

CARMINE SCARPITTA

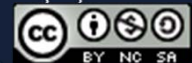


SDN Architecture for IPv6 Segment Routing Enabled Networks

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"ORIO CARLINI"
ROMA

Roma Consortium GARR, 27/06/2019

Borsisti Day 2019



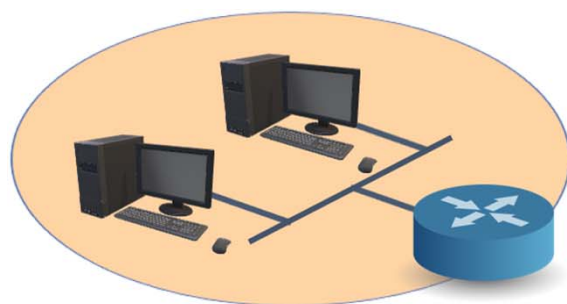


Goals and Objectives

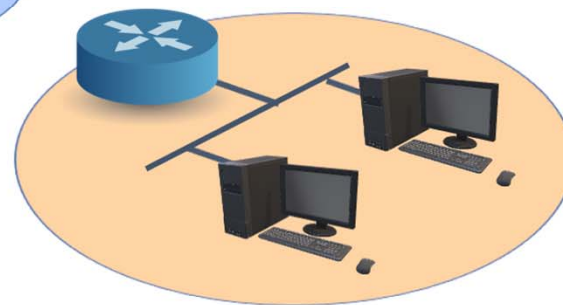
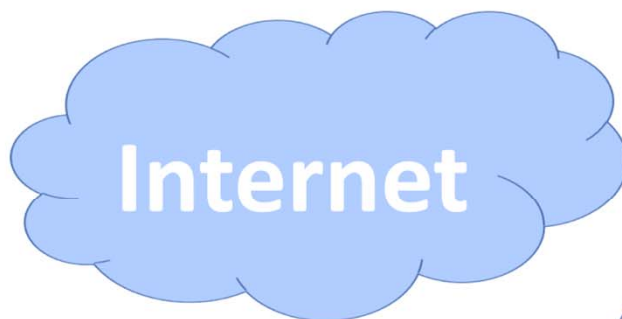
1. Defining a **SDN architecture based on IPv6 Segment Routing**
2. Realization of Traffic Engineered Virtual Private Networks (**VPN-TE**)



