Autonomic management of resources in virtualized networks

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Network virtualization is a key concept for the future Internet. It may bring architectural pluralism and separation between infrastructure and services providers [1]. These new features will increase the networks complexity and will make the management of them more difficult. For this reason, some researches address the use of new paradigms like autonomic computing [2], which use fault tolerant and artificial intelligence techniques for computing aided management.

The proposal of this work is to build and evaluate an algorithm for autonomic management of resources in virtualized network. In this case, autonomic management means self-configuration and self-optimization of virtual networks for the substrate network. The parameter to be optimized is the bandwidth [3]. The management should be distributed to not incur on a single point of failure and not cause excessive overhead.

To evaluate the proposed management, it is intended to make a simulation with NS-3, but it doesn't support network virtualization. The modeling of a solution and some NS-3 extensions for enabling virtualized networks simulation are proposed. The initial requirements are: the mapping between virtual and substrate networks should be dynamic; it is desired that the virtual networks could run different protocols.

The model of node virtualization is inspired on Xen [4]. The substrate node will have a list of virtual nodes, that can be accessible beyond virtual network devices. This can be a problem for the isolation guarantee between virtual networks. There must have a way of separating the virtual flows. The virtual link is a path and so a communication between adjacent virtual nodes has to be routed in the substrate network.

The proposed solutions are based on marking packets and virtual bridges. Put a tag in a packet is simple in NS-3. The changes includes a layer responsible for multiplexing and demultiplexing packets among virtual nodes. The virtual bridge is a virtual node that just forwards packets from one network device to another belong to the virtual link. As well as virtual nodes, they should be created, destroyed and moved on simulation time for change the mapping of virtual links on the substrate network.

A virtual router configuration can be done with the Click Modular Router. The Click is a modular architecture that handles packets and can be used for many purposes. It was integrated to NS-2 for node configuration and it was called Nsclick [5]. Therefore, a simulated experiment can be migrated to an implementation easier, because the router configuration is almost the same. Nsclick is not compatible with the NS-3, but the community is working on it.

We intend to implement and evaluate the solution for autonomic management with this simulator. It is based on the principle an autonomic manager executes a proactive life cycle over a managed element and interacts with the environment and other managers to accomplish the objectives of the overall application. Its features, autonomy, pro-activity, interactivity and cooperation, are inherent for multi-agent modeling [6]. The life cycle of an autonomic manager is often divided into four stages: monitor, analyze, plan and execute. The objectives could be expressed with high-level policies, that define what to do, but not how to do.

On this work, the life cycle of the autonomic manager will be performed in following way: in the monitoring phase, the manager collects data from links; in the analyzing phase, it correlates data and evaluates the need of changing according to high-level policies; for the planning phase, some optimization technique is used; in the execution phase, the mapping of the virtual networks into the substrate network can change, by moving virtual nodes; and after this, the algorithm backs to the monitoring phase.

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