OLSR-H: A Satellite-Terrestrial Hybrid Broadcasting for OLSR Signaling

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Abstract. Mobile ad hoc networks (MANETs) are proposed for emergency situations because they are self-organized and infrastructure-less. However, the mobility of the nodes and the lack of infrastructure pose challenges to the routing protocols. The signaling of these protocols is affected by the same problems as the data traffic: a multi-hop environment with limited bandwidth, collisions and bit errors. This paper proposes a modification of the Optimized Link State Routing (OLSR) protocol to combine satellite and terrestrial broadcasting for their signaling and evaluates its performance in a forest fire fighting scenario.

Keywords: Routing, ad hoc networking, emergency, satellite.

1 Introduction

Mobile ad hoc networks have awoken the interest of the research community in the last decade. The mobility of the nodes produces frequent topology changes that should be reflected in the routing tables. For that reason, routing protocols exchange network state information to achieve proper routing of data packets to their destinations[1].

Satellites can play an important role in the distribution of routing signaling by offering a broadcast medium ensuring quality of service. This contribution is based on the Optimized Link State Routing OLSR[2] protocol. We chose a link state protocol because the route computation and topology discovery phases are well separated and therefore subject to different optimizations. Finally OLSR is among the popular and standardized routing protocols. OLSR-SAT[3] proposes to modify OLSR to distribute the broadcast signaling messages over satellite. It shows an improvement in packet delivery ratio for data packets traversing several hops.

However, this modification requires all nodes to have a satellite interface. In this paper we relax this constraint by combining satellite broadcast with the default OLSR terrestrial broadcast. This solution is called Optimized Link State Routing-Hybrid (OLSR-H).

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The broadcasting procedures of OLSR, OLSR-SAT and OLSR-H are explained in Section 2. A forest fire scenario is described in Section 3 and the simulation results of the protocols in this scenario are presented in Section 4.

2 OLSR Hybrid Broadcast

Proactive routing protocols such as OLSR broadcast network state information in order to support the computation of routing tables. However, broadcasting in a multi-hop wireless network as a MANET is not a trivial task[4].

The main broadcast signaling messages of OLSR are topology control (tc) messages. OLSR broadcasts these messages using multipoint relays (MPRs). The rationale is to reduce signaling overhead by using selective flooding. Each node selects a set of neighbors as multipoint relays. These neighbors will be the only ones allowed to forward broadcast messages from the node. This set of neighbors must be selected so to cover all the 2-hop neighbors.

In OLSR-SAT a geostationary satellite is used to broadcast the tc messages instead of MPRs in OLSR. It mitigates the impairments caused by partition, bit errors and collisions on the wireless medium. It also sets a constant travel delay of ca. 250 ms in place of variable travel delays caused by the multiple hops of the MPR broadcast. However for OLSR-SAT to be operational, all nodes must have a working transmission and reception satellite interface.

A more realistic approach is taken in this paper. A hybrid system combining both MPRs and satellite broadcasting systems is devised as OLSR-H. A node originating a broadcast message always sends it via terrestrial wireless and via satellite

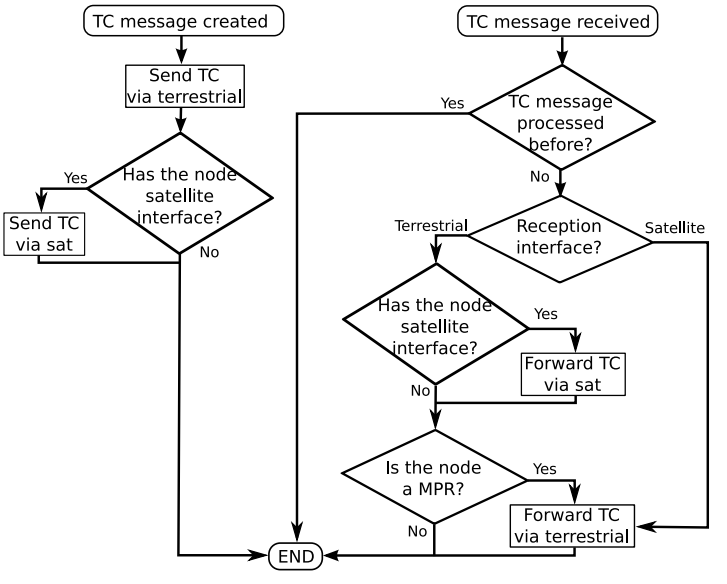

Fig. 1. OLSR-H broadcasting flow chart