A Survey on Parallel Algorithm For Cluster-Based Wireless Sensor Network Design

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Abstract— Wireless sensor networks (WSN) are used in many applications like environmental monitoring, infrastructure security, healthcare applications, and traffic control. The design issue of such applications must address related to challenges around WSN Characteristics on one hand and the applications on the other. Middleware is a software that provides a common platform for the heterogeneity in WSN, enabling multiple applications to work parallel on a distributed network. This paper surveys the work state of research in middleware design, development and general issues in designing a middleware for WSN. It also examines the various approaches of middleware design, the trends and challenges to be addressed when designing and developing these solutions for WSN.

Keywords: WSN, Middleware, Parallel Algorithm, Distributed Networks, QoS.

I. SENSOR NETWORKS

In recent years, Wireless Sensor Networks (WSNs) are applied in many areas, such as environment monitoring, medical treatment, traffic control and target tracking, etc. However, the limited and irreplaceable battery power of each sensor node have hindered the development of WSNs. Making use of sensor node's energy to prolong the networks lifetime is a primary goal when designing WSNs routing protocol. Due to the energy conserving and well expansibility [1], Cluster-based routing protocol has been caused a wide attention. The concept of wireless sensor networks is based on a simple equation:

Sensing + CPU + Radio = Thousands of potential applications

As soon as people understand the capabilities of a wireless sensor network, hundreds of applications spring to mind. It seems like a straightforward combination of modern technology.

However, actually combining sensors, radios, and CPU's into an effective wireless sensor network requires a detailed understanding of the both capabilities and limitations of each of the underlying hardware components, as well as a detailed understanding of modern networking technologies and distributed systems theory. Each individual node must be designed to provide the set of primitives necessary to synthesize the interconnected web that will emerge as they are deployed, while meeting strict requirements of size, cost and power consumption.

A core challenge is to map the overall system requirements down to individual device capabilities, requirements and actions. To make the wireless sensor network vision a reality, architecture must be developed that synthesizes the envisioned applications out of the underlying hardware capabilities.

Sensor networks are not (necessarily) connected to any static (i.e. wired) infrastructure. An ad-hoc network is a LAN or other small network, especially one with wireless connections, in which some of the network devices are part of the network only for the duration of a communications session or, in the case of mobile or portable devices, while in some close proximity to the rest of the network.

To achieve the goal of providing connectivity anywhere, ad Sensor networks have special properties that differentiate them from other networks. Ad-hoc networks are temporary networks because they are created to fulfill a special purpose and finish to exist after fulfilling this purpose. Mobile devices might randomly join or leave the network at any time, thus ad hoc networks have a dynamic infrastructure. Most mobile devices use radio or infrared frequencies for their communications that leads to a very limited transmission range.

Usually the transmission range is increased by using multi-hop routing paths. The most distinguishing properties of ad hoc networks are that the networks are self-organized. All network connections have to be executable in the absence of a trusted third party (TTP), such as the establishment of a secure channel between nodes and the initialization of newly joining the nodes. Hence, when compared to wireless networks, ad hoc networks do not rely on a fixed infrastructure and the accessibility of a TTP. The self-organizing property is unique to ad hoc networks and makes implementing security protocols a very challenging task. The simple architecture of sensor network is shown in figure 1.

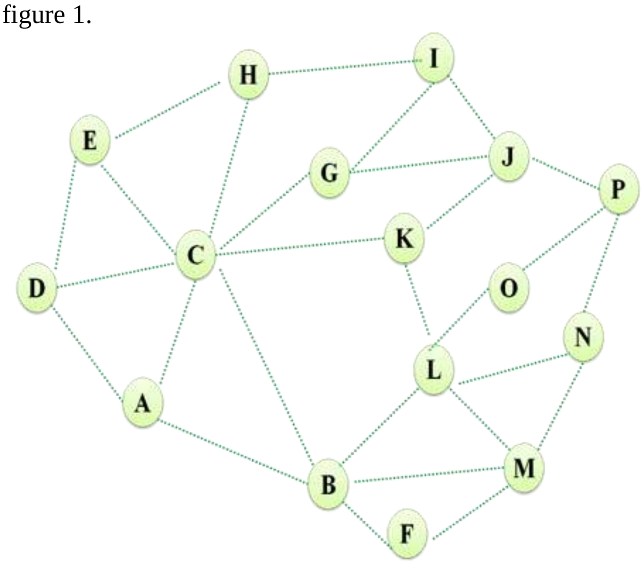

Figure 1: Simple sensor network

There are some nodes connected to each other. These nodes has its own range of data transmission so that it can send data one node to another node easily. This range can overlap each other so that is possible to communicate to other node. Routing data detected from the source to the sink node in an environment of limited resources is always a challenge. An optimal path is selected based on parameters such as the gradient information, the minimum hop, at least transportation cost, high residual energy, etc. to carry data between the source and drain.

Many routing protocols try to reduce power consumption in the nodes to increase the lifetime of the network. This allows optimal trajectory between the source and destination. Selecting an optimal path between the source and destination and sending data so you cannot increase the network life. Power consumption in this type of approach is not as thoughtful and ff approaches in multipath routing.

The multi-path routing protocols select multiple routes available between source and receiver node. There are multi-path routing paths bareheaded is much more than simple routing path. On the other hand, the route discovery frequency is much less in a network using multi-path routing, since the network can still operate even if one or more of the multiple paths between a source and a destination fail. The maintenance of the route mechanism allows the other way to route data from an active form is a failure.

II. SENSOR NETWORK ROUTING

Routing in sensor networks involves finding a path from the source to the destination, and delivering packets to the destination nodes while nodes in the network are moving freely [2]. Due to node mobility, a path established by a source may not exist after a short interval of time. To manage with node mobility nodes need to maintain routes in the network. Depending on how nodes establish and maintain paths, routing protocols for ad-hoc networks broadly fall into pro-active, reactive, hybrid, and location-based categories as shown in figure 2.

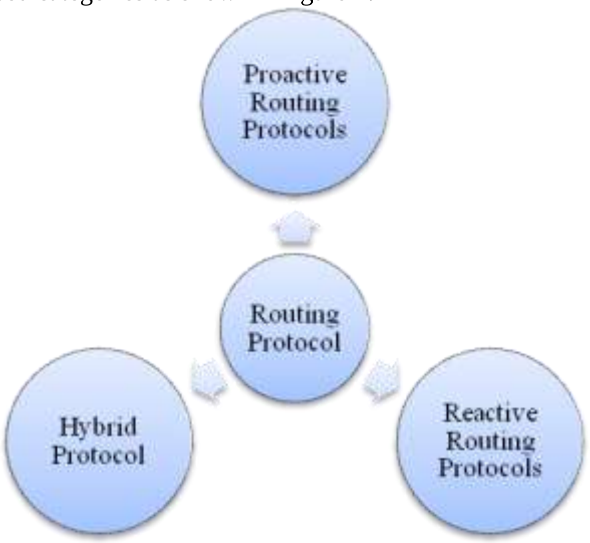

Figure 2: Protocol Used in sensor network

If a routing protocol is needed, why not use a conventional routing protocol like link state or distance vector. They are well tested and most computer communications people are familiar with them. The main problem with link-state and distance vector is that they are designed for a static topology, which means that they would have problems to converge to a steady state in an ad-hoc network with a very frequently changing topology.

Link state and distance vector would probably work very well in an sensor network with low mobility, i.e. a network where the topology is not changing very often. The problem that still remains is that link-state and distance-vector are highly dependent on periodic control messages [3]. As the number of network nodes can be large, the potential number of destinations is also large. It requires large and frequent exchange of data among the network nodes.

