Practical Channel Assignment and Routing in a Multi-Radio Mesh

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Mesh networks are becoming popular as an inexpensive way to provide community Internet access. Most current mesh deployments assign all nodes a single static channel and thus are unable to utilize the available capacities in multiple orthogonal channels. With the ever decreasing costs of commodity radios, equipping each mesh node with multiple radios is a cost effective way to utilize multiple channels without requiring rapid channel switches. This poster presents ROMA (Routing Over a Multi-radio Access-network), a distributed protocol that performs routing and channel assignments in a dual-radio network to achieve good end to end throughput.

The main task of a multi-radio protocol is assign channels to links in a distributed fashion to maximize throughput. Traditionally, channel assignment is done independently from routing [1–3]. Since each node has far fewer radios than available channels, such an approach requires all nodes to operate on a common channel so as not to disrupt the network topology used by the routing protocol. Using a common channel for a dual-radio mesh not only results in heavier load on the common channel and potentially lower throughput for long paths because every other link on these paths have to be assigned to the same control channel. Since every other link interferes with each other, the throughput of the resulting paths is only 1/2 of a single link's capacity.

Instead of assigning channels independently from routing, ROMA explicitly relies on the routing protocol to guide channel assignment in order to optimize the performance of paths to a few gateway nodes. Optimizing performance to gateway nodes only make sense for mesh networks that provides Internet access where all nodes cooperatively forward traffic to a few gateways with wired external Internet connections. In ROMA, a gateway node chooses a random sequence of channels and advertises the sequence as part of route advertisement. A node determines its channel assignment based on its best route to the gateway and the correspond channel sequence from the gateway. For example, if gateway G uses channel sequence $g_1, g_2, ...$, a node i hops away from G will assign channel g_i and g_{i+1} to its two radio interfaces. Thus, ROMA's approach eliminates the use of a common channel while still ensuring that the routing protocol can find low overhead paths. Furthermore, since the assignment uses different channels for successive hops on a path to the gateway, the end to end throughput of this path is maximized. Many practical challenges remain to make this simple idea work well in practice. Specifically, our contributions are:

- The design of a distributed routing and channel assignment protocol that does not require the use of a common channel. Eliminating the use of a common channel allows ROMA to significantly improve end to end throughput.
- A protocol that handles the practical challenges of wireless networks well. ROMA does not assume links have the same delivery ratio on different channels and can deal with the significant difference in transmission ranges of 11b/g and 11a links.
- A prototype implementation of ROMA in Click and an experimental evaluation of ROMA over a testbed of 24 dual-radio mesh nodes.

References

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