

Stefano Rosiello

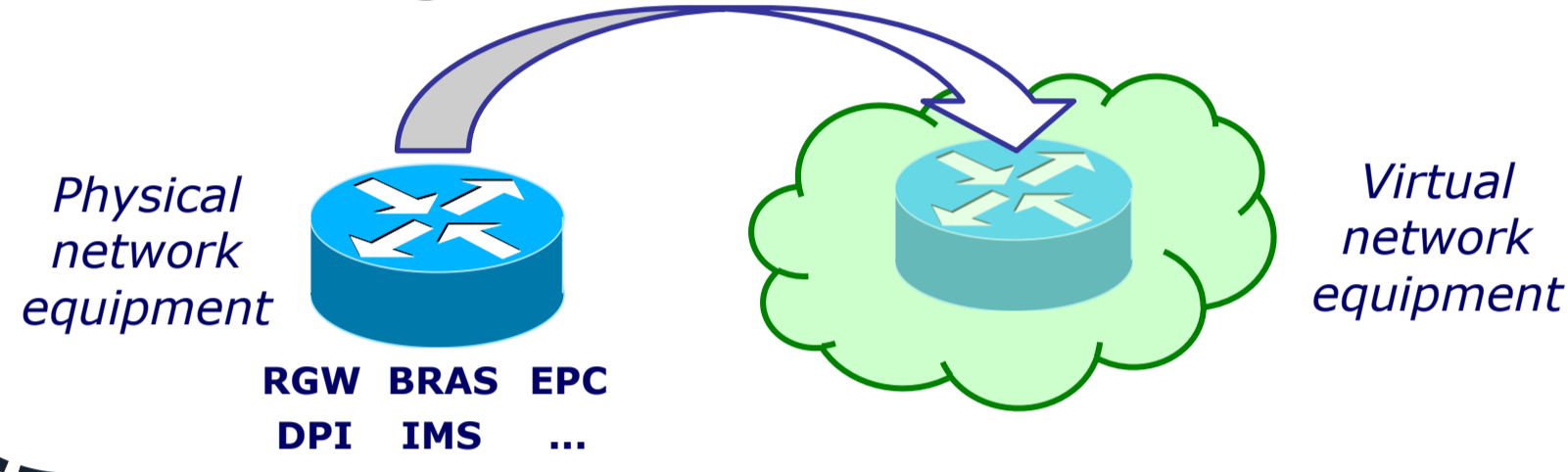
Tutor: prof. Domenico Cotroneo

XXXI Cycle - II year presentation

Toward Reliable Virtual Network Services

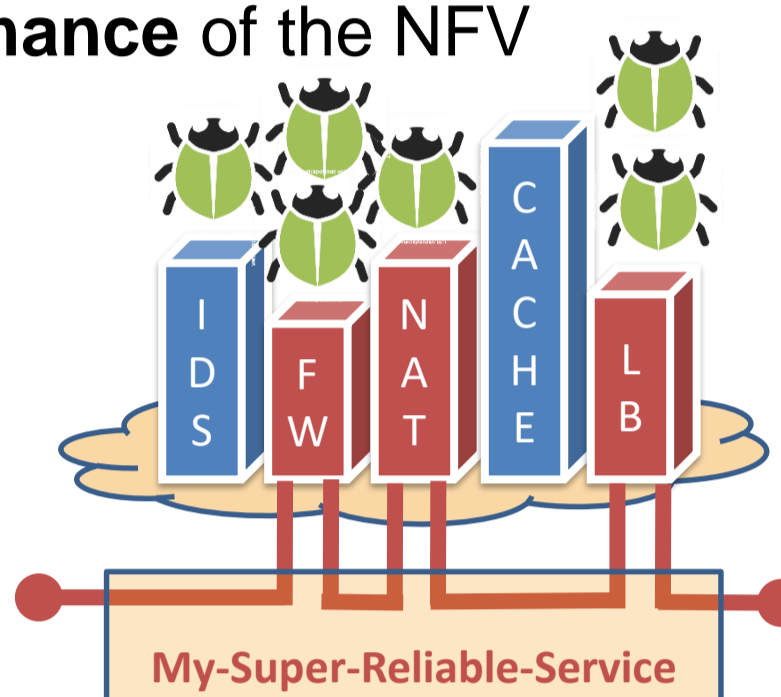
Research Context

- Network Function Virtualization (NFV) is transforming the way to architect computer networks
- Virtual Network functions (VNFs) are **implemented in software**, and leverage on **virtualization and cloud computing** technologies.
- NFV **reduce costs** and **ease the creation and the management** of custom network services by **orchestrating chains of VNFs**



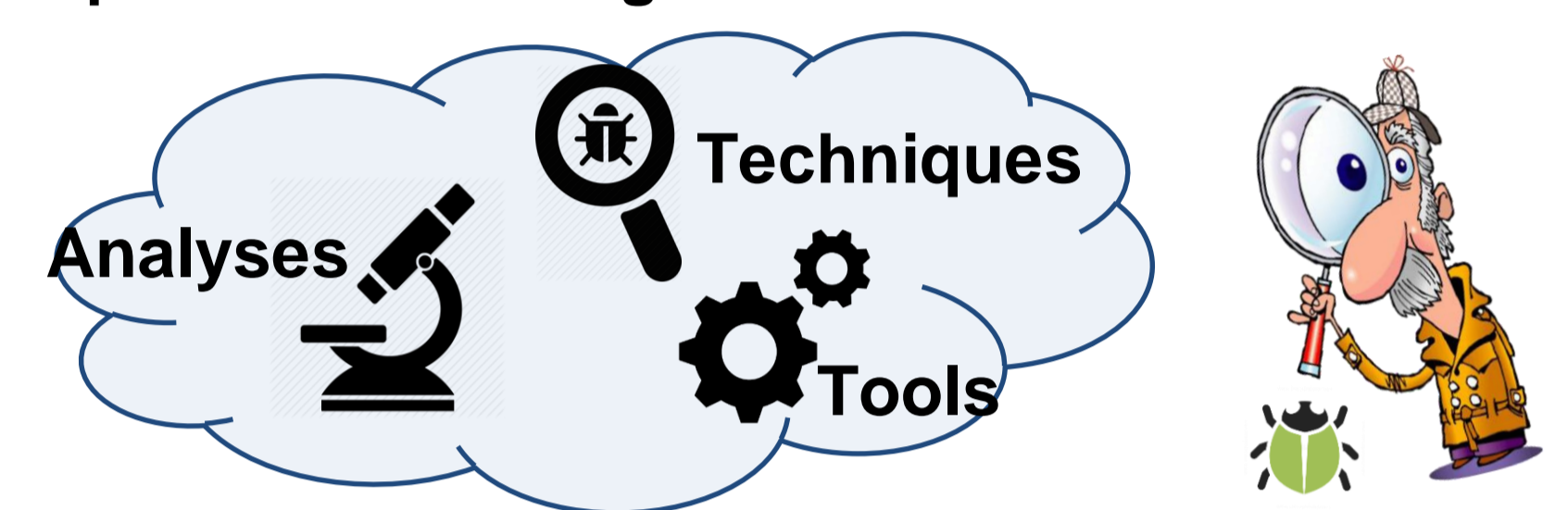
Motivation

- NFV need to **ensure the same carrier-grade requirements of performance and availability** as the traditional networks appliances.
- Threats** coming from the infrastructure, from the software and from the end-users may **affect the capacity and the performance** of the NFV services.
 - Software bugs
 - Virtual machines or processes crashes
 - Resource contention
 - Overload conditions



Needs

- How **NFV services perform**, despite such **threats** ?
- How **detect performance anomalies** in complex network services, despite the **heterogeneous mix of both hardware and software** ?
- How **mitigate the effect** of such anomalies in order to **prevent a QoS degradation** ?



