ISSN (Online) 2278-1021
ISSN (Print) 2319 5940

International Journal of Advanced Research in Computer and Communication Engineering
Vol. 4, Issue 10, October 2015

Power and Pressure Efficient Data Dissemination Protocol for Underwater Sensor Networks

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Abstract: Underwater sensing element networks are pictured as small power affected devices, which may be scattered over a part of interest, to alter observance of that region for Associate in nursing extended amount of your time. The sensing element devices are pictured to be capable of forming Associate in nursing autonomous wireless network, over that detected knowledge will be delivered to a nominal set of destinations. This work considers a wireless sensing element network and addresses the matter of minimizing power consumption in every sensing element node regionally whereas guaranteeing 2 world (i.e., network wide) properties: (i) communication property, and (ii) sensing coverage. A sensing element node saves energy by suspending its sensing and communication activities consistent with a weighted truthful planning theoretical account. The proposed system presents a weighted truthful planning model and its answer for steady state distributions to work out the operation of one node. Given the steady state chances, we tend to construct a non-linear improvement downside to reduce the facility consumption. Simulation studies to look at the collective behavior of huge variety of sensing element nodes turn out results that are foretold by the analytical model.

Keywords: Underwater wireless sensor networks, Power and Pressure, DSR and AODV.

I. INTRODUCTION

The Underwater wireless sensor networks of the near future are envisioned to consist of hundreds to thousands of inexpensive wireless nodes, each with some computational power and sensing capability, operating in an unattended mode. They are intended for a broad range of environmental sensing applications from vehicle tracking to habitat monitoring. The hardware technologies for these networks – low cost processors, miniature sensing and radio modules – are available today, with further improvements in cost and capabilities expected within the next decade. The applications, networking principles and protocols for these systems are just beginning to be developed.

Sensor networks are quintessentially event-based systems. A sensor network consists of one or more "sinks" which subscribe to specific data streams by expressing interests or queries. The sensors in the network act as "sources" which detect environmental events and push relevant data to the appropriate subscriber sinks. Because of the requirement of unattended operation in remote or even potentially hostile locations, sensor networks are extremely energy-limited. However since various sensor nodes often detect common phenomena, there is likely to be some redundancy in the data the various sources communicate to a particular sink. In-network filtering and processing techniques can help to conserve the scarce energy resources.

A Wireless Sensor Network is comprised solely of wireless stations. The communication between source and destination nodes may require traversal of multiple hops because of limited radio range. Existing routing algorithms can be broadly classified into topology-based and position-based routing protocols.

Topology-based routing determines a route based on network topology as state information, which needs to be collected globally on demand as in routing protocols DSR and AODV or proactively maintained at nodes as in DSDV. The scope of this paper is focused on position-based routing, also called geometric or geographic routing. Position-based routing protocols are based on knowing the location of the destination in the source plus the location of neighbors in each node.

II. LITERATURE REVIEW

P. Gupta and P. R. Kumar[1]introduced when n identical randomly located nodes, each capable of transmitting at W bits per second and using a fixed range, form a wireless network, the throughput $\lambda(n)$ obtainable by each node for a randomly chosen destination is $\Theta(W/\sqrt{(nlogn)})$ bits per second under a noninterference protocol. If the nodes are optimally placed in a disk of unit area, traffic patterns are optimally assigned, and each transmission's range is optimally chosen, the bit-distance product that can be transported by the network per second is $\Theta(W\sqrt{An})$ bit-meters per second. Thus even under optimal circumstances, the throughput is only $\Theta(W/\sqrt{n})$ bits per second for each node for a destination nonvanishingly far away. Similar results also hold under an alternate physical model where a required signal-to-interference ratio is specified for successful receptions.

Gross glauser [2] proposed the capacity of ad hoc wireless networks is constrained by the mutual interference of concurrent transmissions between nodes. We study a model of an ad hoc network where nodes communicate in random source–destination pairs. These nodes are assumed to be mobile. We examine the per-session throughput for

ISSN (Online) 2278-1021
ISSN (Print) 2319 5940

International Journal of Advanced Research in Computer and Communication Engineering
Vol. 4, Issue 10, October 2015

applications with loose delay constraints, such that the topology changes over the time-scale of packet delivery. Under this assumption, the per-user throughput can increase dramatically when nodes are mobile rather than fixed. This improvement can be achieved by exploiting a form of multiuser diversity via packet relaying.

