VyOS Networks

SOLUTION BRIEF

# VYOS SEGMENT ROUTING: TRAFFIC ENGINEERING USING SDN CONTROLLER

## Introduction

Deploying **Segment Routing Traffic Engineering (SR-TE)** on **VyOS.** VyOS supports modern traffic engineering architectures based on **Segment Routing (SR)**, enabling deterministic path control without the signaling complexity of traditional RSVP-TE. SR-TE simplifies network design while improving scalability and operational efficiency.

## Centralized SR-TE

In a centralized SR-TE model, path computation and segment list generation are handled by an external controller. VyOS routers act as enforcement points and are responsible for:

- Advertising the IGP topology to the controller
- Receiving computed SR-TE policies
- Steering traffic into the appropriate SR-TE policies

Although centralized SR-TE is simpler than RSVP-TE, routers must support several key protocols and mechanisms, including:

- **BGP-LS** for topology advertisement
- **BGP SR-TE** or **PCEP** for receiving SR-TE policies
- Automated traffic steering mechanisms

In this architecture, the external controller plays a critical role by defining traffic engineering policies and computing the paths that routers must follow. In our case, this functionality is provided by the **Traffic Dictator**, which is discussed in more detail later in this document.

## Use Cases

1. **Improved Resilience and Service Assurance**
   Organizations that require seamless routing between services and high network resilience can use traffic engineering to design and calculate optimal paths, ensuring reliable service delivery and consistent network performance.

2. **Cost Efficiency and Reduced Operational Complexity**
   VyOS Segment Routing-TE significantly improves cost efficiency by simplifying traffic engineering operations across the network. By leveraging SR-TE policies, operators can avoid maintaining multiple parallel protocols or complex per-service configurations to accommodate different traffic requirements.

3. **High-Availability for Critical Network Services**
   Applications that rely on consistent routing behavior, such as microservices platforms, multi-tenant environments, or security services, require the fast failover and predictable routing delivered by VyOS Segment routing with traffic engineering.
4. **Automated Deployment for DevOps and Platform Teams**
   Teams managing large, repeatable cloud environments can bootstrap the entire network setup using automation, ensuring consistent provisioning across accounts and regions.

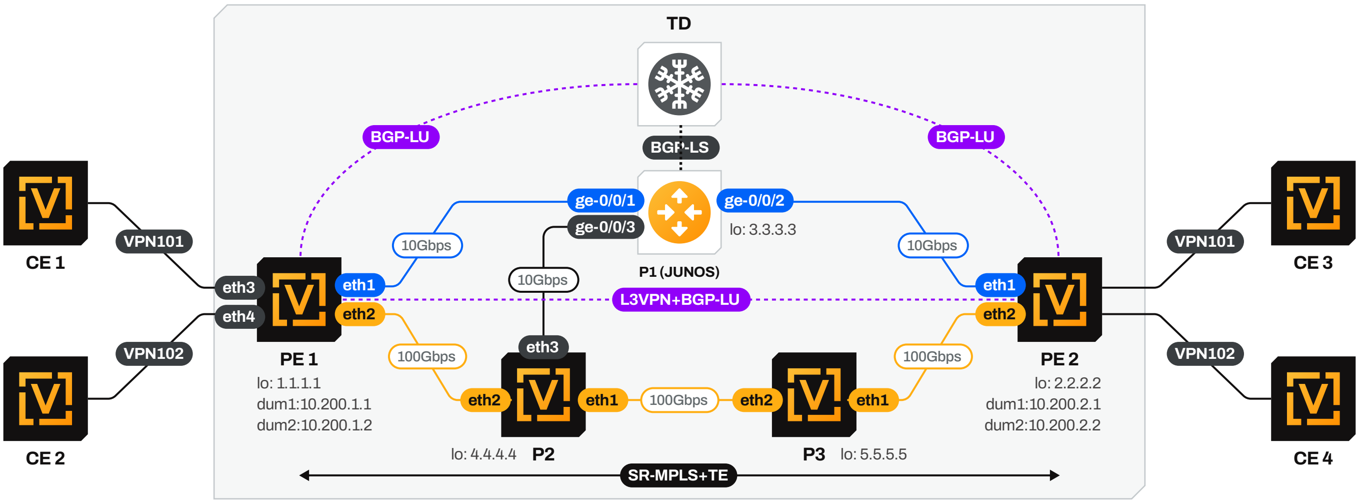
## Architecture Overview

This scenario deploys a simple scenario in which multiple VRFs are configured on the same Provider Edge (PE) routers, a common use case in ISP environments.

On PE1 and PE2, two VRFs are configured: **VPN101** and **VPN102**.

- **CE1** and **CE3** belong to VRF **VPN101**
- **CE2** and **CE4** belong to VRF **VPN102**

Traffic engineering is used to steer traffic from each VRF over different network paths.



