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# Conservation of Energy for VBS Using Centralized and MIS Based Algorithm in WSN

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**Abstract**

Virtual Backbone is one of the emerging trends in wireless sensor networks. Virtual backbone construction based on Connected Dominating Set (CDS) is a competitive approach among the existing methods used to establish virtual backbone in WSNs. Traditionally, CDS size was the only factor considered in the CDS-based approach. The motivation was that smaller CDS leads to simplified network maintenance. However, routing cost in terms of routing path length is also an important factor for virtual backbone construction. In our research, both of these two factors are taken into account. Specifically, we attempt to devise a polynomial-time constant-approximation algorithm that leads to a CDS with bounded CDS size and guaranteed routing cost. We prove that, under general graph model, there is no polynomial-time constant-approximation algorithm unless P ¼ NP. A polynomial time constant approximation algorithm GOC-MCDS- C that produces a CDS whose size is within a constant factor from that of the minimum CDS. In addition, for each node pair u and v, there exists a routing path with all intermediate nodes in D and path length at most 7 _ dðu; vÞ, where dðu; vÞ is the length of the shortest path between u and v. Our theoretical analysis and simulation results show that the distributed version of the proposed algorithm, GOC-MCDS-D, outperforms the existing approaches.

***IndexTerms—****virtual backbone, fault tolerant routing, adhoc network, cluster formation*

## I. Introduction

Wireless Sensor Network's recent advances in micro-electro-mechanical systems (MEMS) technology, wireless communications, and digital electronics have enabled the development of low-cost, low-power, multifunctional sensor nodes that are small in size and communicate unmetered in short distances. These tiny sensor nodes, which consist of sensing, data processing, and communicating components, leverage the idea of sensor networks based on collaborative effort of a large number of nodes. Sensor networks represent a significant improvement over traditional sensors, which are deployed in the following two ways:

Sensors can be positioned far from the actual phenomenon, i.e., something known by sense perception. In this approach, large sensors that use some complex techniques to distinguish the targets from environmental noise are required.

Several sensors that perform only sensing can be deployed. The positions of the sensors and communications topology are carefully engineered. They transmit time series of the sensed phenomenon to the central nodes where computations are performed and data are fused. A sensor network is composed of a large number of sensor nodes, which are densely deployed either inside the phenomenon or very close to it.

The sensor nodes are usually scattered in a sensor field as shown in Fig. Each of these scattered sensor nodes has the capabilities to collect data and route data back to the sink and the end users. Data are routed back to the end user by a multihop infrastructure less architecture through the sink. The sink may communicate with the task manager node via Internet or Satellite. The protocol stack used by the sink and all sensor nodes. This protocol stack combines power and routing awareness, integrates data with networking protocols, communicates power efficiently through the wireless medium, and promotes cooperative efforts of sensor nodes. The protocol stack consists of the application layer, transport layer , network layer, data link layer , physical layer , power management plane , mobility management plane, and task management plane. Depending on the sensing tasks, different types of application software can be built and used on the application layer. The transport layer helps to maintain the flow of data if the sensor networks application requires it. The network layer takes care of routing the data supplied by the transport layer. Since the environment is noisy and sensor nodes can be mobile, the MAC protocol must be power aware and able to minimize collision with neighbors' broadcast. The physical layer addresses the needs of a simple but robust modulation, transmission and receiving techniques. In addition, the power, mobility, and task management planes monitor the power, movement, and task distribution among the sensor nodes. These planes help the sensor nodes coordinate the sensing task and lower the overall power consumption.

