Einsatz eines SDN WAN Controllers für konvergente multi-layer optische und IP Netze

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Software Defined Networking

Different people expect different things from Software
Software Defined Networks (SDN):

### Orchestration
- Virtual Network Function (VNF) Management
- Physical Network Function (PNF) Management
- Direction of Controller

### OSS Automation
- Puppet
- Chef
- Python
- Ansible
- Junos Space
- Junos Scripting
- Junos SDK

### OpenFlow Controllers
- Data Centre Controller Based
- Manipulates Forwarding Plane of devices directly

### Overlay Controllers
- Data Centre - Controller Based
- Relies on physical network underlay for connectivity.
- Tunnelling Based
  - VxLAN
  - MPLSoverGRE
  - NVGRE
  - STT

### WAN Controller
- Controller Based
- Relies on:
  - Topology discovery
  - Utilisation analytics
  - Traffic engineering
  - Path Computation Element (PCE) architectures
  - Traffic steering

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**NorthStar**
Overlay Controller Architecture

Components
- Controller for Configuration, Control, Analytics
- Virtual Router

Functionality
- Network Virtualization
- Service Chaining
- Analytics and Visualization

Use Cases
- Private/public/hybrid cloud
- Cloud CPE and NFVs
- Virtual business edge
WAN SDN Controller Improves OPEX Efficiencies
Simplifies Complex Network Designs

- Turn offline into online optimization and automation
- Simplify RSVP-TE designs
- Easily create and modify LSPs
- Automate maintenance events
- Create diverse path in seconds
- Trouble shooting
The SDN Controller – Automating The Core

PCEP
- TE LSP discovery
- IGP-TE, BGP-LS
  - TED discovery (BGP-LS, IGP)
  - LSDB discovery (BGP-LS, IGP)

RSVP signaling

PCEP
- Create/Modify TE LSP
- One session per LER(PCC)

A flow diagram showing the steps of analyze, optimize, and automate with RSVP signaling and PCEP protocols.
3rd Party Validation and Interop tests

EANTC validation
- Discovery
- Optimization use cases (Global Opt., TE++, ...)
- Automation use cases (Diverse Path, Maint., ...)

ISOCORE interop test
- BGP-LS, PCEP
- Northstar SDN Controller with 3rd party PCC
- Juniper PCC with 3rd party SDN Controller

Global Visualization
Simplifies Troubleshooting

- Global view for easy troubleshooting
  - Node details
  - LSP path details
  - Link details
  - SRLG details
- Playback historical events
Saves CAPEX With Global Optimization
Like Defragmenting Your Hard Drive

- Automate global optimization
- CAPEX deferral, getting more out of your network
  - Reduce hot spots
  - Improve service quality
Application Aware Traffic Engineering
Based On Application Requirements

- Optimized based on application specific requirements
- Differentiated optimization Metrics
  - Latency or Jitter
  - Cost (Hop count, IF cost)
  - Shortest path
  - User defined values
- TE++ path optimization
Bandwidth Calendaring
Automate LSP Provisioning

- Automate LSP provisioning
  - Create, modify or delete
  - Combine with other applications
    - Bandwidth on Demand
    - Maintenance Mode
    - LSP provisioning
Multi-Layer Optimization With Optical Controller

- Maintaining operational boundaries
- Optical layer abstraction
- Standards base controller to controller solution
  - REST/RESTCONF
  - IETF Yang Topology *
- Visualization & optimization
- SRLG exchange
- Coordinated maintenance

Visibility to transport layer restoration with abstracted topology exchange

After a failure on the transport layer the packet demands are restored using MPLS fast re-route (FRR) or a similar sub-50ms restoration mechanism.

FRR = Fast Re-Route
Visibility to transport layer restoration with abstracted topology exchange

An abstract topology update after the transport layer restoration event allows the IP/MPLS layer to re-optimize packet demands

MBB = Make Before Break
Multi-layer Maintenance with abstracted topology exchange

An abstract topology update is pre-signaled using timestamp information that allows the IP/MPLS layer to re-signal packet demands in advance

MBB = Make Before Break
Multi-layer Maintenance with abstracted topology exchange

Topography exchange with timestamps allows for hitless multi-layer optimization before a maintenance window and/or after a restoration event

MBB = Make Before Break
Additional Bed Time Reading

Juniper External Resources:

Path Computation Element – Communication Protocol PCEP:
- RFC 5440: Path Computation Element (PCE) Communication Protocol (PCEP)
- RFC 7150: Conveying Vendor-Specific Constraints in the Path Computation Element Communication Protocol

BGP-Link State:

Yang Data Model: