**Description du sujet:**

*Context*

Private clouds offer an efficient approach to perform extensive computing tasks and host enhanced Internet services for enterprises or ISPs. These clouds build upon a physical infrastructure to deploy on demand virtual topologies composed of virtual machines (VMs) and switches.

Private Cloud managers, such as Openstack provides a wealth of information on the physical infrastructure and the performance of the virtual machines. In parallel, a variety of monitoring tools exist either at the physical level, the virtual switch level, or even inside the VMs, to monitor traffic and detect performance issues. These tools can perform passive (e.g. sFlow [6]) or active (e.g. iPerf[2]) measurements. Still, the troubleshooting of private clouds remains challenging [10]. First because the cloud management suite consists of several distributed components that span over a large set of physical servers [12, 5]. Second, because the path between VMs spans over virtual and physical [7]. In addition, the VMs of different tenants might interfere with each other.
*Challenges*

Our focus in this thesis will be on monitoring and troubleshooting private clouds. These environments bear specific opportunities and challenges that differ from the ones in public clouds. Indeed, public cloud providers like Amazon Web Services or Google cloud, face the challenge of the scale, where the sheer numbers of switches and links leads to frequent physical level errors [13]. In contrast, the relatively smaller size of private cloud networks as compared to public clouds limits such a risk. During troubleshooting, public cloud providers also face a black-box issue, as they have no access to the VMs of tenants [7]. In private clouds, accessing the guest operating system inside the VMs is an option. As an example, in [11], the authors correlate, in a Facebook datacenter (a large scale private cloud), end hosts (hence system level metrics) and network measurements to discover network failures.

We will focus on the following challenges during the thesis:
- Measuring at all possible levels of the cloud stack, from the physical network up to the application stack, while controlling the impact on the tenants’ traffic.
- Troubleshooting performance problems based on the above measurements, which entails identifying flows or VMs running in troublesome conditions [10] and next discovering the root cause of the problems using statistical inference techniques among others [3, 9].
- Anticipating the anomalies at the application level, and taking appropriate counter-measures. This might require modifying the network routing rules or interacting with the task/VM placement algorithm [8] with the objective to reallocate the tasks and VMs to accommodate the actual infrastructure conditions and offered load.

*Methodology*

In this thesis, we will first pre-select a subset of measurements tools that allow the most completed monitoring of the virtualized environment. Second, we will investigate the optimal deployment of these tools so as to cover the monitored system of applications and infrastructure in the most effective way - see our recent work [6]. Once this optimal set of monitoring tools identified, we will move to the second part of the thesis where we bridge the gap between the obtained measurements and the quality of service at the application level. A data driven approach can be followed here, where models can be inferred linking between application level quality of service and infrastructure performance as monitored by the deployed monitoring tools. These models will be our lever to troubleshoot the cloud environment and to anticipate anomalies. By confronting the models to each other for different application quality of service metrics, we will be able to identify the underlying problems most likely behind the observed pattern at the application level. We will be also able to predict, starting from the measurements, to predict the occurrence of an anomaly at the application level and investigate actions to counter it.

References


URL: [http://www.i3s.unice.fr/~urvoy/PhD_thesis_Private_Cloud.pdf](http://www.i3s.unice.fr/~urvoy/PhD_thesis_Private_Cloud.pdf)

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