Ph.D. in Information Technology: Thesis Defenses

February 14th, 2020

Room Beta – 10.30 am

Davide ANDREOLETTI – XXXII Cycle

"Privacy-Preserving Service Delivery in Internet"

Advisor: Prof. **Massimo Tornatore**

Abstract:

In Internet, several different and (generally) independent entities cooperate to deliver services to final users. Prominent examples of such entities are the Internet Service Providers (ISPs), the Content Providers (CPs) and the Online Social Network Providers (OSNs). By exploiting several enabling technologies (e.g., in-network caching) and the different information the involved entities have (e.g., about the final users and the network infrastructures), it is possible to devise advanced forms of cooperation that lead to an improvement of the Quality of Experience (QoE) perceived by users. However, such cooperation requires the exposition of sensitive and business-critical information (e.g., about network infrastructure) that raises severe privacy concerns. The overall objective of this thesis is the development of methodologies to enable the main Internet players to cooperate and exchange information for realizing improved services while fulfilling their privacy requirements.

To this end, we design privacy-preserving protocols to address the privacy/utility dilemma within the context of video content delivery. In particular, we employ data perturbation, secure multiparty computation and secure secret sharing schemes to realize caching systems that are (i) effective (i.e., hit-ratio and retrieval latency are optimized), (ii) privacy-preserving (i.e., users' requests and locations, as well as contents' popularity are not disclosed) and compliant with Network-Neutrality regulations (i.e., ISPs reserve fair amounts of caching storage to the CPs).

Moreover, we propose a machine-learning-based tool that Twitter users can employ to measure the vulnerability to attacks aimed at inferring their location from publicly-available data. This tool also allows to quantitatively evaluate the effects that several factors (e.g., the frequency of exposition of location data) have on users' privacy, thus enabling their proper control.

Finally, we study the problem of optimally deploying a virtual graph over a wide-area network composed of several independent and mutually-distrustful ISPs. We develop a reinforcement learning algorithm based on the Shamir Secret Sharing scheme, which is capable to effectively deploy the virtual graph while not requiring the exposition of salient infrastructural information (e.g., cost of embedding into the physical nodes).

Sebastian TROÌA – XXXII Cycle

“Machine-Learning Defined Networking: Applications for the 5G Metro-Core”

Advisor: Prof. **Guido Maier**

Abstract:

With the advent of 5G technology and an ever-increasing traffic demand, today Communication Service Providers (CSPs) experience a progressive congestion of their networks. The operational complexity, the use of manual configuration, the static nature of current technologies together with fast-changing traffic profiles lead to: inefficient network utilization, over-provisioning of resources and very high Capital Expenditures (CapEx) and Operational Expenses (OpEx). This situation is forcing the CSPs to change their underlying network technologies, and have started to look at new technological solutions that increase the level of programmability, control, and flexibility of configuration, while reducing the overall costs related to network operations. Software Define Networking (SDN) and Network Function Virtualization (NFV) are accepted as effective solutions to reduce CapEx and OpEx and to boost network innovation. Although the implementation of SDN and NFV in networking gained big momentum in the last years, it also brings a whole new level of complexity. Virtualization breaks traditional networking into dynamic components and layers that have to work in unison and that can change at any given time. The high complexity introduced by these new technologies has led to the research for increasingly smart algorithms to optimize the network resource allocation. This thesis investigates new Machine Learning (ML) based algorithms in order to efficiently optimize resources in 5G metro-core SDN/NFV networks. The main goal is to provide the modern CSP with intelligent and dynamic network optimization tools in order to address the requirements of increasing traffic demand and 5G technology. The present study can be divided in two main activities: 1) propose novel ML algorithms in order to optimize the resource allocation of 5G metro-core networks; 2) implement the proposed algorithms in different emulated and real network scenarios.

PhD Committee:
Prof. **Achille Pattavina**, DEIB
Prof. **Giuseppe Bianchi**, Universita' di Roma Tor Vergata
Prof. **José Hernandez**, Universidad Carlos III de Madrid