This is in contradiction with the fact that all updates in a wireless interconnected sensor network are transmitted over the air and thus are costly in resources such as bandwidth, battery power and CPU. Because both link-state and distance vector tries to maintain routes to all reachable destinations, it is necessary to maintain these routes and this also wastes resources for the same reason as above [4].

Another characteristic for conventional protocols are that they assume bi-directional links, e.g. that the transmission between two hosts works equally well in both directions. In the wireless radio environment this is not always the case. The classification of routing protocol used in wireless sensor network (WSN) is shown in figure 3.

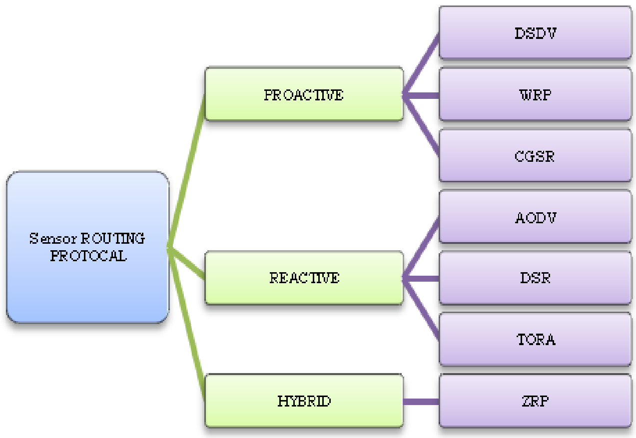

Figure 3: Hierarchy of routing protocol over WSN

A. Pro-active Routing Protocols

Pro-active routing protocols are table-driven protocols that maintain up-to-date routing table using the routing information learnt from the neighbors on a continuous basis. Routing in such protocols involves selecting a path form the source to the destination, where the source node and each intermediate node selects a next hop, by routing table look up, and forwarding the packet to next hop until destination receives the packet [5]. A drawback of such protocols is the proactive overhead due to route maintenance and frequent route updates to manage with node mobility. An example of this class is the DSDV.

DSDV: The Destination-Sequenced Distance-Vector Routing protocol (DSDV) is an enhanced version of distributed Bellman-Ford algorithm, for sensor networks. In this protocol, each node maintains a routing table that contains an entry for every node in the network. Each entry in the routing table consists of the destination ID, the next hop ID, a hop count, and a sequence number for that destination. The sequence number helps nodes maintain a fresh route to the destination and avoid routing loops. To cope with frequently changing network topology, nodes periodically broadcast routing table updates thought-out the network [6]. When a node receives a route-update packet, it changes its routing table entries if the sequence number of the destination in the update packet is higher (fresh) than the one in its routing table.

If the sequences numbers are the same, then the node selects a route with smaller metric (hop count). To reduce the network traffic due to large update packets, DSDV employs two types of updates full dump and incremental. A full dump packet generated by a node contains all entries in its routing table. Whereas an incremental packet contains only the routing table entries that are changed by the node since the last full dump. A node triggers an update when either the metric for a destination changes or when the sequence number changes.

B. Reactive Routing Protocols

Reactive routing protocols are demand-driven protocols that find path when necessary. In such protocols, establishing a new route involves a route discovery phase consisting of route request (flooding) and a route reply (by the destination node) [5]. Nodes maintain only the active routes until a desired period or until destination becomes inaccessible along every path from the source node. A drawback of such protocols is the delay due to route discovery. We briefly discuss the AODV and DSR protocols next.

Dynamic Source Routing (DSR) was one of the first reactive routing protocols for ad-hoc networks. In DSR, nodes use RREQ, RREP, and RERR packets to establish and maintain paths to the destination. However, unlike AODV, RREQ packet accumulates a list of node IDs along the path from the source to the destination and the corresponding RREP packet carries this list of IDs back to the source. Once the source node receives RREP packet, it starts transmitting data packets to the destination by embedding the route from the source to the destination in the packet header.