Virtual Private Network (VPN) 1/2



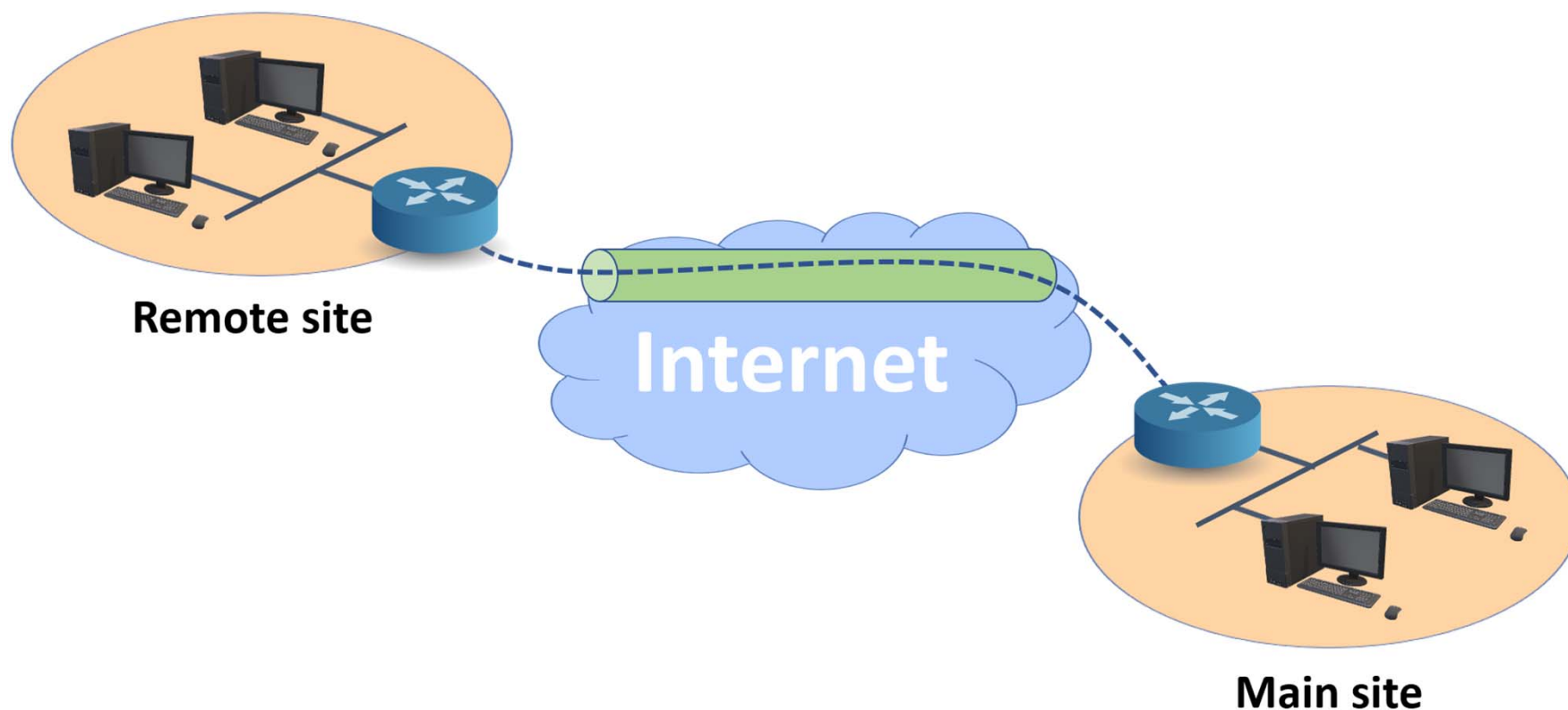
Remote site



Main site



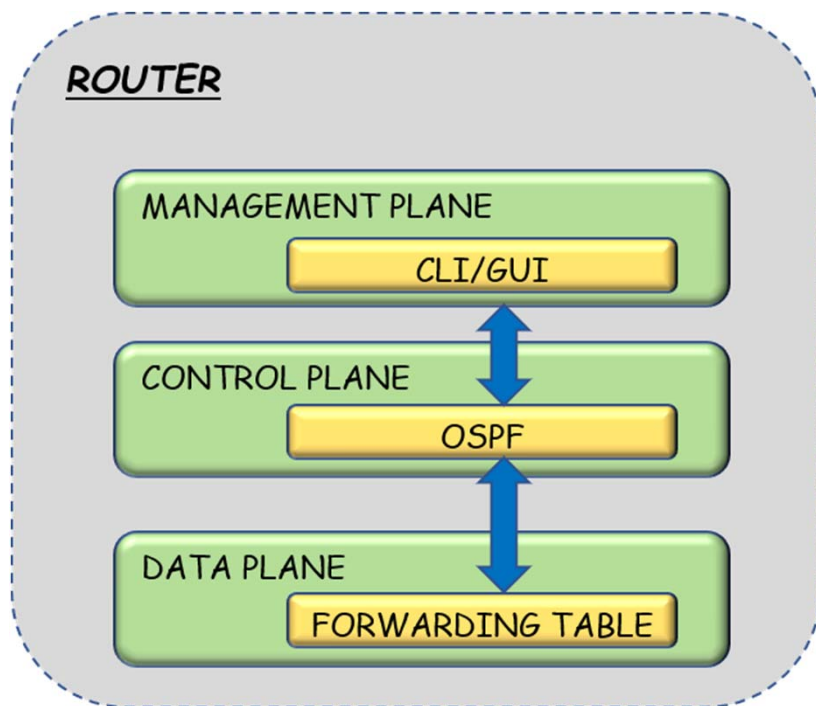
Virtual Private Network (VPN) 2/2



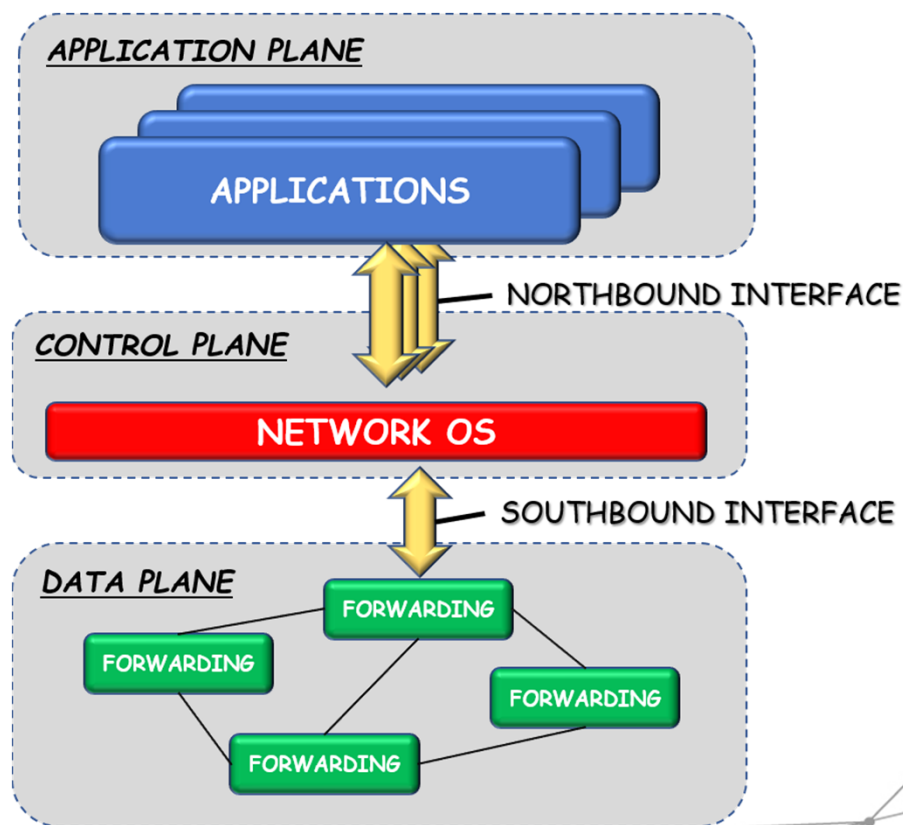


Software Defined Network

Traditional model



SDN





Segment Routing over IPv6 (SRv6)

- ❑ **Segment routing** is a form of **source routing**
- ❑ It can use **MPLS** or **IPv6** as **dataplane technology**
In our project we consider IPv6 dataplane (**SRv6**)
- ❑ “The network programming consists in combining segment routing functions, both simple and complex, to **achieve a networking objective** that goes beyond mere packet routing”



SDN-SRv6 Architecture



Open source project: <https://netgroup.github.io/rose/>

❑ Several advantages:

- ✓ High flexibility
- ✓ Costs reduction
- ✓ Simplify service delivery

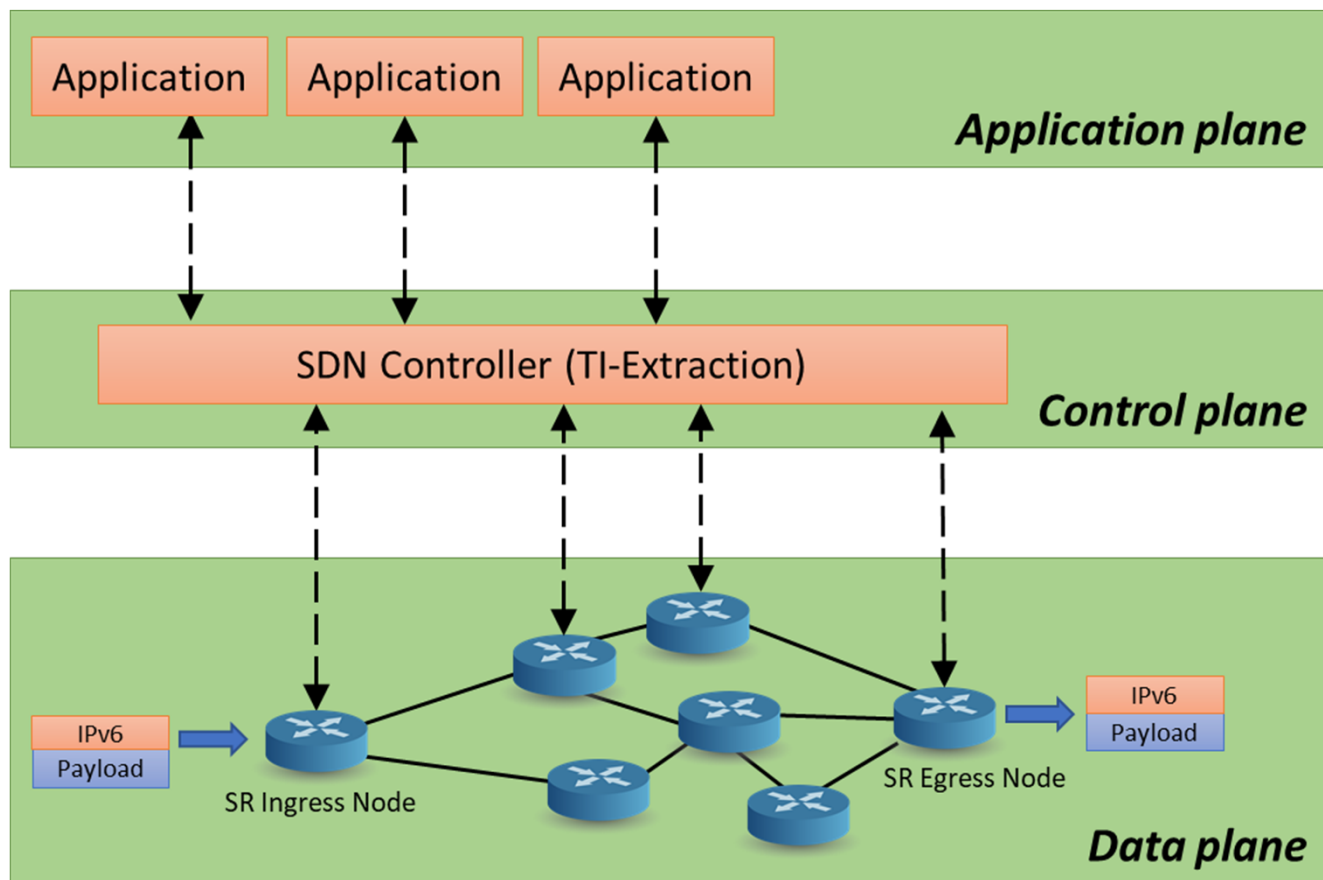


Outline

- ☐ SDN-SRv6 Architecture
- ☐ Southbound Interface
- ☐ Topology Information Extraction / Interface Discovery
- ☐ Northbound Interface
- ☐ Contribution to open source projects (Linux kernel / pyroute2)
- ☐ Virtual Testbed

