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Self Restorative Cluster Head Selection In Heterogeneous Network

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Abstract

Communication between heterogeneous networks became unavoidable. Clustering simplifies the communication. Cluster head is the leader of the cluster. If the cluster head fails or becomes unreachable an alternative efficient algorithm is required to recover from the failure. This proposes the algorithm which initiates the alternative cluster head selection in a heterogeneous environment.

Keywords: Network Protocols, Wireless Network, Mobile Network, clustering.

Introduction

In real time scenario, the wired and wireless devices are overlapped. There are different types of network. In this paper we assumed the Wireless sensor network (WSN), Mobile Ad hoc network (MANET) and Wired network. These entire networks together form a heterogeneous network. Homogeneous network consists of similar devices. Heterogeneous network is defined as a network connecting computers and other devices with different protocol or with different OS. Imagine a conference hall, the wired and wireless devices are overlapped and they need to establish communication efficiently. The devices are grouped into small clusters using various parameters. In Wireless sensor network the clusters are decided based on some parameters like the Node ID, Node Degree, and Energy consumption of each sensor node. In Mobile Ad hoc network the parameters like node mobility, speed, and number of neighbours are considered while forming groups. Clustering is an efficient way of packet exchanging in a network.

Clustering is the method of grouping nodes of similar kind. After cluster formation, the cluster head is elected. All nodes except cluster head are cluster members. The cluster head is the base station within the cluster. All the communication is routed through the cluster head. If a node from one cluster wants to

communicate with another node within the cluster, it is called as Intra-cluster communication. If a node from one cluster wants to communicate with another node in another cluster, it is called as Inter-cluster communication.

Related Work

In [1]the author surveyed on the clustering algorithm in sensor networks. He discussed the existing clustering protocols LEACH, TL-LEACH, Energy Efficient Clustering Scheme (EECS), and Hybrid Energy Efficient Distributed Clustering and also the limitations that exist in forming clusters in those WSN clustering protocols.

In [2] different clustering schemes are classified and discussed with cluster head selection strategies. The requirements during cluster formation in each round for selecting cluster head, parameters used, effects of cluster head selection, creation of balanced cluster creation, distribution of cluster heads over the network, are compared based on their performance.

In [3] the authors proposed a cluster-head selection and update algorithm in the networks, where the nodes are moving in a concerted action as a group and he discussed about the clustering algorithms in the wireless ad hoc network and the overheads that are caused by the frequent updates.

In [4] the authors have briefly presented a scenario about the cluster infrastructure, functioning of a cluster and the responsibilities of cluster head and cluster members while transmitting a packet and receiving a packet. They explained about the inter cluster and intra cluster communication methodology along with the intrusion detection techniques. Extending the system to heterogeneous intrusion detection is the future work that has been suggested.

In [5] they have formed a hybrid network with both virtual network in ns3 and the real world network. Various networks like infrastructure network, infrastructure less network, delay tolerant network, Mobile Ad hoc Network are connected together using the Message Delivery in Heterogeneous, Disruption-prone Networks (MeDeHa) Gateway. The modules within the MeDeHa-DTN and MeDeHa Gateway are illustrated with an architecture diagram. Thus heterogeneous scenario is implemented and simulated.

Existing Concept

Wireless Sensor Network

In Wireless Sensor Network (WSN) consists of sensor nodes which is the main component of a WSN, fixed in particular location and performs sensing. The major function of the sensor nodes is the data collection. Well-organized data must be collected and the node energy must be utilized efficiently. Clusters are the hierarchical units for WSN. Large network is divided into smaller clusters to simplify the communication.

Cluster Heads are the leader of the cluster. Base Station provides the communication between the wired and sensor network. Forming a cluster in wireless sensor network is done through protocols like LEACH protocol.

Challenges in WSN Cluster formation

Efficient energy utilization is the major challenge in WSN since the sensor nodes are small-size battery operated sensors, so they have limited energy storage. It is impractical to recharge or replace the batteries after exhaustion. Energy consumption can be balanced by conducting re-electing CHs based on their residual energy.

But this causes various drawbacks like uncertain cluster size, consumption of energy for re-clustering, uneven distribution of cluster head, death of low-energy sensor nodes.

