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**FAST REROUTING AGAINST MULTI-LINK FAILURES WITHOUT TOPOLOGY CONSTRAINT**

**ABSTRACT:**

Multi-link failures may incur heavy packet loss and degrade the network performance. Fast rerouting has been proposed to address this issue by enabling routing protections. However, the effectiveness and efficiency issues of fast rerouting are not well addressed. In particular, the protection performance of existing approaches is not satisfactory even if the overhead is high, and topology constraints need to be met for the approaches to achieve a complete protection. To optimize the efficiency, we first answer the question that whether label-free routing can provide a complete protection against arbitrary multi-link failures in any networks. We propose a model for interface-specific-routing which can be seen as a general label-free routing. We analyze the conditions under which a multi-link failure will induce routing loops. And then, we present that there exist some networks in which no interface-specific-routing (ISR) can be constructed to protect the routing against any k-link failures (k ≥ 2). Then, we propose a tunneling on demand (TOD) approach, which covers most failures with ISR, and activate tunneling only when failures cannot be detoured around by ISR. We develop algorithms to compute ISR properly so as to minimize the number of activated tunnels, and compute the protection tunnels if necessary. We prove that TOD can protect routing against any single-link failures and dual-link failures. We evaluate TOD by simulations with real-world topologies. The results show that TOD can achieve a near 100% protection ratio with small tunneling overhead for multi-link failures, making a better tradeoff than the state-of-the-art label-based approaches.