Invitation à la soutenance publique de thèse

Pour l'obtention du grade de Docteur en Sciences de l'Ingénieur

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Reaping the Benefits of IPv6 Segment Routing

Segment Routing (SR) is a source routing paradigm. It enables traffic sources to arbitrarily specify the path of their packets within a network. This contrasts with classical IP routing where packets are forwarded, hop-by-hop, along a shortest path. Segment Routing allows to deviate from that shortest path by attaching a list of instructions to each packet. These instructions are called segments. Each segment can steer packets through a network node, link, or virtual function. For each packet, the full list of segments is imposed at the ingress edge of the network. All core routers do not need to maintain this additional state. As such, the SR architecture enables scalable and fine-grained traffic engineering, and more efficient network management and troubleshooting.

In this thesis, we focus on SRv6, the IPv6 version of Segment Routing.

First, we implement SRv6 into the Linux kernel. We describe the main components of our implementation, the data plane, control plane, and security extensions. We describe our custom-made testing environment and discuss its limits. We evaluate the performance of our implementation on real hardware and show that it yields little overhead and scales linearly with the available CPU cores. Our implementation is available in the mainline Linux kernel since version 4.10, ensuring its widespread availability.

Second, we explore the benefits of SRv6 in two aspects. The first aspect is the support of low-latency real-time services. We show that by duplicating traffic across disjoint paths, SRv6 is able to absorb the adverse effects of unexpected packet loss or jitter. The second aspect is network monitoring. Using SR, we send probes over cycles, from a single vantage point. This monitoring technique, SCMon, is able to quickly and efficiently detect single-link failures.

Finally, we design and implement the Software Resolved Network (SRN) architecture. SRN is an SDN-like architecture for IPv6 enterprise networks. Using a central controller, applications can reserve network resources through DNS extensions. The controller, called SDN Resolver, translates the reservations into network paths, that are implemented with SRv6. We describe all the components running in an SRN and implement a full prototype of the controller. We evaluate the performance of our implementation through benchmarks and simulations. We show that our solution meets the performance expectations of large enterprise networks.

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