Mobile Ad hoc Network

A mobile ad hoc network consists of nodes that show random movement. The nodes keep on moving from one location to another location. The home agent is the base station with which the mobile node is connected with the physical care of address. When the node moves to another network where there is a foreign agent, a new virtual care of address is allocated to the nodes, this address is stored in home agent through the binding update. All the packets that are destined to the mobile node reach the node through the home agent, access router and mobile router. When the mobile node resides in foreign network, all the packets are forwarded by the home agent to the access router that resides within the foreign network. Clustering is a hierarchical addressing methodology that simplifies the communication.

Challenges In Cluster Formation In Wireless Ad Hoc Network

Formation of cluster in mobile ad hoc network considers various parameters like mobility, speed of the node, node ID, and number of neighbour nodes. In Lowest ID clustering algorithm the nodes are assigned unique ID and clusters are formed. The cluster head will be chosen with lowest ID. The algorithm is simple but it doesn't guarantee the balanced distribution of cluster head, frequent updating of cluster head may also impose traffic load.

The highest-degree clustering algorithm aims at minimizing the number of clusters. Each node sends control messages and becomes aware of the neighbour nodes; the node having the highest number of neighbours is elected as the cluster head. If many nodes have the same number of neighbours the node with lowest-ID becomes the cluster head. The number of cluster-head is relatively low. However, geographical distribution of the cluster head becomes undesirable in this algorithm and when the mobility increases, the cluster-head updates increases the overheads.

Weighted Clustering Algorithm considers design factors, such as transmission power, battery power of mobile nodes. Then it assigns weight to each of these factors appropriately. Based on the application environment the weight will vary for each factor and attains the network performance. When the nodes join or leave the zone the independent instructions performs the weighting procedures which leds to network segmentation and to sharp network performance degradation.

Proposed System

In this paper, we consider a heterogeneous environment in which devices included from various network. Each device varies in its topology, resources and other parameters. Clusters are formed in each network. The cluster head is selected in each cluster within each network. Alternative cluster head selection during the cluster head failure is proposed.

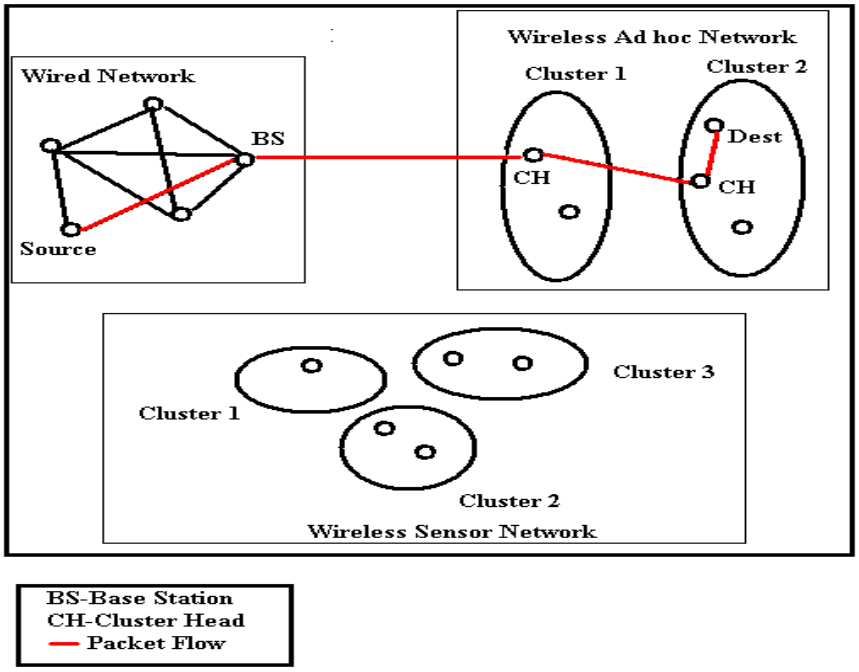

Figure 1: Packet transmission in Heterogeneous Network

This helps in self restoration of the network during node failure. Most recently, a survey of few clustering schemes are presented in [8], of which aim is to discuss their objectives, features and complexity. However to the author's knowledge, no overview of the clustering proposals emphasize on alternative cluster head selection in heterogeneous network.