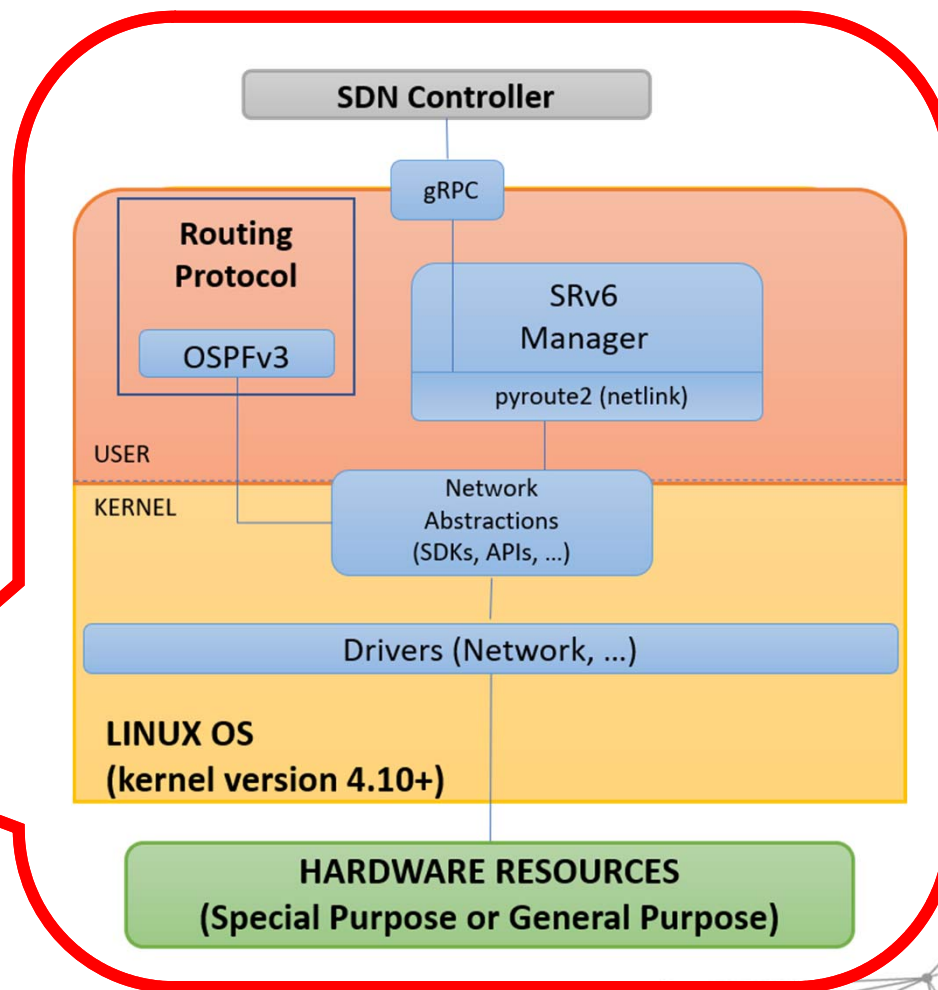
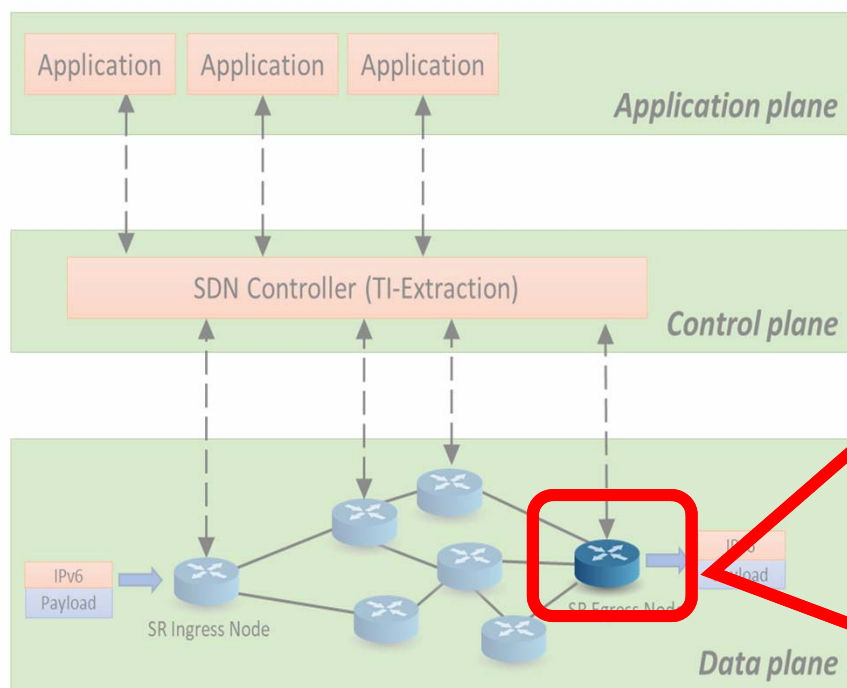


SDN-SRv6 Architecture



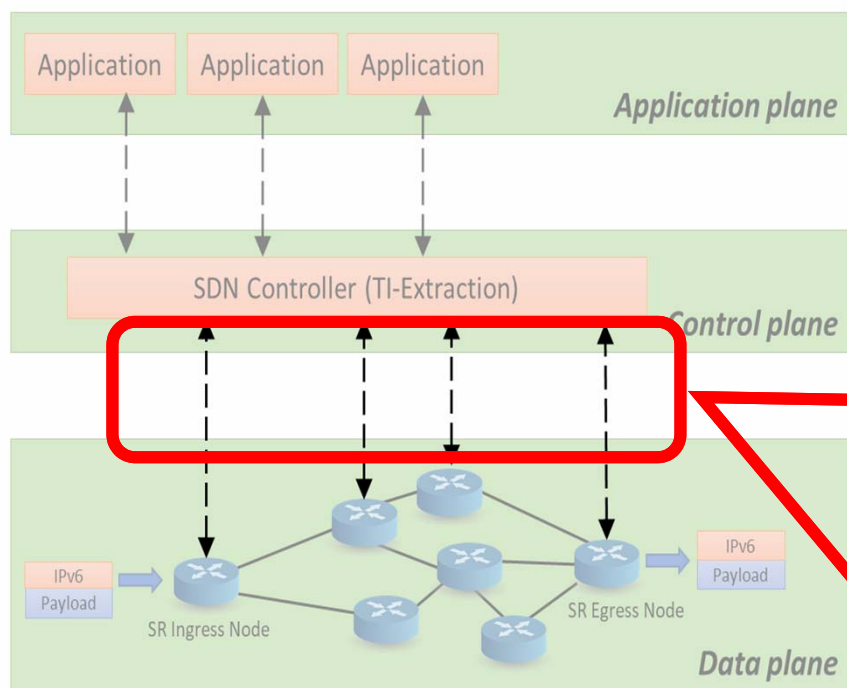


SRv6-enabled node





Southbound Interface



☐ Create / Remove / Update / Delete

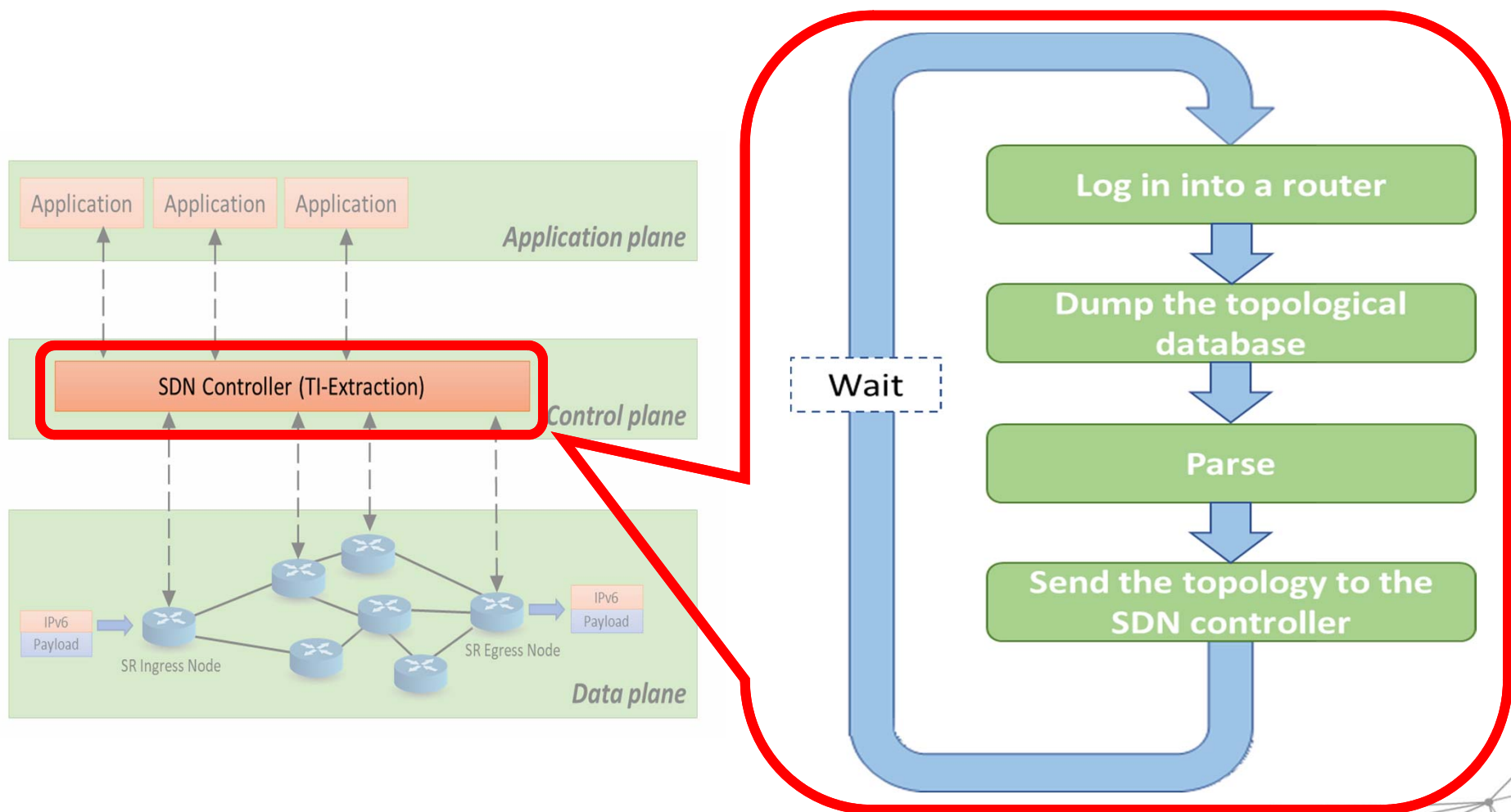
- ✓ SRv6 path
- ✓ Local Processing Function
- ✓ VRF Device
- ✓ IP rule / route / address

