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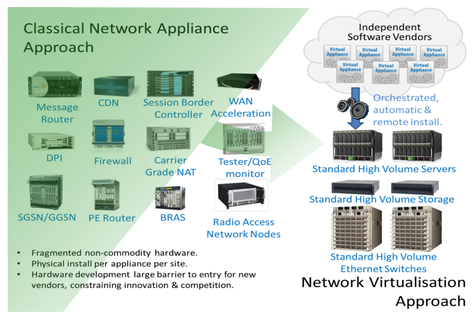
XXIX Cycle - II year presentation

Performance assessment of software-based network technologies

Research Context

Network function virtualization (NFV), **software-defined networking** (SDN) and **network virtualization** (NV) are attracting significant attention from both academia and industry as innovative ways to provide **telecommunication services by means of virtualization technology**.

- **SDN**: separates the network's control and forwarding planes and provides a centralized view of the distributed network for more efficient orchestration and automation of network services.
- **NFV**: by decoupling Network Functions (NFs), such as DNS, firewalls, etc., from proprietary hardware appliances, so they can run in software. NFV has the potential to lead to significant reduction in CAPEX and OPEX and accelerate service innovation and provisioning.



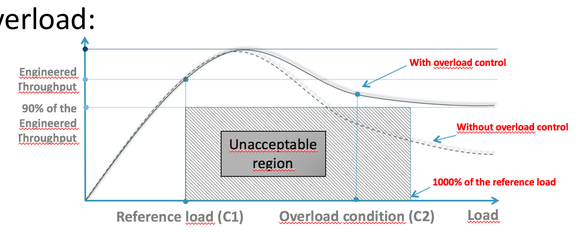
Motivations

Since **carrier-grade** networks' reliability requirements are stricter than traditional IT, Network Service Providers (NSP) need to continue to meet those requirements as they move to NFV.

The **network overload** represents a well know problem that may cause performance degradation (such as high response times, service failures.

Possible causes of Network overload:

- **Flash crowds**
- **Poor capacity planning**
- **Component failure**
- **Avalanche restart**



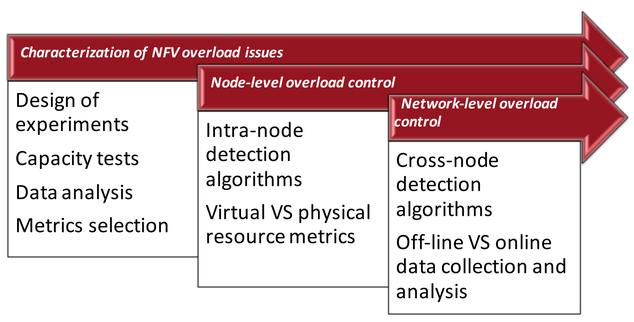
Since the traditional mechanisms adopted in the virtualization environment to face overload condition are not suitable (they take too much time) for the NFV context, a more efficient approach is needed.

1. Objectives

- Performance analysis of NFV-oriented IP Multimedia Subsystem (MS).
- Determine a metric or a combination of metrics useful to detect overload conditions.
- Determine whether the overload is due to a sudden workload increment or to contention on physical resources (**overprovisioning**).
- Proposal for an overload detection and mitigation solution.

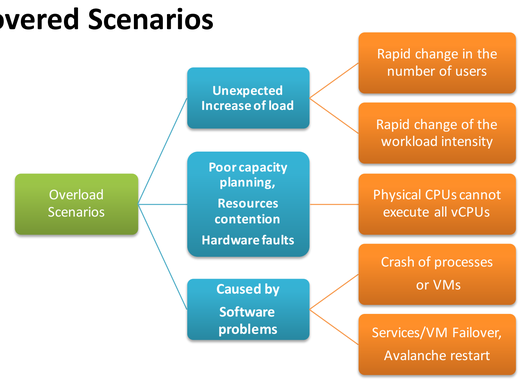
2. Methodology

- Overload detection at **node level**
  - Single machine providing a specific network function
- Overload detection at **network level**
  - Whole system, using VNFs, to provide a service (e.g., IMS)

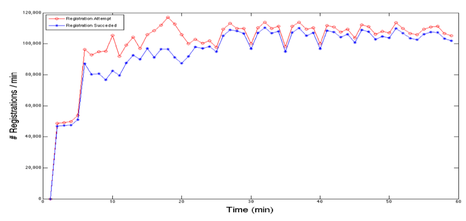


3. IMS performance analysis

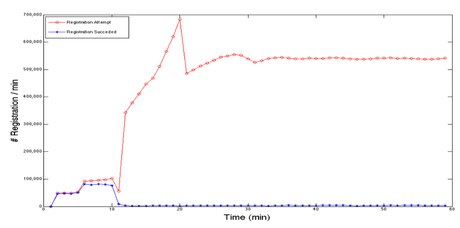
- **Covered Scenarios**



- **Results with sudden workload increment**
  - Stress tests on the Clearwater open-source IMS showed that the IMS is **able to handle light overload conditions** (+20% - +100% than engineered level)....



  - ...but the IMS is **not able to handle severe overload conditions** (+640% - + 1000% than engineered level)



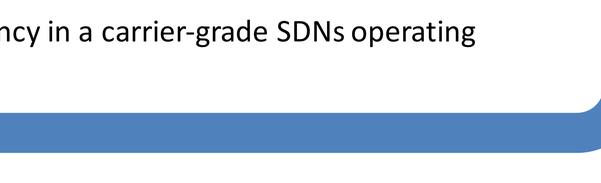
4. Results and ongoing activities

- In VNF as a service, the overload control solution cannot access the internals of the NFV infrastructure, and must only use **metrics collected at the VM-level**.
- However, the **vCPU** utilization measurements can be **inaccurate** under specific situations, such **as physical CPU contention.**
  - We are developing a model for discriminating between high workload and physical CPU contention.
- The model estimates the **rCPU footprint** of the VM, using measurements from the **guest OS** and the **NFV infrastructure**.

$$\overline{rcpu} = \alpha + \beta\ vcpu - \gamma\ steal - \delta\ vcpu * steal$$

- $\alpha + \beta\ vcpu$: The **main contribution** is due to the vCpu Load (β %)
- $-\gamma\ steal$: The **average effect of the steal time** ($-\gamma$ %)
- $-\delta\ vcpu * steal$: The **combined effect** of the steal time and vCPU load. It takes into account also the virtualization overhead.

- We are developing a closed-loop architecture for overload control based on vCPU and rCPU measurements



I am a member of **Mobilab** research group. I collaborate with a **global leader company of TLC solutions**, in a project that aims to identify possible solutions to the NFV Network Overload problems.

For the activities of the next year, I will join the **Alcatel Lucent** research group at **Bell Laboratories** (NJ) with a **1-year Fellowship financed by Bell Labs**.

Bell Labs

Alcatel·Lucent

Topics that will be covered are related to different facets of **resiliency** of **advanced networking and control** technologies (**SDN/NFV**) in the context of development of distributed **Network Operating System**, such as:

- Run-time injections for continuous testing in carrier-grade SDN operating systems
- System-level failure detectors and distributed failover techniques for fast recovery in carrier-grade SDN
- Running user-level network stacks to reduce latency in a carrier-grade SDNs operating system