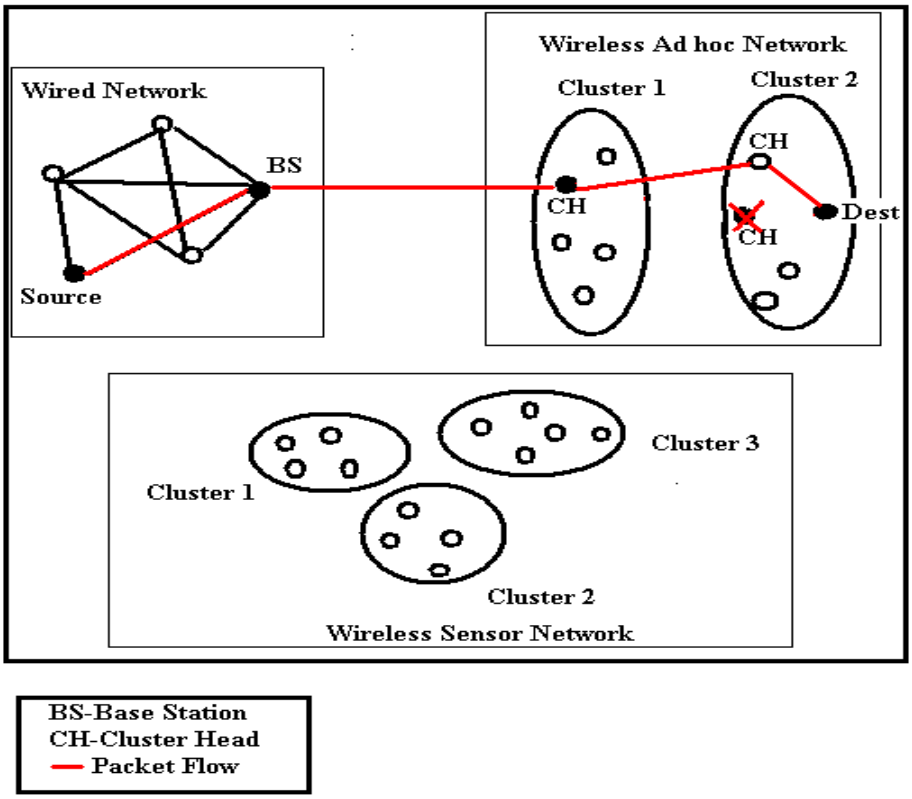

Figure 2: Proposed Alternative Head Selection

Within each network, as soon as the network is formed, the nodes send control messages. The node which gets most of the hello messages as pre-defined will be chosen as the cluster head in the wireless sensor network. Nodes with highest node degree will be chosen as the cluster head in the mobile ad hoc network. Based on the physical location the cluster head is chosen within the wired network since there are no limitations on the power consumption and mobility.

In heterogeneous network communication, when the node from one network wants to communicate with the node in another network the communication is enabled through the cluster head. Consider the scenario, the source node from network A wants to communicate with destination node in network B. The source node sends the packet to the cluster head within the cluster; the cluster head analyzes the destination and forwards the packet to the corresponding network. If the network is far away, the packet is forwarded to the intermediated clusters and sent to the destination network. When a packet is received from the cluster head in the intermediate node the CH checks whether the packet belong to it, if not it will forward the packet to the next intermediate network, thus the packet reaches the destination network B. In the network B the cluster head receives the packet and forwards it to the corresponding node within the cluster.

The cluster head plays a vital role within the cluster, thus the CH failure causes damage to the network. An immediate recovery of the cluster head must be done or alternative cluster head must be chosen as soon as possible.

Alternative Cluster Head Selection Process

The successful packet delivery is assured by receiving the acknowledgement back from the destination node. If the source node does not receive the acknowledgement back then the source node must ensure whether the cluster head within its cluster and the destination node is available or not. The source node generates Availability Check Request (ACR) message and checks availability of the cluster head within the network. If the cluster head within the network is alive then the source node broadcasts the Availability Check Request message to the destination cluster. If the nodes within the destination cluster receive the ACR packet, checks the availability of the cluster head. If the cluster head is found to be dead, the node broadcasts the CH Failed message. The initial CH will take the responsibility to choose the next cluster head based on the parameters like mobility, speed, topology, energy consumption, node ID, etc based on the network type.

