Euro-NF Vision on Future Communications

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The European Network of Excellence „Network of the Future“ (Euro-NF) is permanently discussing and revising its vision on the Internet of the future. A lot has been already said on the Internet of the future, on evolution versus disruption; we believe that evolution and disruption will continue to co-exist, as has been the case in the past. E.g. P2P introduced a disruption in content distribution. We don't pretend here to describe the networked world of the future, we present a set of concepts and principles that will most probably partially shape and enable it.

As we already mentioned in a previous document delivered in May 2006, we believe that focusing on the Internet of the future without a broader view on the future "networked world" is too restrictive to allow a proper understanding of the consequences of the visible or foreseeable networking trends. The present homogeneous IP networking paradigm has to support a diversity of applications with quite different requirements while hiding a diversity of transport technologies. A transition towards a service-/application-aware, user-/ machine-/business-aware and -centric, dynamic interconnection of a large diversity of heterogeneous networking paradigms is foreseen, hidden by a global architecture. Personalized, location and context aware applications will become ubiquitous and pervasive, accessible through a large diversity of access technologies, and globally mobile, which means mobility across any type of borders. I.e. we'll be phased with a polymorphic networking environment.

In the presence of the foreseeable networking trends the concepts of the current Internet seem no longer to be adequate, especially w.r.t. their generality. Quality of Service as well as security and privacy issues have to be reconsidered. The current architecture is too inflexible, the concept of a fixed layer architecture is outdated. The concept of Service Oriented Architectures will apply to larger systems, encompassing the future networks. Following the principal of composability of services, a network can be seen as a service component, leading to the concept of "network as a service". In a recursive way, the network of the future can be considered as the composition of various heterogeneous networks, each of them being considered as a "service component", which itself is composed of service components of finer granularity. The corresponding architecture follows in a dynamic way ("architecture follows services"), based on new paradigms such as publish/subscribe.

On the other hand side, the combination of new optical networking paradigms and semantic routing, separating identification and location, will reshape the present core network architectures and routing strategies.

At the edge of the infrastructure we see a ring of self-organized networks, based on heterogeneous networking paradigms, in some cases cooperating with the infrastructure, i.e. there will be no single unique networking paradigm, valid over the whole 'world'.

A second ring will make the real world collide with the new generation of WSANs, RFIDs, etc. allowing the so much discussed merging of the digital world with the real physical world. Objects will no longer be connected to the Internet, they will become the Internet by their own. The next generation of the Internet of Things, however, will be based on coordinated and cooperative interactions among things, providing an integrated experience in the context of an ever increasing diversity of applications.

Intelligence between overlays and networks will be dynamically redistributed for global optimization. Some functionality will move into the network. Centralized policy based management and control will be replaced by self-organization and autonomy in order to master the ever-increasing complexity. Cognitive radio for advanced spectrum sharing approaches is just a first example.

Virtualization and programmability will represent key enablers for realizing the previously introduced concepts and principles to guarantee the required implementation flexibility.

The network of the Future will go along with more complex governance challenges. Internet Governance of the future will be decentralized, diversified and adjusted according to the special needs of given issues globally or locally. Global Internet Governance of tomorrow will be a federated system where all stakeholders - governments, private sector, civil society and the technical community - will be involved in their respective roles.

Faced with a situation such as this, what needs to be done?