Research Activities

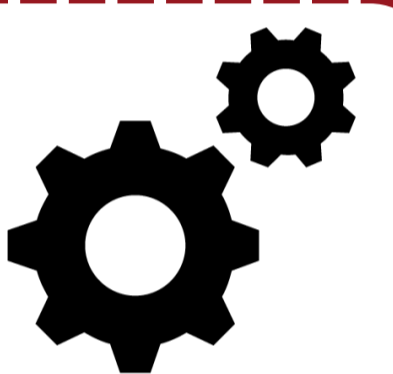
- Performance analysis** of software-based network services in **presence of faults**.



- Novel approaches to perform **performance anomaly detection** in **large-scale systems**

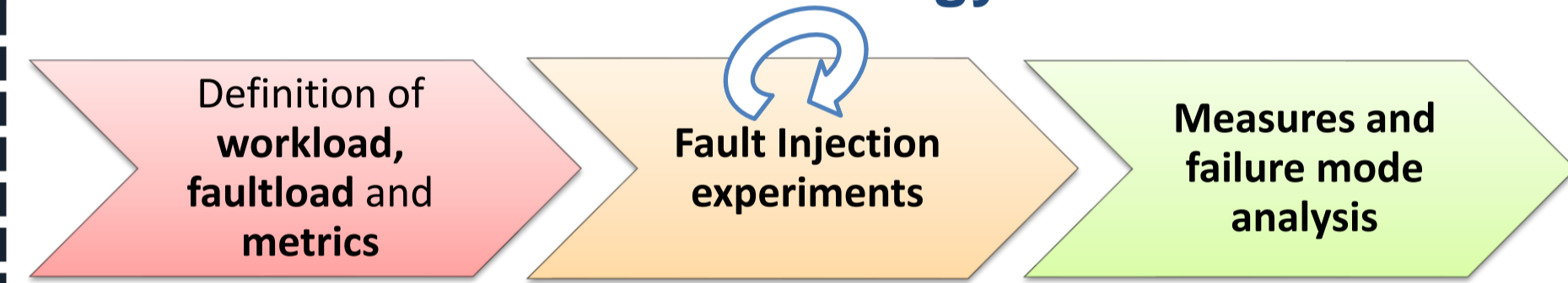


- Capacity Management** and **Overload Control** solutions suited for NFV to meet the **carrier-grade performance and availability** requirements.



Analysis of Performance Failures

Methodology



A case study

An opensource NFV-ready IP Multimedia Subsystem (IMS)

