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Analysis and Improve Packet Delay Problem in Wireless Sensor Networks

KEYWORDS

Information propagation, multi-hop communication, network connectivity, Packet delay, wireless network.

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ABSTRACT *An optimal network planning and protocol design to accelerate packet delivery in multi hop wireless networks but packet delay problem is lightly loaded large-scale multi hop wireless networks in terms of the packet propagation speed to avoid packet delay via rebroadcasting packets. To achieve fastest information delivery in large-scale wireless networks, this is instrumental to the delay-minimization routing protocol design in wireless networks. Existing approach introduced unified speed upper bound for broadcast and unicast communications The speed upper bound found is also applies to the wireless networks with arbitrary traffic loads and routing protocols since heavy load and non optimal path selection incur extra packet transportation delay. The tightness of the speed upper bound and packet delay is occurring. To overcome heavy load and packet delay problem using fastest packet Transmission Algorithm. Design routing algorithm that identifies the next-hop relay nodes to achieve the fastest packet transmission. As this new algorithm assumes the knowledge of node locations, it is a variant of the geographic routing algorithms.*

I. INTRODUCTION

The wireless networks Figure 1.1a provide alternative networking services in places where fixed wire line networks are unnecessary or impossible to be deployed. However, the performance of wireless networks is not optimistic because the wireless medium is subject to various communication constraints, such as limited spectrum bandwidth, high environmental noise, intense wireless interference, dynamic channel condition, and fast signal attenuation. As such, understanding and improving the achievable network performance have been under intensive study in the wireless circumstances.

Wireless Sensor Networks (WSNs) [1]:

Figure 1.1b consists of spatially distributed autonomous sensor 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, and so on.

The WSN is built of "nodes" from a few to several hundreds or even thousands, where each node is connected to one (or sometimes several) sensors. Each such sensor network node has typically several parts: a radio transceiver with an internal antenna or connection to an external antenna, a microcontroller, an electronic circuit for interfacing with the sensors and an energy source, usually a battery or an embedded form of energy harvesting. A sensor node might vary in size from that of a shoebox down to the size of a grain of dust, although functioning "motes" of genuine microscopic dimensions have yet to be created. The cost of sensor nodes is similarly variable, ranging from a few to hundreds of dollars, depending on the complexity of the individual sensor nodes. Size and cost constraints on sensor nodes result in corresponding constraints on resources such as energy, memory, computational speed and communications bandwidth. The topology of the WSNs can vary from a simple star network to an advanced multi-hop wireless mesh network. The propagation technique between the hops of the network can be routing or flooding.[1][2]

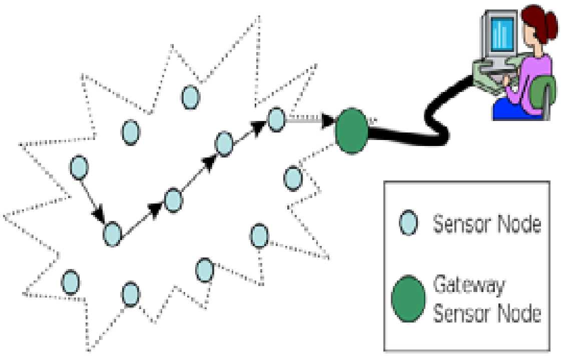


Figure 1.1b Typical multi-hop wireless sensor network architecture

Figure 1.1a Wireless Networks

II. SOFTWARE DESCRIPTION

Front End: Discrete-event simulators are important scientific tools and the focus of a vast body of computer science research that is directed at their efficient design and execution. The JiST[4] system, which stands for Java in Simulation Time, follows a long line of simulation frameworks, languages and systems. JiST is a new Java-based discrete-event simulation engine with a number of novel and unique design features. The purpose of this document is to expose those features with examples, to describe the overall functioning of the system and to leave the reader with an understanding of how to use JiST to construct efficient, robust and scalable simulations.

Due to their popularity and widespread utility, discrete event simulators have been the subject of much research into their efficient design and execution. From a systems perspective, researchers have built many types of simulation kernels and libraries. And, from a modelling perspective, researchers have designed numerous languages specifically for simulation. I introduce each of these three alternative simulator construction approach below. Simulation kernels, including systems such as the seminal Time Warp OS, transparently create a convenient simulation time abstraction. Such systems operate at the process boundary: they control process scheduling, inter-process communication and the system clock in a manner that transparently virtualizes time for its applications.

Simulation languages often introduce simulation time execution semantics, which allow for parallel and speculative execution transparently, without any program modification. Such languages often also introduce handy constructs, such as messages and entities, that can be used to logically partition the application state. Constraints on simulation state and on event causality can be statically enforced by the compiler and they also permit important static and dynamic optimizations.