☐ Subscribe Netlink messages

☐ Get interfaces

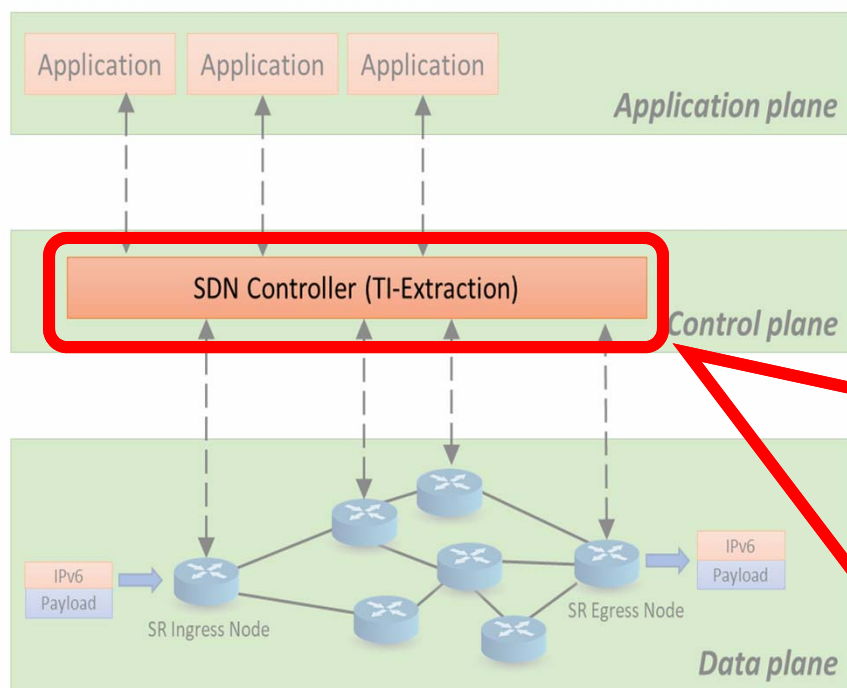


Topology Information Extraction





Interface Discovery



❑ Topology Information Extraction

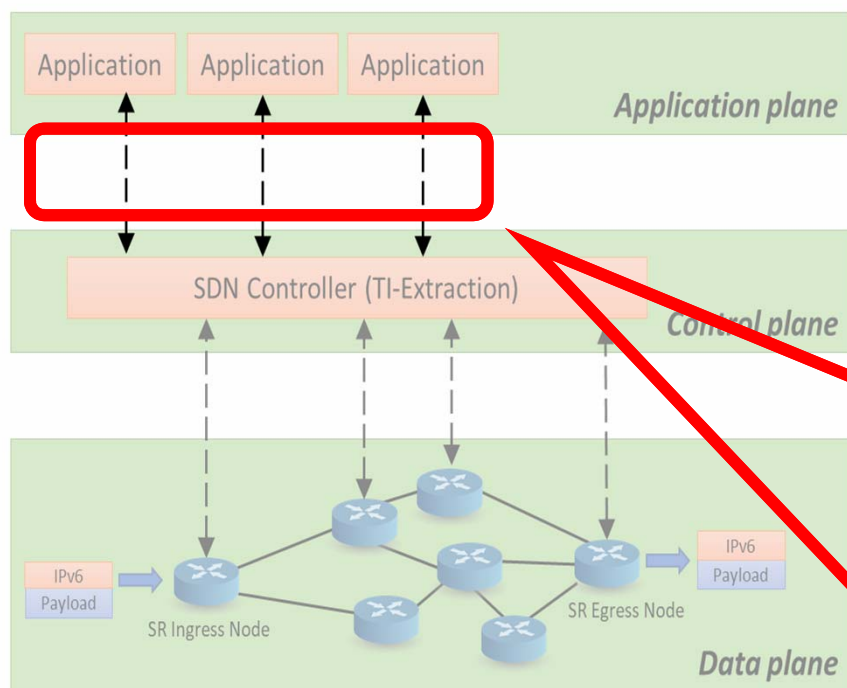
- ✓ Routers
- ✓ Links
- ✓ Stub networks

❑ Interface Discovery

- ✓ Interface name
- ✓ IP addresses
- ✓ MAC address



Northbound Interface



CreateVPN(intent)

RemoveVPN(name, tenantID)

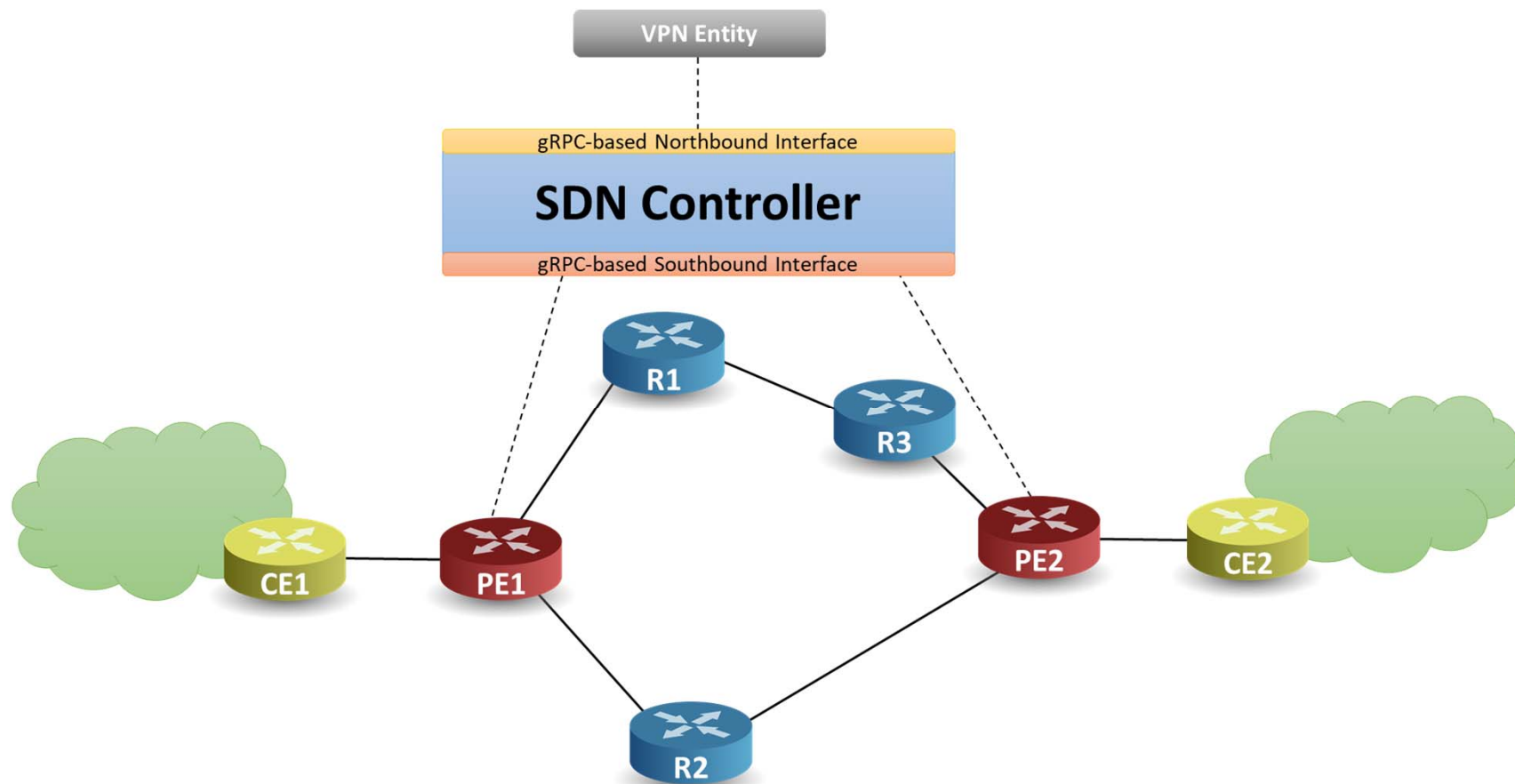
AddInterface(name, tenantID, interface)

