Title: Challenges in Network Virtualization

Presenter: Dr Omar Cherkaoui

Duration: Half day

Abstract: This tutorial provides an overview to the discipline of Network Virtualization (NV). Previously, Network Virtualization has consisted in deploying network services (VLAN, VPN, etc) and today it has evolved in the deployment of multiple distinct networks over the same physical infrastructure. Each network instance requires a level of isolation from the other instances. This isolation uses some old OS concepts of virtualization like: Hypervisor (VMM) and Containers. Furthermore, those concepts use an independent layer for the control and sharing of resources like network links, CPU, memory, interfaces, etc.

Virtualization has emerged as an active research area. Many large research projects (GENI, 4ward, Federica, Clean Slate, Horizon, JGN2 Japan) have been launched during the last two years. Those initiatives mainly try to develop the next generation network based on the network virtualization concept.

Network virtualization will require resolving many research issues and challenges.

We need to know where to push this virtualization: on which network/equipment and at which layer (L3/L2/L1)? We also need to determine the right trade-off between isolation, performance and flexibility of migration. It means that we need to decide where to push virtualization: at the data plane, control plane or management plane. Another approach is to determine if virtualization needs to be established at the hardware level, OS level or service level. New Infrastructure virtualization architectures need to be developed. Resource allocation algorithms will have to be adapted to the network virtual instances. This virtualization also adds a new level of configuration complexity that requires resolution.

We will review the way the main architectures proposed by the different projects like GENI, VINI, Find, Clean slate, Horizon, etc. handle those virtual slices and instances. We will expose different migration strategies in order to offer resiliency and reliability in this new virtualized environment.

Outline including a short summary of every section

1. Why we need the virtualization in the network?
2. Which Virtualization?

a. Micro-kernel (Type I) vs Containers (Type II)

b. VMM (Hypervisor)

3. Where we can push this virtualization?

a. On which network/equipment?

b. On which layer (L3/L2/L1)?

c. Business case

4. Open Research Issues in Network Virtualization

a. Isolation vs Performance: virtualization at the data plane, control plane or management plane

b. Virtualization at Hardware level, OS level or service level

c. Infrastructure virtualization architecture;

d. Resource allocation to virtual instance;

e. Configuration complexity for infrastructure virtualization

5. Projects on network virtualization
6. Security issues with virtualized infrastructure.

Potential attendee profile

This tutorial/course is intended for researchers (and students) in the field of network management of virtualized network. The tutorial/course is also useful to industry

professionals that wish to have a system/technology based analysis of the current and emerging virtualized network architecture evolution.

Biography

Dr. Omar Cherkaoui received his M.Sc. (1981) and Ph.D. (1988) from the University of Montreal (Canada). He is a Professor of Computer Science at University of Quebec in Montreal (Canada). Dr. Omar Cherkaoui teaches computer networks and distributed systems and conducts research in the area of network management and virtualization. He has published more than 100 papers in refereed journals and conference proceedings. He has authored multiple invited, keynote, and tutorial presentations, technical reports, and two patent disclosures. He worked during four years as a researcher at Cisco where he developed configuration and automatic test case generation solutions for the 12000 series. He participated to many industrial projects with companies such as Norlel, Bell, Telus, Hydro, etc. He created the research laboratory in computer networks (Lab Téléinformatique) where he supervised dozens of projects in the domain of hi-speed network management, Web services platform and new multimedia software (UCLP, Validmaker, Articiel, BIOGRID,..). His research interests include network management (standardization, protocols, configuration, validation, modeling, testing), optical networks, etc. Omar is a member of the technical program committees of a dozen network management conferences.