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DISH-Distributed Information Sharing System for Energy Efficiency in MANETs

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Abstract

This project proposes a cooperative transmission link in wireless networks as a transmitter cluster and a receiver cluster. And then propose a cooperative communication protocol for establishment of these clusters and for cooperative transmission of data. We derive the upper bound of the capacity of the protocol, and we analyze the end-to-end robustness of the protocol to data-packet loss, along with the tradeoff between energy consumption and error rate.

The energy efficient protocol contains two main phases of mode

- Routing phase,
- Recruiting and transmission.

The analysis results are used to compare the energy savings and the end-to-end robustness of our protocol with two non-cooperative schemes, as well as to another cooperative protocol published in the technical literature.

1. INTRODUCTION

In wireless sensor networks, nodes have limited energy resources and, consequently, protocols designed for sensor networks should be energy-efficient. One recent technology that allows energy saving is cooperative transmission. In cooperative transmission, multiple nodes simultaneously receive, decode, and retransmit data packets. In this paper, as opposed to previous works, we use a cooperative communication model with multiple nodes on both ends of a hop and with each data packet being transmitted only once per hop. In our model of cooperative transmission, every node on the path from the source node to the destination node becomes a cluster head, with the task of recruiting other nodes in its neighborhood and coordinating their transmissions. Consequently, the classical route from a source node to a sink node is replaced with a multihop cooperative path, and the classical point-to-point communication is replaced with many-to-many cooperative communication. The path can then be described as “having a width,” where the “width” of a path at a particular hop is determined by the number of nodes on each end of a hop.

Our cooperative transmission protocol consists of two phases. In the routing phase, the initial path between the source and the sink nodes is discovered as an underlying “one-node-thick” path. Then, the path undergoes a thickening process in the “recruiting-and-transmitting” phase. In this phase, the nodes on the initial path become cluster heads, which recruit additional adjacent nodes from their neighborhood. Due to the fact that the cluster heads recruit nodes from their immediate neighborhood, the inter-clusters distances are significantly larger than the distances between nodes in the same cluster. Recruiting is done dynamically and per packet as the packet traverses the path. When a packet is received by a cluster head of the receiving cluster, the cluster head initiates the recruiting by the next node on the “one-node-thick” path.

Once this recruiting is completed and the receiving cluster is established, the packet is transmitted from the sending cluster to the newly established receiving cluster. During the routing phase, where the “one-node-thick” path is discovered, information about the energy required for transmission to neighboring nodes is computed. This information is then used for cluster establishment in the “recruiting-and-transmitting” phase by selecting nodes with lowest energy cost. Medium access control is done in the “recruiting-and-transmitting” phase through exchanges of short control packets between the nodes on the “one-node-thick” path and their neighbor nodes. A key advantage of cooperative transmission is the increase of the received power at the receiving nodes. This decreases the probability of bit error and of packet loss. Alternatively, the sender nodes can use smaller transmission power for the same probability of bit error, thus reducing the energy consumption. One of the goals of this paper is to study the energy savings achieved through cooperation. We also study the increase in the reliability of packet delivery, given some level of cooperation among the nodes. Finally, we also study the capacity of the cooperative transmission protocol.

2. LITERATURE SURVEY

Title: A New Cooperative MAC Protocol for Wireless LANs

Author: Samir Sayed, Yang Yang

Description:

This project introduces a new cooperative MAC-protocol for wireless LANs. This scheme is totally compatible with the legacy systems and leverages the multi-rate capability of IEEE systems. The proposed protocol is evaluated via theoretical analysis and the result shows a throughput improvement using the same physical layer as in IEEE802.11b.

Title: Cooperative Routing in Wireless Networks

Author: Amir Ehsan Khandani, Jinane Abounadi, Eytan Modiano and Lizhong Zheng

Description:

The joint problem of transmission-side diversity and routing in wireless networks is studied. It is assumed that each node in the network is equipped with a single mni-directional antenna and multiple nodes are allowed to coordinate their transmissions to achieve transmission-side diversity. The problem of finding the minimum energy route under this setting is formulated. Analytical asymptotic results are obtained for lower bounds on the resulting energy savings for both a regular line network topology and a grid network topology. For a regular line topology, it is possible to achieve energy savings of 39%. For a grid topology, it is possible to achieve energy savings of 56%. For arbitrary networks, we develop heuristics with polynomial complexity which results in average energy savings of 30% ¡ 50% on simulations.

Title: Implementing a Cooperative MAC Protocol for Wireless LANs

Author: Thanasis Korakis, Sathya Narayanan, Abhijit Bagri, Shivendra Panwar

Description:

In wireless LANs that provide multi-rate support, stations that experience poor channel quality tend to use low transmission rates to reduce the bit-error rate (BER) of each transmission. This phenomenon usually leads to a throughput fairness problem between the stations with good channel quality and those without. This fairness problem has been shown to result in throughput degradation for the whole network. The MAC protocol proposed in addresses this issue using an efficient cooperative scheme. Under this scheme, low rate stations are assisted by a high rate station, referred to as helper stations, in its transmissions. With such assistance, the low rate station will be able to transmit data at a higher rate in a two-hop manner using the helper station. We implemented this new protocol in a Linux testbed. This project describes the assumptions, the implementation process and the challenges we were presented with. We evaluated the protocol using our testbed through experiments. The implementation of the protocol shows that it performs efficiently in supporting TCP applications.

Title: User Cooperation Diversity—Part I: System Description

Author: Andrew Sendonaris, Elza Erkip and Behnaam Aazhang, Fel

Description:

Mobile users' data rate and quality of service are limited by the fact that, within the duration of any given call, they experience severe variations in signal attenuation, thereby necessitating the use of some type of diversity. In this two-part project, we propose a new form of spatial diversity, in which diversity gains are achieved via the cooperation of mobile users. Part I describes the user cooperation strategy, while Part II focuses on implementation issues and performance analysis. Results show that, even though the inter user channel is noisy, cooperation leads not only to an increase in capacity for both users but also to a more robust system, where users' achievable rates are less susceptible to channel variations.

Title: User Cooperation Diversity—Part II: Implementation Aspects and Performance Analysis

Author: Andrew Sendonaris, Elza Erkip and Behnaam Aazhang.

Description:

This is the second in a two-part series of papers on a new form of spatial diversity, where diversity gains are achieved through the cooperation of mobile users. Part I described the user cooperation concept and proposed a cooperation strategy for a conventional code-division multiple-access (CDMA) system. Part II investigates the cooperation concept further and considers practical issues related to its implementation. In particular, we investigate the optimal and suboptimal receiver design, and present performance analysis for the conventional CDMA implementation proposed in Part I. We also consider a high-rate CDMA implementation and a cooperation strategy when assumptions about the channel state information at the transmitters are relaxed. We illustrate that, under all scenarios studied, cooperation is beneficial in terms of increasing system throughput and cell coverage, as well as decreasing sensitivity to channel variations.

