

Panel: The Future of Datacenter Networking Software-Defined Networking (SDN) for Datacenter Interconnect and Cloud Computing

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Evolution of cloud architectures

Phase 1	Phase 2	Phase 3
Resource Virtualization	Data Center Virtualization - infrastructure flexibility -	Network Virtualization - platform agility -
- economic savings -		
Utilization Scalability Redundancy	Flexibility High availability Workload balancing	Capacity on demand Adaptive infrastructure Dynamic service automation
2007	2010	2015



Long-Distance Datacenter Interconnect

- Datacenters are globally distributed and have to exchange / synchronize information
- Long distance carrier technology used for inter-DC networks
 - ROADM-based Long-haul, high capacity transmission, 10...100Gbit/s, 40/80/96 ch, ...
- Datacenter operators are their own transport network customers
 → more flexible network operation
- Increasing programmability and flexibility of intra-datacenter connectivity
 → increasing flexibility and programmability for the long-distance data center interconnectivity







Cloud Computing

- Datacenter and Web 2.0 service providers have increasing impact on Transport Network
- Cloud computing is currently decoupled from the transport networking control and operation
- Goal is to converge cloud computing and networking
- This required a more dynamic mode of control and operation and new functionality of the network such as network virtualization
- → Software Defined Networking







Software Defined Networking



- Open interface between a (centralized) control and the forwarding plane
- Key Goal: Network Virtualization
- Convergence of the virtualized networks with VMs in the data centers
- One possible solution: OpenFlow
 - focused on packet based networks (Ethernet, IP, MPLS Networks)
- Key benefit: Simplicity
- Main issues:
 - Scalability and security
 - Not well suited for circuit switched and optical networks yet



Network Virtualization and API's

- Network resource sharing driven by specific use cases
 - Beyond today's VPNs
 - Includes physical layer resource carve-out
 - Must be convenient and drive revenue opportunities
- Tools/mechanisms for carving out an entire virtual network topology from an existing physical network
 - Dynamically and rapidly reconfigure network infrastructure in response to specific use cases
 - Analogy to bringing up OS instances on a whim within cloud computing infrastructures
 - Examples present in Ethernet networks in datacenters using OpenFlow
 - How can the same functionalities be realized within a packet-optical transport network?
- APIs... Application Programming Interfaces
 - Applications aware of (virtualized) network resources
 - Able to dynamically reserve, reconfigure and release network components, to serve their specific needs



Modes of Operation

- Network API (aka Big Fat Switch)
 - Optical Network acts as one Virtual Switch
 - Plain packet-based OpenFlow Controller
 - Optical layer functionality is abstracted by single OpenFlow agent
 - internal signaling can be based on existing GMPLS control plane (OpenFlow UNI)



- Network Element API
 - Optical Network fully controlled by OpenFlow API
 - OpenFlow Controller and OpenFlow Protocol requires Optical extensions
 - OpenFlow agent on each NE models optical constraints





ADVA's Activities towards SDON

- Geysers
 - green aware extensions on the industrial CP class solution
 - verification of interworking with legacy GMPLS-based virtualization mechanisms
 - slice of network as specified and fixed set of labels (wavelengths, time slots etc.)
 - slice of network as a number of unspecified labels





 OpenFlow in Europe – Linking Infrastructure and Applications

> First ROADM-based optical OpenFlow networking testbed developed in cooperation with University of Essex





Optical Networking



Thank you

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