Ecole Doctorale STIC

Sciences & Technologies de l'Information et de la Communication

ED STIC - Proposition de Sujets de Thèse

pour la campagne d'Allocation de thèses 2015

Axe Sophi@Stic :	SystèmesRéseaux|
Titre du sujet :	Enabling New Challenging Applications and Services through Software Defined Networking
Mention de thèse :	Informatique
HDR Directeur de thèse inscrit à l'ED STIC :	Thierry Turletti

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Laboratoire d'accueil :	INRIA

Description du sujet :

The DIANA team:

The INRIA Diana research team (previously called Planète) conducts research in the domain of networking, with an emphasis on designing, implementing, and evaluating Internet protocols and applications. The main objective of the project-team is to propose and study new architectures, services and protocols to support efficient and secure communication through the Internet. One of our research axis focuses on the design of an evaluation environment for the future Internet. We are highly involved in the design and implementation of ns-3, an efficient and realistic network simulator that includes accurate models and allows integrating real applications and communication stacks. In parallel, an important part of our activities focuses on experimental

evaluation, which complements theoretical modeling and simulation.

Description of PhD topic:

Software-Defined Networking (SDN) [1,2] has been proposed recently as a way to programmatically control networks, facilitating the deployment of new applications and services, as well as tuning network policy and performance. It represents a disruptive change in the way networks are architected, built, and operated. In this new promising networking paradigm, network control is decoupled from forwarding and is directly programmable. SDN thus promotes migration of network functions (e.g., caching, ciphering, load balancing, DHCP) from dedicated hardware (e.g., network middleboxes) to virtual machines running on shared commodity hardware, aka Network Function Virtualization (NFV). The main goal of this PhD thesis is to design efficient mechanisms to flexibly manage virtualized network resources for new applications on the Internet by providing an abstract view of current available network resources. So, smart applications will be able to determine the amount of resources they can utilize, compute their optimal placement, and accordingly request network services.
SDN can ease network configuration provided that a faithful view of network conditions is available to take appropriate measures and decisions in real time. Getting this faithful view of the network at low cost is a challenging problem, especially because decisions should be frequent and the traffic can be variable, hence requiring adaptation of the configuration. It thus becomes important to design efficient mechanisms that allow monitoring the network in real time without overwhelming its resources. In particular, the PhD candidate is expected to study and propose mechanisms for providing isolation between different traffic instances and services, for measuring the level of workload (traffic) on links, for detecting and analyzing the underlying topology of the network to get an adapted positioning of the controllers. Another task consists in designing a distributed control plane for future SDN solutions with advanced reconfiguration possibilities and decision-making algorithms. In addition to the definition of protocol mechanisms, it will be important to optimize the control plane in order to dynamically allocate and reconfigure roles of the different local entities to ensure resilience and efficient scaling. Target scenarios include dynamic network topologies that vary slowly, i.e., with links that are not always available due to varying network conditions. Proposed mechanisms will have to detect (and react to) congestion and link failures and then to take appropriate actions on the data plane and/or the control plane.
The new network algorithms designed during the PhD thesis will be evaluated analytically, with simulations and also experimentations on real testbeds. They will likely be deployed upon existing, widely accepted SDN and NFV technologies, such as OpenFlow [3] for the standard communication interface between the control and the data planes, OpenStack [4] to deploy and operate Network Virtualized Functions (NVF) and the OpenDaylight [5] OpenFlow controller.

Requirements:

The candidate will have strong background in Internet protocols, network modeling and good

C/C++ programming skills.

References:
[1] NcKeown, N., ”Software Defined Networks and OpenFlow”, NANOG 50, October 2010.
[2] B. Astuto, M. Mendonca, X.N. Nguyen, K. Obraczka, T. Turletti, "A Survey of Software Defined Networking: Past, Present, and Future of Programmable Networks", in IEEE Communications Surveys and Tutorials, Volume 16, Issue 3, August 2014, pp. 1617-1634.
[3] OpenFlow Web Page. URL: http://www.openflow.org/.
[4] OpenStack Web page. URL: https://www.openstack.org/
[5] OpenDaylight controller. URL: http://www.opendaylight.org/.

English version: