Evaluation of Next Generation Network Architectures and Further Steps for a Clean Slate Networking-Approach

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The entire telecommunications and information technology industry currently undergoes a deep transformation. The wide availability of broadband connectivity to end users at decreasing cost in combination with novel services, such as Voice-over-IP (VoIP) and Internet Protocol television (IPTV) to name but a few, disrupt existing technological approaches and traditional business models, and force carriers to radically adapt their strategies. Academic research has taken on the challenge to rigorously evaluate existing network architectures and protocols, and prepares for a radical redefinition (and hence simplification) of the well-known IP architecture and protocol suite as well as related technologies, an effort summarized under the framework of a 'clean slate approach'. Although a clean slate approach offers the advantage of an architectural re-design and significant streamlining in the long term, carriers need to find ways to gradually transform their networks already within a 5-10 year timeframe. Inevitably these networks will still heavily rely on conventional IP functionalities. In this presentation the architectural implications of different network architectures are discussed, serving as a first indication to the impact a clean slate approach might have on the design and operation of future networks.

The presentation focuses on new architectural approaches beyond standard IP networks, suitable for future backbone networks with multiple Terabit-per-second throughputs. Such approaches will be necessary to substitute existing infrastructure within a 5-10 year timeframe before actual concepts developed in the course of a clean slate approach might be validated and technically implemented. In particular we discuss the trade-off between options for fine-granular packet-based operation (IP, Ethernet) and transport-based solutions (Optical Transport Hierarchy, OTH, or optics). It is shown that there is no best approach to network architectures, but that the choice of architecture significantly correlates with the network topology, the type and volume of different services offered to the network. Three architectural approaches are compared:

(a) Conventional IP over statically provisioned optical connections.
(b) IP in combination with a dynamic transport plane (layer 1), e.g. OTH.
(c) Ethernet replacing IP and taking over vital functions in the core, whilst routing is carried out only at the network edge.

The architectural evaluation is accompanied by an evaluation of the network management and control plane approaches which can be taken to efficiently operate and manage the network processes and resources. In particular the advantages of a common control plane (e.g. generalized multi protocol label switching, GMPLS) are compared with individual control planes for each network layer.

Finally we will discuss a number of steps that would need to be taken to evolve from such transitional architectures towards even more radical designs.