DESCRIPTION FOR THE GENERAL PUBLIC

Recently, we celebrated the 50th anniversary of the first Internet transmission, since on October 29, 1969, a first transmission was made in the Advanced Research Projects Agency Network (ARPANET) – the forerunner to the modern internet. ARPANET was an experimental system that pioneered the idea of networking different kinds of computers together. The ARPANET project was sponsored by the US Defense Department's Advanced Research Projects Agency (then known as ARPA but since renamed as DARPA). The basic principles of operation of communication networks have been the same for 50 years, i.e., various types of data is sent in the form of packets between different devices connected to the network. However, because IT systems and applications are constantly evolving, a lot of research works related to communication networks have been carried out over the past 50 years in order to answer new challenges and solve the emerging problems. The main trend observed in the Internet since its beginning is constantly growing network traffic. Nevertheless, the continually emerging new services and applications that need a well-functioning communication network also have a huge impact on network development. At the beginnings of communication networks, the only goal of the network was to deliver the information, i.e., the networks were operating according to the 'best effort' principle. However, in parallel with the development of various IT systems, the communication networks have begun to offer new functionalities including Quality of Service (QoS) guarantees and traffic engineering capabilities. One important driver behind these changes was to satisfy growing needs of customers. Another significant driver was to provide network operators tools to provision good services in a cost-effective way, since network operators compete with each other on the open market and cost-effectiveness is a key requirement. In consequence, modeling and optimization of communication networks have been an principal topic to both researchers and practitioners for many years. Efficient algorithms allow to design and optimize communication networks across various technologies, topologies, services, applications and traffic patterns to provide solutions that meet the expected cost and performance goals.

This project is focused on optimization of multilayer application-aware networks. The key goal of the project is to develop, implement, and analyze models and algorithms for optimization of multilayer application-aware networks. An application-aware network can be defined as a network that is able to identify and classify applications and then use suitable optimization techniques to provision these application using resources accessible in the network in order to achieve acceptable application performance metrics. In turn, a multilayer network is a network modeled as a set of separate layers using various technologies and protocols applied to transmit data. In the context of this project, we assume that the network consists of two layers: packet layer and optical layer. The packet layer is used to directly serve the applications, i.e., to establish in the network demands required to serve various types of applications. In turn, the optical layer is used to establish virtual topologies to provision flows aggregated over the packet layer service demands.

The network optimization can be performed considering each single layer of the network separately. However, multilayer optimization allows to improve the overall network performance, namely, reduce CAPEX expenditures and at the same time holding the QoS (Quality of Service) parameters required by the applications by identifying the network configurations that jointly optimizes packet and optical resources. The idea of application-aware networking has been known for many years, however the vast majority of previous works in this area have been focused on a single layer (packet layer) optimization, i.e., the routing algorithms have been aware only of the packet layer resources and constraints. While at the same time, the configuration of optical layer resources have not been updated according to changing requirements. Moreover, recent trends in application characteristics, namely, the increasing diversity of requirements in almost all performance indicators (e.g., bitrate, latency, resilience, security) and new network capabilities trigger the need of multilayer application-aware networking.

In this Project, we form a hypothesis that it is possible to design new optimization methods for multilayer application-aware 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. 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 and optimize communication networks.