Loop-Free and Localized Fast Reroute in Underwater Ad Hoc Networks

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***Abstract*—Underwater ad-hoc networks (UANETs) suffer from slow propagation, high error rates, and sluggish control-plane reaction, making them highly vulnerable to sudden multi-node failures. Stale routes during convergence send packets along obsolete next hops, creating blind zones with cascading losses and severe energy waste, while existing recovery schemes rely on slow signaling, heavyweight computation, or non-trivial overhead that does not fit dynamic underwater conditions. This paper presents UW-LFRR, a lightweight, data-plane-driven fast-recovery mechanism. UW-LFRR constructs a purified local topology view, models failure impact via a severed-branch abstraction, and uses a two-stage relay selection strategy that first searches near the original shortest path and then performs a constrained fallback search inside the affected region. A minimal-overhead first-packet paving procedure installs temporary forwarding entries along the detour, enabling subsequent packets to bypass the damaged area without additional computation. Results from NS-3 simulations indicate that UW-LFRR achieves loop-free recovery using only local connectivity information with locality-bounded computation cost, while maintaining high packet-delivery ratios and low end-to-end delay with substantially reduced control overhead across diverse multi-failure scenarios, demonstrating its practicality for resilient underwater networks.**

***Keyword*—Underwater Ad-hoc Networks, Fast Reroute, Localized Repair, Loop-Free Forwarding, Multi-Node Failures**

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