3. EXISTING SYSTEM

3.1 OVERVIEW

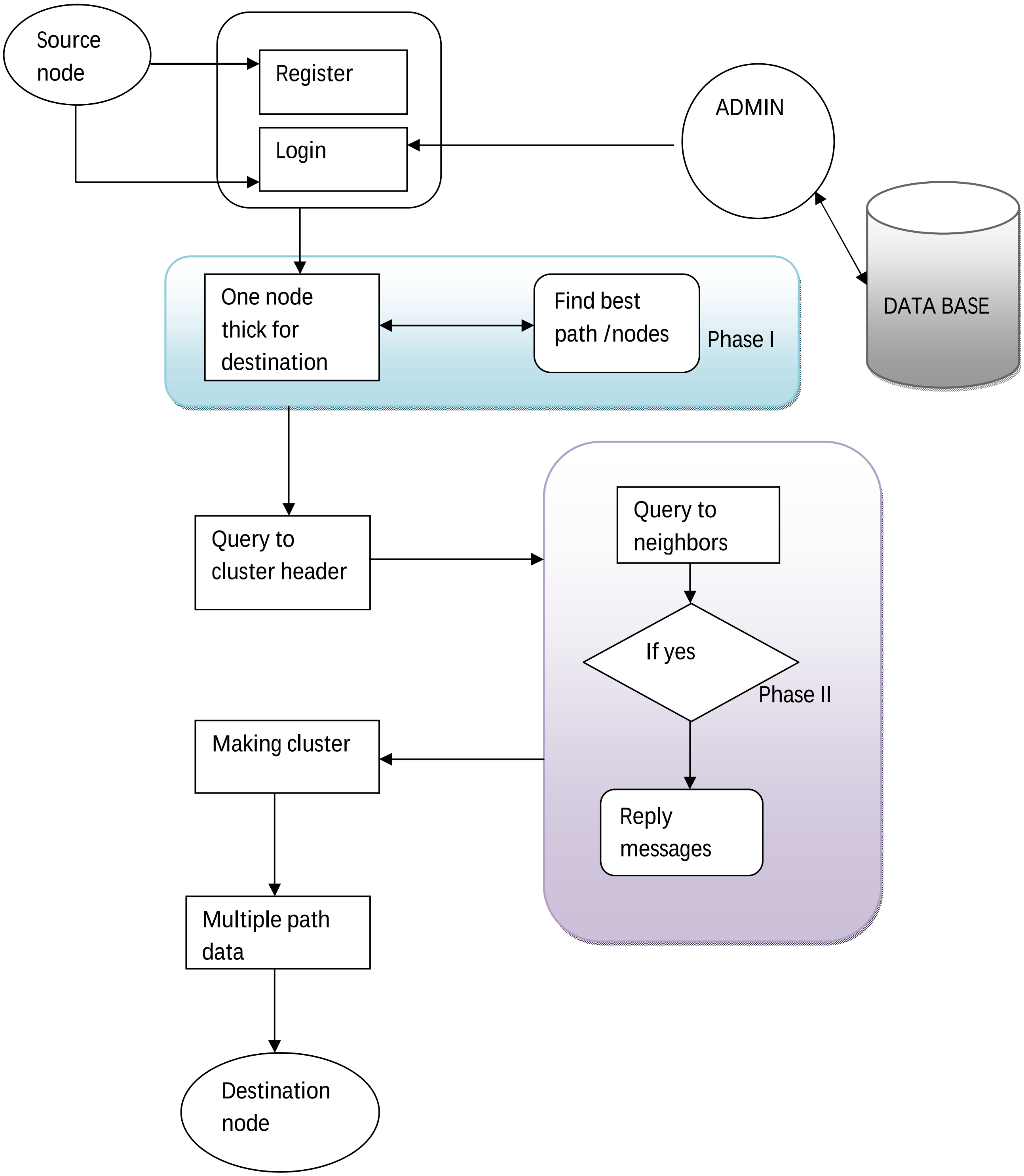
As most of the current works look at the cooperation from the transmitter side only. Due to this activity the data loss occurred regularly and lot of prevention security mechanisms updated but still the security issues arising. The existing approach follows the transmitter alone instead of the data path and the destination. Here if the client not receives ant ACK from end node then the retransmission process initiate at the sender side. But the main issue is without making the data path efficient all security techniques are worthless. Even in the use of multiple nodes for data transmission, whole data will be transferred and the nodes are randomly selected another neighbor. So overhead may be possible at every node when data reaches. In some existing methods the data which are travel through several nodes not exactly reaches the destination at the proper time, because of some node traffic and data delay that node data packet alone reaches destination lately. And also the neighbor detection is not a dynamic one in existing approaches, if a node is busy with another process then the current data should wait it can't takes over to another node which is ready to transmit the data. This will decrease the data efficiency, data integrity and reliability.