The path in the data packet header is referred to as the “source route". Every node in the network stores route to other nodes in the network by maintaining a dynamic route cache. A node learns routes to other nodes when it initiates a RREQ to a particular destination or when the node lies on an active path to that destination. In addition to these, a node may also learn a route by overhearing transmissions along the routes of which it is not a part.

C. Hybrid Routing Protocols

Hybrid protocols combine the advantages of various approaches of routing protocols into a single protocol. The Zone Routing Protocol (ZRP) is one such hybrid protocol that combines both the proactive and reactive routing approaches. ZRP takes advantage of pro-active discovery within a node’s local neighborhood, and uses a reactive protocol for communication between these neighborhoods. The local neighborhoods are called Zones, and each node may be within multiple overlapping zones [1-3].

ZRP is motivated by the fact that “the most communication takes place between nodes close to each other. Changes in the topology are most important in the locality of a node - the addition or the removal of a node on the other side of the network has only limited impact on the local neighborhoods". The performance of ZRP depends on choosing a radius, which decides the transition from pro-active to reactive behavior. With a carefully chosen radius, ZRP can achieve better efficiency and scalability over both pro-active and reactive routing protocols.

D. Position-based Routing Protocols

Position-based routing protocols utilize position of nodes in the network and make the least use of the topology information. Routing protocols using such a scheme eliminate drawbacks due to frequently changing network topology. DREAM, GPSR, and LAR are some of the examples of position-based routing protocols. In Position-based routing protocols nodes maintain local (one or two hop) topology information with the help of a hello protocol. To route a packet to the destination, the source node uses a greedy-forwarding to select a next hop towards the destination [7].

In greedy-forwarding, a node selects a next-hop towards the destination that is geographically closest to the destination among its neighboring nodes. Since there is no pre-established route from a source to the destination, each packet may follow a different path depending on the network topology. There are two parts to position-based routing: (a) given the position of the source, the position of the destination, and a local neighbor table of each node, delivering packets from the source to the destination, and (b) given that each node can determine its own position, using some positioning system like GPS, obtaining the position of any other node in the system.

The former part is the position-based routing, examples include GFG, GPSR. Position-based routing is typically greedy-forwarding along with a recovery mechanism to avoid local optima due to greedy-forwarding, a condition where there is no node close to an intermediate node in its neighborhood than the node itself [7].

The later part is called the location service. Some of the examples of location-service protocols are GLS, DLM, and RLS. Interestingly, most location-service protocols including GLS and DLM rely on the underlying greedy forwarding algorithm to send and receive control packets like location updates and location queries. The advantage of these protocols is that nodes need not establish, maintain routes, and these protocols are more scalable compared to reactive and pro-active routing protocols.

III. CURRENT SCENARIO

It is seen that most of the previous approaches for chose alternate path directly when any node shout down that dropped performance and have relative higher complexity. As the mobile nodes operate on the limited power of battery

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therefore it becomes very necessary to develop techniques which can successfully maintaining lesser complexity.

Wireless sensor networks have been developed and applied to industrial, commercial, defense and civil sector applications. Energy is the main obstacle in sensor networks. Techniques energy management increases the life cycle of the sensor array and to improve production efficiency. Approaches to multi-hop communication and clustering are used to save node energy in sensor networks.

Protocols energy to minimize the participation of current sensor nodes with less energy and select the optimal path to the threshold energy. In sensor networks, cluster heads (CHS) to collect data from sensor nodes and sent to the neighbor CHS and finally to the base station (BS). CHS help save energy node. Cluster management techniques designed to minimize the number of clusters, the density of the cluster and the cluster energy consumption. In this paper, we propose Energy organized aware clustering protocol (SECC) for sensor networks wireless sensor network group based energy node and groups of remote nodes. If the energy of the node is less than the threshold value, SECC self-organized clusters of forms and reorganize the sensor array [8].