E. Leonardi [3]discussed study the throughput capacity of hybrid wireless networks. A hybrid network is formed by placing a sparse network of base stations in an ad hoc network. These base stations are assumed to be connected by a high-bandwidth wired network and act as relays for wireless nodes. They are not data sources nor data receivers. Hybrid networks present a tradeoff between traditional cellular networks and pure ad hoc networks in that data may be forwarded in a multi-hop fashion or through the infrastructure. It has been shown that the capacity of a random ad hoc network does not scale well with the number of nodes in the system [1]. In this work, we consider two different routing strategies and study the scaling behavior of the throughput capacity of a hybrid network. Analytical expressions of the throughput capacity are obtained. For a hybrid network of n nodes and m base stations, the results show that if m grows asymptotically slower than √ n, the benefit of adding base stations on capacity is insignificant. However, if m grows faster than √n, the throughput capacity increases linearly with the number of base stations, providing an effective improvement over a puread hoc network. Therefore, in order to achieve non-negligible capacity gain, the investment in the wired infrastructure should be high enough.

Liu[4] introducedthe transport capacity of ad hoc networks with a random flat topology under thepresent support of an infinite capacity infrastructure network. Such a network architecture allows ad hoc nodes to reach each other by purely using ad hoc nodes as relays. In addition, ad hoc nodes can also utilize the existing infrastructure fully or partially by reaching any access point (or gateway) of the infrastructure network in a single or multi-hop fashion. Using the same tools as in [1], we show that the per source node capacity of Θ(W/log(N)) can be achieved in a random network scenario with the assumptions that the number of ad hoc nodes per access points is bounded above and that Nad hoc nodes excluding the access points, each capable of transmitting at W bits/sec using a fixed transmission range, constitute a connected graph. This is a significant improvement over the capacity of random ad hoc networks with no infrastructure support which is found as Θ(W/pNlog(N)) in [1]. Although better capacity figures are obtained by complex network coding or exploiting mobility in the network, infrastructure approach provides a simpler mechanism that has more practical aspects. We also show that even when less stringent requirements are imposed on topology connectivity, a per source node capacity figure that is arbitrarily close to Θ(1) cannot be obtained. Nevertheless under these weak conditions.

U. C. Kozat and L. Tassiulas [5] proposedthe capacity of static wireless networks, both adhoc and hybrid, under the Protocol and Physical Models of communication, proposed in [1]. For ad hoc networks with n nodes, we show that under the Physical Model, where signal power is assumed to attenuate as 1=r_, _ > 2, the transport capacity scales as (p n) bit-meters/sec. The same bound holds even when the nodes are allowed to approach arbitrarily close to each other and even under a more generalized notion of the Physical Model wherein the data rate is Shan- non's logarithmic function of the SINR at the receiver. This result is sharp since it closes the gap that existed between the previous best known upper bound of O(n_?1_) and lower bound of (p n). We also show that any spatio-temporal scheduling of trans- missions and their ranges that is feasible under the Protocol Model can also be realized under the Physical Model by an appropriate choice of power levels for appropriate thresholds. This allows the generalization of various lower bound constructions from the Protocol Model to the Physical Model. In particular, this provides a better lower bound on the best case transport capacity than in [1]. For hybrid networks, we consider an overlay of _n randomly placed wired base stations. It has previously been shown in [5] that if all nodes adopt a common power level, then each node can be provided a throughput of at most (1log n) to randomly chosen destinations. Here we show that by allow- ing nodes to perform power control and properly choosing.It is further possible to provide a throughput of (1) to any fraction f, 0 < f < 1, of nodes. This result holds under both the Protocol and Physical models of communication. On the one hand, it shows that that the aggregate throughput capacity, measured as the sum of individual throughputs, can scale linearly in the number of nodes. On the other hand, the result underscores the importance of choosing minimum power levels for communication and suggests that simply communicating with the closest node or base station could yield good capacity even for multihop hybrid wireless networks.

III. TWO DIMENSIONAL HYBRID RANDOM WALK MODEL

Consider a unit square which is further divided into 1=B2 squares of equal size. Each of the smaller square is called a RW-cell (random walk cell), and indexed by (Ux;Uy) where Ux;Uy∈ {1; : : : ; 1=B}.A node which is in one RW-cell at a time slot moves to one of its eight adjacent RW-cells or stays in the same RW-cell in the next time-slot with a same probability. Two RW-cells are said to be adjacent if they share a common point. The node position within the RW-cell is randomly and uniformly selected.

Mobility time scales: Two time scales of mobility are

Fast mobility: The mobility of nodes is at the same time scale as the transmission of packets, i.e., in each time-slot, only one transmission is allowed.

Slow mobility: The mobility of nodes is much slower than the transmission of packets, i.e., multiple transmissions may happen within one time-slot.

