Rijkswaterstaat SRv6

Business Case and Use Cases

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Rijkswaterstaat – what we do in 3 images

90.192 km2 water
45 km dunes
154 km dikes and dams
10 weirs
6 storm surge barriers

water system

3.462 km canal / river
92 lock complexes
128 lock chambers
325 (movable) bridges
44 Dynamic Information Panels
1416 cameras

waterways

7.372 km road
56 movable bridges
3100 video camera systems
320 GMS2 (road condition)
20.000 Speed loop pairs
17.000 signal sensors

roads

Rijkswaterstaat – Dutch government organization

- Nationwide OT-grade IP-network crucial for visibility, data collection, remote operation of objects, “smart” traffic, etc..
- ≈5000 km optical, MPLS backbone, 4 data center locations, regional traffic management centers.
- Evolution from “Enterprise” (demand/customer driven) to “Service provider” (standard services) model started in 2018.
- IT network must be made future proof, “automatable”
  - deterministic behavior,
  - autonomous functioning,
  - self healing.

RWS business case for Segment Routing

- Network **convergence** for OT: ≥1s interrupt can trigger Safety Protocols, SR-MPLS/SRv6 promises predictable fast convergence.
- **Stateless** property of SR crucial to deterministic network behavior. Minimal “unforeseen side effects” of automated changes.
  Cf. software industry best practice of stateless REST-APIs.
- **Reduce Cost** by replacing dedicated DWDM Infrastructure with Routed Optical Network (RON).
- SR Flex Algo **Traffic Engineering** can do the same as DWDM path protection, BUT with more flexibility!

Benefits of statelessness

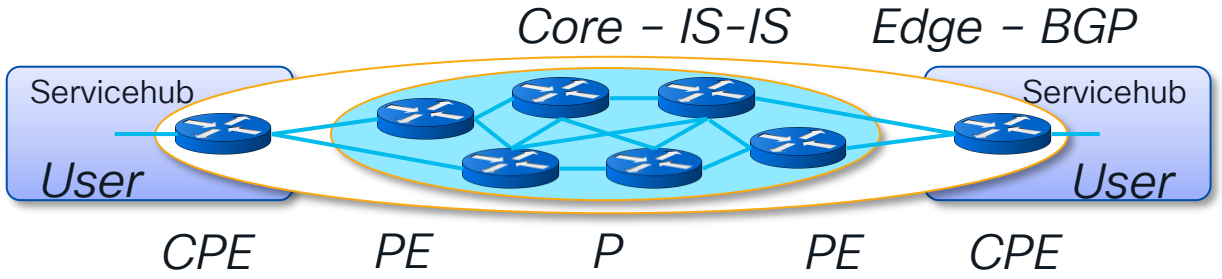
- State of the entire network is **deterministically** defined at any point in time. The network has no memory or history.
- Deterministic test conditions result in Changes **with no surprises or packet loss**. Very suitable for a Desired State automation approach.
- SR is stateless, because the SID is part of the data frame. Any “memory” is gone as soon as a packet leaves the network.
- SIDs truly behave as REST API calls to network routing plane!

Status of SR-MPLS/SRv6 implementation at RWS

- SRMPLS stack live when Backbone (P-PE) LCM in 2019.
- SR-MPLS signaling/control plane traffic for autonomous IP protection. Better network convergence. SR-MPLS at that time no business case for wider adoption over MPLS.
- SRv6 development finished and production tests in progress:
  - Multi-domain SRv6, Customer Edge is a separate uSID domain from the Backbone Core for security reasons.
  - SRv6 + Flex Algo together with DCO and RON for L2 Ethernet Private Line (EPL).
  - L2 EPL over SRv6 Transport replaces DWDM.
- Legacy DWDM network is to be discontinued in Q2 2025.

Multi domain SRv6 solves RWS specific challenges

- Huge part of the physical network is easily accessed (along public roads) – security implications!
- Multi domain SR: BGP (single control plane in our network) signals SIDs of connected PE-routers to CPE routers (co-operation with Alberto's team).
- Single domain SRv6 with IS-IS (link-state protocol) lacks security features for ≈900 servicehubs (+ 700 wireless)



Other fun SRv6 stuff: Migration and Availability

- **Dual stack** IPv4+MPLS and IPv6+SR-MPLS within 1 “MPLS”-VPN, adds IPv6 to the backbone network without touching the IPv4 configurations or protocol stack.
- Switch between MPLS and SRv6 **without packet loss** and without changing our MPLS-VPN structure. Perfect fit with RWS chosen evolutionary development.
- **Increasing Availability** of LAN Ring topology: close LAN Rings along highway sections by emulating “Fiber path” via the IP Backbone using L2VPN services over SRv6 Transport. Huge cost savings on fiber cable installation.

Thank you

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