

**Enhancing Fault Tolerance and Resource Utilization In Unidirectional Quorum-Based Cycle Routing**

**Abstract:**

Cycle-based optical network routing, whether using synchronous optical networking rings or p-cycles, provides sufficient reliability in the network. Light trails forming a cycle allow broadcasts within a cycle to be used for efficient multicasts. Optimal communication quorum sets forming optical cycles based on light trails have been shown to flexibly and efficiently route both point-to-point and multipoint-to-multipoint traffic requests. Commonly, cycle routing techniques use pairs of cycles to achieve both routing and fault tolerance, which use substantial resources and create the potential for underutilization. Instead, we intentionally utilize *R* redundancy within the quorum cycles for fault tolerance such that every point-to-point communication pairs occur in at least *R* cycles. We develop a generalized *R* redundancy cycle technique that provides optical networks high fault-tolerant communications capability. When applied using only the single unidirectional cycles rather than the standard paired cycles, the generalized *R* redundancy technique has been shown to almost halve the necessary light-trail resources in the network. However, due to unidirectional nature, a small percentage of node pairs for one-to-one communication may not have exactly two paths. For this reason, we further develop a greedy cycle direction heuristic and show a reduction of missing pairs. More importantly, we show that the resource requirement is reduced while maintaining the fault tolerance and dependability expected from cycle-based routing. The result is a set of cycles with 96.6%–99.37% fault coverage, while using 42.9%–47.18% fewer resources.

**Existing System:**

Failures within a network are to be expected and can happen as much as every couple of days. Protecting against these optical circuit faults is critical and many different approaches have been developed to manage them depending on the network needs and circumstances. Knowing the unicast or multicast requests a priori is often not possible. This constraint makes protection against faults in

arbitrary communication paths a challenge. An efficient protection scheme supporting both unicast and multicast communication is necessary.

**Proposed System:**

We analyze the fault tolerance capabilities of the Quorum-based cycle routing algorithms and then develop a novel method to enhance fault tolerance capabilities of using enhanced cycles to cover multiple faults. Some of the initial work on Quorum-based routing has been reported.

Observing that communication pairs can be protected by more than one cycle, we define *R*-redundant quorums to improve resource efficiency (also reported).

We establish that these redundant Quorums support multiple paths between any two nodes and deliver the fault-tolerant capabilities of cycles with very high coverag.