Scheduling Policies: We assume that there exists a scheduler that has all the information about the current and past status of the network, and can schedule any radio transmission in the current and future time slots, similar to We say a packet p is successfully delivered if and only if all destinations within the multicast session have received the packet. In each time slot, for each packet p that has not been successfully delivered and each of its unreached destination k, the scheduler needs to perform the following two functions:

Capture: The scheduler needs to decide whether to deliver packet p to destination k in the current timeslot. If yes, the scheduler then needs to choose one relay node (possibly the source node itself) that has a copy of the packet p at the beginning of the timeslot, and schedules radio transmissions to forward this packet to destination k within the same timeslot, using possibly multi-hop transmissions. When this happens successfully, we say that the chosen relay node has successfully captured the destination k of packet p. We call this chosen relay node the last mobile relay for packet p and destination k. And we call the distance between the last mobile relay and the destination as the capture range.

Duplication: For a packet p that has not been successfully delivered, the scheduler needs to decide whether to duplicate packet p to other nodes that does not have the packet at the beginning of the time-slot. The scheduler also needs to decide which nodes to relay from and relay to, and how.

All transmissions can be carried out either in ad hoc mode or in infrastructure mode. We assume that the base stations have a same transmission bandwidth, denoted by Wi for each. The bandwidth for each mobile ad hoc node is denoted by Wa. Further, we evenly divide the bandwidth Wiin to two parts, one for uplink transmissions and the other for downlink transmissions, so that these different kinds of transmissions will not interfere with each other.

Uplink: A mobile node holding packet p is selected, and transmits this packet to the nearest basestation. Infrastructure relay: Once a base station receives a packet from a mobile node, all the other mbase stations share this packet immediately, (i.e.,the delay is considered to be zero) since all basestations are connected by wires. Downlink: Each base station searches for all the packets needed in its own subregion, and transmit all of them to their destined mobile nodes. At this step, every base station will adopt TDMA schemes to delivere different packets for different multicast sessions.

IV. ENERGY EFFICIENT ROUTING PROTOCOL

In contrast to simply establishing correct and efficient routes between pair of nodes, one important goal of a routing protocol is to keep the network functioning as long as possible. As discussed in the Introduction, this goal can be accomplished by minimizing mobile nodes' energy not only during active communication but also when they are inactive. Transmission power control and load distribution are two approaches to minimize the active communication energy, and sleep/power-down mode is used to minimize energy during inactivity. Table 1 shows taxonomy of the energy efficient routing protocols. Before presenting protocols that belong to each of the three approaches in the following subsections, energy-related metrics that have been used to determine energy efficient routing path instead of the shortest one are discussed.

- energy consumed/packet,
- time to network partition,
- variance in node power levels,
- cost/packet, and
- Maximum node cost.

The first metric is useful to provide the min-power path through which the overall energy
Consumption for delivering a packet is minimized. Here, each wireless link is annotated with the link cost in terms of transmission energy over the link and the min-power path is the one that minimizes the sum of the link costs along the path. However, a routing algorithm using this metric may result in unbalanced energy spending among mobile nodes. When some particular mobile nodes are unfairly burdened to support many packet-relaying functions, they consume more battery energy and stop running earlier than other nodes disrupting the overall functionality of the ad hoc network. Thus, maximizing the network lifetime (the second metric shown above) is a more fundamental goal of an energy efficient routing algorithm: Given alternative routing paths, select the one that will result in the longest network operation time.

However, since future network lifetime is practically difficult to estimate, the next three metrics have been proposed to achieve the goal indirectly. Variance of residual battery energies of mobile nodes is a simple indication of energy balance and can be used to extend network lifetime. Cost-per-packet metric is similar to the energy-per-packet metric but it includes each node's residual battery life in addition to the transmission energy. The corresponding energy-aware routing protocol prefers the wireless link requiring low transmission energy, but at the same time avoids the node with low residual energy whose node cost is considered high. With the last metric, each path candidate is annotated with the maximum node cost among the intermediate nodes (equivalently, the minimal residual battery life), and the path with the minimum path cost, min-max path, is selected. This is also referred to as max-min path in some protocols because they use nodes' residual battery life rather than their node cost.