The power management plane manages how a sensor node uses its power. For example, the sensor node may turn off its receiver after receiving a message from one of its neighbors. This is to avoid getting duplicated messages. Also, when the power level of the sensor node is low, the sensor node broadcasts to its neighbors that it is low in power and cannot participate in routing messages. The remaining power is reserved for sensing. The mobility management plane detects and registers the movement of sensor nodes, so a route back to the user is always maintained, and the sensor nodes can keep track of who are their neighbor sensor nodes. By knowing who are the neighbor sensor nodes are, the sensor nodes can balance their power and task usage. The task management plane balances and schedules the sensing tasks given to a specific region. Not all sensor nodes in that region are required to perform the sensing task at the same time. As a result, some sensor nodes perform the task more than the others depending on their power level. These management planes are needed, so that sensor nodes can work together in a power efficient way, route data in a mobile sensor net-work, and share resources between sensor nodes. Without them, each sensor node will just work individually. From the whole sensor network standpoint, it is more efficient if sensor nodes can collaborate with each other, so the lifetime of the sensor networks can be prolonged.

Wireless Sensor Networks is a booming technology for various applications that involve long-term and low-cost monitoring in such applications. In most WSNs, the battery is the sole energy source of the sensor node. Sensor nodes are expected to work on batteries for several months to a few years without replenishing. Thus, energy efficiency becomes a critical issue in WSNs.

Constructing virtual backbone is one of major ways to save limited network resources and optimize network performance [1, 2]. A smaller virtual backbone will not only benefit the design of energy-efficient routing, but also save energy of non dominated nodes which can enter sleep (energy-saving) mode without monitoring task.

At present, researchers [3,4] focus on virtual backbone construction inWSNs. There are two major methods. The Backbone Scheduling (BS) [9], which dynamically turns off the radio of the sensor nodes to save energy. BS lets a fraction of some of the sensor nodes in the network in a WSN turn on their radio to forward messages, which forms a backbone; the rest of the sensor nodes turn off their radio to save energy. This technique does not affect communication quality because WSNs have redundancy. By redundancy, we mean that turning off the radio of some sensor nodes in a WSN does not affect the connectivity of the network. This redundancy results in more than necessary wireless links. Thus, it is possible to construct communication backbones to save energy [5]. Specifically, we use Connected Dominating Set (CDS) [6,7] algorithms to construct such backbones.

The energy level of the sensor nodes may vary in different sensor nodes. This takes life time of the sensor node is always critical.

In this project we propose a distributed algorithm [8] for virtual backbone construction at various energy levels. A motivating example is illustrated in Fig. 1. The figures show a network of five sensor nodes and one sink. The stack beside each node represents its initial energy. Assume that two sensor nodes have same battery level energy that is almost equal and the remaining three nodes are same energy level.

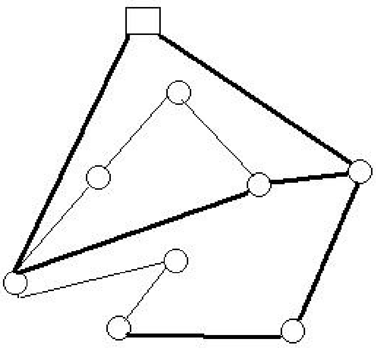

Fig.1 An example of backbone in a WSN

Assuming that first two sensor nodes consumes 1 unit of energy per time and the remaining three are 2 unit of energy per time. Since only one disjointed CDS, which is {sink,0,1}, {sink,0,3} or {sink,1,3}, can be constructed, the network life time is three units of time. On the contrary, VBS schedules {sink,0,1} to work for 1, {sink,0,3} for 1, and {sink,1,3} for 2 units of time, which achieves a network life time of 4 units of time.

VBS combines BS with Duty Cycling by letting backbone sensor nodes work in a duty cycled fashion. Our contributions in this project are as follows:We propose Virtual Backbone construction and duty cycling method for WSN with redundancy.We implement a distributed algorithm that minimizes the distortion of constructed virtual backbone structure to improve life time of sensor nodes at various energy levels.We demonstrate, through extensive analyses and simulations that our proposed solutions significantly prolong the network lifetime compared to the existing approach.

A biocomplexity mapping of the environment requires sophisticated approaches to integrate information across temporal and spatial scales. The advances of technology in the remote sensing and automated data collection have enabled higher spatial, spectral, and temporal resolution at a geometrically declining cost per unit area. Along with these advances, the sensor nodes also have the ability to connect with the Internet, which allows remote users to control, monitor and observe the biocomplexity of the environment.

