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Path Adjustment in Wireless Sensor Network using Gateway Nodes

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Abstract: In wireless sensor networks, exploiting the sink mobility has been considered as a good strategy to balance the nodes energy dissipation. Despite its numerous advantages, the data dissemination to the mobile sink is a challenging task for the resource constrained sensor nodes due to the dynamic network topology caused by the sink mobility. For efficient data delivery, nodes need to reconstruct their routes toward the latest location of the mobile sink, which undermines the energy conservation goal. In propose system we propose a new system which will adopt new strategy for the construction of network backbone with the gateway nodes.

Key words: Routes reconstruction; energy efficiency; mobile sink; wireless sensor networks.

I. Introduction

Wireless Sensor Network (WSN) a self-organized network of tiny computing and communication devices (nodes) has been widely used in several un-attended and dangerous environments. In a typical deployment of WSN, nodes are battery operated where they cooperatively monitor and report some phenomenon of interest to a central node called sink or base-station for further processing and analysis. Traditional static nodes deployment where nodes exhibit n-to-1 communication in reporting their observed data to a single static sink, gives rise to energy-hole phenomenon in the vicinity of sink. In addition, several application environments naturally require sink mobility in the sensor field e.g., in a disaster management system, a rescuer equipped with a PDA can move around the disaster area to look for any survivor. Similarly, in a battlefield environment, a commander can obtain realtime information about any intrusion of enemies, scale of attack, suspicious activities etc. via field sensors while on the move. In an Intelligent Transport System (ITS), sensor nodes deployed at various points of interest junctions, car parks, areas susceptible to falling rocks, can provide early warnings to drivers (mobile sink) well ahead of their physical approach. The proposed scheme enables sensor nodes to maintain nearly optimal routes to the latest location of a mobile sink with minimal network overhead. It partitions the sensor field into a virtual grid of K equal sized cells and constructs a virtual backbone network comprised of all the cell-headers. Nodes close to the center of the cells are appointed as cell-headers, which are responsible for data collection from member nodes within the cell and delivering the data to the mobile sink using the virtual backbone network. The goal behind such virtual structure construction is to minimize the routes re-adjustment cost due to sink mobility so that the observed data is delivered to the mobile sink in an energy efficient way.

II. Literature Survey

Several virtual infrastructure based data dissemination protocols have been proposed for mobile sink based WSN in the last decade. Based on the mobility pattern exhibited by the sink in the sensor field, the data collection or dissemination schemes can be classified into controlled and uncontrolled sink mobility schemes. In controlled sink mobility schemes, the mobility (speed and/or direction) of the sink is manipulated and controlled either by an external observer or in accordance with the network dynamics. The uncontrolled sink mobility based schemes are characterized by the fact that the sink makes its next move autonomously in terms of speed and direction. This paper considers the uncontrolled sink mobility environments and in the following lines, we briefly describe the related works in this context including their methodology and the relative strengths and weaknesses.

VGDRA: A Virtual Grid-Based Dynamic RoutesAdjustment Scheme for Mobile Sink-Based Wireless Sensor Networks Abdul Waheed Khan, Abdul Hanan Abdullah, *Member, IEEE*,Mohammad Abdur Razzaque, *Member, IEEE*, and Javed Iqbal Bangash presented how to construct the virtual infrastructure and how to maintain fresh routes towards the latest location of the mobile sink. We design a virtual infrastructure by partitioning the sensor field into a virtual grid of uniform sized cells where the total number of cells is a function of the number of sensor nodes. A set of nodes close to centre of the cells are appointed as cell-headers which are responsible for keeping track of the latest location of the mobile sink and relieve the rest of member nodes from taking part in routes re-adjustment. Nodes other than the cell-headers associate themselves with the closest cell-headers and report the observed data to their cell-headers. Adjacent cell-headers communicate with each other via gateway nodes. The set of cell-headers nodes together with the gateway nodes constructs the virtual backbone structure.

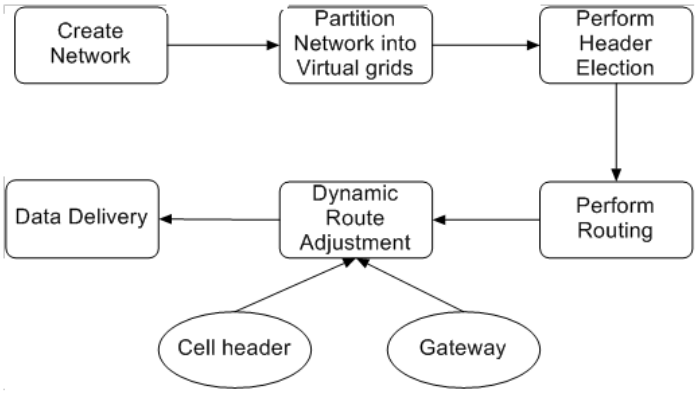
Chen et al. presented Geographic converge cast using mobile sink in wireless sensor networks,[1] a converge-cast tree algorithm called Virtual Circle Combined Straight Routing (VCCSR) that constructs a virtual structure comprised of virtual circles and straight lines. A set of nodes are appointed as cluster heads along these virtual circles and straight lines. Together the set of cluster-heads form a virtual backbone network. The sink circulates the sensor field and maintains communication.

