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Imesh Environment Creation Using OLSR Protocol

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Abstract

Broadcast has been widely used in mobile ad hoc networks (MANETs) as a communication means to disseminate information to all reachable nodes. However, the conventional broadcast scheme that broadcast packets omnidirectionally suffers from several drawbacks: excessive amount of redundant traffic, exaggerated interference/contention among neighboring nodes, and limited coverage (as a result of contention/collision).

This is termed as the broadcast storm problem in [20]. In this paper, we address this problem in MANETs with the use of directional antennas. We propose three schemes: on/off directional broadcast, relay-node-based directional broadcast and location-based directional broadcast, in the increasing order of implementation complexity. We implement the proposed schemes in QualNet and compare their performances against the conventional broadcast scheme. The simulation results indicate that the proposed schemes outperform the conventional omnidirectional scheme with respect to coverage, latency, and redundancy over a wide spectrum of network topology and node mobility.

1. Introduction

Broadcast has been widely used in mobile ad hoc networks (MANETs) as a communication means to disseminate information to all reachable nodes. It has been used in, for example, routing protocols such as DSR [7], AODV [6], ZRP [24] and LAR [22], to discover routes. The simplest way of realizing broadcasts is via flooding – upon receipt of a broadcast packet, a node simply sends it out in all directions.

In particular, packets are conventionally transmitted with the use of omnidirectional antennas, and neighboring nodes receive and forward these packets omnidirectionally. This, however, generates an excessive amount of redundant traffic and exaggerates interference in the shared medium among neighboring nodes. Moreover, because of the frequent contention and transmission collision among neighboring nodes, some nodes may not receive the broadcast packet. This is termed as *the broadcast storm* problem in [7].

Recently, use of directional antennas for data transmission has received much attention as it demonstrates the capability of increasing the network capacity with spatial reuse, and mitigating the interference and contention among neighboring nodes. Succinctly, directional antennas [15, 16] concentrate more energy in a certain direction, and hence can achieve higher signal-interference-ratio and narrower beam width and mitigate inter-symbol interference (ISI) due to multipath fading. These features have been judiciously used to maximize the number of on-going connections and to reduce the interference and contention [12, 13, 16, 23]. Motivated by the above research work, we consider in this paper use of directional antennas to mitigate the broadcast storm problem. The objective is to ensure broadcast packets reach most, if not all, nodes, and yet reduce the amount of redundant traffic. We propose three schemes: *on/off directional broadcast, relay-node-based directional broadcast* and *location-based directional broadcast*, in the increasing order of implementation complexity. In the *on/off directional broadcast* scheme, on receipt of a broadcast packet that has not been forwarded before, a node only forwards it in three directions other than the direction in which the packet arrives.

This is achieved by setting the directional antennas in the active/passive (or on/off) mode. In the *relay-node-based directional broadcast* scheme, a node forwards a broadcast packet only if the immediate upstream sender assigns it to be the relay node in the angle of arrival (AOA) direction. Determination of relay nodes is facilitated by a neighbor discovery mechanism and is determined based on the relative signal strength of received hello/data packets. In the *locationbased directional broadcast* scheme, the delay in forwarding broadcast packets in each of the three directions are determined by the location information of both the immediate upstream sender and the node. We implement the proposed schemes in *QualNet* [14] and conduct a simulation study over a wide spectrum of network topologies, node mobility, and system configurations. The simulation results indicate that the proposed schemes improve the coverage and reduce the amount of redundant traffic substantially.

Use of directional antennas to mitigate MAC level contention and interference and to improve the performance of routing protocols has been reported, respectively. However, to the best of our knowledge, there exists little work on exploiting directional antennas for broadcasts.

DIRECTIONAL BROADCAST SCHEMES

A. On/Off Directional Broadcast (Scheme 1) As the name suggests, in this scheme the MAC layer is able to set each directional antenna to the *active/on* or *passive/off* mode. Similar to the omnidirectional broadcast scheme, when a node receives a broadcast packet that it has not seen before, it forwards it after a uniformly distributed random delay. However, it will only forward the packet in the directions other than that in which the packet arrives. Specifically, if a broadcast packet arrives from a certain angle-of-arrival (AOA) and is received by one of the four directional antennas, say, AOA1, the packet will only be forwarded in the other three antennas by setting AOA1 *passive*. To further reduce broadcast redundancy, if the same packet is received by another antenna AOA2 before the delay timer expires, antenna AOA2 will also be set to *passive*. In this manner, by the time the delay timer expires and the channel is sensed idle, only antennas that have not received the packet will be set to *active* and forward the packet.

