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Multi-scheme recovery in MPLS networks

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ABSTRACT: *MultiProtocol Label Switching* (MPLS) networks have been proposed as a solution to offer reliable, efficient and differentiated telecommunication services. Connection oriented technologies allow the use of traffic engineering approaches to select routes and are also expected to enhance the reliability of IP networks. Routing protocols can be robust and survivable but take a long time to recover from faults, which will not be acceptable for many applications. Therefore several schemes and frameworks for MPLS recovery have been proposed, some of which allow network recovery in the tens of milliseconds.

In this work is proposed a multi-scheme recovery methodology, which intends to increase overall network resilience, while using network resources efficiently by taking into account resilience requirements of different class types. The objective of the methodology will be to offer protection to a set of services by choosing the most appropriate recovery scheme, taking into account the service class, the network state, and the characteristics of available recovery schemes. The appropriate recovery scheme will therefore be chosen based on a combination of quantitative measures and qualitative classification.

1 INTRODUCTION

MPLS networks have been proposed as a solution to offer reliable, efficient and differentiated telecommunication services. Connection oriented technologies as MPLS allow the use of traffic engineering approaches to select routes, *Label Switched Paths* (LSPs), and are also expected to enhance the reliability of *Internet Protocol* (IP) networks. Routing protocols (OSI layer 3) are robust and survivable but they take a long time to recover from faults, which will not be acceptable for many applications. Therefore several schemes and frameworks for MPLS recovery have been proposed, some of which allow network recovery in the tens of milliseconds. Compared to the (usually faster) lower layer recovery, MPLS recovery can make use of additional information to provide differentiated recovery, only to those traffic flows that require it, therefore saving resources.

Service providers must satisfy agreed throughput, maximum delay, and maximum down times, among other performance measures, as stated in contractual *Service Level Agreements* (SLAs). MPLS has been chosen by network service providers because it allows explicit control of traffic flows in the network and also quick recovery in the presence of link and/or node failures, and therefore reduces the risk of disrespecting SLAs.

The paper is organised in the following manner. First, MPLS networks and the concept of MPLS-based recovery procedures will be introduced. Then, a short overview of recovery approaches, in the context of MPLS networks, will be presented. Finally a multi-scheme recovery methodology, which intends to increase network resilience, while using network resources efficiently, will be proposed.

1.1 *MPLS networks*

MPLS is a network technology that offers *Quality of Service* (QoS), *Traffic Engineering* (TE) and many new applications, to overcome some the IP based network limitations. An MPLS network is made of routers known as *Label Switching Routers* (LSRs). At the ingress points of an MPLS network (the ingress LSR), labels are added to incoming packets, and all forwarding in the MPLS domain, along a *Label Switched Path* (LSP), is made based on those labels.

A packet label is removed at the egress LSR, before the packet is sent to a non MPLS-router. Figure 1 presents an active LSP, as well as the corresponding Ingress and Egress LSRs. Because packet forwarding in MPLS is based only in label switching, it tends to be faster than IP. MPLS supports two kinds of routing: implicit (hop-by-hop) routing, and explicit routing. In hop-by-hop routing for a LSP, each node chooses the