	Kernel	Library	Language	JiST
Transparent	✓		✓	✓
Efficient		✓, ×	✓, ×	✓
Standard	✓	✓		✓

Table 2.1 Trade-offs of different approaches for constructing simulations.

These observations influenced the design and direction of JiST.

III. RELATED WORK

3.1 MULTI-HOP COMMUNICATION

Multi-hop[5][6][7], or ad hoc, wireless networks use two or more wireless hops to convey information from a source to a destination. There are two distinct applications of multi-hop communication, with common features, but different applications.

3.1.1 Mobile ad hoc networks (MANETS)

A mobile ad hoc network consists of a group of mobile nodes that communicate without requiring a fixed wireless infrastructure. In contrast to conventional cellular systems, there is no master-slave relationship between nodes such as base station to mobile users in ad hoc networks. Communication between nodes is performed by direct connection or through multiple hop relays.

Mobile ad hoc networks[6][8][9] have several practical applications including battlefield communication, emergency first response, and public safety systems. Despite extensive research in networking, many challenges remain in the study of mobile ad hoc networks including development of multiple access protocols that exploit advanced physical layer technologies like MIMO, OFDM, and interference cancellation, analysis of the fundamental limits of mobile ad hoc network capacity, practical characterization of achievable throughputs taking into account network overheads.

3.1.2 Multi-hop cellular networks

Cellular systems conventionally employ single hops between mobile units and the base station. As cellular systems evolve from voice centric to data centric communication, edge-of-cell throughput is becoming a significant concern. This problem is accentuated in systems with higher carrier frequencies (more path loss) and larger bandwidth a promising solution to the problem of improving coverage and throughput is the use of relays. Several different relay technologies are under intensive investigation including fixed relays mobile relays as well as mobile fixed relays There has been extensive research on multi-hop[9] cellular networks the last few years under the guise of relay networks or cooperative diversity.

The use of relays, though, impacts almost every aspect of cellular system design[8][9][10] and optimization including: scheduling, handoff, adaptive modulation, ARQ, and interference management. These topics are under intense investigation. WSIL is actively researching many aspects of multi-hop wireless networks including both MANETs and cellular networks, from the perspectives of signal processing, networking, information theory, and prototyping.

3.2 THE CAPACITY OF WIRELESS NETWORKS

Wireless networks consist of a number of nodes which communicate with each other over a wireless channel. Some wireless networks have a wired backbone with only the last hop being wireless. Examples are cellular voice and data networks and mobile IP. In others, all links are wireless. One example of such networks is multi-hop radio networks or ad hoc networks. It is to these types of all wireless networks that this paper is addressed.

Such networks[5][6][7] consist of a group of nodes which communicate with each other over a wireless channel without any centralized control; Shown in figure 3.2, nodes may cooperate in routing each others' data packets. Lack of any centralized control and possible node mobility give rise to many issues at the network, medium access, and physical layers, which have no counterparts in the wired networks like Internet, or in cellular networks.

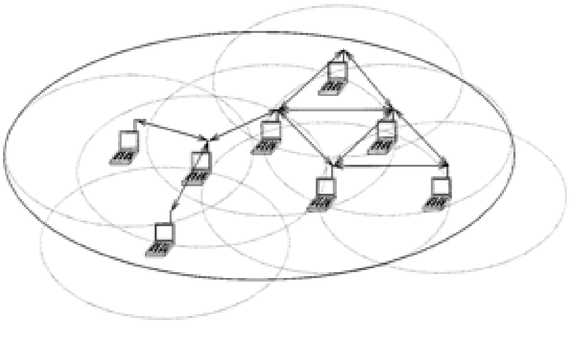


Figure 3.2 An ad hoc wireless network.

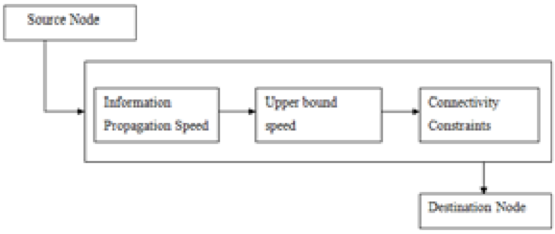
3.2.1 Local traffic pattern

The information packets that are relayed through a particular cell create load for the nodes in the cell, and it is important to compute the maximum number of routes passing through any cell. This helps us estimate how much traffic, apart from its own, each cell has to relay, and the reduction in the no de-throughput[12] induced by the relay traffic. I recall that a route is the collection of cells a source will use to forward packets to a destination following the straight line connecting the source to the destination.

