Network Layer Protocols in Wireless Networks for Efficient Routing with Minimal Distance

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Abstract

A simple framework for designing protocols for wireless networks includes localized routing and broadcasting. The simple framework is based on the ratio of the cost of making certain decisions such as reduction in distance count. Routing protocol is one of the major networks found in this application of wireless networks.

The commonly used routing techniques in the network layers are described as follows. In Distributed routing approach each node checks whether the cost of routing via a given neighbor is smaller than that of currently used nodes. In the 'ad hoc' networks, it has bandwidth limitation of the wireless channel. In dynamic ad hoc networks, a localized approach based on 'on-demand route discovery' by flooding destination is used. But it is inefficient to use flooding as routing scheme in wireless networks since it has power and bandwidth limitation. Localized protocols describes the amount of information required (i.e.) it gives the average number of messages transmitted per node in a protocol. In a strictly localized protocol it is either local or global in nature. Thus the goal of the project describes the concept as a general framework of some existing protocols.

The Proposed framework of the localized routing scheme is based on the cost measure, which depends on the assumptions for the minimal routing path to be selected and the progress measure depend on the advances towards the destination. Network simulator is used to implement this scenario.

***Keywords: -** Wireless network, localized routing, power aware routing*

I. Introduction

The routing task is consider, in which a message is to be sent from a source node to a destination node (in a sensor or ad hoc wireless network). Due to propagation path loss, the transmission radii are limited. Thus, routes between two hosts in the network may consist of hops through other hosts in the network. The nodes in the network may be static (e.g. thrown from an aircraft to a remote terrain or a toxic environment), static most of the time (e.g. books, projectors, furniture) or moving (vehicles, people, small robotic devices). Wireless networks of sensors are likely to be widely deployed in the near future because they greatly extend our ability to monitor and control the physical environment from remote locations and improve our accuracy of information obtained via collaboration among sensor nodes and online information processing at those nodes. Networking these sensors (empowering them with the ability to coordinate amongst them on a larger sensing task) will revolutionize information gathering and processing in many situations. A wireless network that received significant attention in recent years is ad hoc network .Mobile ad hoc networks consist of wireless hosts that communicate with each other in the absence of a fixed infrastructure. Some examples of the possible uses of ad hoc networking include soldiers on the battlefield, emergency disaster relief personnel, and networks of laptops. Desirable qualitative properties [MC] include: distributed operation, loop-freedom, demand-based operation and 'sleep' period operation, while hop count and delivery rates are among quantitative metrics. We shall further elaborate on these properties and metrics, in order to address the issue of routing in wireless networks while trying to minimize the energy consumption and/or reduce the demands on nodes that have significantly depleted batteries.

II. Localized Routing Concept

In localized routing, nodes make decision on its own, based on the information available in the neighbor nodes as well as the destination node. It has no knowledge about the other nodes. By keeping track on the information about the neighbors, it will choose the minimal one and send the data through it. Then the node which has received the data is act as source node and follows the procedure mentioned above. This progress will take place until the data reaches the destination.

In dynamic ad hoc networks, a localized approach based on on-demand route discovery by flooding destination request packets is appropriate. However, power and bandwidth limitation, reduced computational capabilities wireless channel characteristics (omni directional antennas and communication on a single common channel), and the dynamic nature of wireless networks require the design of network layer protocols satisfying a number of further properties under a general localized paradigm. It is extremely (power and bandwidth) inefficient to use flooding as a routing scheme in sensor networks, if a solution that provides a route competitive to the shortest (weighted) path is available. For sensor networks, path-based solutions like those discussed in this article are therefore the only viable routing approach.

