# Implementation and Experimental Evaluation of On-Line Simulation Server for OSPF-TE

Hitomi Tamura, Tsuyoshi Okubo, Yousuke Inoue, Kenji Kawahara, and Yuji Oie
Department of Computer Science & Electronics,
Kyushu Institute of Technology
Iizuka, Fukuoka 820-8502, Japan
Email: {tamu, laurel, yousuke}@nile.cse.kyutech.ac.jp, {kawahara, oie}@cse.kyutech.ac.jp

## Abstract

*As the amount of traffic transfered on the Internet are increasing, dynamic Traffic Engineering (TE) becomes important to avoid link congestion. In Open Shortest Path Fast(OSPF)-based networks, link costs are statically set according to its long-term utilization for reducing traffic on some congested nodes, hence temporary performance degradation may occur due to short-term traffic fluctuation. For dynamic TE on OSPF-based networks, measurement of the utilization of links / nodes, inferring the set of link costs for improving transmission behavior and setting the cost set to routers are necessary and so-called On-Line Simulation (OLS) system can operate these functions autonomously and periodically. In this paper, we construct the server prototype in OLS system, and evaluate its scalability and control performance in our testbed network. Experimental results show that the server succeeds in providing low-cost network management and real-time control even if there is the large amount of traffic on the network. Furthermore, the total throughput over the network was greatly improved by the OLS.*

## 1 Introduction

The number of users and the amount of traffic transmitted on the Internet are increasing since a variety of applications should be dealt with the Internet. In addition, emergence of ubiquitous applications will get traffic volume increase due to active development of ubiquitous networking. In this way, the Internet has grown and become more complex and dynamic system, however, the current Internet does not efficiently accommodate its dynamics such as the fluctuation of traffic demand / volume, route change, link failure, and so on, due to its best effort service nature.

In order to accommodate the fluctuation of network conditions, some traffic control schemes have been proposed. In particular, Traffic Engineering (TE) [1] is important to provide suitable route for traffic demand in the dynamic networks instead of minimum cost with static link weight or minimum hop routing used in the current Internet, therefore some TE schemes have been proposed, e.g., reconfiguring the link weights of Open Shortest Path First (OSPF) [2] [3], using the explicit routing function over Multi-Protocol Label Switching (MPLS) [4]. However, the schemes have difficulty in setting their control parameters, for example, the control parameters are determined depending on forepast long-term traffic demand, hence temporary performance degradation may occur due to short-term explosion of traffic demand.

In order to mitigate the transient performance degradation, suitable control parameters to the short-term network condition should be derived and applied automatically. Therefore, we focus on On-Line Simulation (OLS) system [5] that is an integrated system of measurement, parameter decision, and feedback control for adjustment the variable network condition. The system runs the following three functions automatically and periodically every control period; (1) measurement and estimation to get network conditions, (2) inference of the near future conditions and derivation of the appropriate parameters according to some traffic control policy through several simulations with different parameters, and (3) automatic re-configuration of control parameters. It has a great possibility for providing flexible reconfiguration of control parameters to the network as well as reducing the management cost.

So far, parallel network simulator for large-scale network simulation [6] [7] and search algorithms of better parameter set for network optimization [8] have been developed as parts of OLS system. Moreover, dynamic TE for minimizing packet loss based on OSPF link cost control by OLS has been proposed [9]. In [9], the evaluation was based on computer simulation, and the other previous studies didn't

0-7695-2946-1/07 $25.00 © 2007 IEEE
DOI 10.1109/HIS.2007.42