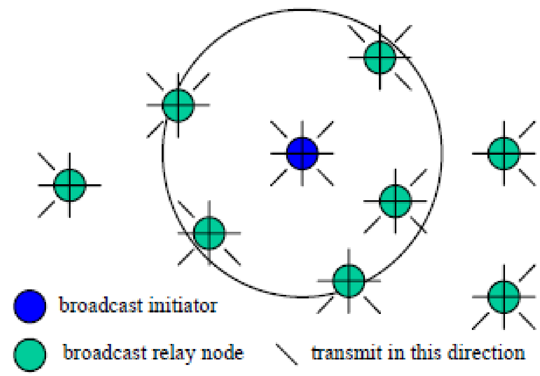

Figure 1. On/Off Directional Broadcast

Figure 1 illustrates the idea.

B. Relay-Node-Based Directional Broadcast (Scheme 2)

To further reduce the possibility of multiple nodes relaying the same broadcast packet, we use the notion of *relay* nodes. Each node *n* designates, for each direction, one and at most one relay node to forward broadcast packets, where a relay node in a direction is the one-hop node that is farthest from node *n* in that direction (and thus the signal strength of packets sent from the relay node is the weakest in that direction). To help discovering one-hop neighbor nodes and assigning relay nodes, every node sends *hello* messages periodically to its neighbor nodes. A node updates its neighbor information and relay nodes assignment by snooping all packets received.

Based on the signal strength of received packets, each node chooses, for each direction, a *relay* node, if one exists. Associated with the relay node information is a refresh timer, and each node re-assigns relay nodes (if any) upon timer expiration. A node attaches the information of relay nodes in the head of each broadcasting packet.

Upon receipt of a broadcast packet for the first time, a node *n* forwards the packet in the directions other than the incoming AOA, only if (i) node *n* is assigned to be the relay node in the incoming AOA as indicated in the packet header, or (ii) no relay node is assigned in the incoming AOA. Note that case

(ii) occurs when the sender is not aware of any neighbor in the corresponding direction or the relay node information is outdated by the time the broadcast packet is sent. Similar to the omni directional broadcast scheme, a designated relay node will delay for a random time before it sends the broadcast packet. If the same packet arrives in a direction before the delay timer expires, the directional antenna in that direction will be set to *passive* to disable packet forwarding in that direction. On the other hand, if a node that is not assigned as the relay node by the first broadcast packet it receives, it will not perform relaying even if later it receives the same packet from other sender, which assigns it a relay node. Figure 2 illustrates the scheme.

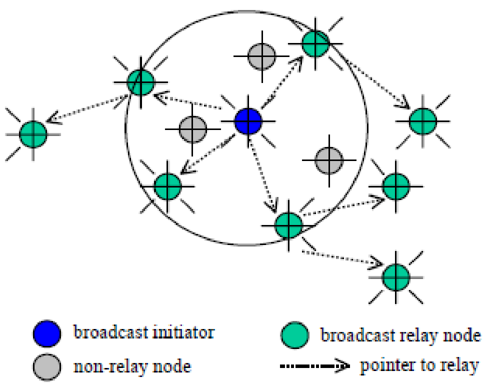

Figure 2. Relay-Node-Based Directional Broadcast

C. Location-Based Directional Broadcast (Scheme 3)

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Ideally a relay node should be a node that covers the largest extra area that the broadcast packet has not reached in certain direction. Unfortunately the relay-node-based directional broadcast scheme does not fully realize this, as the neighbor node that is farthest away from the sender does not necessarily cover the largest extra area. Another important factor that should be considered is the relative orientation of two nodes.

The *location-based directional broadcast* scheme is proposed to improve the performance along this avenue. Similar to the on/off directional broadcast scheme, upon receipt of a broadcast packet for the first time, a node forwards the packet in the directions other than the incoming AOA. However, the delay is no longer uniform for all the directions. Instead, the delay in forwarding a broadcast packet in different directions varies, and is determined by the extra coverage that can be made if the packet is forwarded along a direction. The larger the extra coverage is, the smaller the delay will be. If the node receives the same packet in certain direction by the time the delay timer expires, it does not forward the broadcast packet in that direction. Figure 3 illustrates the idea. The delay for each direction is proportional to the extra coverage ratio, where the extra coverage ratio is defined as the extra coverage over ¼ of the circle area.