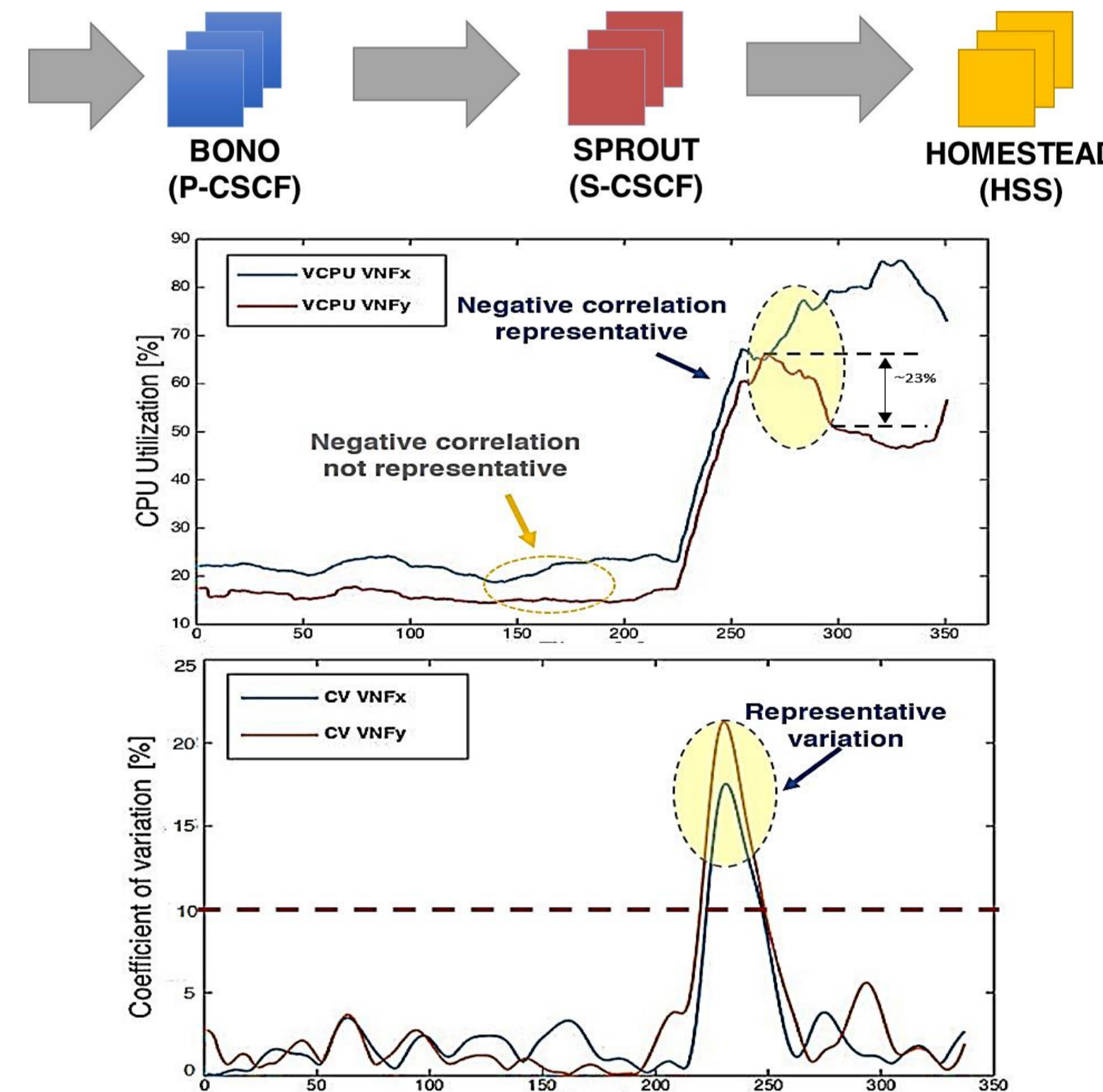


- Severe **overload conditions**
- Workload 10x higher than the capacity** (at 10 min)
- Graph showing Request Rate and Throughput over time, with a red box indicating 'Resource exhaustion and crashes of VMs'.
- Faults that may reduce the system capacity**
- Physical resource contention (injected at 20 min)
- Graph showing Request Rate and Throughput over time, with a red box indicating 'Throughput reduced by 30%'.

Anomaly Detection

Approach

- Analyze the **co-variation of multiple Network Functions over the time** to infer potential performance anomalies at each stage of a VNF chain.