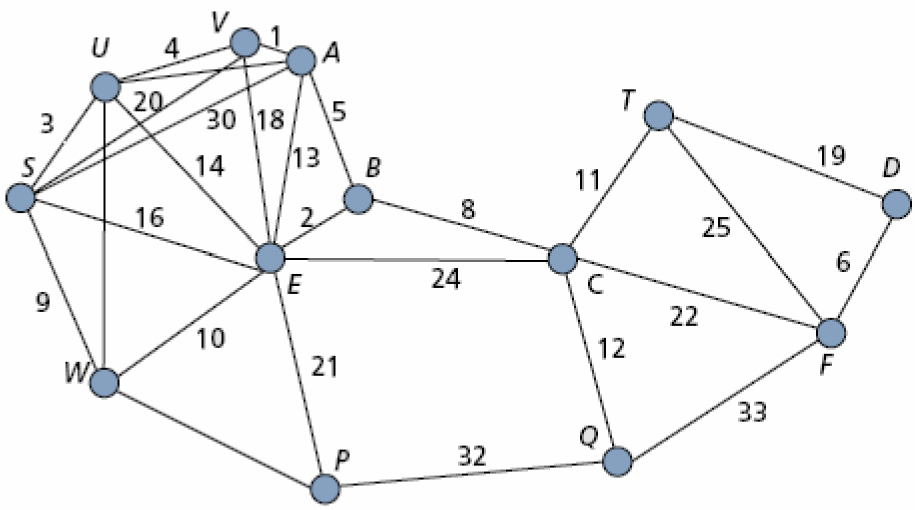
Localized protocols can be further divided according to the amount of information required and the overhead in the construction and maintenance phases. This is especially important for network layer problems that inherently affect all nodes in the network, such as broadcasting and sensor area coverage. The amount of required information is related to the message complexity, which can be defined as the average number of transmitted messages per sensor node in a protocol. In a strictly localized protocol, all information processed by a node is either local or global in nature, but obtainable in short constant time by querying only the node’s neighbors or itself.

III. General Framework for localized Routing

In general framework for localized scheme, local knowledge at each node includes the cost of each of its links to neighboring nodes. The position of neighbors may be gained via periodic exchange of hello messages.

The following points explained about the localized framework.

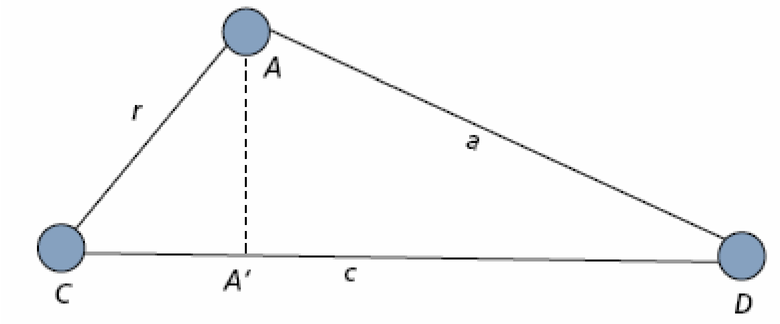
- Each edge has cost measure.
- The cost measure depends on the assumption and metrics used.



A network with costs at each edge

IV. Localized Power-Aware Routing

The next consideration is localized power-aware routing. The power needed to send a packet from C to A is proportional to ra + c, where a is power attenuation factor (2 £ a £ 6), r = |CA|, while c is a constant (c > 0). Constant c accounts for the energy needed to run electronic circuits at transmitter and receiver and minimal signal strength for correct signal reception. This power measure can be used as a cost measure in our general protocol. Therefore, the neighbor that minimizes (ra + c)/(c – a) will be selected. This means that the selected neighbor minimizes the power spent per unit of progress made in terms of getting closer to the destination. If additional nodes can be placed at desired locations, the optimal forwarding distance is (c/(a –1))1/a. This is used to derive a formula for minimal power v (a) for routing between two nodes at distance a. The neighbor that minimizes ra + c + v (a) is then selected. The optimal forwarding distance can also be confirmed using the cost-progress ratio concept. The cost of transmitting a packet at distance r is ra + c, while the progress made toward the destination is r.