RemoveInterface(name, tenantID, interface)

GetVPNs()

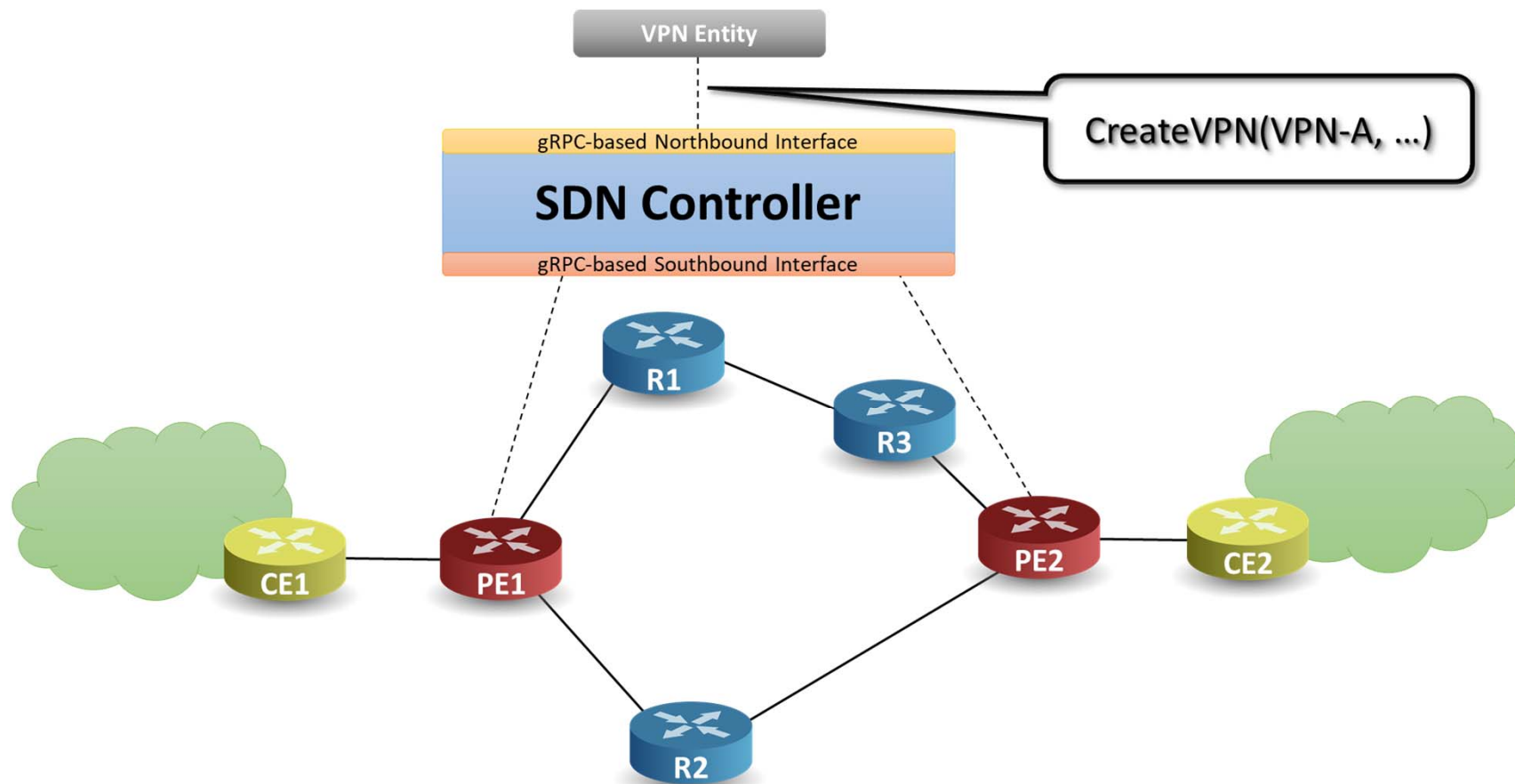


Example 1/4



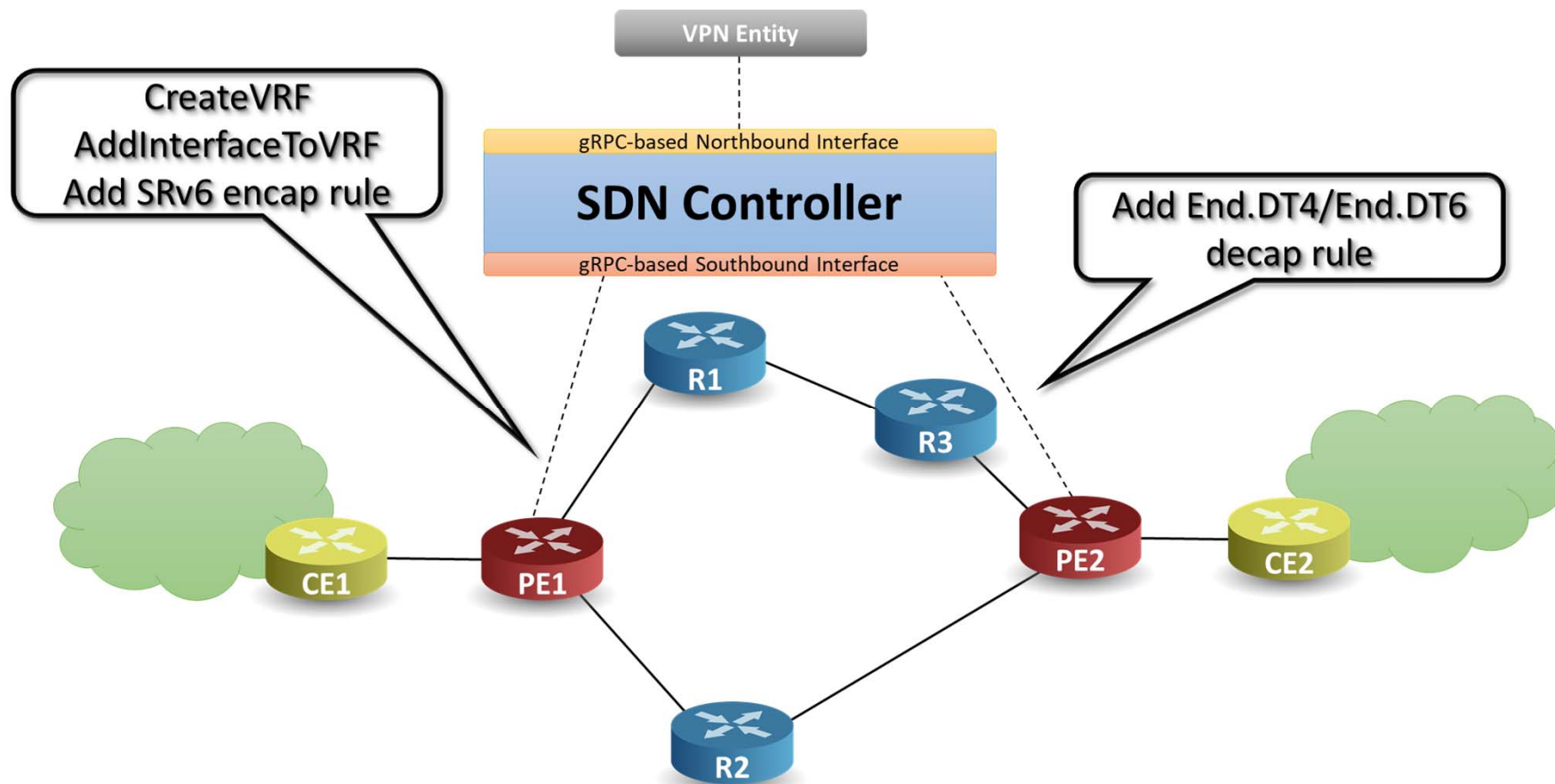


Example 2/4



