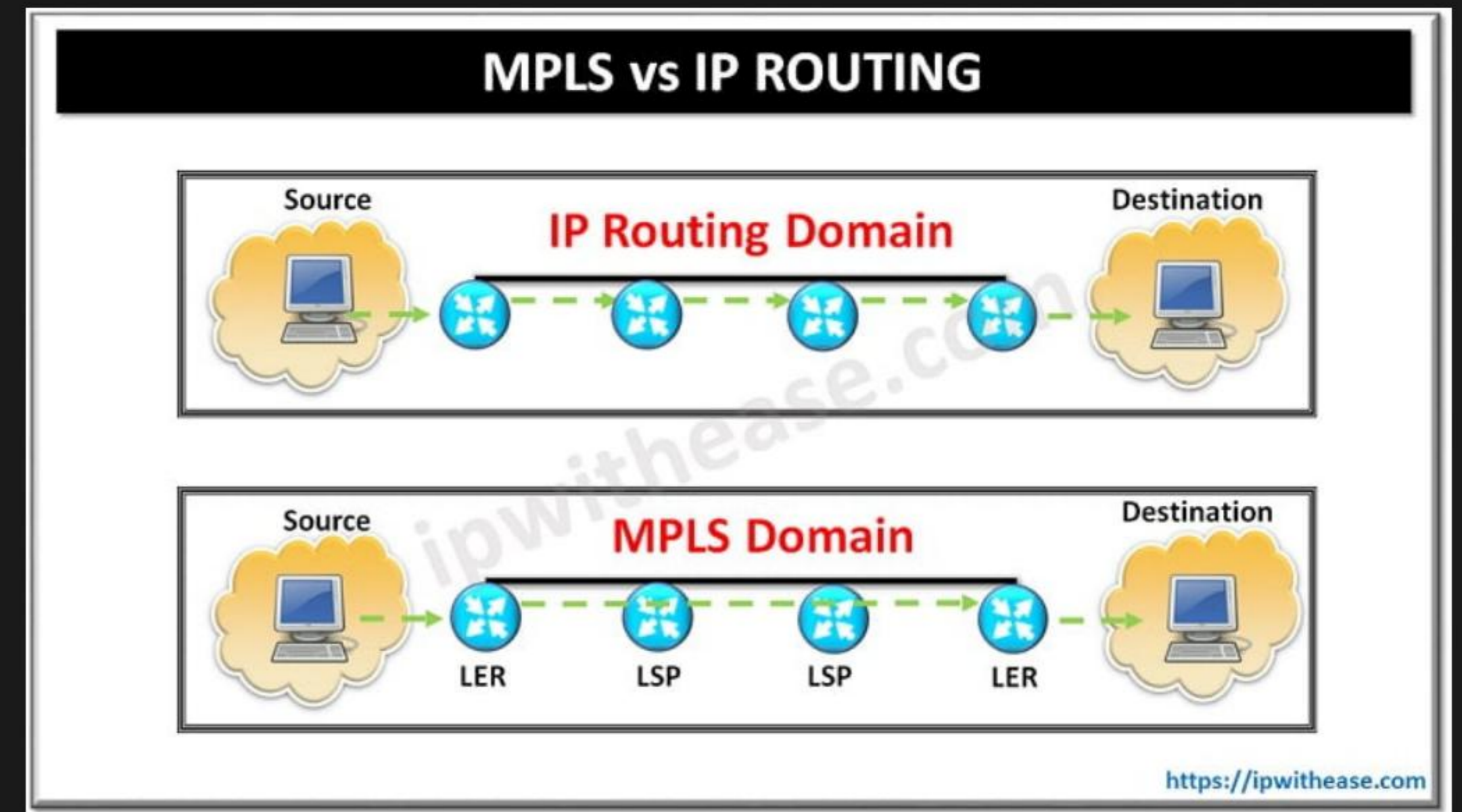


# Introduction to MPLS

## What is MPLS?

Multiprotocol Label Switching (MPLS) is a routing technique that directs data from one node to the next based on short **labels** rather than long network addresses.

- **Layer 2.5:** Operates between the Data Link and Network layers.
- **Efficiency:** Avoids complex lookups in routing tables by using simple label swapping.
- **Protocol Agnostic:** Can encapsulate packets of various protocols (IPv4, IPv6, Ethernet).



# Network Architecture



## LER (Label Edge Router)

The entry and exit point of an MPLS domain. It performs the "Push" (adding a label) at ingress and the "Pop" (removing a label) at egress.