Although satellite and airborne sensors are useful in observing large biodiversity, e.g., spatial complexity of dominant plant species, they are not fine grain enough to observe small size biodiversity, which makes up most of the biodiversity in an ecosystem. As a result, there is a need for ground level deployment of wireless sensor nodes to observe the biocomplexity. One example of biocomplexity mapping of the environment is done at the James Reserve in Southern California. Three monitoring grids with each having 25–100 sensor nodes will be implemented for fixed view multimedia and environmental sensor data loggers.

Flood detection: An example of a flood detection is the ALERT system deployed in the US. Several types of sensors deployed in the ALERT system are rainfall, water level and weather sensors. These sensors supply information to the centralized database system in a pre-defined way. Research projects, such as the COUGAR Device Database Project at Cornell University and the Data Space project at Rutgers, are investigating distributed approaches in interacting with sensor nodes in the sensor field to provide snapshot and long-running queries. Precision Agriculture: Some of the benefits is the ability to monitor the pesticides level in the drinking water, the level of soil erosion, and the level of air pollution in real time.

Thevirtual backbone structure on the ad-hoc network, in order to support unicast, multicast,and fault-tolerant routing within the ad-hoc network. This virtual backbone differs from the wired backbone of cellular networks in two key ways: (a) it may change as nodes move, and (b) it is not usedprimarily for routing packets or flows, but only for computing and updating routes. The primary routes for packets and flows are still computed by a shortest-paths computation; the virtual backbone can, if necessary provide backup routes to handle interim failures. Because of the dynamic nature of the virtual backbone, our approach splits the routing problem into two levels: (a) find and update the virtual backbone, and (b) then find and update routes. The key contribution of this project is to describe several alternatives for the first part of finding and updating the virtual backbone. To keep the virtual backbone as small as possible we use an approximation to the minimum connected dominating set (MCDS) of the ad-hoc network topology as the virtual backbone. The hosts in the MCDS maintain local copies of the global topology of the network, along with shortest paths between all pairs of nodes.

Topology control is one vital factor to a wireless network's efficiency. A Connected Dominating Set (CDS) can be a useful basis of a backbone topology construction. In this project, a special CDS, named α Minimum routing Cost CDS (α-MOC-CDS), will be studied to improve the performance of CDS based broadcasting and routing. In this project, we prove that construction of a minimum α-MOC-CDS is NP-hard in a general graph and we propose a heuristic algorithm for construction of α-MOC-CDS.

## II. Proposed System

In this work, inspired by the backbone concept in wired networks,virtual backbone is expected to bring substantial benefits to routing in WSNs. Once a virtual backbone is used inWSNs, the routing path search space will be restricted to thebackbone instead of the whole network. This can lead toshorter routing path search time, smaller routing table size,and simpler routing maintenance. In addition, due to thelimited number of sensor nodes in the virtual backbone,WSNs with the virtual backbone feature can adapt totopology changes quickly.In our research, we take both CDS size and routing costinto consideration. Specifically, we attempt to devise apolynomial-time constant-approximation algorithm thatleads to a CDS with bounded CDS size and guaranteedrouting cost in terms of routing path length.Further to improve energy conservation, we introduce the concept of Dynamic Sleep – Awake Mechanism (DSAM) in the virtual backbone construction path and extend the life time of the network.

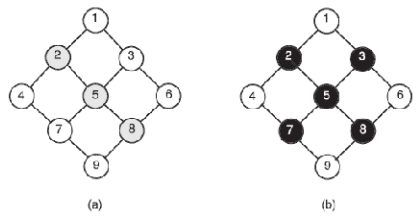


Fig 2 (a) An example MCDS (b) An example CDS.