Steps to initiate CH selection in Heterogeneous Network

Step 1: Source sends packet to destination and waits for acknowledgement packet. If acknowledgement is received continue packet transmission.

Step 2: When acknowledgement not received, source node checks CH availability within network by sending ACR (Availability Check Request) to the CH within the cluster.

Step 3: If CH within cluster is not alive then alternative cluster head is chosen and packet transmission is continued.

Step 4: If CH within cluster is alive then CH replies to the source node by CH Reply message then the ACR packet is forwarded and broadcasted to the nodes in the destination network. Nodes that receive the ACR packet check the availability of the CH in their network. If the CH is not available re-election is initiated.

Step 5: After the cluster head is elected the CH Elected message is sent to the source node and the packet transmission continues.

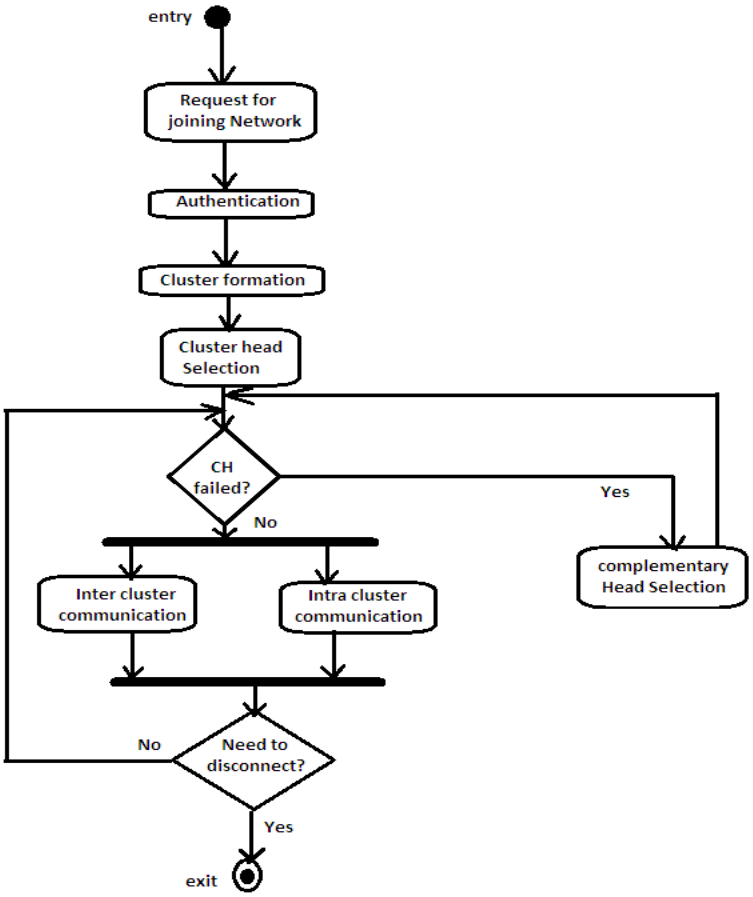

Figure 4: Cluster Head Selection

The Source node which sends packet initiates the CH availability checking process when the acknowledgement is not received back. Thus the proposed algorithm performs the CH election only when needed. This proposed mechanism eliminates the drawback that occurs in the normal clustering techniques and provides an alternative algorithm for the alternative cluster head selection. The rotation of cluster head reduces the efficiency; this downside is solved in the proposed algorithm. The cluster head is chosen only when the transaction fails. Thus the energy that is consumed for regular election is minimized. The retransmission of dropped packets is suggested so as to mitigate the information loss. It solves the problem of alternative cluster head selection in a heterogeneous network.

Conclusions

In this paper a heterogeneous network which includes wired network, wireless sensor network, wireless ad hoc network, the clustering methodologies and cluster head selection are discussed. The alternative cluster head selection during the failure of the

cluster head in a heterogeneous network is proposed in this paper. The future works involve the consideration of secured algorithm with negligible time delay in exchanging the packets.

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