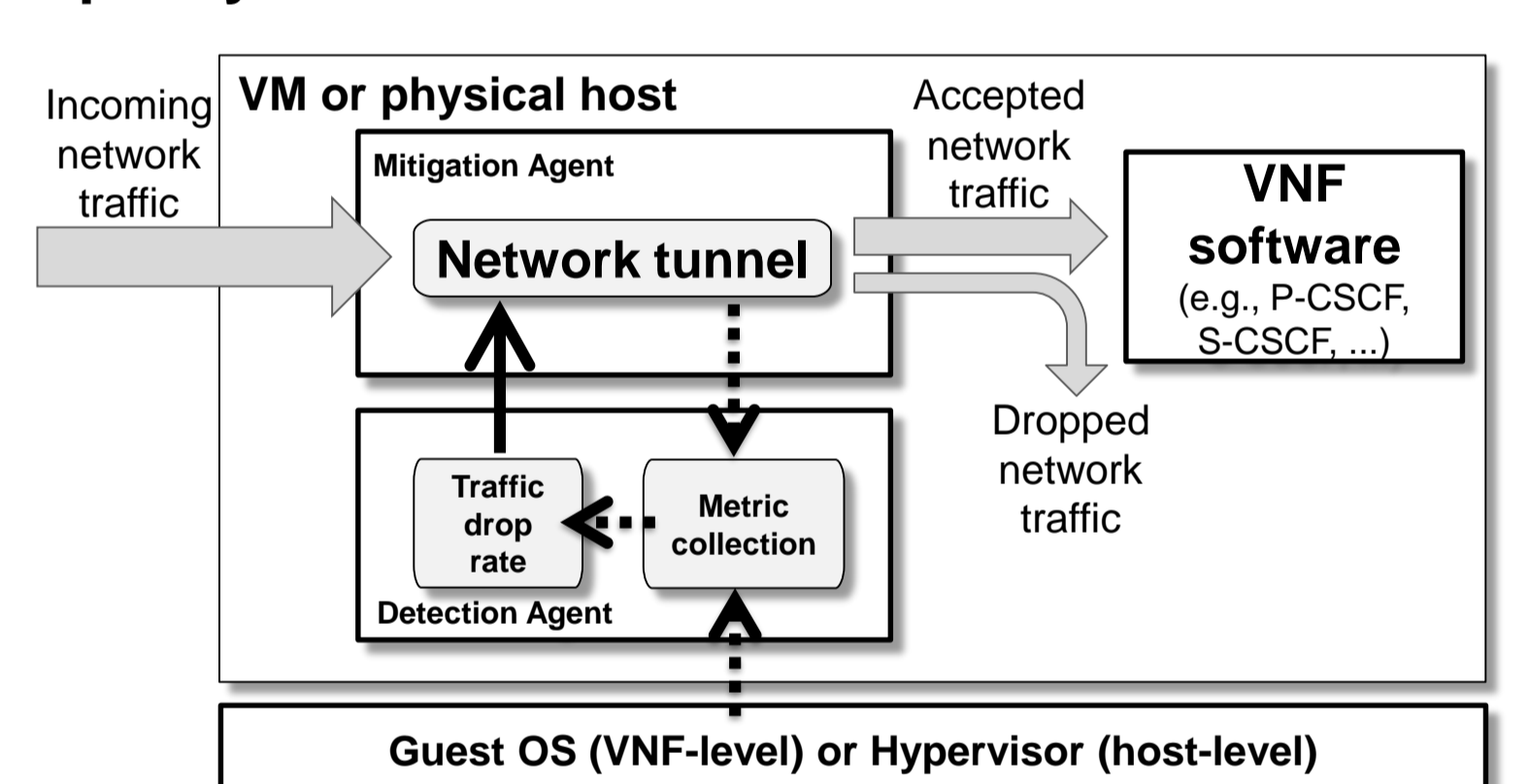


Negative correlations between adjacent VNFs are symptoms of performance anomalies

