



# Master Thesis

2018-04-20

## Network Aware Cloud Simulation environment

### Context

With the advancement of Cloud computing, a new era has begun where a significant number of applications of various kinds are being migrated to Cloud data centres. Among the applications, some are resource demanding and business critical such as High Performance Computing (HPC) simulations or Data intensive computing (DIC) applications. These applications require large amount of compute and storage resources and are often executed as distributed or even parallel applications involving significant amount of communication with low latency among the hosted Virtual Machines. Moreover, the resource usage behaviour of such cloud applications are often dynamic. The decision process if more resources are needed, resources can be released or Virtual Machines should be migrated, might be triggered by simple rules or complex decision algorithms. In those algorithms, resources like CPU, Memory, Storage etc. are mainly considered where other parameters such as network load or, usage pattern are commonly not considered as decision parameter. Recently, more research work is being conducted to design network-aware VM placement and migration algorithms where, network load in the topology, resources such as bandwidth, latency induced by the networking equipments etc. have been the main focus of research.

As the cloud data centres are growing rapidly in size by adding hundreds of thousands of computing clusters, the resource allocation algorithms need to be validated with respect to their scalability, optimality and stability before they can be used in real life. For such validation, a wide range of simulators and emulators are being used. However, while using cloud simulators, it is often experienced that there is less options to perform an in-depth simulation of the data centre networking environment. On the other hand, network simulators lack functionalities for creating a cloud data centre architecture.

### Scope of the Thesis

The goal of this thesis is to provide an overview of the existing solutions for simulating cloud data centre and networks and to evaluate their capabilities on conceptual and practical level to address network related performance assessment. Based on the analysis either one tool should be enhanced to meet the demands or, a combination of tools should be selected that can be integrated to cover cloud and network related aspects. For the validation of the simulation environment, a testing strategy has to be developed based on the defined use cases and comparison with measured results on an existing cloud infrastructure. The last part of the thesis is to assess the capabilities of the realised simulation environment in terms of scalability and performance.

### Requirements and Comments

1. Knowledge on fundamentals of Cloud data centre
2. Knowledge on data centre networks
3. Skills in a functional or, object oriented programming language

If you are interested, please contact Stefan Wesner and Mitalee Sarker either by mail or directly in the office.

**Mail:** stefan.wesner@uni-ulm.de, **office:** Uni West, 43.2.210  
mitalee.sarker@uni-ulm.de **office:** Uni West, 43.2.220

**Faculty of Engineering and  
Computer Science**

Institute of Information  
Resource Management