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Performance Evaluation of Route Failure Detection in Mobile Ad Hoc Networks

Abstract

Many ad hoc routing protocols need to determine link failures in the network. For that they keep track of the "next hop" nodes, which are used as next relay points in the routes. Hence the node must be able to recognize the case when a link to a next hop is failed. Ad hoc routing protocols may detect broken links using 1) hello messages , 2) feedback provided to the protocol by the MAC layer and 3) passive acknowledgements. Although large number of papers have performed simulations using one of the mechanisms, no papers, as far as we know, clearly compare them in terms of detection delay, energy consumption, impact on network throughput. As passive acknowledgements did not find wide application in ad hoc networks research from aforementioned reasons, we will restrict our focus in the presentation on most used approaches: hello messages and MAC feedback. In the presentation we will address advantages and drawbacks of both approaches and show the delay of MAC feedback approach.

While MAC feedback works better than hello messages with small network load we identified that if the traffic load on the network is high, the amount of incorrect decisions about link failures that the MAC layer make also dramatically increases that results in lower throughput. The revealing link failures based on MAC layer feedback may not be reliable if the traffic in the network increases. The reason for this behaviour is that IEEE 802.11 DCF, used in our simulation, increases the amount of RTS collisions as the traffic load increases. The collisions are so frequent that the MAC layer (after 7 RTS retransmission according to IEEE 802.11) sends incorrect feedback to the routing protocol, a sign that initiates AODV to send a Route Error to the source. In that way the source node then floods a network with Route Request control packet. As the traffic load on the network grows, the amount of incorrect decisions about link failures that the MAC layer reports also dramatically increases. This increments the amount of Route Requests being broadcasted on the network and induces additional overhead. We have discovered that most of the collisions, occurred due to virtual carrier sense, happen in this scenario: the sender transmits RTS to next hop neighbour, but it could not answer with CTS as its NAV was set. So many incorrect decisions about link failures are made as the intended receiver of RTS could not transmit CTS back due to NAV, but in the reality the link exists. The MAC feedback method reduces the overhead of the regular hello messages, but partly modifies the protocol; for instance, all link failure detection in AODV is solely on-demand, and from that a failed link cannot be recognized until a packet has to be sent over the link. In contrary, using the periodic hello messages in standard AODV allows failed links to be detected before a packet is sent to the next hop. But as AODV needs periodic Hello broadcasting when run over MAC layer protocols that do not provide feedback about the presence of the next hop, the consumed energy and the volume of control traffic caused with these MAC protocols are significantly greater than when it is run over MAC IEEE 802.11.