Future Mobile Network: Use Cases for Network Virtualization

Wolfgang Kellerer, Jörg Widmer, Ashiq Khan, Dan Jurca
Ubiquitous Networking Research
DOCOMO Communications Laboratories Europe
Munich, Germany
[lastname]@docomolab-euro.com

I. MOTIVATION

Network virtualization has been adopted as a very useful tool to enable large-scale network experiments [1] and the deployment of experimental facilities (GENI, AKARI, G-Lab). It is also regarded as a key building block to solve some of the problems imposed by the current internet. In particular, network virtualization helps to break up the ossification of the current internet and allows the deployment of new service concepts in a future internet architecture [2]. A virtual network created by the interconnection of virtual routers through virtual links is called a slice. Slices can be used to facilitate experimentation with different future internet architectures, but it may even be that no single architecture will emerge, and different new architectures are permanently run side-by-side.

Network infrastructure providers such as mobile operators may thus give much greater flexibility to service providers for the creation of network and application services that are not possible with today's Internet architecture. In particular, mobile operators may deploy specific mobility solutions or quality management adapting to device and access heterogeneity [3]. At the same time cost reductions are expected due to more efficient hardware utilization and lower operational costs within one slice.

In order to realize this vision, it is necessary to develop technologies and business models for the operation of virtual networks to efficiently provide end-to-end connectivity. Concrete use cases provide the guidelines for the development of suitable technologies to support network virtualization effectively in a future mobile network.

II. USE CASES

The potential of network virtualization for a future mobile network is discussed, giving the following use cases as examples.

A. Beta Slice

This use case addresses a fast and scalable introduction of new services by operators or third party providers, e.g., specific media optimized services or Web 2.0 applications, which can be run in fully isolated slices for trials and can be scaled up after the experimentation phase.

B. Multi generation network

Based on a virtual network architecture, multiple generations of a network architecture, e.g., 3G and different beyond 3G cellular versions can run in parallel on the same physical network reducing infrastructure expenditure (CAPEX) and also operational cost (OPEX) as maintaining two physical substrates is not necessary.

C. Technology migration

To reduce deployment cost in terms of hardware and operational cost, a virtual network architecture facilitates an efficient migration to new network technologies, e.g., replacement of communication protocols or provisioning of networks based on protocols beyond the conventional IP protocol stack.

D. Network Isolation

Special purpose networks, e.g., kids' Internet, banking Internet, can be run in parallel to best effort open internet networks in fully isolated slices.

E. Resilience and energy efficiency

A flexible and possibly dynamic adaptation of the virtual network topology to the actual needs allows to improve resilience and to reduce energy consumption. Topology change becomes possible by migrating virtual machines from one node to another without any downtime.

III. CONCLUSION

We are currently setting up a testbed for network virtualization to validate the described advantages with the above use cases.

[1] A. Bavier, N. Feamster, M. Huang, L. Peterson, and J. Rexford, In vini veritas: Realistic and controlled network experimentation, ACM Sigcomm, 2006.

[2] N. Feamster, L. Gao, and J. Rexford. How to Lease the Internet in Your Spare Time. ACM SIGCOMM Computer Communication Review, 37:61–64, January 2007.

[3] W. Kellerer, J. Widmer, H. Berndt. Next Generation Mobile Internet - Network and Service Platform. Information Technology, Oldenbourg-Verlag, München, special issue on Next Generation Internet, 2008.