The following are the individual modules of the proposed system.

i) WSN Establishment

ii) Clustered Formation

iii) Connected Dominating set

iv) Link Management

v) Performance analysis

## WSN Establishment

A wireless sensor network (WSN) consists of spatially distributed autonomoussensors to monitor physical or environmental conditions, such as temperature, sound, pressure, etc. and to cooperatively pass their data through the network to a main location. The more modern networks are bi-directional, also enabling control of sensor activity. The development of wireless sensor networks was motivated by military applications such as battlefield surveillance; today such networks are used in many industrial and consumer applications, such as industrial process monitoring and control, machine health monitoring.

## Cluster Formation

Cluster analysis or clustering is the task of grouping a set of objects in such a way that objects in the same group (called a cluster) are more similar (in some sense or another) to each other than to those in other groups (clusters). It is a main task of exploratory data mining, and a common technique for statisticaldata analysis, used in many fields, including machine learning, pattern recognition, image analysis, information retrieval, and bioinformatics.

## Connected Dominating

A connected dominated set and a maximum leaf spanning tree are two closely related structures defined on an undirected graph.*Definition* :A connected dominating set of a graph G is a set D of vertices with two properties:

1. Any node in D can reach any other node in D by a path that stays entirely within D. That is, Dinduces a connected sub graph of G.
2. Every vertex in G either belongs to D or is adjacent to a vertex in D. That is, D is a dominating set of G.

A minimum connected dominating set of a graph G is a connecting dominating set with the smallest possible cardinality among all connected dominating sets of G. The connected domination number of G is the number of vertices in the minimum connected dominating set.

Any spanning treeT of a graph G has at least two leaves, vertices that have only one edge of T incident to them. A maximum leaf spanning tree is a spanning tree that has the largest possible number of leaves among all spanning trees of G. The max leaf number of G is the number of leaves in the maximum leaf spanning tree.

## Link Management

Used for control of the radio link between two devices, handling matters such as link establishment, querying device abilities and power control. Implemented on the controller. The primary objective of link management is to call attention to hyperlinks that don't work. There are many reasons why a URL might fail. For example: the resource being referenced doesn't exist, the cents on an HTTPS connection is stale or invalid, firewall issues, timeouts, etc. Minimizing a website's "links to nowhere" requires some up-front design work, as well as regular maintenance and monitoring. Pointing to a resource using a URL is more subtle than it might appear at first because: Websites often employ multiple schemes for classifying/naming resource, Evaluation context can alter how a link binds to a resource (e.g.: via cookies, referrer, etc.), Links can be unintentionally ambiguous or overly specific

Therefore, the tasks of URL design and maintenance within a website are intertwined. The design and evaluation context of a link implies things about what website changes will cause it to break, point at something else, or remain the same. It is normal to have broken links during website development, and important to allow developers to create them temporarily. Without this ability, reorganizing a collection of interdependent assets can become needlessly painful, and can even lead to "deadlock" situations. Further, because websites can generate links on the fly based on any computation, it is theoretically impossible to check "all the links"; there's simply no way to tell that every link the site can generate has been generated,

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or even if the set is finite! For these reasons, the goal of link management is to find certain well-defined problems (not all of them), and to report them (not prevent them).

Alfresco includes several features that identify a wide range of problems at submit time, during reviews, within workareas (on demand), and prior to publishing a website. Unlike a simple file parser utility, Alfresco's link validation service makes requests for web pages to a server; thus links that are created dynamically within these pages can also be tested, along with whatever content filters the website/webapp has in place. This approach is much more thorough than a simple "flat file parser", as it simulates what a normal user would experience if they were to browse the site.

Because websites can be very large, may contain a substantial number of JSPs (each of which must be compiled before running), and may reference external sites that are slow to respond, even an incomplete validation can be cpu, memory, bandwidth, and time-intensive.

## Performance Analysis

Performance analysis involves gathering formal and informal data to help customers and sponsors define and achieve their goals. Performance analysis uncovers several perspectives on a problem or opportunity, determining any and all drivers towards or barriers to successful performance, and proposing a solution system based on what is discovered. Performance analysis is the front end of the front end. It's what we do to figure out what to do. Some synonyms are planning, scoping, auditing, and diagnostics.

