DESCRIPTION FOR THE GENERAL PUBLIC

According to forecasts of Cisco – the leading manufacturer of equipment for communication networks – the number of devices connected to the Internet will go beyond the world population this year (over 8 billion), whilst more than half of the world population is already using the Internet today. The growing number of devices will mostly follow from the increasing popularity of the Internet of Things (IoT) concept. The main goal of IoT is to connect to the Internet many objects and devices such as cars, refrigerators, washing machine, clothes, sensors, etc. The second important trend influencing the Internet traffic is popularity of bandwidth demanding services such as video streaming and cloud computing. For instance, about 35% of the US Internet traffic is generated by Netflix. In consequence, the traffic in the Internet will grow on average with annual compound growth rate (CAGR) of 24% in years 2016-2021.

The growth in Internet popularity is bringing a huge volume of digital traffic and enforcing advanced networking requirements. While the wireless technologies are the most popular solutions for the first mile of the Internet connection, it is the world of optical networks, which establishes the backbone of such a massive networking ecosystem. This follows from the fact that the Internet consists of many single networks connected together by a backbone based on optical technologies. A good analogy to backbone optical networks are highways connecting cities and countries. The shortage of highways can significant limit the development of particular regions or countries. Similarly, limitations in the optical backbone networks can be a bottleneck in the progress and development of the Internet and networking services and applications.

In the meantime, artificial intelligence has evolved from science fiction movies or books to a real world. While various aspects of digital intelligence applied for consumer-focused goals, including targeted advertising in social media, advising products for purchase, fraud detection, predicting customer profitability, chat bots, etc., have triggered the first waves, artificial intelligence technologies are currently changing IT and business infrastructures of many sectors.

New technical systems that apply various types of artificial intelligence can be called *cognitive*, since cognition – according to the the Oxford dictionary – is “the mental action or process of acquiring knowledge and understanding through thought, experience, and the senses”. Cognitive optical network is a new type of a network that utilizes advanced solutions from several research areas (i.e., machine learning, knowledge representation, optical network, network management) to solve some contemporary problems in optical networks. A cognitive optical network may be defined as a network with cognitive processes that can perceive the current network conditions, and then plan, decide, and act on this information. The cognitive processes, which learn or make use of past history to improve performance apply various *data analytics* solutions typically utilizing machine learning techniques. An illustrative example of the cognitive optical network application might be a system that uses prediction of the future network traffic on the base of historical data, and next adjusts the routing and allocation decisions in order to improve the network performance.

This project is focused on optimization of cognitive optical networks. The key goal of the project is to develop, implement, and analyze models and algorithms for optimization of cognitive optical networks. The existing optimization methods developed in the context of conventional (non-cognitive) optical networks do not make use of additional knowledge that can be obtained by data analytics methods. In this project, we form a hypothesis that it is possible to design new optimization methods for optical networks in order to improve the network performance by utilizing additional information that can be provided by cognitive processes including data analytics mechanisms based on machine learning methods. The key performance metrics of optical networks, we want to improve by using cognitive methods are: CAPEX cost, OPEX cost, network resource consumption, delay, latency, throughput, energy consumption. Potential recipients of the Project results are network operators, network service providers, and producers of network equipment and software, since results of the Project can be applied to design, optimize and improve optical networks.