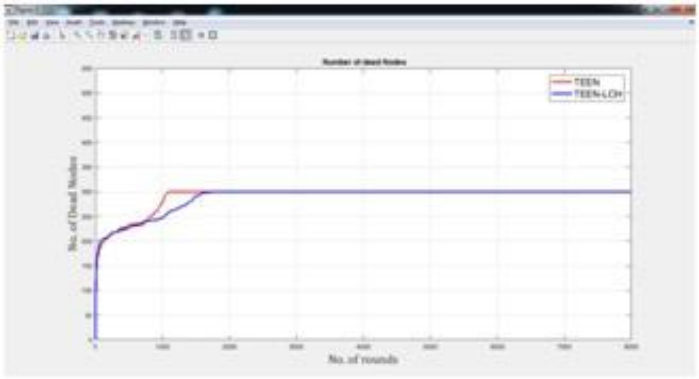

Figure 7. Number of dead Nodes in WSN using TEEN Protocol.

Figure 8 represents the throughput of the Network using TEEN and TEEN-LCH Protocol. In above graph *X*-axis represents the number of rounds of data transmission in the Network and *Y*-axis represents the count of data packets to be transmitted to the base station.

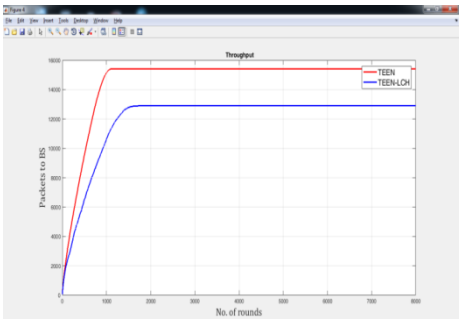

Figure 8. Throughput of Network using TEEN and TEEN-LCH protocol

Figure 9 represents the count of Alive Nodes in Network Area using GA and TEEN-LCH Protocol. In above graph X-axis represents the Data Transmission rounds and *Y*-axis represents the count of alive nodes.

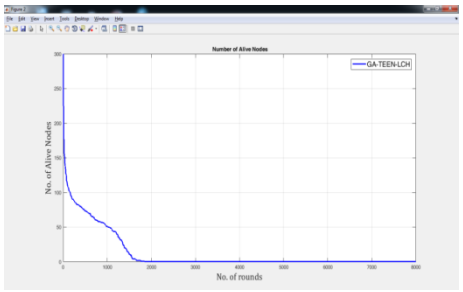

Figure 9. Number of Alive Nodes in WSN using GA and TEEN-LCH.

Figure 10 represents the dead Nodes number in the Network Area using GA and TEEN-LCH Protocol. In above graph, *X*-axis represents the Data Transmission rounds and *Y*-axis represents the dead nodes number.

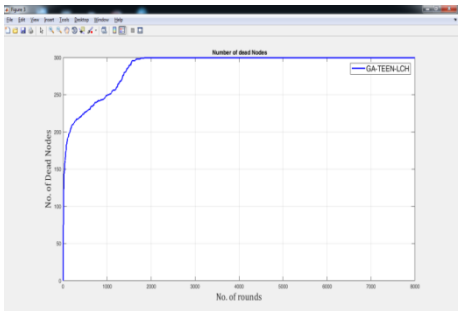

Figure 10. Number of dead Nodes in WSN using GA and TEEN-LCH.

Figure 11 represents the throughput of the Network using GA and TEEN-LCH Protocol. In above graph, *X*-axis represents the number of rounds of data transmission in the Network and *Y*-axis represents the count of data packets transmitted to the base stations.

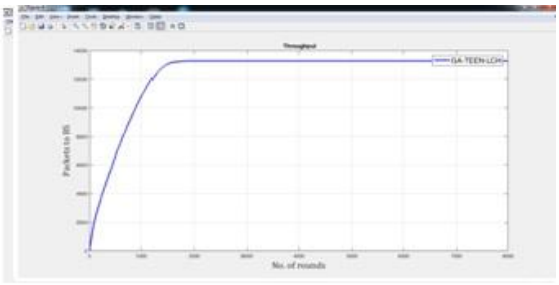

Figure 11. Throughput of Network using GA and TEEN-LCH protocol.

Figure 12 represents the Alive Nodes number in the Network Area using TEEN, TEEN-LCH and GA Protocol where *X*-axis represents the Data Transmission rounds and *Y*-axis represent the count of alive nodes.

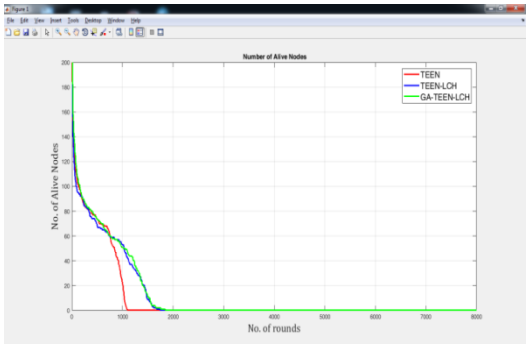

Figure 12. Number of Alive Nodes in WSN using TEENTEEN-LCH and GA Protocol.

Figure 13 represents the count of dead Nodes in the Network Area using TEEN, TEEN-LCH and GA Protocol. In above graph, the Data Transmission rounds represented by *X*-axis and *Y*-axis represents the count of dead nodes.

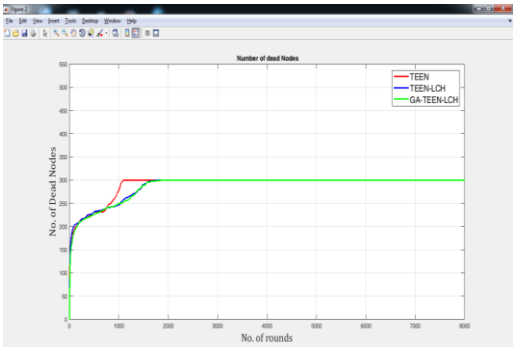

Figure 13. Number of dead Nodes in WSN using TEENTEEN-LCH and GA Protocol.

Figure 14 represents the throughput of the Network using TEEN, TEEN-LCH and GA Protocol. In above graph, the number of rounds of data transmission in the Network represented by *X*-axis and the count of data packets which is send to the base stations represented by *Y*-axis.

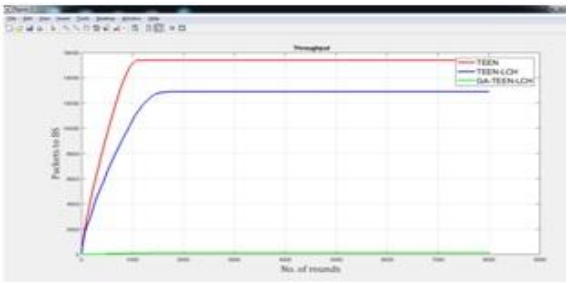

Figure 14. Throughput of Network using TEEN TEEN-LCH and GA protocol.

V. Conclusion

In this research paper, we have proposed GA which is an energy-aware adaptive multi-sink routing protocol that is applied directly on linearly improved field. Randomly, equal numbers of concerning nodes or hubs are conveyed in each area. Three set which are positioned inside the network system, get hold of data from theirs close by CHs yet nodes. CH is selected among each area as receives sensed information on nodes or after aggregate transfers it in accordance with BS. Similarly, consequences exhibit to that amount the proposed scheme enhances the network life and enhances the

throughput. In future, we would like to do the implementation of multiple mobile sinks together with band based thoroughly routing.

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