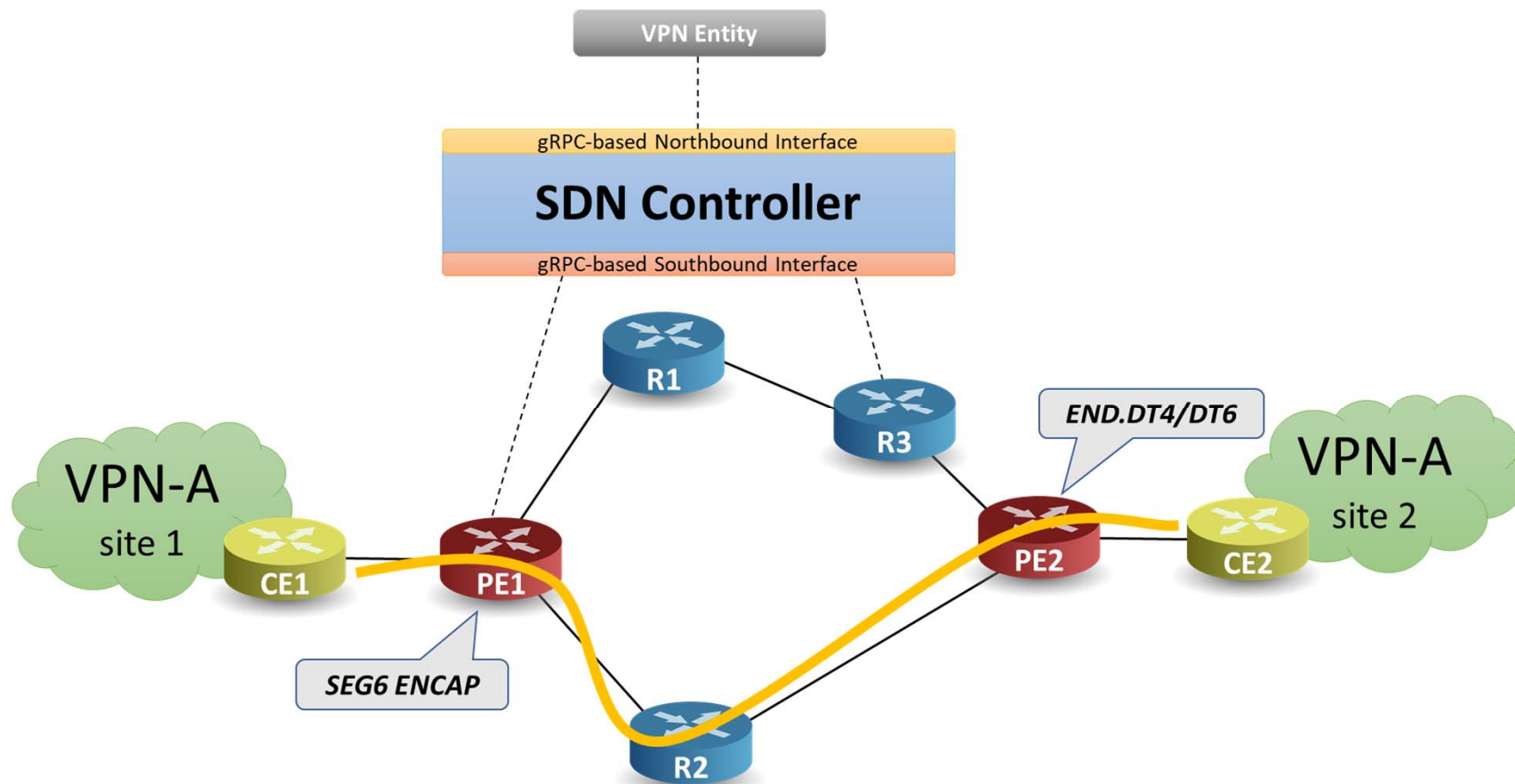


Example 3/4



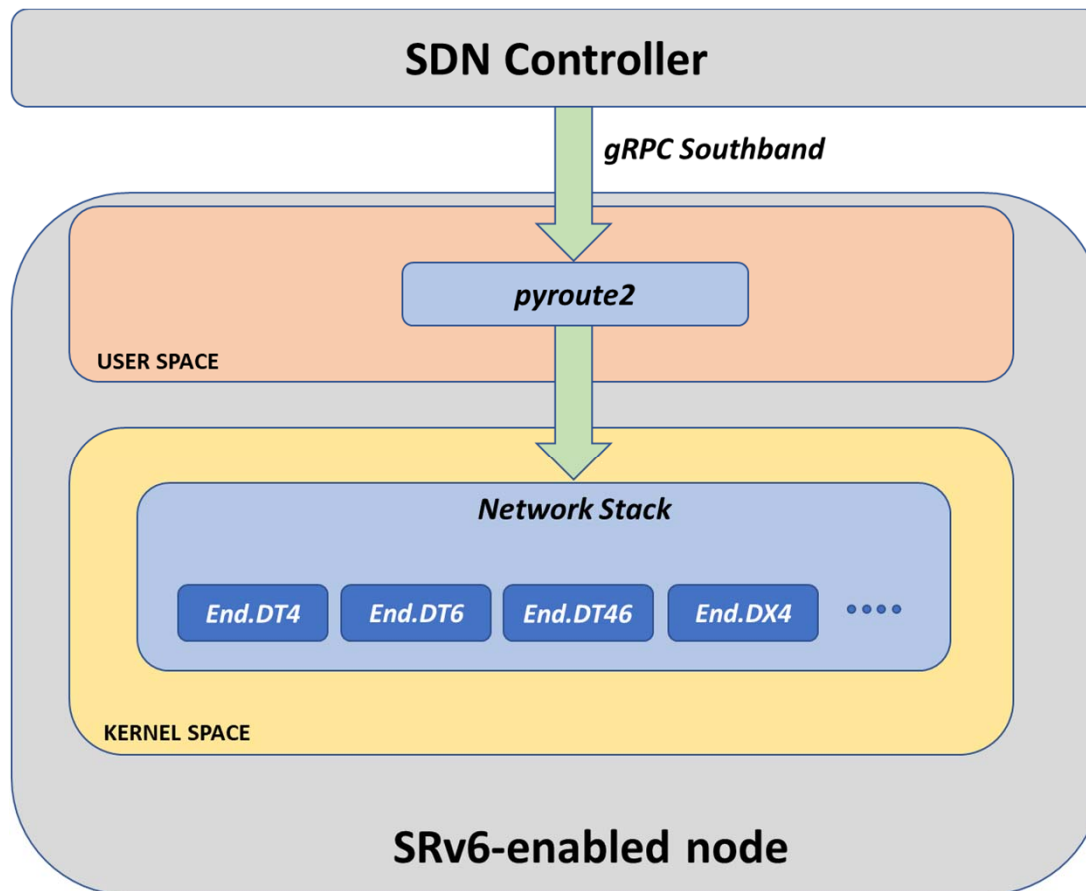


Example 4/4



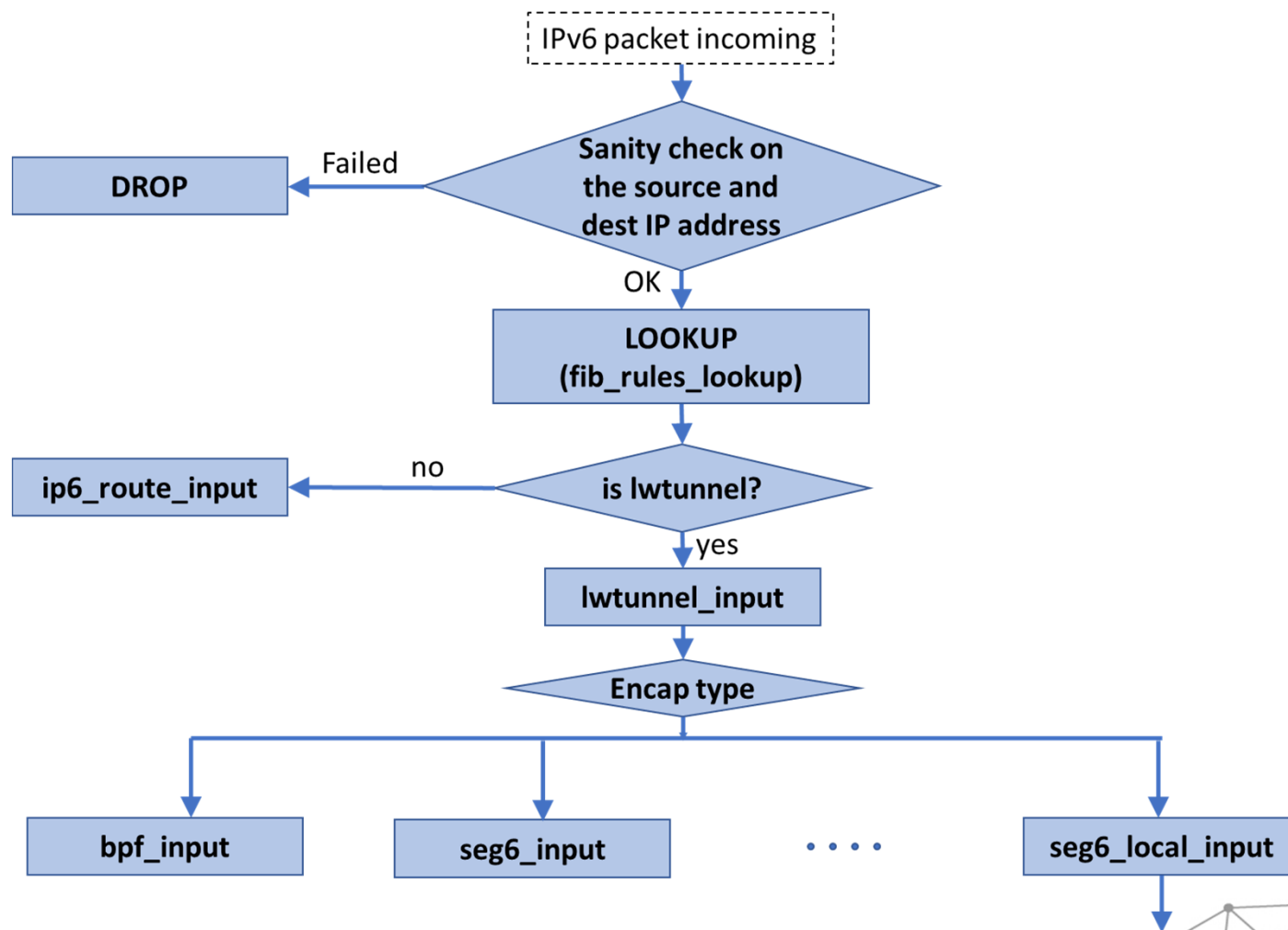


Contribution to open source projects