Wireless sensor network (WSN) consists of sensor nodes with tiny sensors, computing and wireless communications capabilities. Today, he is finding wide application deployment and increasing because it allows reliable monitoring and analysis environment. The design of routing protocols for WSN is affected by many factors such as difficult fault tolerance, energy efficiency, scalability, latency, energy consumption and network topology. In this article, we focus primarily on reducing end to end latency efficiency and energy as the main design of routing protocols for WSN goals without overshadowing other design factors [3].

The energy of the wireless sensor network (WSN) is usually powered by limited batteries and portable. As it is not a big challenge, coupled with the growing demand in sensor networks for multimedia applications, the use of renewable energy in sensor networks becomes essential. In this work, WSN nodes generate renewable energy used for routing and detection by the solar panel and a routing protocol for energy efficiency energy recovery WSN is designed and implemented. In route selection, quality of transmission, energy consumption and energy expenditure are taken into account and the effect of bit error rate (BER) is considered. The quality of the transmission varies as a BER Bernoulli process [4].

The design of protocols for efficient and reliable routing for mobility-oriented energy wireless sensor networks (WSN) applications such as wildlife monitoring, battlefield surveillance and health monitoring is a big challenge because the network topology changes frequently. Existing routing protocols based on clusters to mobiles-Enhanced-Leach-Mobile Leach CBR-Mobile are designed for mobile sensor networks that make up the energy efficiency of sensor nodes [5].

The speed of approach of routing protocol is provided, since the residual energy in routing decisions. Due to the limited area of a sensor node power, energy efficient routing is a very important issue in sensor networks. This approach finds paths of energy efficiency for delay data limited in real-time traffic. Speed protocol does not consider any energy metric in its path. In our approach, the routing is based on a weighting function, which is a combination of three factors: Delay, power and speed. In this case, the node value of the largest of the weight function should be selected as the next hop of the transmission [6].

Extend the life of the network depends on the efficient management of sensing node energy resource. Thus, energy consumption is one of the most important problems in the design of WSN. Hierarchical routing protocols are known with regard to energy efficiency. Using a clustering technique hierarchical routing protocols greatly reduce the energy consumed in the collection and dissemination of data. In this article, we offer energy efficiency hierarchical balanced adaptive routing protocol (HABRP) to reduce the probability of failure of nodes and prolong the time before the death of the first node (stable period) and duration of increased life heterogeneous wireless sensors is crucial for many applications [7]. Because of the limited wireless sensor networks (WSN) routing energy plays a crucial role in improving energy efficiency.

The protocol hierarchy adaptation for low energy (Leach) combination is a classic way to reduce energy costs, but does not take into account the residual energy of sensor nodes and long range communication that is network coverage and low energy intensive. To avoid these drawbacks, we propose an efficient routing protocol based on the energy grid (GEERP) that focuses on three improvements: energy, energy efficiency and network coverage. In GEERP, sensor networks are divided into two levels: one is called secondary network (SG), which is formed by a cluster head (CH) and cluster members (CMS); the other level is main grid (PG), which consists of nine adjacent SG. In each round, CH is selected as a function of the level of residual energy of sensor nodes in a cluster. CH fused to flow through node multihop routing is determined by the minimum weight data is then transferred [8].

Parallel algorithm for the solution of an integrated topology control and routing problem in Wireless Sensor Networks (WSNs). After presenting a mixed-integer linear optimization formulation for the problem, for its solution, they develop an effective parallel algorithm in a Master–Worker model that incorporates three parallelization strategies, namely low-level parallelism, domain decomposition, and multiple searches (both cooperative and independent) in a single Master–Worker framework [9].

IV. CONCLUSION

In this paper, it is seen that most of the previous approaches for chose alternate path directly when any node shout down that dropped performance and have relative higher complexity. As the mobile nodes operate on the limited power of battery therefore it becomes very necessary to develop techniques which can successfully maintaining lesser complexity. The objective of this dissertation is to promote energy efficiency, i.e., high spatial redundancy of sensors present in dense deployments can be exploited by only allowing a subset of sensors active in a period while all other sensors save energy being in inactive state.

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