## LSR (Label Switch Router)

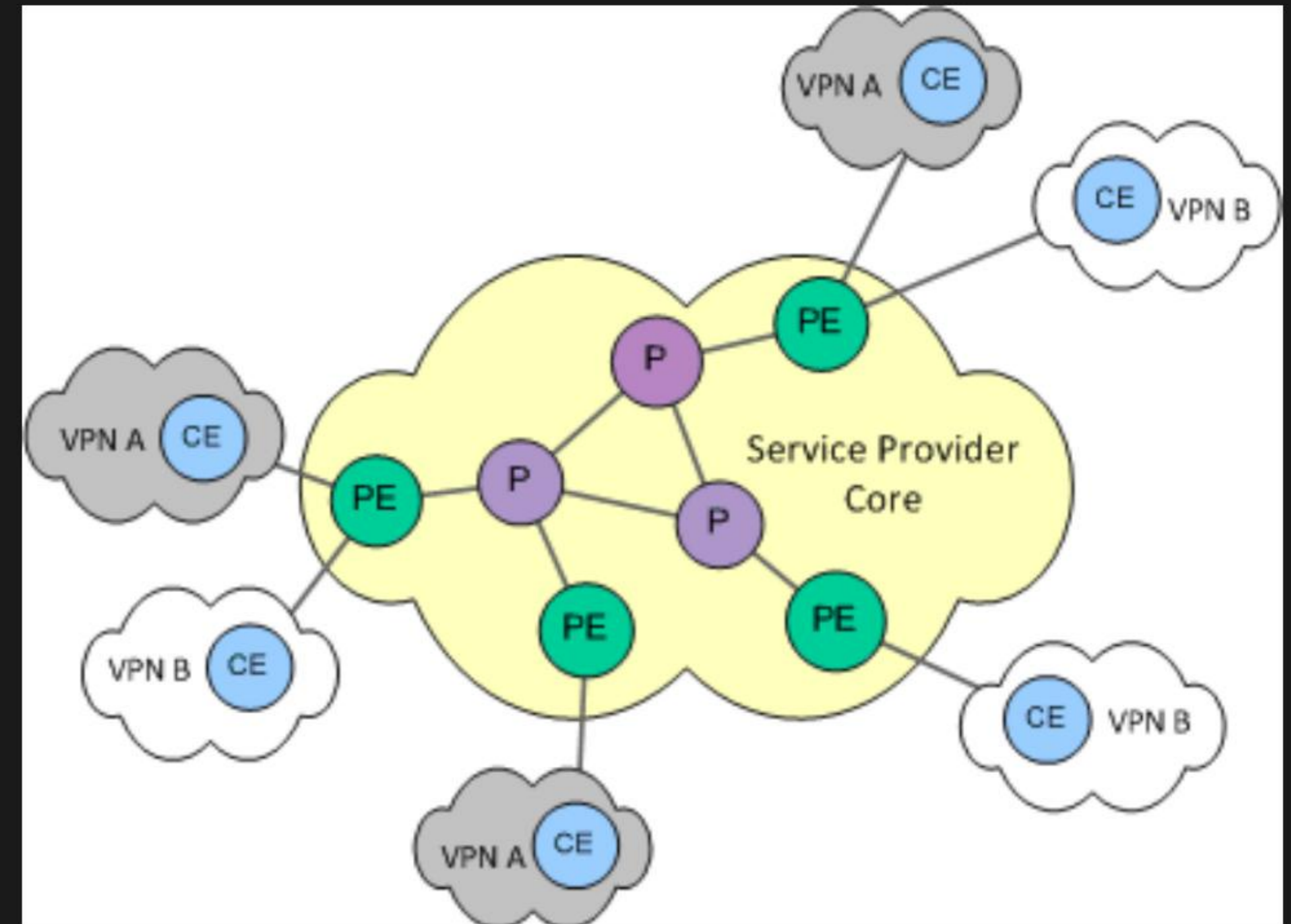
Core routers that perform the "Swap" operation. They only examine the MPLS label to determine the next hop, ensuring high-speed transit.

# Lab Topology Overview

## Standard L3VPN Lab

Our lab environment utilizes three distinct layers of routers to simulate a service provider core:

- **P (Provider):** Core transit routers running only IGP and LDP.
- **PE (Provider Edge):** Edge routers running MP-BGP and VRFs.
- **CE (Customer Edge):** Customer routers unaware of the MPLS core.



# Lab Configuration Workflow



## Step 1: IGP Setup

Configure OSPF/IS-IS for loopback reachability.

## Step 2: MPLS/LDP

Enable label distribution across core interfaces.

## Step 3: MP-BGP

Establish iBGP VPNv4 peering between PE routers.

## Step 4: VRF & CE

Configure VRFs and exchange routes with CE devices.

# Comparative Performance

Feature	Standard IP Routing	MPLS / MP-BGP
Forwarding Basis	Destination IP Lookup	Short Label Matching
Routing Complexity	Full table on every hop	Full table only at the edge
Security	None by default	Isolated VRF instances
Traffic Engineering	Limited (Metric based)	Advanced (RSVP-TE / SR)