Current node selects the path in localized routing scheme

Power-aware routes may drain energy from certain nodes. It is therefore desirable to consider instead the maximal lifetime routing problem, where the goal is to maximize the number of routing tasks the network can perform. This definition does not provide a clear measure of optimality. Two such measures considered are reluctance and power reluctance. Reluctance corresponds to the willingness of a node to participate in routing. Nodes with more energy are more eager to assist, while nodes with less remaining energy show more reluctance to do so. As a particular choice for the reluctance measure f(A) of node A, the inverse of the normalized (i.e., maximum energy corresponds to 1) remaining energy can be used. The algorithm then selects neighbor A that minimizes f(A)/(c – a). If reluctance metric is used, nodes need to include the information on their remaining energy in their “hello” messages. Somewhat better results are obtained when power_ reluctance cost measures f(A)(ra + c) is used. This leads to the protocol that selects the neighbor minimizing f (A) (r a + c)/(c – a). Such a choice avoids the use of parameters (combining separate power and reluctance measures with certain parameter weights), show that such a parameter less choice is not inferior to a number of attempted parameter-based combined measures. These experiments also show competitive performance of the described localized protocols with respect to the “optimal” shortest-weighted-path based solutions, which require global knowledge at nodes to be applied.

V. Design Goals

a) Loop-freedom: The routing protocols should be inherently loop-free, to avoid timeout or memorizing past traffic as cumbersome exit strategies.

b) Maximize the number of routing tasks that network can perform: Some nodes participate in routing packets for many source-destination pairs, and the increased energy consumption may result in their failure. Thus pure power consumption metric may be misguided in the long term. A longer path that passes through nodes that have plenty of energy may be a better solution. Alternatively, some nodes in the sensor or ad hoc network may be temporarily inactive, and power consumption metric may be applied on active nodes.

c) Minimize communication overhead: Due to limited battery power, the communication overhead must be minimized if number of routing tasks is to be maximized. Proactive methods that maintain routing tables with up-to date routing information or global network information at each node are certainly unsatisfactory solution, especially when node mobility is high with respect to data traffic.

d) Maximize delivery rate: Our localized algorithms achieve a very high delivery rates for dense networks, while further improvements are needed for sparse networks. The final important goal of a routing algorithm is to handle node mobility with proper location update schemes.

e) Avoid memorizing past traffic or route: Solutions that require nodes to memorize route or past traffic are sensitive to node queue size, changes in node activity and node mobility while routing is ongoing (e.g. monitoring environment). Flexibility in selecting routes is thus preferred.

