

MONSTER

Managing an Operator's Network with Software
Defined Networking and Segment Routing

Candidato

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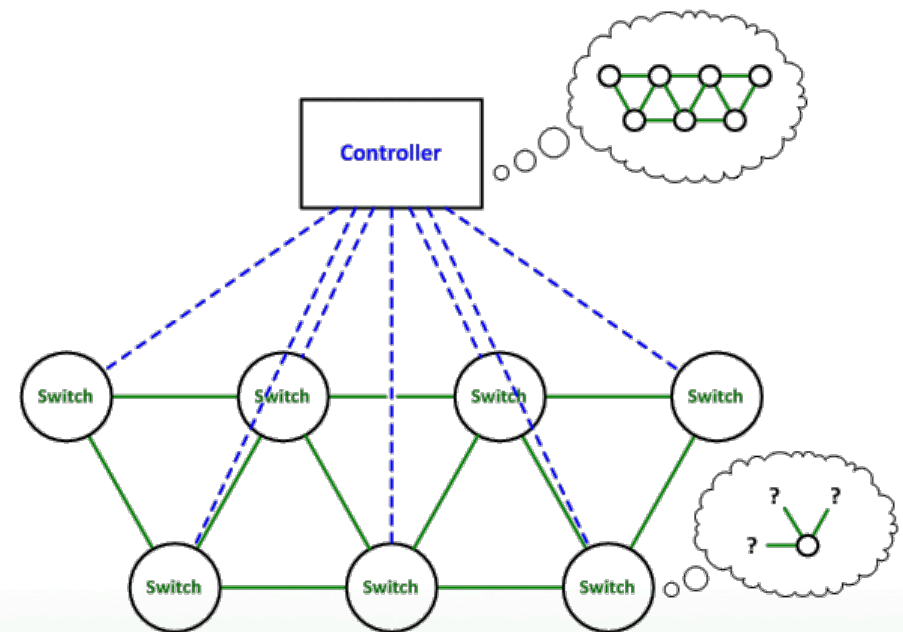
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- Software Defined Networking (SDN)
- Traffic Engineering (TE)
- Segment Routing (SR)
- Proposed research activity

Software Defined Networking

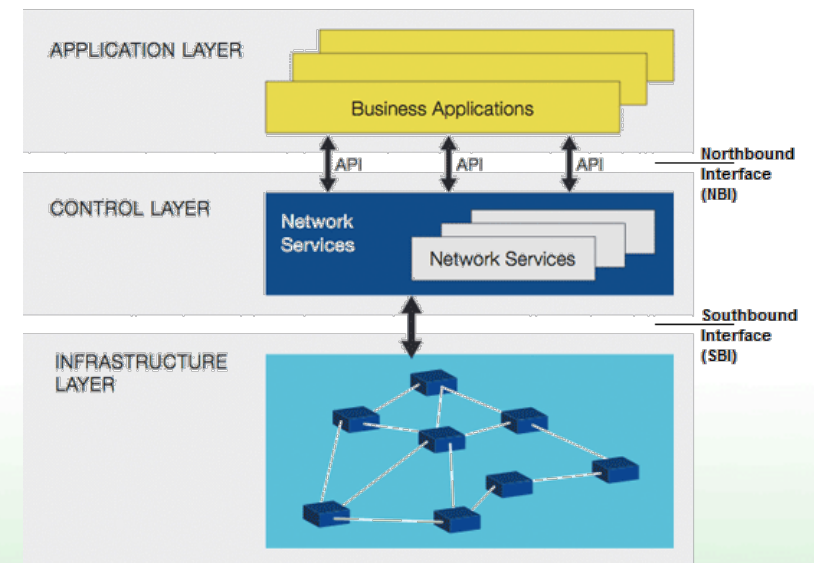
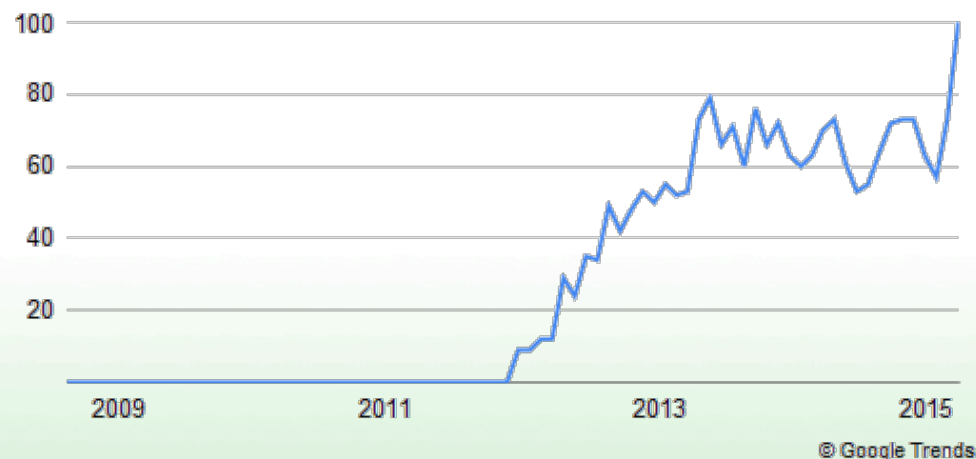
- Key computing trends: changing traffic patterns, rise of Cloud services, Big data
- Current network constrained: complexity that leads to stasis, inability to scale, vendor dependence
- Virtualization
- Allows to decouple **control** layer, with traffic control function, from the underlying **infrastructure** layer, composed by network hardware
- Networks must be able to adapt in terms of security, scalability, and manageability
- Directly programmable, programmatically configured, centrally managed



Software Defined Networking (cont.)

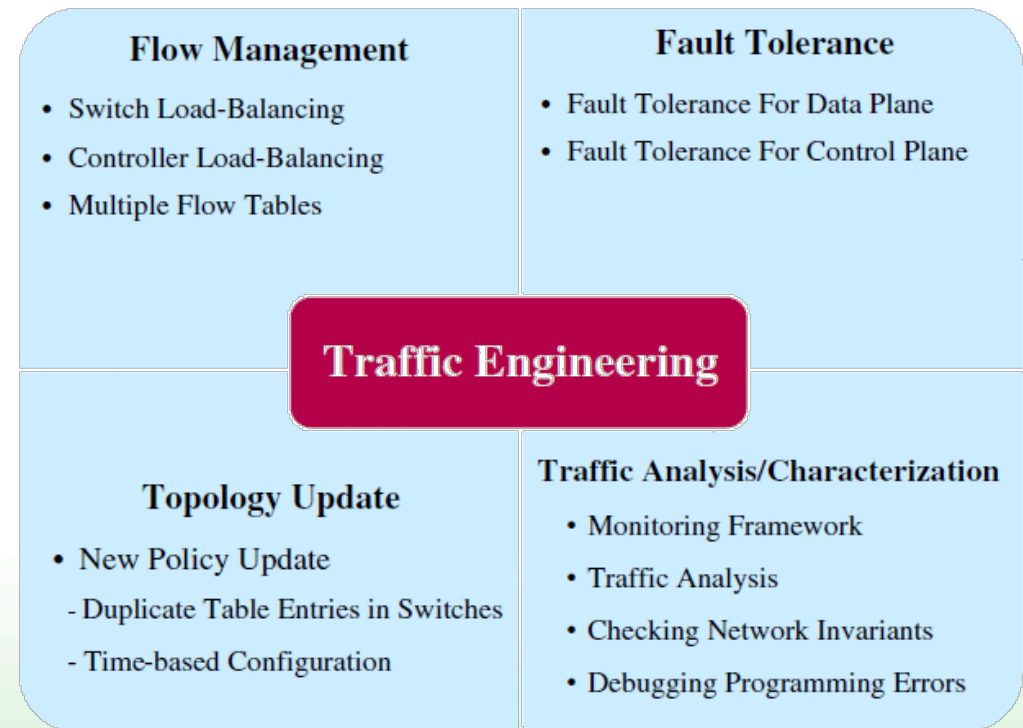
- Better QoS, separating the control planes from the data plane, and abstracting the underlying hardware complexity
- Interaction with APIs at both Northbound and Southbound interfaces
- *Pure* solution, with SDN protocol-enabled devices only
- *Hybrid* solution, combining SDN protocols IP, to maintain IP features, increasing devices functionalities

Software Defined Networking \neq OpenFlow



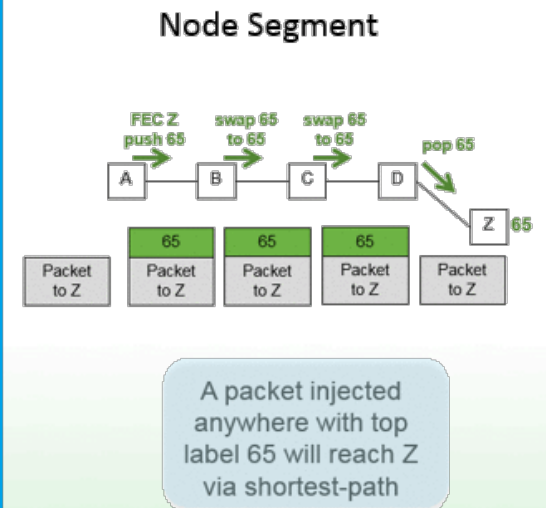
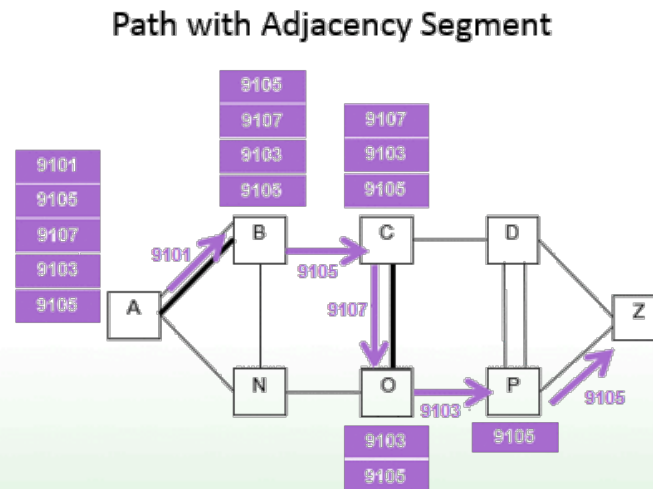
Traffic Engineering

- Mechanisms to optimize the performance of data network by dynamically analyzing, predicting and regulating the behavior of transmitted data
- Traffic-oriented performance objectives rely on traffic streams QoS enhancement, packet loss and delay minimization, throughput and Service Level Agreements enforcement
- Resource-oriented performance objectives treat aspects related to resource utilization and network congestion management, investigating for overloaded and congested scenarios, while other feasible paths remain underutilized.
- Congestion resulting from inefficient resource allocation can be reduced by adopting load balancing policies, obtaining packet loss decreases, transit delay decreases, and aggregate throughput increases.



