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Increasing transmission efficiency with advanced processing

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Abstract. Not too long after its emergence, the Internet became an integral part of everyday lives of men in modern societies. It constantly fuels growing opportunities for new advanced services which can better respond to quickly changing society needs. Previously such services often led to increases in energy consumption which is today in a strong contrast with the global drive for a greener and energy more efficient environment. We need network infrastructures which will support these growing needs but at the same time will also stay zero-carbon emission complaint. Such requirements are more imperative today than were ever before. In optical IP networks the power consumption could be reduced via green photonics and concepts known as green networking [1]. In line with these concepts we proposed a novel energy savings approach based on so called "node hibernation" technique. This approach is designed to help reduce network power consumption and optimise its energy usage by taking advantage of a hibernation algorithm we have developed. Its implementation into the network management structure will save the energy, operating cost to network operators and will deliver reduced carbon footprint.

Key words

WDM, energy efficiency, GMPLS, green photonic networks, power consumption, carbon footprint.

1. Introduction

The Internet today offers an easy and convenient way to gain access to entertainment, social networking, and desired learning tools. The Internet became even the place to conduct business. These rapidly expanding activities result in power consumption increases which in turn could put our environment at a greater risk. However such risky trends could be hardly acceptable as a long term solution. Therefore novel *greener* concepts are gradually being developed and are being implemented into today's communication networks. Thanks to these innovative approaches with better energy conservation and decreased carbon emission we can have better environment and a healthier lifestyle. All such activities are considered *green* if they:

- generate or help to conserve energy;
- help to reduce greenhouse gas emission;
- will help to reduce pollution thus consequently lead to improvements in the public health.

By considering all the above we proposed an approach which could help to reduce power consumption and increase an energy efficiency in optical networks via optimisation and better power management of the control algorithm by implementing a novel approach to Generalized Multi-Protocol Label Switching (GMPLS) control plane. Implementation of this methodology results in a significant reduction of energy usage and helps to cut the network operating cost without compromising the connectivity/performance. We have also investigated the impact of our technique on the heat transfer rate in IP routers even further enhance energy savings. Our energy savings approach was studied on optical networks with Generalized Multi-Protocol Label Switching (GMPLS) protocol. Our performance evaluations of various power saving schemes were conducted successfully and included various challenging issue to help to make the current networking "greener" by reducing the overall power consumption thus lowering the carbon footprint.

2. Network Energy Model

In order to evaluate overall network power consumption and the consumed energy per one bit of transmitted data we use so called *equivalent network energy model* (see Fig. 1) which is based on the Internet Protocol/ Generalized Multi-Protocol Label Switching (IP/GMPLS) over optical layers. In our model, network carrier bandwidth of OC-192 and average energy consumption of 1019nJ per bit was assumed after [2-4]. Symbol G_n (see Fig. 1) denotes dissipated power of 10kW within a router and consumption of 1000nJ/bit.