4. PROPOSED SYSTEM

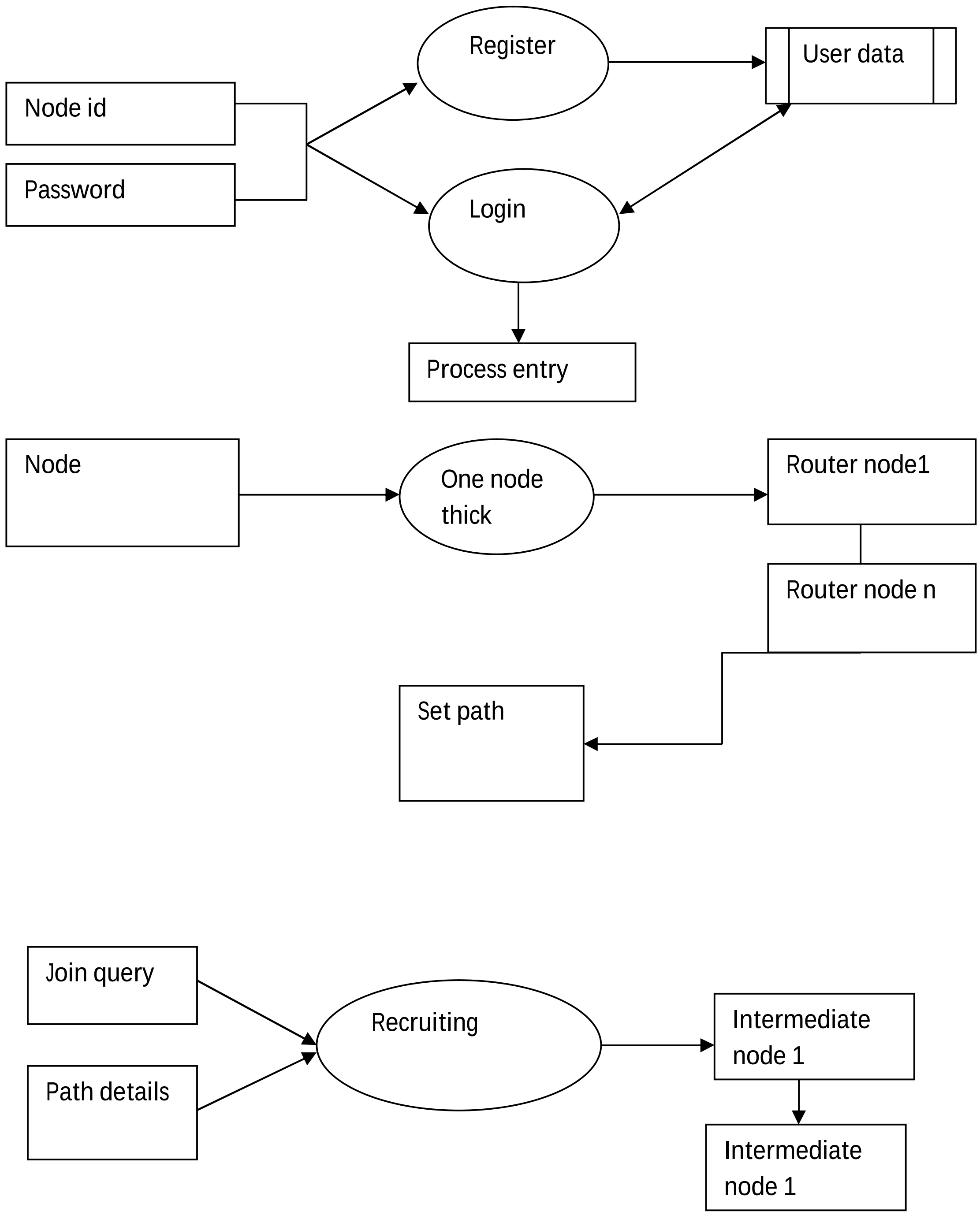
4.1 OVERVIEW

In proposed model of cooperative transmission, every node on the path from the source node to the destination node becomes a cluster head, with the task of recruiting other nodes in its neighborhood and coordinating their transmissions. Every node in the receiving cluster receives from every node in the sending cluster. Sending nodes are synchronized, and the power level of the received signal at a receiving node is the sum of all the signal powers coming from all the sender nodes. This reduces the likelihood of a packet being received in error. A key advantage of cooperative transmission is the increase of the received power at the receiving nodes. This decreases the probability of bit error and of packet loss. At first the initial path between the source and the sink nodes is discovered as an underlying "one-node-thick" path, and then nodes on the initial path become cluster heads, which recruit additional adjacent nodes from their neighborhood. Due to the fact that the cluster heads recruit nodes from their immediate neighborhood, the inter-clusters distances are significantly larger than the distances between nodes in the same cluster. Here a new protocol to facilitate cooperative transmission that minimizes the energy consumption and increases the transmission reliability in comparison to the other schemes.

5. SYSTEM ARCHITECTURE



6. DATA FLOW DIAGRAM



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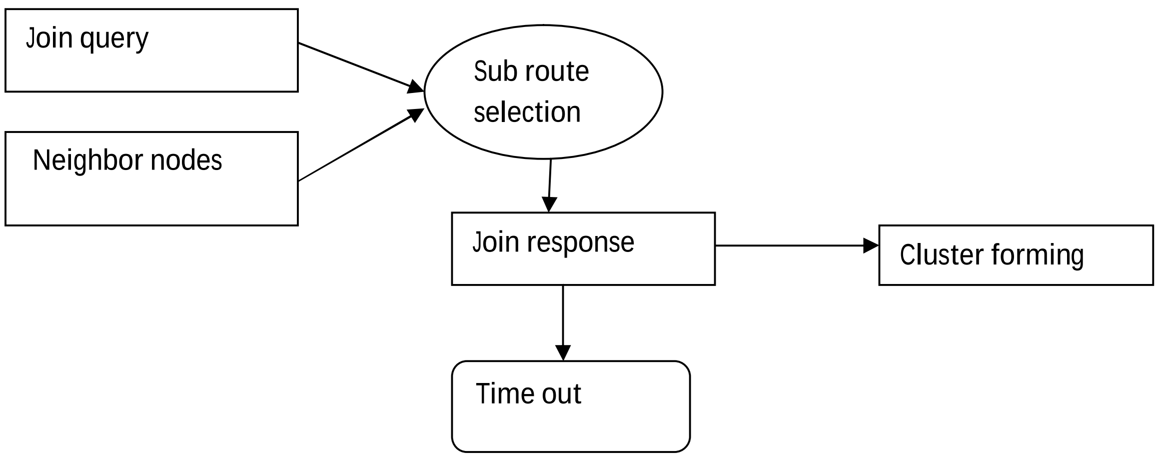