## Algorithms

### *Algorithm 1:Centralized Algorithm GocMcds*

1: Initially Set D ->0

2: Step 1. Construct a maximal independent set I.

3: Step 2. For every pair of nodes u, v in I with d (u, v) < = 3compute a shortest path p(u, v) and put all intermediate nodes of p(u, v) into C.

4: Output D = C U I

### *ALGORITHM 2. CONSTRUCT A MIS I (STAGE 1)*

1: Initially Every node is colored in white and is assigned with a positive integer ID; different nodes have different IDs.

2:Every white node send its ID to its neighbors and then compares its ID with received IDs from neighbors. If its ID is smaller than every received ID from neighbors, then it turns the color from white to black.

3: Every black node sends message ”black”to its neighbors. If a white node receives a message ”black”, then it turns its color from white to gray.

4: Go back to Step 1 until no white node exists.

5: Output All black nodes form a maximal independent set I

CONNECT THE MIS I (STAGE 2)

1: Every black node send its ID to its neighbors.

2: Every node add its own ID id2 to each received ID id1 and then send those pairs of IDs, (id1; id2), to all its neighbors.

3: Each node do the following: Suppose its ID is id*

1) For each pair of IDs id1 and id1_ received in Step 1, if id1 < id1*, then send a message (id1*,id*,id1) to the neighbor with ID id1.

2) For each message (id1, id2) received at Step 2 and ID id1_ received at Step 1, if id1 < id1*, then send a message (id1*,id*,id2, id1) to the neighbor with ID id2; otherwise, send a message (id1, id2, id*; id1* ) to the neighbor with ID id1*.

4: When a node with ID id2 received a message (id1*; id*; id2; id1), it sends this message to its neighbor with ID id1.

5: Each black node with ID id1 collects all messages in form (id3; id2; id1) or (id4; id3; id2; id1) or received in Step 3 and Step 4. Suppose those messages form a set M. Then perform the following computation. while M != do begin

choose (idh; . . . ; id2; id1) 2 M;

send message (idh; . . . ; id2; id1) to node with ID id2;

delete all messages starting with idh from M;

end-while

6: when a node with ID idi received a message (. . . ; idi_1; idi; . . .), it turns black. In addition, if idi is not the leftmost id in the message, then it passes this message to node with ID idi_1; if idi is the leftmost id in the message, do nothing.

7: If no message is passed in Step 6, then stop.

Otherwise, go back to Step 6

## III. Experimental results

It involves collecting formal and informal data to help customers and sponsors define and achieve their goals.And uncovers several perspectives on a problem or opportunity.Thendetermining barriers to successful performance, and proposing a solution system based on what is discovered.

## IV. Conclusion and Future Work

CDS-based virtual backbone construction with bounded CDS size and guaranteed routing cost is NP-hard under both general graph and UDG model. Under UDG model, we propose an innovative polynomial-time constant-approximation algorithm, GOCMCDS- C, that produces a CDS with bounded CDS size and guaranteed routing cost in terms of routing path length. The distributed version, GOC-MCDS-D, is studied thoroughly through theoretical analysis and extensive simulations. Our simulation results clearly show that GOC-MCDS-D outperforms the existing algorithms. Further to improve energy conservation, we develop the concept of Dynamic Sleep – Awake Mechanism (DSAM) in the virtual backbone construction path and extend the life time of the network. we presented a distributed algorithm which produces a CDS D with size$|D| \leq 443\frac{2}{3}\text{opt}_{\text{MCDS}} + 201\frac{2}{3}$

and with property that for any pair of nodes u and v,

$d_D(u,v) <= 5d(u,v)$.

The result in this project indicates that when it is increased from 5 to 7, the size of the CDS can be reduced significantly. This tradeoff was first found through computational experiments.

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