V. PROBLEM DEFINITION

4.1 MODULES

4.1.1 Network and Information Propagation Speed



A wireless network [Figure 4.1] of 'N' nodes in a very large area. The nodes are static and randomly distributed obeying a Poisson point process All the nodes share a β -Hz available frequency band . Any two nodes can communicate over the direct link between them. In multi-hop wireless networks, the transportation of a packet is via rebroadcasting[5][6][7]. A node initiates packet transportation, it broadcasts the packet to all the neighbours inside its coverage area, and these neighbours continue to rebroadcast the packet to a farther distance until the packet is received by the destination node. Depending on the routing protocol used, not every intermediate node that hears the packet is required to rebroadcast. Besides, node scheduling is often implemented in large wireless networks to separate the simultaneous transmissions such that their packets do not collide[3].

From the perspective of information theory, the interference from simultaneous transmissions only degrades the quality of wireless channels, but does not necessarily preclude communications. Therefore, theoretically speaking, communications are still possible without node scheduling. However, in order to be consistent with the de facto practice, I assume that a random percentage of nodes are scheduled for transmission at any time. Thus, considering packet routing and node scheduling; only a subset of the nodes that have received the packet from rebroadcast [3] to transport the packet.

4.1.2 Upper bound on speed

A constant upper bound[10][11][13] on that is attainable when several conditions are satisfied simultaneously. One of the conditions requires that the source and the destination be separated by a distance that is multiple of the optimal transmission radius, where is a constant independent of the source–destination distance. I note that, in broadcast communications, might be the best transmission strategy for fast packet dissemination since the number of destinations may be large and their locations may not be known. However, in unicast communications there is only one destination, the location of which is possibly known to the source and relay nodes.

If the known source destination distance is not a multiple of I show that there exists a tighter speed upper bound that is achieved at a different transmission radius.

4.1.3 Broadcast and unicast Communication

Figure 4.2 A packet is transmitted [3] from V0 has reached the location Z in direction. Let P={V0,V1…. Vm} denote the relay path from V0 to Z and node Vi.

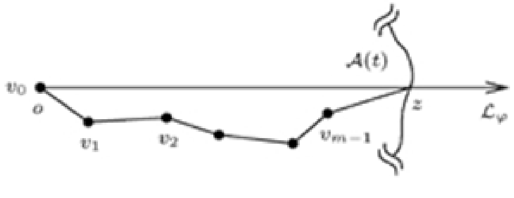


Figure 4.2 Packet relay path in direction

The following conditions are satisfied:

- Every relay node uses the optimal transmission radius ;
- Relay nodes are lined up and equispaced by ; and
- The distance from to the destination node (or the farthest recipient node in broadcast communications) is a multiple.

In unicast communications [10][11][13], though I can always require every node transmit in the radius , the distance between the source and the destination nodes may be known and not equal to a multiple. Upper-bounded more tightly by another constant that is achievable when a different transmission radius[9].

- If the source–destination distance is shorter than , direct transmission from to achieves the fastest speed; and
- If the source–destination distance is longer than, the fastest speed is achieved when the optimal transmission radius takes the value closest to and dividing the source–destination distance.

4.2 FASTEST PACKET TRANSMISSION ALGORITHM

To achieve fastest information delivery in large-scale wireless networks, which is instrumental to the delay-minimization routing protocol design in wireless networks? The speed upper bound found is also applies to the wireless networks with arbitrary traffic loads and routing protocols since heavy load and non optimal path selection incur extra packet transportation delay. The tightness of the speed upper bound, packet delay is occurring. To overcome heavy load and packet delay problem using fastest packet Transmission Algorithm. The results figures are listed out below.

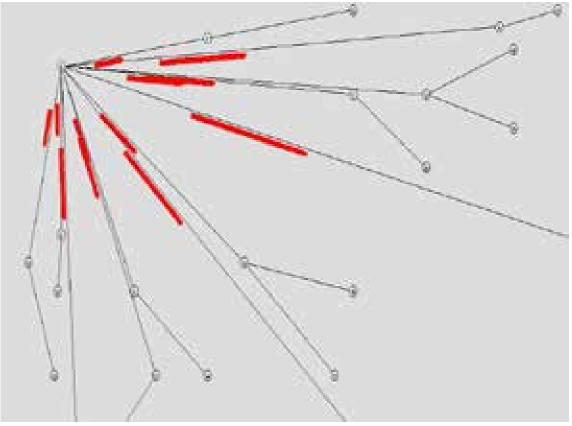


Figure 4.2a Fastest Path Packet Transmission

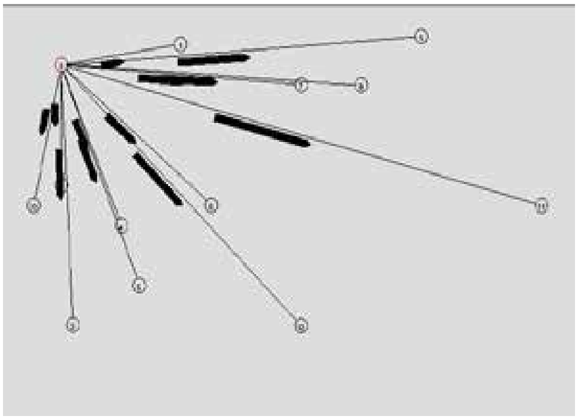


Figure 4.2b Multicast Packet Transmission

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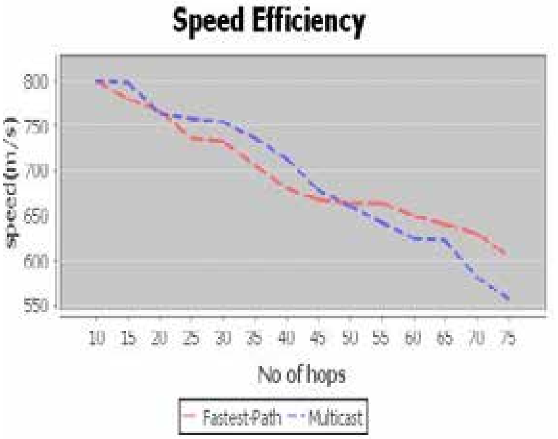

Figure 4.2d Efficiency of Fastest path vs Multicast

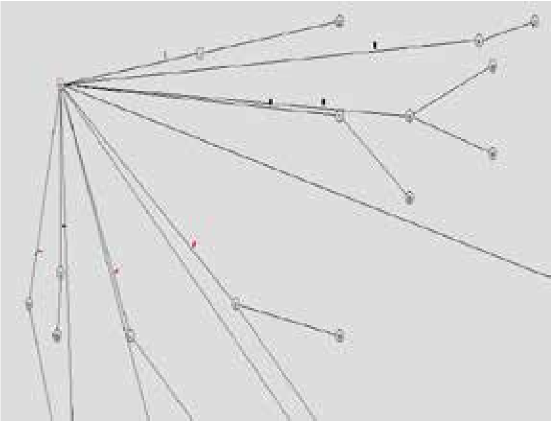

Figure 4.2c Receiving Acknowledgement

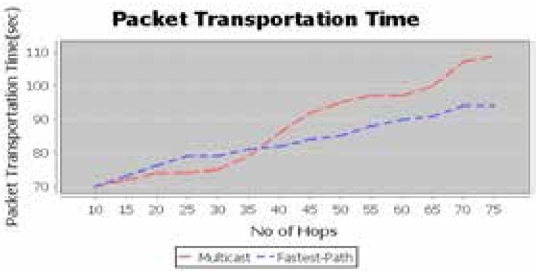

Figure 4.2e Packet Transportation Time between Fastest path and Multicast

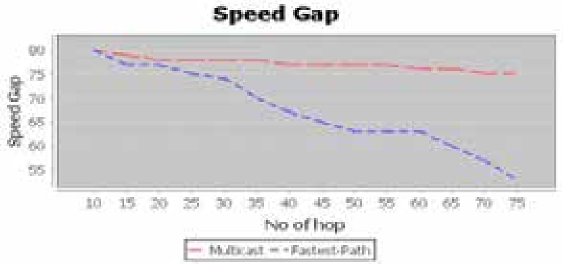

Figure 4.2f Speed analyses of Fastest path and Multicast

V. CONCLUSION

Packet delay problem in large-scale multi-hop wireless networks in terms of the packet propagation speed. I find that there exists an upper bound, determined by the network parameters, on the information propagation speed. This upper bound is different for broadcast communications and unicast communications, but the two bounds converge in large-scale networks. As a necessary condition for achieving this upper bound, all the relay nodes must use an optimal transmission radius. I also reveal that, when network connectivity is considered, the feasible speed upper bound is a function of node density. If the noise in the network is constant, the speed bound is constant when node density exceeds a threshold. If the noise is an increasing function of node density, the speed bound decreases to zero as node density grows to infinity. Finally, a packet propagates omni directionally in large-scale random networks, and the gap between its actual speed and the upper bound decreases exponentially when node density increases to infinity. The fastest information delivery in large-scale wireless networks, which is instrumental to the delay-minimization routing protocol design in wireless networks.

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