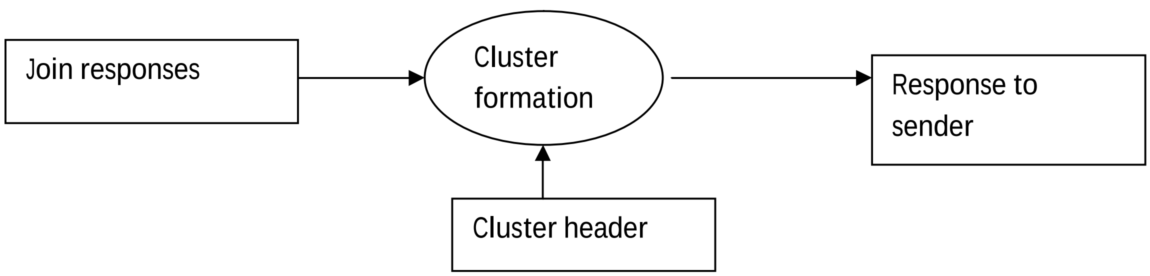

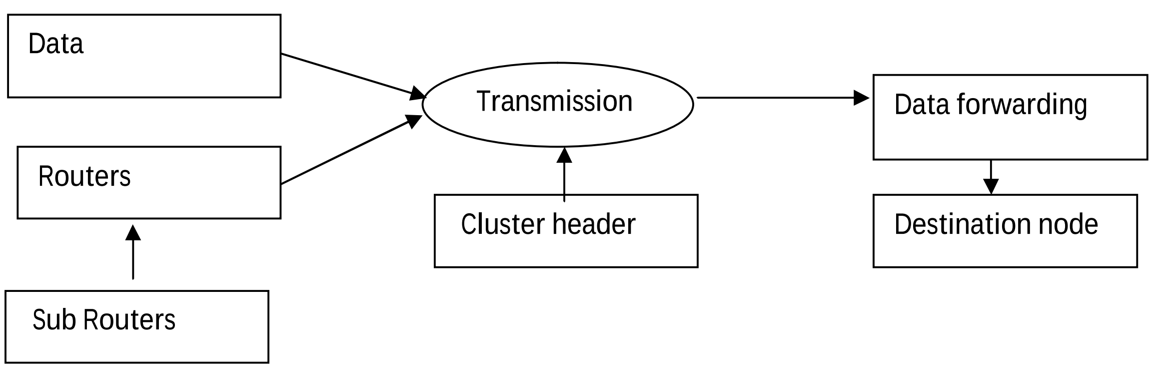

7. SYSTEM IMPLEMENTATION

7.1 MODULES

This energy efficient project consists of six main modules. The modules are as follows.

1. Sender node,
2. Receiver node,
3. Admin,
4. One node thick,
5. Recruiting and Transmitting and,
6. Reports.

1. Sender node:

This module is the initiate module for the data transfer between the nodes in network communication. A sender node is the data source node which will transmit that data to desired destination /receiver node. Before the data initiated, here the sender should choose its path to transmit the data without any channel failure occurs. Once it sends the data it will receive the acknowledgement for the data from corresponding destination node. The ack will receive through the one node thick path.

2. One node thick

This is the first phase of the proposed method, where the path will be chooses by the sender based on the shortest and efficient path. In the every node of the selected path called as header for the purpose of making group around it to transfer the data from source to destination nodes. The source node send the query in the network for the transmission once the destination connected to source node then next phase works will starts.

8. CONCLUSION

We evaluated the performance of cooperative transmission, where nodes in a sending cluster are synchronized to communicate a packet to nodes in a receiving cluster. In our communication model, the power of the received signal at each node of the receiving cluster is a sum of the powers of the transmitted independent signals of the nodes in the sending cluster. The increased power of the received signal, the traditional single-node-to-single-node communication, leads to overall saving in network energy and to end-to-end robustness to data loss. We proposed an energy-efficient cooperative protocol, and we analyzed the robustness of the protocol to data packet loss. When the nodes are placed on a grid and as compared to the disjoint-paths scheme, we showed that our cooperative protocol reduces the probability of failure to deliver a packet to destination.

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