New Routing Schemes for Highly Meshed Networks

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I. BACKGROUND

Over the past years, traffic in IP core networks has been growing at a rate of 50–60% annually. If the current growth rate of traffic volumes continues, we will soon face a situation where core network routers can no longer scale up to the required throughput while maintaining current hierarchical multi-hop network architectures (see Fig. 1). Even an "evolutionary" approach to the Future Internet will therefore have to consider the consequences of ever increasing traffic volumes on a network and device architecture level. Fully or highly meshed IP core networks (see Fig. 2) are one option for scaling up network capacity at an acceptable level of cost and power consumption in the core, as they reduce the average number of hops a packet passes in a network and correspondingly reduce the effort for packet handling in a network.

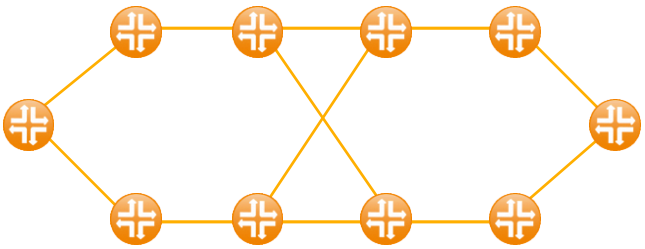

Figure 1. Current multi-hop core network

II. HIGHLY MESHED NETWORKS

In highly meshed networks, the current Internet shortest path based routing protocols solve the wrong problem. Finding the shortest path in a full mesh is a trivial task, as every node is connected to every other node by a one-hop link.

On the other hand, load balancing in a full mesh is a task beyond the capabilities of a shortest path algorithm. Even with equal cost multi-path (ECMP) options enabled, the optimum shortest path routing is usually to use just the direct path.

Interface metric optimization cannot effectively cope with a fully meshed network, as every effort to distribute traffic over more just than the direct link between an ingress and an egress node automatically leads to side effects offloading traffic also from other direct links, which is generally not beneficial for load distribution (see Fig.3).

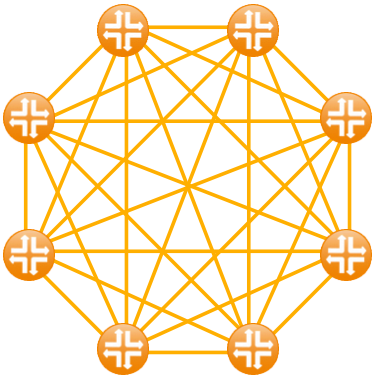

Figure 2. Fully meshed network

Multi-Protocol Label Switching is an option to enforce a dedicated traffic distribution even on a fully meshed network, but it has its own drawbacks in requiring pre-provisioned backup paths for all failure scenarios.

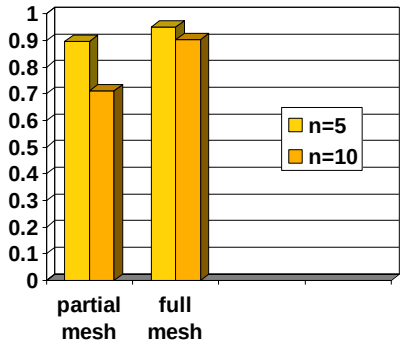

Figure 3. Load reduction from metric optimization in partially and fully meshed networks with 5 and 10 nodes (example)

In this presentation we substantiate the shortcomings of current shortest path based Internet routing when applied to highly meshed networks and provide some ideas for alternative routing approaches.