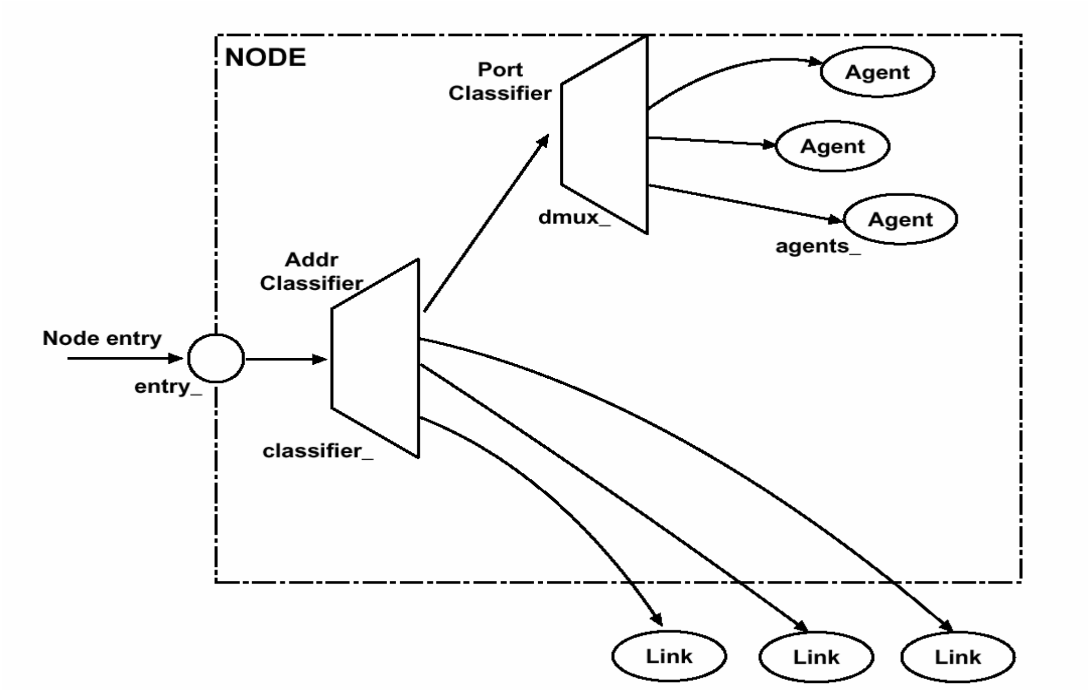
f) Localized algorithms: Localized algorithms are distributed algorithms that resemble greedy algorithms, where simple local behavior achieves a desired global objective. In a localized routing algorithm, each node makes decision to which neighbor to forward the message based solely on the location of itself, its neighboring nodes, and destination. While neighboring nodes may update each other location whenever an edge is broken or created, the accuracy of destination location is a serious problem. In some cases, such as monitoring environment by sensor networks, the destination is a fixed node known to all nodes (i.e. monitoring center). All non-localized routing algorithms proposed in literature are variations of shortest weighted path algorithm.

g) Single-path routing algorithms: The task of finding and maintaining routes in mobile networks is nontrivial since host mobility causes frequent unpredictable topological changes. Most previously proposed position based routing algorithms (e.g. [BCSW, KV]) for wireless ad hoc networks were based on forwarding the actual message along multiple paths toward an area where destination is hopefully located, hoping to achieve robustness. Single-path strategies may be even more robust (for instance, they can guarantee delivery and with less communication overhead. The significant communication overhead can be avoided if a variant of source-initiated on-demand routing strategy is applied. In the strategy, the source node issues several search 'tickets' (each ticket is a 'short' message containing sender's id and location, destination's id and best known location and time when that location was reported, and constant amount of additional information) that will look for the exact position of destination node. When the first ticket arrives at the destination node D, D will report back to the source with brief message containing its exact location, and possibly creating a route for the source. The source node then sends full data message ('long' message) toward exact location of destination. The efficiency of destination search depends on the corresponding location update scheme. A quorum based location update scheme is being developed in [S2]. Other schemes may be used, with various trade-offs between the success and flooding rates (including an occasional flooding). If the routing problem is divided as described, the mobility issue is algorithmically separated from the routing issue, which allows us to consider (in this paper) only the case of static networks with known destination in our algorithms and experiments. The choice is justified whenever the destination does not move significantly between its detection and message delivery, and information about neighboring nodes is regularly maintained. Yet another routing method may forward message toward imprecise destination location, hoping that closer nodes will locate destination more accurately.

VI. Network Simulator 2

NS2 is a freely available discrete-event object-oriented network simulator, which provides a framework for building a network model, specifying data input, and analyzing data output and presenting results. Network Simulator uses two languages because simulator has two different kinds of things it needs to do. On one hand, a detailed simulation of protocols requires a systems programming language which can efficiently manipulate bytes, packet headers, and implement algorithms that run over large data sets.