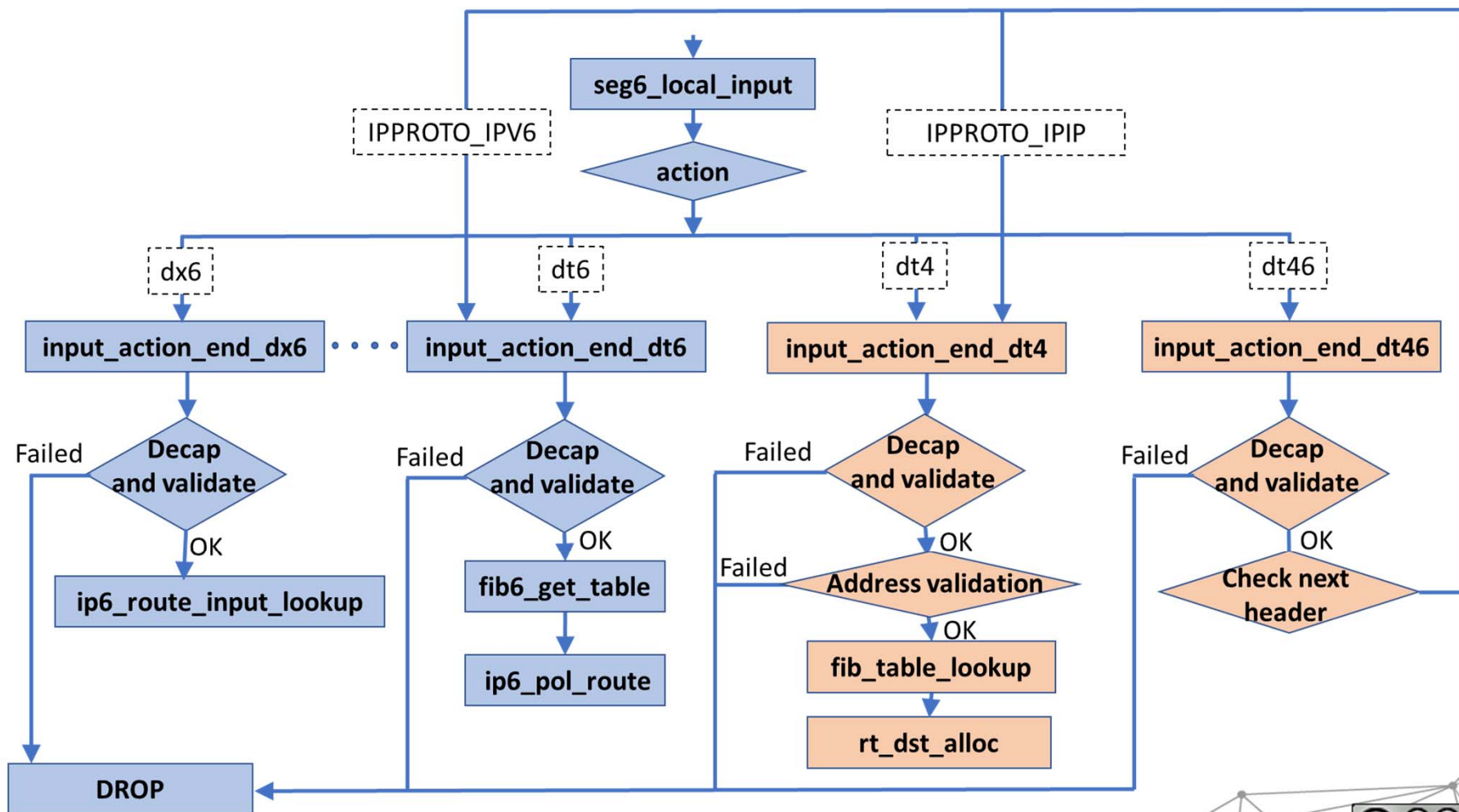


Contribution to Linux kernel (seg6local) 1/2





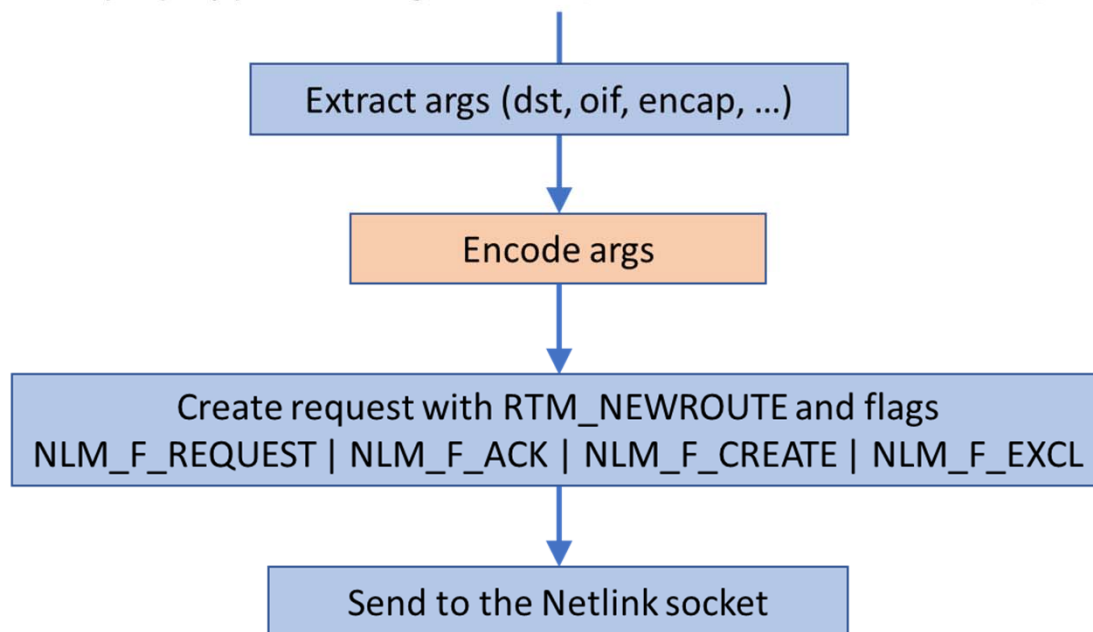
Contribution to Linux kernel (seg6local) 2/2





