Self-management of Lambda-Connections in Optical Networks

Tiago Fioreze and Aiko Pras

University of Twente
Design and Analysis of Communication Systems (DACS)
Enschede, The Netherlands

Abstract. This paper presents a new idea for the management of lambda-connections in optical networks. The idea consists of making multi-service optical switches responsible for automatically detecting IP flows at the packet-level, creating lambda-connections for them, and moving them to the optical-level. In addition to that, they are also in charge of tearing down the connections when no longer needed. This new idea is the result of 1 year of research work at the University of Twente (UT) and it is aimed at resulting in a Ph.D. thesis by the end of 4 years of Ph.D. research.

1 Introduction

Optical networks can send vast amounts of data (IP flows) through lambda-connections. These connections are established through multi-service optical switches, which have the capability to perform forwarding decisions at different levels in the protocol stack. As a result, long and big IP flows (elephant flows) could be moved from the packet-level to the optical-level. This move could result in a better QoS for both elephant flows and remaining IP flows: the former would have no jitter and plenty of bandwidth at the optical-level; the latter would be better served due to the off-load of elephant flows.

The detection of IP flows and the management of lambda-connections are important tasks to achieve the desired move. Two approaches are currently used for that \[1\]: conventional management and GMPLS signaling. The former is characterized by a centralized management entity (e.g., human manager or an automated management process) that is in charge of establishing lambda-connections and deciding which IP flows should be moved to the optical-level. In contrast, the latter is characterized by the fact that optical switches coordinate the creation of lambda-connections among themselves. The decision which IP flows will be moved to the optical level however should be taken by a centralized management entity, or by the entities responsible for the generation of the data flow.

However, there are several problems using these approaches. Both approaches require human interaction to detect flows and manage lambda-connections. This interaction may be slow, since humans need time to perform those tasks, and it is also error prone. For instance, IP flows eligible to lambda-connections may not be detected by network managers.
It is interesting to mention that the research work presented in this paper has been developed within the context of the SURFnet GigaPort Next Generation (Gigaport-NG) Research on Networking (RoN) project [2]. This work has also the support of the EMANICS community [3], more specifically the collaboration of the INRIA Lorraine institute [4].

The remaining of this paper is structured as follows. Section 2 introduces our idea on self-management of lambda-connections in optical networks. Then the research questions and the approaches to answer those questions are introduced in section 3. Finally, conclusions and future plans are drawn in section 4.

2 Proposed Idea

This section introduces what self-management of lambda-connections stands for. Self-management of lambda-connections consists of an automatic cooperation between the IP and optical domain in order to create lambda-connections for IP flows. The network domain is in charge of detecting IP flows to be transferred over lambda-connections and signalizing the optical domain about the existence of these IP flows. On its turn, the optical domain is in charge of creating lambda-connections for IP flows and releasing them when no longer needed. Figure 1 depicts how our proposed idea would look like.

In Figure 1 IP routers located at IP domain B detect one elephant flow transiting between IP domains A and C. They start then talking to one another in order to confirm the existence of the detected elephant flow (step 1). When confirmed the existence, the IP routers signalize the optical switches in lambda domain A (step 2). The optical switches coordinate among themselves in order to create a dedicated lambda-connection to the detected elephant IP flow (step 3). From that point on, the elephant flow is switched at the optical level.

Further information about our idea on self-management can be found at [5].