V. EXPERIMENTAL RESULTS

The selection of the cluster by the nodes and the attributes for the selection of cluster head is very important and a hot topic among the researchers. The different factors for clustering techniques. The important factors that contribute towards the formation of a clustering technique include the Network model, Clustering objectives and Clustering attributes. The network model consists of the architecture and design of the underlying sensor network. There can be further sub factors in network model. First is the network dynamics like the node, cluster head and base

 DOI 10.17148/IJARCCE.2015.41092

ISSN (Online) 2278-1021
ISSN (Print) 2319 5940

International Journal of Advanced Research in Computer and Communication Engineering
Vol. 4, Issue 10, October 2015

station can be static or mobile. The sensor nodes are static normally with a few exceptions, the mobility of cluster head or base station can cause serious problems in clustering process. The events sensed by the nodes can be irregular or continual depending on the situation, and effect in selection of reactive or adaptive clustering. Second is the in-network data processing. The sensor nodes in the same area can generate a lot of redundant data, so there is need for techniques like data aggregation and fusion to eliminate this redundancy.

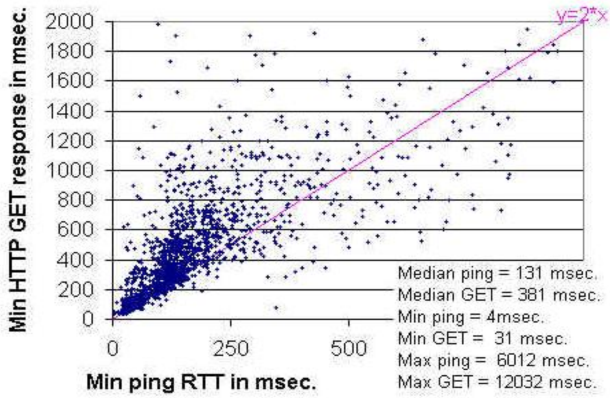
Third one is the node deployment and node features. The nodes can be deployed manually or randomly. In the first case, routing becomes easier as all routes are predefined. Whereas, the nodes self-organize in case of random deployment, so the clustering process is difficult and thought consuming. The nodes can have different features and selection of proper nodes for the application, the selection of cluster head nodes is also of importance in the clustering process. Improved connectivity and reduced delay is also a desirable feature. The cluster heads usually remain interconnected with few exceptions, so that timely information without much delay keeps flowing through the network. Another objective in clustering is the minimal cluster count, especially when the sensor nodes are resource rich and big sized, there is need to keep the cluster count to the minimum. The prime objective of clustering is the energy efficient use of the scarce node resources, to achieve the maximum network lifetime. Clustering attributes are the factors on the basis of which different clustering algorithms can be classified. These can be broadly the cluster properties, cluster head capabilities and clustering process.

The cluster properties include cluster count i.e. the number of clusters can be pre-fixed or variable, the stability of the clusters formed can be provisioned or assumed, intra-cluster topology i.e. the communication between the sensor nodes and the cluster head can be direct link or multi-hop and inter-cluster head connectivity which is required when the cluster head does not have direct communication capacity with the BS, so it has to be connected with other cluster heads in the network. Cluster head capabilities include: it can be static or mobile, in case it is mobile the clusters are formed dynamically and cause problems. The cluster head can either be sane as a member sensor node or may be a node with more computation and energy resources. The role of cluster head can be simple forwarding of the data received from sensor nodes or they can perform data aggregation and fusion function, while sometimes it can also act as BS. Clustering process and characteristics of different clustering algorithms presented in literature vary a great deal. The methodology of clustering process can be distributed, centralized or hybrid of the earlier two approaches. The objectives of clustering as discussed earlier include load balancing, fault tolerance, increased connectivity and reduced delay, minimal cluster count and maximal network lifetime. The cluster head selection can be done either randomly or it may be pre assigned. Algorithm complexity of different clustering techniques presented in literature varies and it can be constant or variable.

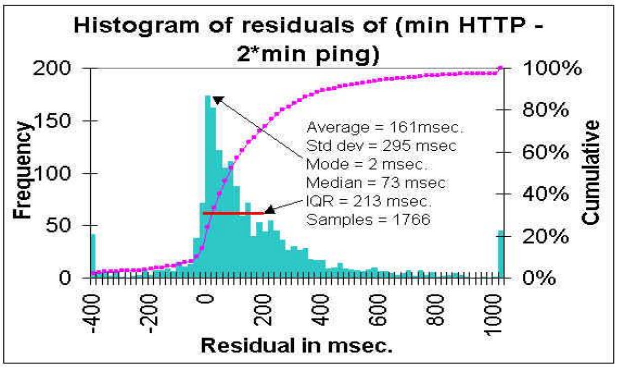
Comparison

Aunt colony optimization ACO due to its distributed nature becomes alternate to GA, in order to determine the optimal route it needs that the base station already has the required information. For fusion process neural networks are well suited because neural networks can learn and dynamically adapt to the changing scenarios. Reinforcement learning is fully distributed and it can adapt quickly to network topology change or any node failure. It has been used efficiently for finding the optimal path for aggregation. GAF based distributed approach using sleep state switching numbers and weighted average operators to perform energy efficient flooding-based aggregation has also been proposed and the system outperforms the previous results. In wireless sensor networks many situations demand aggregating data at a central node e.g. monitoring events. For these situations, the centralized approaches like ACO can be used efficiently to know the features of the data are shown in the screen shots

