Chapter 5
GMPLS for Future Applications:
Performance Characterization and Measurements

Weiqiang Sun
Shanghai Jiao Tong University, China

Wei Guo
Shanghai Jiao Tong University, China

Yaohui Jin
Shanghai Jiao Tong University, China

Lilin Yi
Shanghai Jiao Tong University, China

Weisheng Hu
Shanghai Jiao Tong University, China

ABSTRACT

Generalized Multiprotocol Label Switching, or GMPLS, is a suite of protocols to enable automated resource discovery, automated service provisioning and automated failure recovery. In recent years, a considerable number of efforts have been seen in the area of putting GMPLS into advanced networking/service environments. This is exemplified by the various research programs in the US, Europe, and Asia. In such programs, GMPLS has not only been used as a way to reduce management complexity and increase reliability, like the industry is doing right now, but also it is used as a new way for service provisioning. In this chapter, the authors first review activities in using GMPLS controlled optical networks in high performance computing environments. They try to identify the benefits, as well as the limitations in such networking practices. Then they introduce the past and on-going standardization work in the Internet Engineering Task Force (IETF) about GMPLS network performance characterization and measurement. Finally, the authors present the performance measurement results from a number of deployed GMPLS networks.

INTRODUCTION

Generalized Multiprotocol Label Switching, or GMPLS, is a suite of protocols to enable automated resource discovery, automated service provisioning and automated failure recovery. Driven by the benefit of improved network reliability (through protection or fast failure recovery) and reduced network OPEX, an increasing amount of GMPLS enabled networks are now being deployed in metro area and even in national backbones. In the short run, the deployment of such networks will enable network operators to provide new value added services such as Bandwidth on Demand (BoD)
GMPLS for Future Applications

at a reduced OPEX. In the long run, GMPLS networks have the potential of carrying a big variety of services.

Starting from 2001, the time when the key concepts and features of GMPLS are gradually being standardized, a considerable number of efforts have been seen in the area of putting GMPLS into advanced networking/service environments. This is exemplified by the various research programs in the US, Europe and Asia. In such programs, GMPLS has not only been used as a way to reduce management complexity and increase reliability, like the industry is doing right now, but also it is used as a new way for service provisioning. For example, the GMPLS control plane is often integrated with the application to realize seamless on-demand circuit provisioning, so that dynamic data intensive applications may be served with dedicated bandwidth pipes in an efficient manner.

But before GMPLS can be fully utilized to its potential, it is important that we have good ways to characterize and measure its performance. What seem obvious performance measures include LSP dynamic provisioning performance, failure recovery performance, singling and routing scalability etc. What seems less obvious is the consistency between control plane and data plane.

In this chapter, we will first review activities in using GMPLS controlled optical networks in high performance computing environments. We try to identify the benefits, as well as the limitations in such networking practices. Then we will introduce the past and on-going standardization work in the Internet Engineering Task Force (IETF) about GMPLS network performance characterization and measurement. Finally, we will present our performance measurement results from a number of deployed GMPLS networks. These results are obtained during a time span of more than 6 years, over devices from three different vendors.

APPLYING GMPLS IN HIGH PERFORMANCE COMPUTING ENVIRONMENTS

Distributed storage, high performance computing and next generation e-science applications have long been research interests of the networking and computing communities. Such applications generally require large volumes of data be transferred from one place to another, or a set of steering and control operations from a centralized node be distributed to visualization/computing nodes in a timely manner. Although researches in grid computing has made tremendous advances in connecting widely distributed resources using ubiquitous Internet infrastructure, the fact that Internet is a shared packet switched network and is thus unable to provide the required bandwidth or QoS guarantee has intrigued much interests in building dedicated networks for that purpose. Circuit switched optical networks, because of its huge bandwidth and the guaranteed QoS performance, are regarded as excellent transport infrastructures for such applications.

Given the dynamic and heterogeneous nature of applications, the following requirements make the problem of provisioning circuits to applications even more challenging:

- Meeting the arbitrary communication needs of applications, while at the same maintaining a high level of efficiency.
- Providing an user-friendly interface, such that no or little additional complexity incur in application design.
- Providing optimized performance for a variety of applications with different requirements.

A finely tuned provisioning model that couples the applications with the network management system or control plane is essential to meet such requirements. Intensive research and develop-