The Typical Structure of Node



Node Methods: Configuring the Node

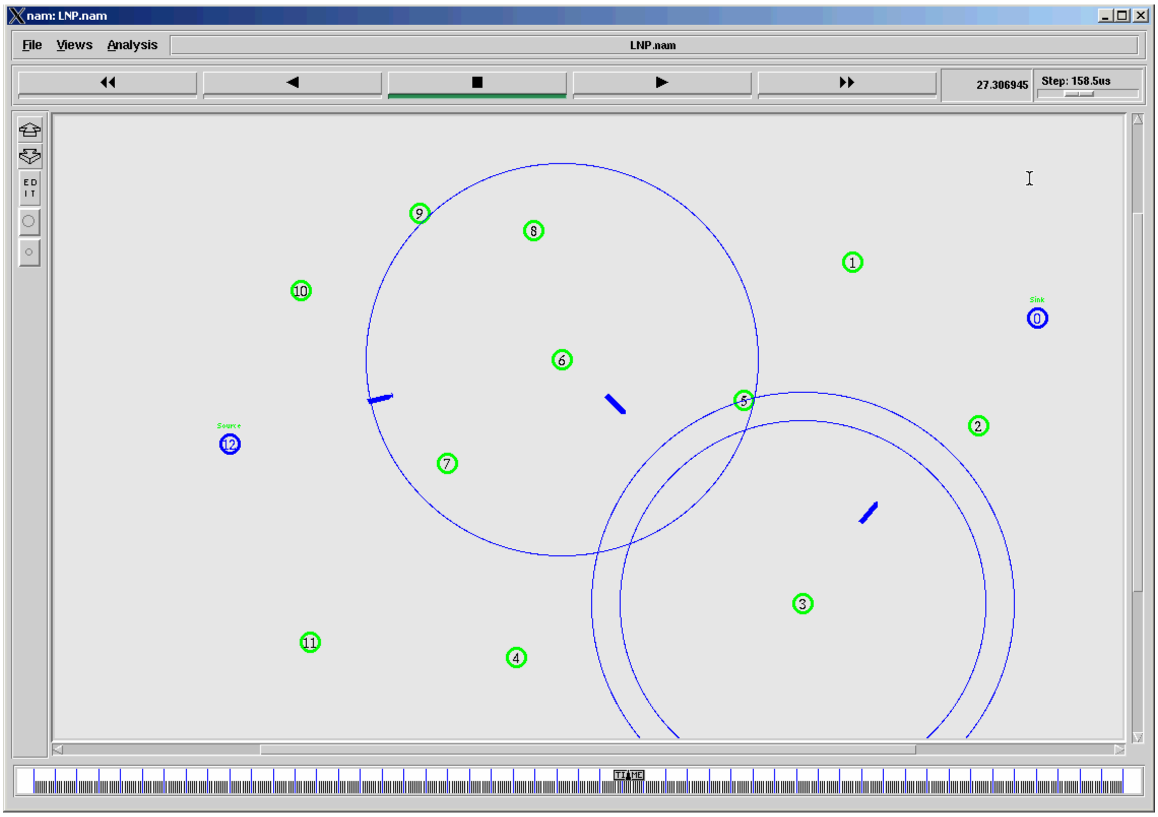
Procedures to configure an individual node can be classified into:

- Control functions
- Address and Port number management
- Agent management

VII. Experimental setup

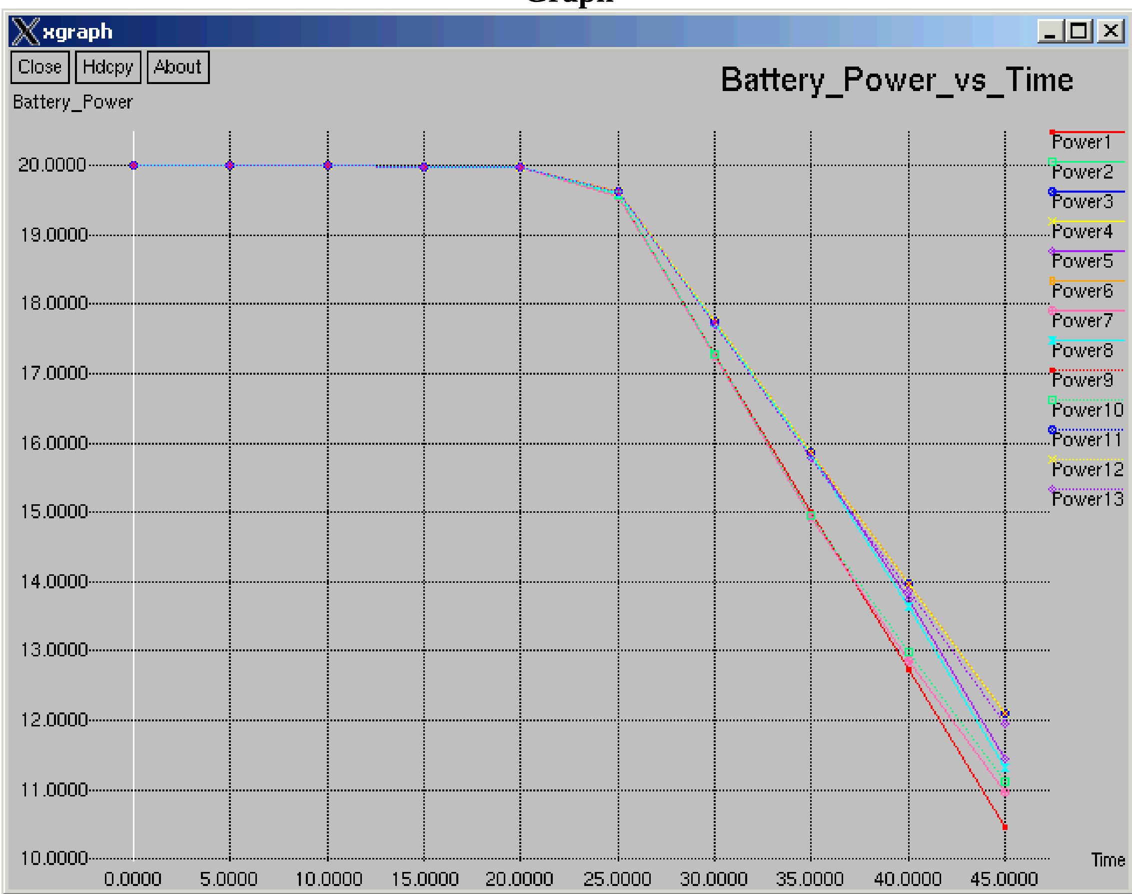
My experimental setup has 13 nodes which is used for data transferring and determine the power of each node using the energy model. DSDV protocol is used for resolve the route. By selecting a path in the network I have analyze the lifetime of the network through power and time. (i.e.) Battery power vs. time. In general concept the energy in the nodes is rapidly reduced and there may be chance for loss of data if the battery power in the network is reduced completely.

So to maximize the life time of the network the localized routing is used. Here I just analyze the energy consumption by each node using energy model. Power aware routing algorithm attempts to minimize the total power needed to route a message between a source and a destination. Cost-aware routing algorithm is aimed at extending battery's worst case lifetime at each node. Thus localized scheme is used to extend the life time of network.



Data transfer between nodes

Graph



Battery power VS Time

VIII. Conclusion

The general framework of network is implemented using network simulator. The Simulation results are visualized by nam window. Output has two files out.tr and out.nam. Data transfer in the network take place on the basis of cost (power). Thus there may be loss of packets due to the battery power down in nodes in regular intervals of time. Due to the selection of the path in static manner will affect the whole network. Energy in the nodes of the selected path will rapidly reduced and cause for loss of data without the use of efficient power in the other nodes.

The proposed work is based on the localized routing concept for effective use of the power over whole network.

network. Thus by using the localized method the lifetime of the network will be better than the general framework. Localized concept is also useful for prevention of loss of packets. Power efficient methods tend to select well positioned neighboring nodes in forwarding the message. Further the research is going for investigation of protocol for efficient use of the cost and power over the network.

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