

Optimal routing in packet radio networks to prevent traffic analysis

Shu Jiang Nitin H. Vaidya Wei Zhao
Department of Computer Science
Texas A&M University
College Station, TX 77843-3112, USA
Email: {jiangs,vaidya,zhao}@cs.tamu.edu

Purpose

The optimal routing problem is studied in combination with communication security problem of preventing traffic analysis. We observe that (1) the set of end-to-end flows in a network as well as their individual traffic demands can be stable or change slowly during a long enough time period, which encourages static routing to optimize the allocation of network resources, (2) drastic changes or periodical changes do happen within a large time frame, which suggests the notion of operation mode. For example, a network operates in different mode at day time and at night. For a military network, the mode at peace time may be distinguishable from the mode at war. Since network mode changes may be linked to observable events and discloses important information about the network users, it is desirable to not let an eavesdropper detect the changes by maintaining constant traffic loads on all links all the time. To implement the so called cover mode, the most required bandwidth is reserved for each link and dummy traffic is brought in when real traffic demand is reduced.

Two questions emerge immediately. First, is the cover mode feasible? The feasibility of a cover mode is even more critical in a packet radio network where the capacities of links are restricted due to the interference between link transmissions. Second, is the cover mode minimal? Since sending dummy packets wastes link bandwidth and consumes power, we desire a cover mode with minimal aggregate link traffic load. The purpose of this paper is to develop routing algorithms to find the optimal path for each flow so that the corresponding cover mode is minimal and is feasible.

Method

The optimal routing problem turns out to be NP-complete. We formulate it as a nonlinear integer programming problem. Then we propose a heuristic-based approximation algorithm which uses the flow deviation(FD) method and is polynomial.

Results

One limitation of flow deviation method is that it often produces local optimal. But the results we obtain from simulation show high probability for our algorithm to find a near-optimal solution.

New aspects

The work presented in this paper is new in two aspects. First, we initiate a new security problem and propose a solution. Second, we explore the feasible routing issue in packet radio networks which has been long ignored.

Conclusion

This paper studied the routing problem in packet radio networks with the purpose of achieving the minimal and feasible link traffic cover mode. Although the problem is very hard, it can be efficiently solved by using the proposed algorithm.