A Demonstration of a Relaying Selection Scheme for Maximizing a Diamond Network's Throughput*

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Abstract. We demonstrate a queue-aware algorithm studied in a diamond network topology. This algorithm's decisions are obtained from an analytical optimization framework relying on our technical work [4] and we devise an implementation part by modifying the features of *ath9k* driver [3] and *click modular router* [5]. Performance evaluation is conducted through experimentation on the NITOS Wireless Testbed and it reveals a significant rise in total throughput considering a particular networking scenario while also it maintains stability of backlog queues when schedules indicated by Lyapunov-based technique as throughput optimal are selected.

NITOS Wireless Testbed website: *"http://nitlab.inf.uth.gr"* [2].

Keywords: Scheduling, Cooperation, Relay Selection.

1 Introduction

This work presents a maximum throughput and queue stable scheduling algorithm that exploits cooperative transmissions in order to forward traffic from source to destination through relays. With cooperative transmission, a packet can be scheduled to be forwarded to a potential helper node (relay) if the direct link from source to destination is worse than the links from source to relay and from relay to destination. We implement a scheduling algorithm by exploiting information on transmission queue lengths and channel quality to indicate the optimal scheduling decision. This scheduling algorithm is implemented by using the features of click modular router [5] and ath9k driver [3] in packet routing and forwarding mechanisms.

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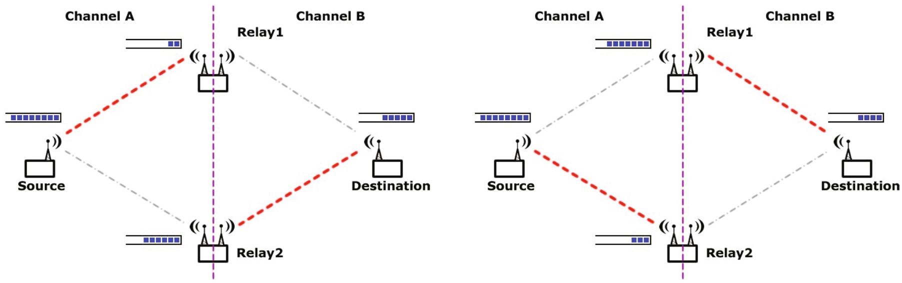
We consider the two-hop network depicted in Fig. 1 consisting of a source node S, two relay nodes R_1, R_2 and a destination D. The relays help the source node when channel conditions (or other factors such as queue congestion) do not favor direct source-destination transmission by carrying out traffic through alternative links. We assume that links are interference limited and impose the constraint that, at any time slot t, only one of the two sets of links (shown in Fig. 1.1 and in Fig. 1.2) can be activated. This is achieved by operating the network in different channels per hop and featuring relay nodes with two wireless interfaces.

We implement this scheduling decision algorithm and we verify its performance in the NITOS wireless testbed [2] . The algorithm quantifies metrics that are related to channel state information and queue lengths from all the network nodes. Every node broadcasts this information to other nodes in the vicinity, so as a common scheduling decision to be taken.



(a) 1st Scheduling Action (b) 2nd Scheduling Action

Fig. 1. Scheduling Actions every Time Slot

2 Relay Scheduling

We describe briefly a simple algorithm that selects relays for forwarding the traffic and schedules transmissions relying on data backlog size. We denote by $Q_a^{(t)}$ the data length size in the queue transmission buffer on each node a at time slot t, and by $r_{ab}^{(t)}$ the transmission rate from node a to node b. Rate $r_{ab}^{(t)}$ is chosen so that to be the maximum of the feasible rates that the link can support subject to an acceptable packet error rate threshold. The algorithm performs its decisions for scheduling by quantifying the following metric Eq. 1. Its central decision relies on enabling a mechanism in the source for gathering information about queue lengths from relays. We elaborate this mechanism by exploiting features of the click modular router [5] . Then the source sends periodically to relays the scheduling activation decisions according to the following rule as given in Eq. 1.

$$\textit{Select } 1^{st} \textit{ Schedule if } (Q_S^{(t)} - Q_{R_1}^{(t)})r_{SR_1}^{(t)} + Q_{R_2}^{(t)}r_{R_2D}^{(t)} > (Q_S^{(t)} - Q_{R_2}^{(t)})r_{SR_2}^{(t)} + Q_{R_1}^{(t)}r_{R_1D}^{(t)}$$

$$\textit{Otherwise, select 2nd Schedule} \quad (1)$$

Then the source node S and the activated relay (either R_1 or R_2) transmit packets in the forthcoming time slot t with the the respective transmission rate that was used in the aforementioned rule. Particularly, if the 1st Scheduling action is selected, then S transmits to R_1, and R_2 to D with rates $r_{SR_1}^{(t)}$ and $r_{R_2D}^{(t)}$ respectively, otherwise if the 2nd Scheduling action is selected, link activations and transmission rates change respectively.

3 Conclusion

We implement a scheduling decision control algorithm by using the *click modular router* along with the *ath9k* driver in order to enable relay assisted cooperative transmissions. Schedules are being activated towards maximizing the total throughput traffic, when networking conditions do not favor direct transmissions from source to destination.

References

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