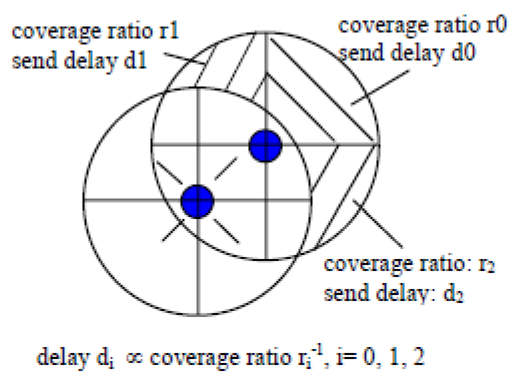

Figure 3. Location-Based Directional Broadcast

To calculate the extra coverage, we assume every node is aware of its location via, for example, GPS, and attaches in the header of an outgoing packet its current location. To obtain the exact extra coverage, one has to calculate the integral of the overlapped area. For simplicity and without loss of much accuracy, we use polygraphs to approximate the areas.

CONCLUSIONS

In this paper, we present three directional antenna-based schemes to mitigate the broadcast storm problem. In the *on/off directional broadcast* scheme, on receipt of a broadcast packet that has not been forwarded before, a node only forwards it in the three directions other than the direction in which the packet arrives.

This is achieved by setting the directional antennas in the active/passive mode. In the *relay-node-based directional broadcast* scheme, a node forwards a broadcast packet only if the immediate upstream sender assigns it to be the relay node in the AOA. Determination of relay nodes is facilitated by a neighbor discovery mechanism and is determined the relative signal strength of received packets. In the *location-based directional broadcast* scheme, the delay in forwarding broadcast packets in each of the three directions other than AOA is determined by the location information of both the immediate upstream sender and the node.

We have carried out a simulation study using QualNet to evaluate the three proposed schemes, with the conventional omnidirectional broadcast scheme as the base line.

The simulation results indicate that by using directional antennas, the broadcast storm problem can be mitigated to a great extent. Specifically, in static wireless networks, the performance improvement with respect to coverage, redundancy, and collision is on average 6~18%, 36~80%, and 21~46%, respectively.

The performance with respect to latency is comparable or slightly improved, except for the *location based directional broadcast* scheme. All the relative performance, except the coverage under *the relay-node-based directional broadcast* scheme, exhibits the same trend in the case of mobility.

We have identified several avenues for future research. As mentioned in Section V.C, we will continue to refine the rule for selecting relay nodes in the *relay-node-based directional broadcast* scheme. We will also study the performance of the proposed schemes (as well as the omnidirectional broadcast scheme) in conjunction with power management.

Note that in power-managed MANETs, some of the nodes may be put into sleep and awakened periodically to check for transmission activities. How the proposed schemes perform in a power managed MANET and how they should be modified is a subject of future study.

REFERENCES

[1] R. Jain and Y. Lin, "An Auxiliary User Location Strategy Employing Forwarding Pointers to Reduce Network Impacts of PCS," Wireless Networks, vol. 1, no. 2, pp. 197-210, 1995.

[2] N. Nandiraju, L. Santhanam, B. He, J. Wang, and D. Agrawal, "Wireless Mesh Networks: Current Challenges and Future Directions of Web-in-the-Sky," IEEE Wireless Comm., vol. 14, no. 4, pp. 79-89, Aug. 2007.

[3] J. Robinson and E. Knightly, "A Performance Study of Deployment Factors in Wireless Mesh Networks," Proc. IEEE INFOCOM, pp. 2054-2062, May 2007.

[4] I.F. Akyildiz, Y.-B. Lin, W.-R. Lai, and R.-J. Chen, "A New Random Walk Model for PCS Networks," IEEE J. Selected Areas in Comm., vol. 18, no. 7, pp. 1254-1260, July 2000.

[5] C. Hirel, B. Tuffin, and K.S. Trivedi, "SPNP: Stochastic Petri Nets, Version 6.0," Proc. 11th Int'l Conf. Computer Performance Evaluation: Modelling Techniques and Tools, pp. 354-357, Mar. 2000.

[6] A. Campbell, J. Gomez, S. Kim, A. Valko, C. Wan, and Z. Turanyi, "Design, Implementation, and Evaluation of Cellular IP," IEEE Personal Comm., vol. 7, no. 4, pp. 42-49, Aug. 2000.

[7] R. Ramjee, T.L. Porta, S. Thuel, K. Varadhan, and S. Wang,"HAWAII: A Domain-Based Approach for Supporting Mobility in Wide-Area Wireless Networks," Proc. Seventh Int'l Conf. Network Protocols (ICNP '99), pp. 283-292, 1999.

[8] H. Lim and C. Kim, "Flooding in Wireless Ad Hoc Networks," Computer Comm., vol. 24, nos. 3/4, pp. 353-363, 2001.

[9] S.-Y. Ni, Y.-C. Tseng, Y.-S. Chen, and J.-P. Sheu, "The Broadcast Storm Problem in a Mobile Ad Hoc Network," Proc. Ann. ACM/ IEEE MobiCom, pp. 151-162, Aug. 1999.