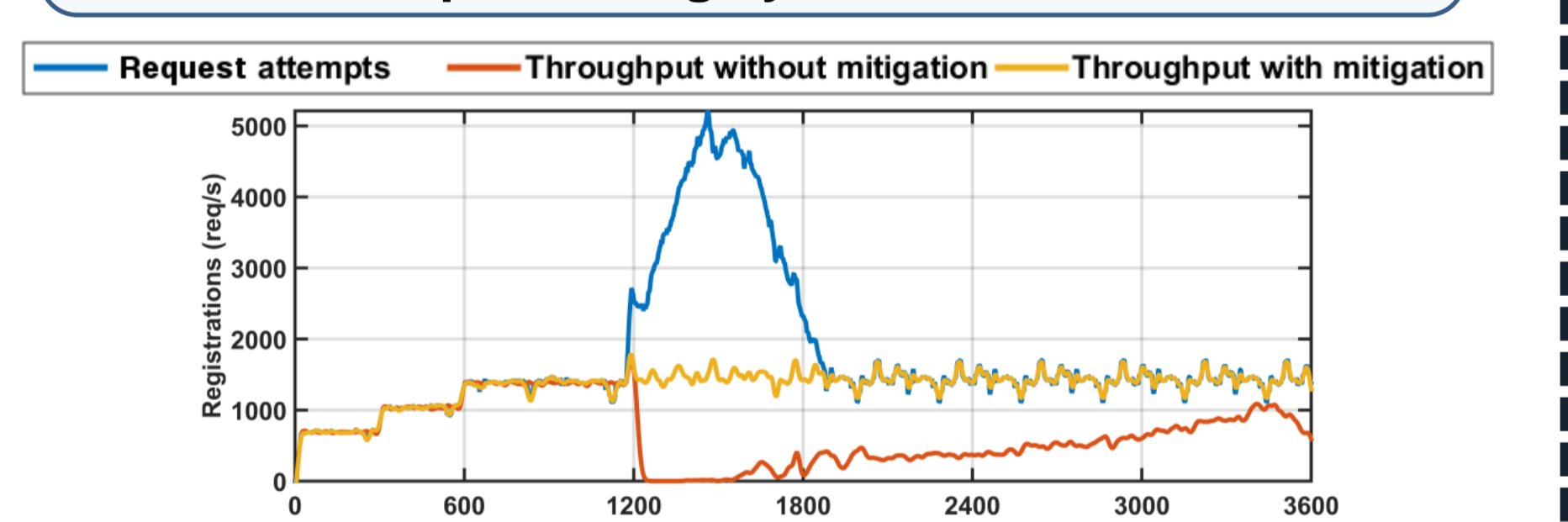
D. Cotroneo, R. Natella, S. Rosiello "A fault correlation Approach to Detect Performance Anomalies in Virtual Network Function Chains", 28th International Symposium on Software Reliability Engineering (ISSRE), IEEE, 2017

Overload Control

- A **framework for overload control** for NFV infrastructures
 - Support for **VNFaaS** and **NFVaaS** models
 - Combine **VNF-level** and **Service-level** protection
- Admission control technology** based on **dynamic capacity estimation** heuristics.



Traffic inspection and session throttling to preserve the QoS for the accepted sessions and preventing system failures



D. Cotroneo, R. Natella, S. Rosiello "NFV-Throttle: An Overload Control Framework for Network Function Virtualization", IEEE Transactions on Network and Service Management, IEEE, 2017

My Research group

I'm a member of the **Dependable System and Software Engineering Research Team (DESSERT)**, formerly known as MobiLab group, at DIETI - UNINA.