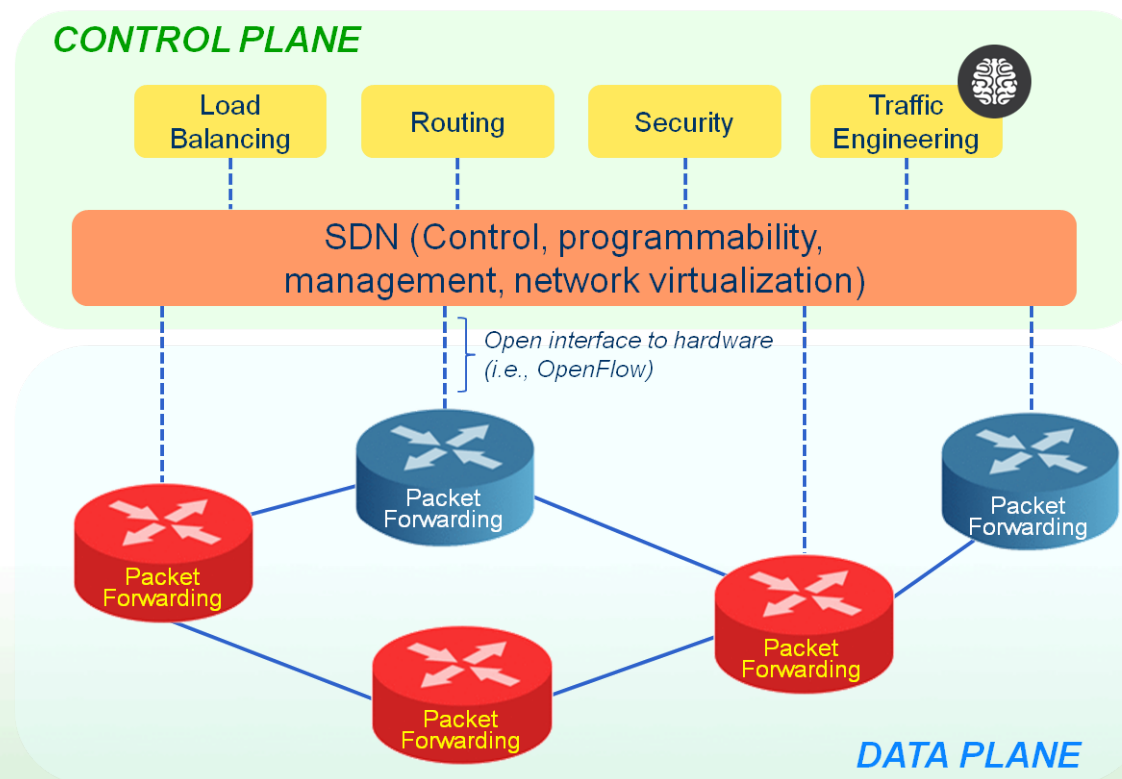
Segment Routing

- Provides enhanced packet forwarding, acting as a LDP to support hop-by-hop Label Switched Paths
- Provides efficient use of network resources, strict performance guarantees and high scalability for application-based transactions
- Provides automatic traffic protection (Fast Re-Route) without any topological restrictions and additional signaling requirements, supporting an efficient centralized optimization capacity planning process (Shortest Path Flows)
- The state of the system goes from network to single packet
- Dispose of PUSH, POP and SWAP operations on Node and Adjacency segments
- Multi-Protocol Label Switching (MPLS): segments directly encoded as MPLS labels
- IPv6: segments as ordered list of IPv6 addresses in routing extension header



Proposed research activity

Use a Segment Routing-based approach to exploit SDN, providing Traffic Engineering and flow protection/restoration in wide area IP networks, adopting open-source solutions



Proposed research activity (cont.)

Data plane

- Hybrid IP/OpenFlow nodes, using MPLS-based Segment Routing, benefited from the availability of existing OpenFlow enabled devices that support MPLS
- Topology emulation using Mininet, capable of running multiple hosts (provider edge, customer edge, core SWs) on a single Linux kernel
- Switching capabilities evaluation, using different geographically distributed VMs, connected via Point-to-Point UDP-based tunnels
- OpenFlow-based software switch: OpenvSwitch, xDpd, lagopus

Proposed research activity (cont.)

Control plane

- Algorithms that combine and optimize classical Traffic Engineering path selection with a Segment Routing-based routing approach
- Runtime traffic measurement for optimizing those algorithms
- Controller platforms evaluation
 - OpenDayLight
 - RYU

