

## **Remaining Grand Challenges in Networking**

**Serge Fdida, University P & M Curie – LIP6/CNRS, Paris, France**

The current internet is stressed by several factors, ranging from new functionalities to be integrated, to scaling challenges. In the future, networked systems will be predominant, with various forms. Virtual worlds will emerge, creating interactions with the physical world through the embedded objects connected to their environments. In parallel, the communication paradigm is moving from connectivity to content, users being not at all interested by packets and flows but rather by data and content that they subscribe to. Content has become a driving force behind many new network architectures and entirely new paradigms are emerging. Obviously, the technology will continue to progress, enabling plenty of new components, from the access, eventually to the core of the network. Network environments are becoming ever more heterogeneous. New generation cellular systems are bringing large numbers of handheld wireless devices into the Internet, and new ways are arising for these devices to self-organise and communicate.

The future Internet will be polymorphic, aggregating all these types of systems. It should be designed as an enabler to service creation and for competition. It will allow the current internet to continue providing basic services to the current main users. The federation of the various forms of the future internet is a critical concern.

We foresee communication needs, evolving towards a few challenges exposed by:

- The (Access) Network is Wireless
- The Network is a Database
- The Network is the People
- The Network is a global virtualized resource
- They're all Federated

We provide a short presentation for the rationale and issues of the above challenges. Moreover, we argue that exploring the foundations of the future internet requires going back to the fundamentals (The Internet "Laws") but should also be complemented by experimentations and benchmarking.

Yet there are few possibilities to experiment in such a hybrid environment. We briefly highlight the Onelab project, which aims to provide a single access model to a diversity of networking technologies, it allows resources to be shared through the powerful paradigm of virtualisation, wherever this is possible, and it enables the federation of multiple test beds. The OneLab project established the PlanetLab Europe test bed, added new capabilities, and federated it with the worldwide PlanetLab system. It should give people wanting to assess new technologies the tools to quickly deploy their experiments, evaluate and analyse the results produced by the test bed but also incentives for federating their own resources. As such, it will lower the entry cost to experimentation, often considered as a complex and heavy activity, with little extra management burden, accelerating proof-of-concept evaluation and competitiveness.