<http://www.dessert.unina.it>



Industrial collaborations

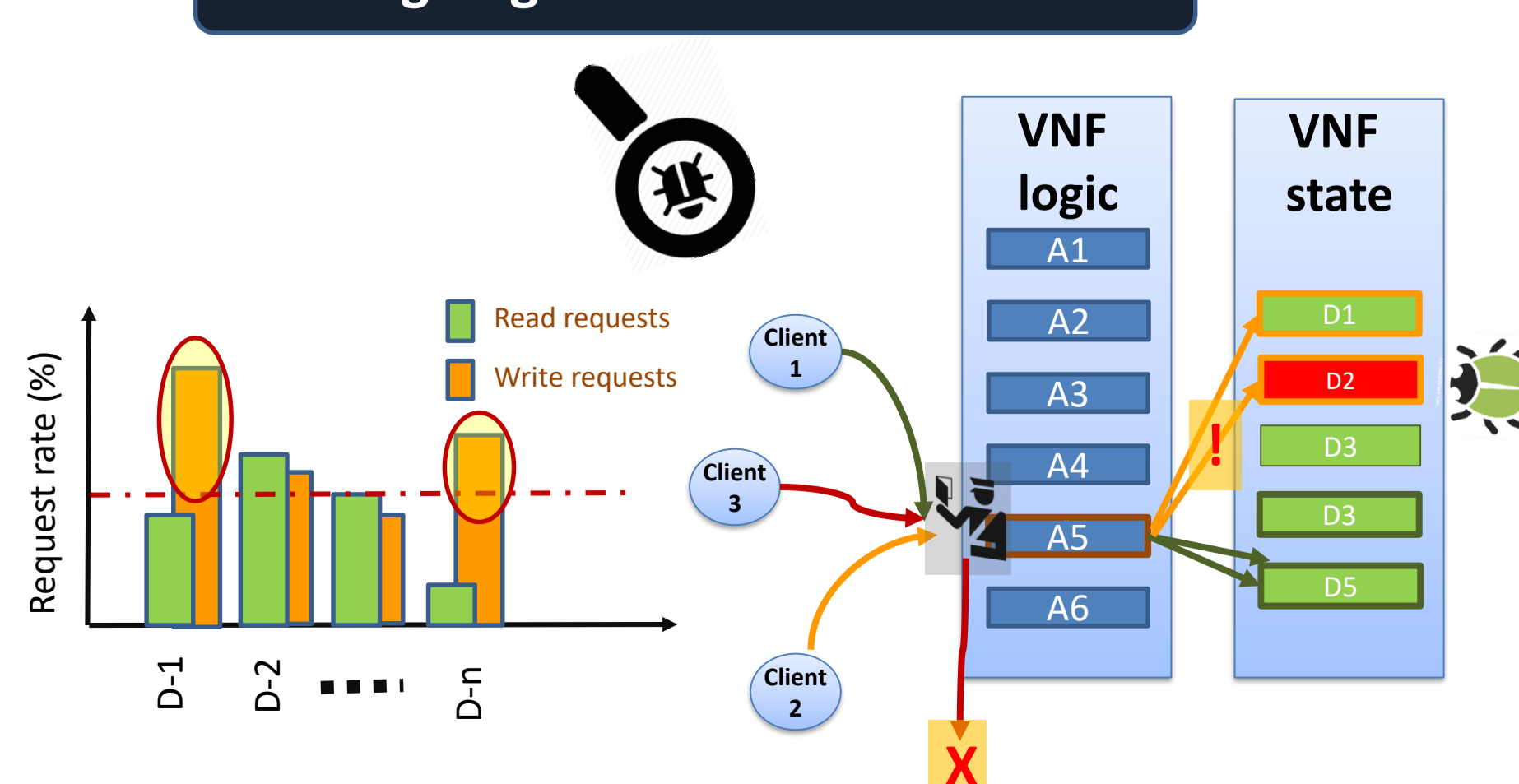
I collaborate with **Huawei Technologies Co. Ltd.** in a research project that aim to research overload control solutions to improve the reliability of NFV technologies.



Ongoing and future activities

To quickly scale network services at carrier-grade, VNFs software are evolving by **shifting the state in highly distributed datastores** (such as Cassandra, Memcached).

- Data dependencies** between application and storage nodes pose **new threats** that may affect the capacity (and the availability) of NFV services.
- Unbalanced accesses** and **Hot-spot** resources
- Physical **resource contention** at storage tier
- Unbalanced capacity** in storage nodes



To preserve the **consistency of data** at application level, **admission control is not possible** in the datastore tier.

- New **overload control solutions** are required to prevent the overload of the datastore tier nodes.
- I am exploring the possibility to **inspect the service requests to predict what data will be accessed** before their actual execution