Hexagonal cell-based Data Dissemination (HexDD)[2] proposed to constructs a hexagonal grid structure to address real-time data delivery while taking into consideration the dynamic conditions of multiple mobile sinks and event sources. Based on the six directions of a hexagon, HexDD defines query and data rendezvous lines to avoid redundant propagation of sinks data queries. Nodes send their data to nearest border line which is then propagated towards the center cell. Nodes along the border line store and replicate the data. Sinks data queries are forwarded towards the center cell and as soon as it approaches a border line node with the relevant data stored, data delivery to the mobile sink starts using the reverse path. To cope with sink mobility, whenever the sink moves from one cell to another, it informs the center nodes as well as the border nodes along the route about the new cell where the sink is currently stationed. This results in high energy consumption especially at higher sinks speeds. Nodes along the border line cells and especially at the center cell are vulnerable to high energy consumption thereby causing early hot-spot problem.

In Quadtree-based Data Dissemination (QDD) [3] proposed by Mir and Ko in, a node upon detecting an event calculates a set of rendezvous points (RPs) by successively partitioning the physical network space into four quadrants of uniform sizes. After partitioning the network, QDD routes the observed data to those nodes which are close to the centroid of each partition. The mobile sink disseminates the query packet using the same strategy by querying the node at closest RP first, followed by the subsequent RP nodes till it reaches the required data report. In static nodes deployments, the same set of nodes become RPs repeatedly which results in early energy depletion of those nodes and thus decreases the overall network lifetime.

Hierarchical Cluster-based Data Dissemination (HCDD) in [4] proposes a hierarchical cluster architecture where the second level cluster-heads of the mobile sink are appointed as routing agents. The routing agents are responsible to keep track of sinks latest location information and all the cluster heads route their collected data to the nearby routing agents. When sink moves from one point to another, it informs the nearest routing agent via the closest cluster-head. The routing agent upon sink discovery broadcasts the sinks latest location information to all the other routing agents. In high sink mobility, nodes using HCDD suffer from high energy consumption. In addition, due to the restricted propagation of sinks location information, the data delivery paths are not optimal which results in high latency.

III. PROPOSED SYSTEM



Architecture of proposed system

We propose a new system which will adopt new strategy for the construction of network backbone with the gateway nodes. Existing system takes more number of hops to deliver packet to the mobile sink. Proposed system works in following stages:

1. Network Partitioning: After creation of network with specified number of nodes network partitioning is applied. Network is partitioned into uniform number of cells.

2. Cell Header election Once the partitioning is performed the election for the cell header is performed. The election is performed using proposed algorithm based on the residual energy.

3. Dynamic route adjustment using proposed method. We will show the role of cell header and gateway nodes in route management using a proposed algorithm.

IV. IMPLEMENTATION

a) Contributions and Objectives

1. We include the role of gateway nodes in route construction and routing process.

2. Implement the shortest path through cell header and gateway node to reduce the number of hops traveled.

3. We implement the algorithm for the cell- header selection based on the residual energy of the nodes in the cell.

b) Proposed Work

We give detailed description of our VGDRA scheme, including how to construct the virtual infrastructure and how to maintain fresh routes towards the latest location of the mobile sink. We design a virtual infrastructure by partitioning the sensor field into a virtual grid of uniform sized cells where the total number of cells is a function of the number of sensor nodes. A set of nodes close to center of the cells are appointed as cell-headers which are responsible for keeping track of the latest location of the mobile sink and relieve the rest of member nodes from taking part in routes re-adjustment.

Nodes other than the cell-headers associate themselves with the closest cell-headers and report the observed data to their cell-headers. Adjacent cell-headers communicate with each other via gateway nodes. The set of cell-headers nodes together with the gateway nodes constructs the virtual backbone structure.

The VGDRA scheme constructs the virtual grid structure by first partitioning the sensor field into several uniform sizedcells based on the number of nodes in the sensor field. The rationale behind such portioning is to uniformly distribute the work-load on part of cell-header nodes which consequently results in prolonged network lifetime.

c) Proposed Algorithm

Let G(V,E) be the graph represent the mobile ad-hoc network. V represents the vertices in the network and E represents the links between the nodes.

The algorithm is:

Input: Packet Pi

Output: Packet Pi.

```
AlgoSend(Pi)
{
  If (P.Dest == MyID)
  ProcessPacket(P);
}
Else if (P.nextho == MyID)
{
  GetNeaighbour();
  GetLocation();
  SelectNextHop(p);
  SendPacket(P);
}
Else
{
  DropPacket(P);
}
}
```

Input: Packet Pi.

Output:Nexthop.

```
AlgoNextHop(P)
{
  If (this.id == Gateway)
{
  Getneighbour(); Getlocation(); Nexthop=GetShortestCellHeader();
}
Else
{
    Getneighbour(); Getlocation(); Nexthop=GetShortestGateway();
```

```
}
    Return Nexthop;
}
```

V. CONCLUSION

We proposed a novel Virtual Grid based Dynamic Routes Adjustment (VGDRA) scheme that incurs least communication cost while maintaining nearly optimal routes to the latest location of the mobile sink. We analyze the performance of our VGDRA scheme at different sinks speeds and different data generation rates of the sensor nodes.

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