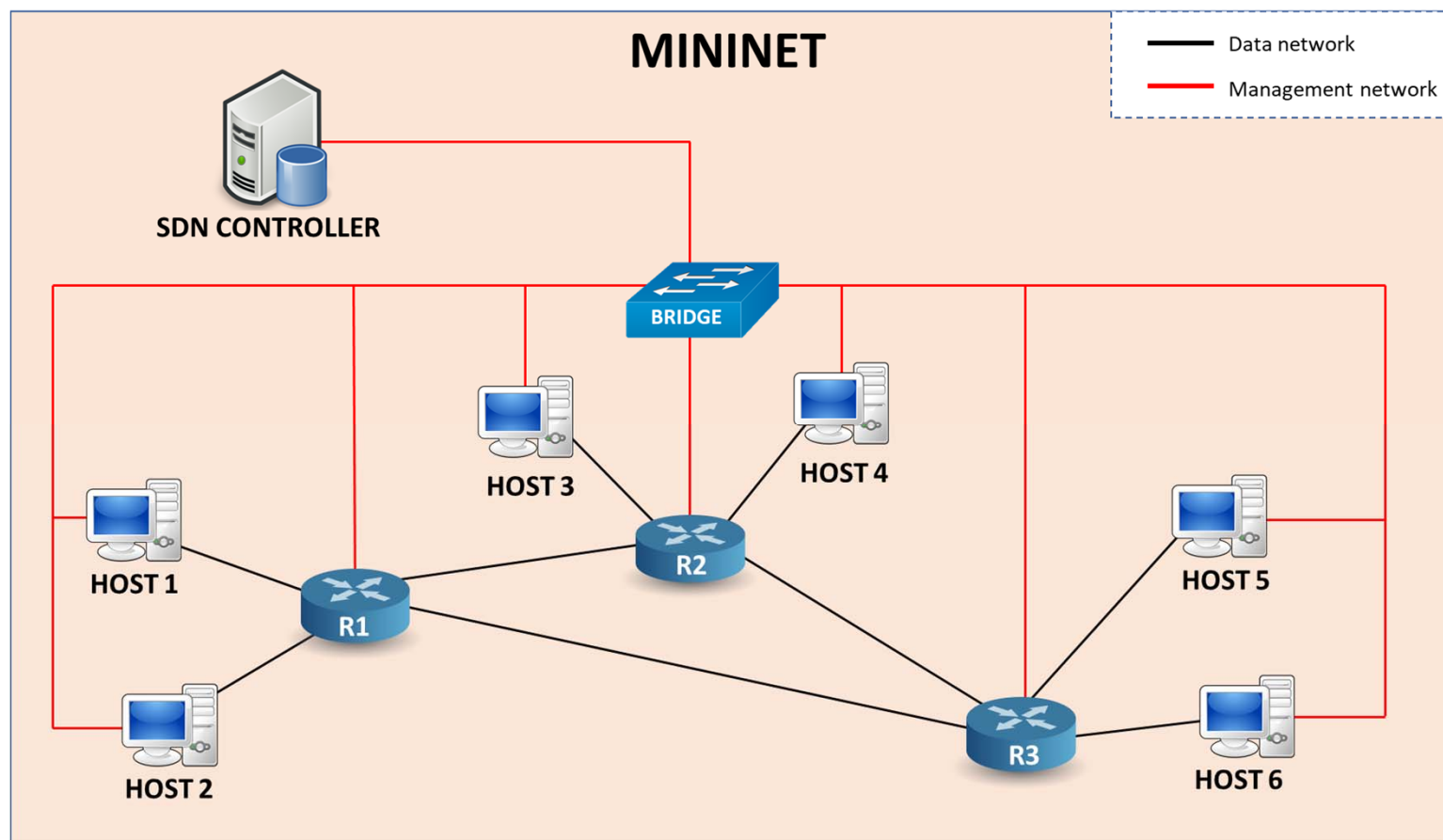
Contribution to pyroute2

```
ip.route('add', dst='2001:0:0:10::2/128', oif=2,  
        encap={'type': 'seg6local', 'action': 'End.DT6', 'table':'10'})
```



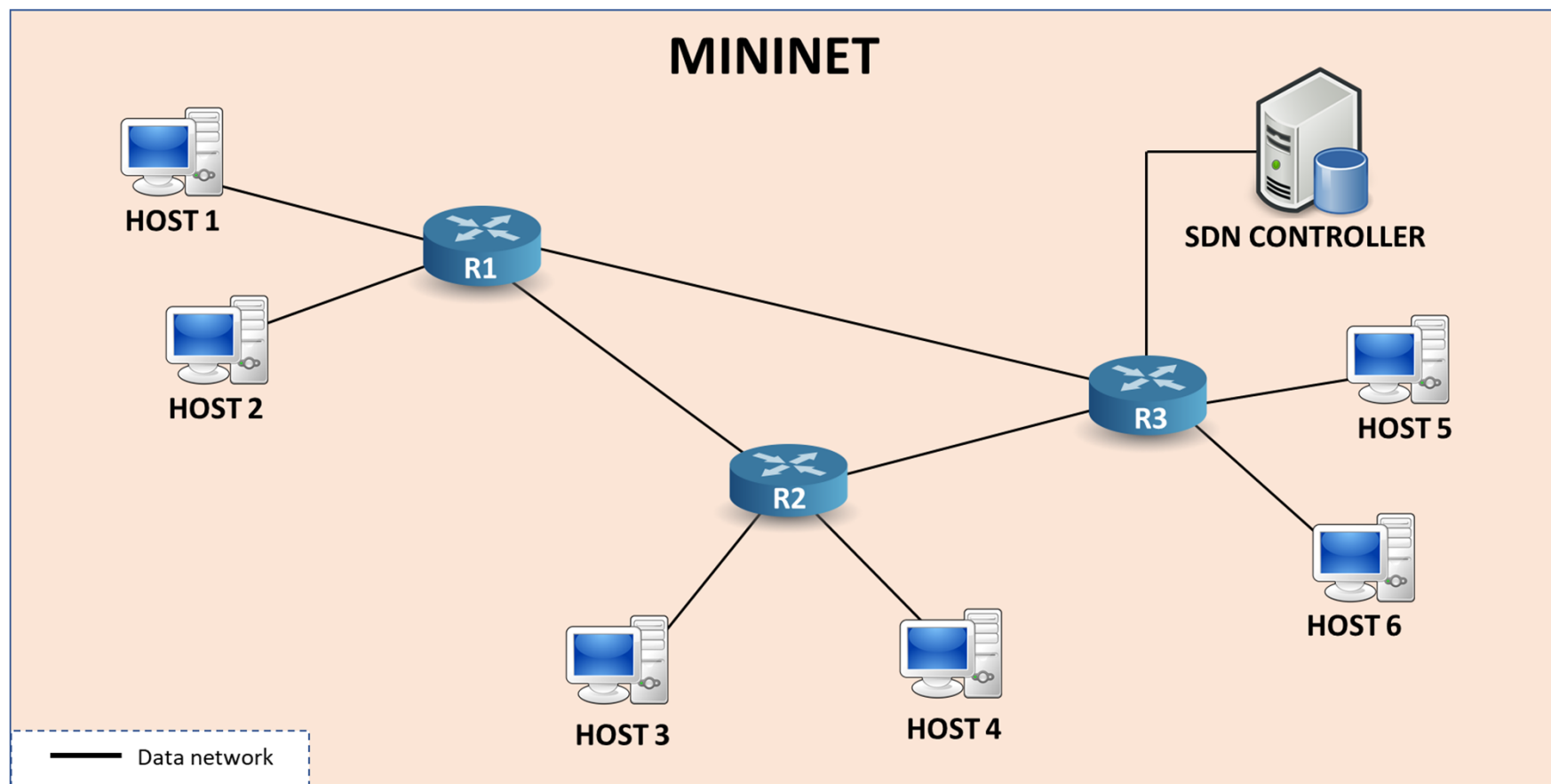


Virtual Testbed (Out-of-band control)





Virtual Testbed (In-band control)





Conclusions

- ❑ We designed and implemented an SDN-SRv6 Architecture
 - ❑ **SRv6 enabled node**
 - ❑ **Southbound protocol** based on gRPC
 - ❑ **Northbound protocol** based on gRPC
 - ❑ **SRv6-based VPN** (based on this architecture)
- ❑ We contributed to the opensource project **Pyroute2** (seg6local support)
- ❑ We contributed to the **Linux kernel** (End.DT4 / End.DT46)
- ❑ We developed **tools for the emulation** of a SRv6 enabled network



Future works

1. Strengthen the technological impact

- Contribute to mainline Linux kernel (DT4 implementation)
- Contribute to the Open Source Pyroute 2 module
- Extend the functionality

2. Achieve scientific impact

- Performance evaluation

3. Tests on GARR infrastructure?



Future works

- Extend the functionality
 - Topology Information Extraction: BGP-LS, interaction with physical routers
 - Network performance monitoring infrastructure based on IPv6 Segment Routing
 - IPsec solution over SRv6 in the Linux kernel
- Performance evaluation
 - Cost of the classification and encapsulation/decapsulation at the edge of the network, performed in Linux based VNFs

Thanks for your attention!
Questions?

