Fast Local Traffic Dispersion for Disaster Recovery in IP Networks

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Abstract

Natural and manmade disasters often cause the failures of network components. Such failures induce communication service interruptions as well as packet and economic losses. According to traditional IP link-state routing protocol (such OSPF or IS-IS), a network component failure will trigger routers to reconstruct its own routing tables. The total recovery time may take up to tens of seconds for the process to re-converge. There are vast packet losses in the duration of the re-convergence. To alleviate the impact of network failures, many fast recovery schemes have been proposed for rerouting traffic in the event of network failures during disasters. An important issue in recovery is to avoid traffic congestion or link overloading since congestion and overloading also cause packet losses.

Many fast IP recovery schemes have been proposed in the literature, including ECMP, LFA, and U-Turns. Equal-Cost Multi-Path (ECMP) is a routing strategy in which shortest path forwarding occurs over multiple paths. ECMP has been applied to fast rerouting, in which multiple paths serve as backup paths for one another. The Loop-Free Alternate (LFA) scheme operates on adjacent routers close to the failed network component to find an alternative route and redirect the affected traffic to bypass the failed component. The selections of the alternative routes have to ensure loop-free properties. The U-Turns scheme is designed to enhance the survivability of the LFA: U-Turns allows packets to travel back to the upstream router. However, these approaches may have lower survivability if the routers adjacent to the failure have no alternate loop-free route.

This presentation will describe a new fast-reroute scheme, called Unaffected Alternate Selection (UAS), to avoid traffic congestion during disaster recovery and to achieve high protection for an IP network running link-state routing protocol. The most often encountered single link/node failures are considered in UAS. UAS searches for an unaffected router to be an alternate node for the protection of single link or single node failures. Once a failure occurs on a link or node, the flows carried on the failed link/node are rerouted to the pre-determined

unaffected router. The unaffected router guarantees successful rerouting of the affected traffic and ensures no routing loops during the fault recovery. Besides, the rerouted flows also can be naturally balanced to avoid link congestion in the failure state.

To evaluate the UAS, in our simulations, three key performance metrics are measured, i.e., survivability, average backup path length, and the maximum link load. The UAS scheme was implemented and compared with conventional IP fast-reroute schemes including ECMP, LFA, and U-Turns in five network benchmarks. Simulation results verify that the proposed UAS scheme can efficiently balance link loads and achieves survivability rates of 90% – 100% and 85% – 100% for single link and node failures, respectively, without incurring long path length.

Keywords: IP Network Recovery, Traffic Dispersion, Routing and Rerouting Schemes