1. Finding Distance



2. Transmission Delay

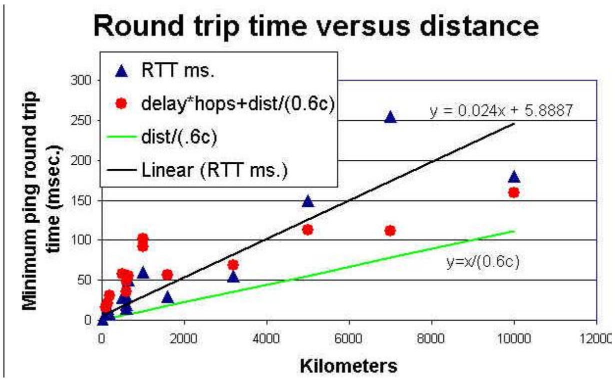


This analysis includes calculating percentage of energy conserved in this protocol as well as the previously known protocol. Further time spend by each node in the sense, transmit, off states are calculated for each node. Based on the above results, power consumption of each node in their corresponding state is calculated. Total power consumed by a single sensor node is calculated based on the individual power consumed by the corresponding node in the sense, transmit, off states.

ISSN (Online) 2278-1021
ISSN (Print) 2319 5940

International Journal of Advanced Research in Computer and Communication Engineering
Vol. 4, Issue 10, October 2015

3. Data Loss deduction



Total power consumption of the entire process is calculated based on the total power consumption of the individual nodes. Finally, percentage of energy conserved in this work and previous work is calculated. Theoretical analysis is performed for both static and mobile events. Theoretical results for static events are shown below:

S.No	Node	TIME SPENT BY EACH NODE IN SENSE STATE
1	node 0	49.92739999999999 ms
2	node 1	49.92739999999999 ms
3	node 3	49.87657999999999 ms
4	node 4	50.0 ms

Table 1: TIME SPENT BY EACH NODE IN SENSE STATE

S.NO	Node	POWER CONSUMED BY EACH NODE IN SENSE STATE
1	node 0	49.9273999999999999 mW
2	node 1	49.9273999999999999 mW
3	node 3	49.7204899999999999 mW
4	node 4	49.8765799999999999 mW

Table 2: POWER CONSUMED BY EACH NODE IN SENSE STATE

S.No	Node	TIME SPENT BY EACH NODE IN SENSE STATE
1	node 0	0.07259999999999999 ms
2	node 1	0.07259999999999999ms
3	node 3	0.27950999999999999 ms
4	node 4	0.12342 ms

Tabe3: TIME SPENT BY EACH NODE IN SENSE STATE

S.No	Node	POWER CONSUMED BY EACH NODE IN TRANSMIT STATE
1	node 0	0.07259999999999999 mW
2	node 1	0.07259999999999999 mW
3	node 3	0.27950999999999999 mW
4	node 4	0.12342 mW

Table 4: POWER CONSUMED BY EACH NODE IN TRANSMIT STATE

VI. CONCLUSION

Preserving coverage and connectivity in a sensor network has been a problem that has been addressed in the past. However, most of the approaches have assumed the aid of either GPS, or have proposed the use of directional antennas or localization infrastructure. Given that sensors are envisioned to be light-weight energy constrained devices, it may not be desirable to equip them with such additions. This work considers a scheme that ensures coverage and connectivity in a sensor network, without the dependence on external infrastructure or complex hardware. In addition, taking advantage of the redundancy of nodes, the scheme can offer energy savings by turning off nodes that may not be required to maintain coverage. It is very obvious that significant energy is saved along with uniform decay of battery life at most of the nodes.

This work deals with the Weighted Fair Scheduling process, which runs locally at each sensor node in order to govern its operation. Each sensor node conserves its energy by switching between Sense/Receive (or) off states only until it senses an event in its proximity, after which it enters the transmit state to transmit the event information.

This work shows that the power saved in each node outperforms the power saved in any other previously known protocols and this work also shows that it is possible to minimize about 51% of the power and maintain 100% coverage and connectivity. Further, simulation study also proves that it is possible to increase the life time of each sensor network by increasing the number of sensor nodes.

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