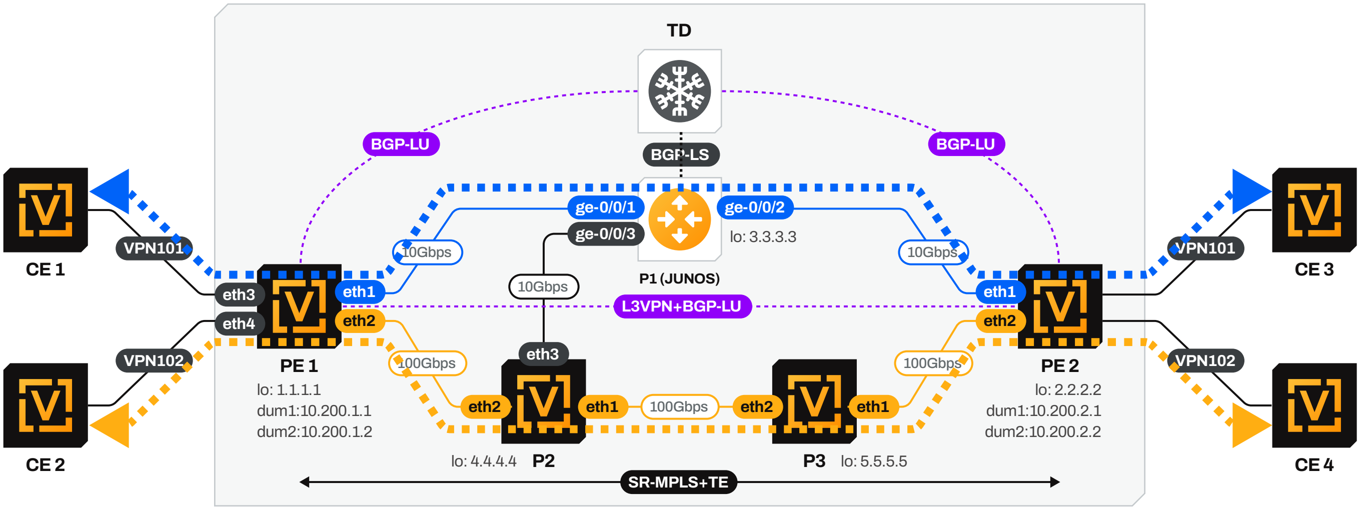

Key architectural components include:

- **SR-MPLS on VyOS Universal Router backbone** acting as PE/P routers.
- **Traffic Dictator**, providing intelligent route calculation and path inside the backbone MPLS.
- **Affinity and Constraints**, enabling different redundancy paths.
- **BGP-LU+ SR-MPLS-TE** delivers the capabilities to create a robust network.
- **Automation framework** from VyOS repository for full-stack deployment.

The primary objective of this design is to simplify the topology in order to support multiple types of use cases. As illustrated in the topology, there are two distinct paths in which affinity can be applied. Specifically, the BLUE path can be used to associate VPN101 with the service loopback interface (dum1), while the YELLOW path can be used to associate VPN102 with the service loopback interface (dum2).

The goal is to deploy traffic engineering using affinity and bandwidth constraints, map different types of traffic to different policies, and ensure there is a predictable failure scenario if some links/routers fail, or if the controller fails completely.

Traffic Dictator is used as a controller. It is easy to deploy and configure, and supports the most basic SR implementations.




## Benefits of Using VyOS

### Enterprise-Grade Routing Intelligence

With VyOS Segment Routing-TE, sophisticated traffic engineering, and broad multi-protocol support, VyOS provides powerful routing capabilities that exceed the limits of traditional cloud networking.

### Path differentiation based on services

By combining traffic engineering with an intelligent controller capable of evaluating and selecting optimal paths, services can achieve enhanced redundancy and more advanced routing behavior

### Automation-Ready

VyOS supports configuration via automation tools (Ansible, Terraform, Python) and integrates seamlessly with CI/CD pipelines, enabling consistent cloud deployments.

### Full Control and Transparency

Unlike proprietary virtual routers, VyOS offers open configuration, logs, and routing visibility, ideal for troubleshooting and advanced network engineering.

### Cost-Sustainable and Flexible

A lightweight universal router that scales elastically and easily, reducing licensing complexity while enabling enterprise-grade functionality.

## Conclusion

The integration of VyOS with Traffic Dictator delivers centralized, policy-driven traffic engineering directly at the network edge. VyOS provides a robust SR-MPLS Traffic Engineering foundation, combining deterministic segment routing, high-performance packet forwarding, and native firewalling and policy enforcement. Traffic Dictator complements this by introducing dynamic traffic classification and real-time decision logic, enabling intent-based steering across the SR-MPLS fabric.

Together, they enable fine-grained traffic steering, prioritization, and enforcement based on application context and network conditions. This approach improves bandwidth utilization, accelerates reaction to changing traffic patterns, and simplifies operations by unifying control and enforcement at the edge—resulting in a more scalable, predictable, and operationally efficient network.

sales@vyos.io
vyos.io