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Exploring Segment Routing MPLS Unleashing Network Scalability and Efficiency

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LTRSPG – 2762

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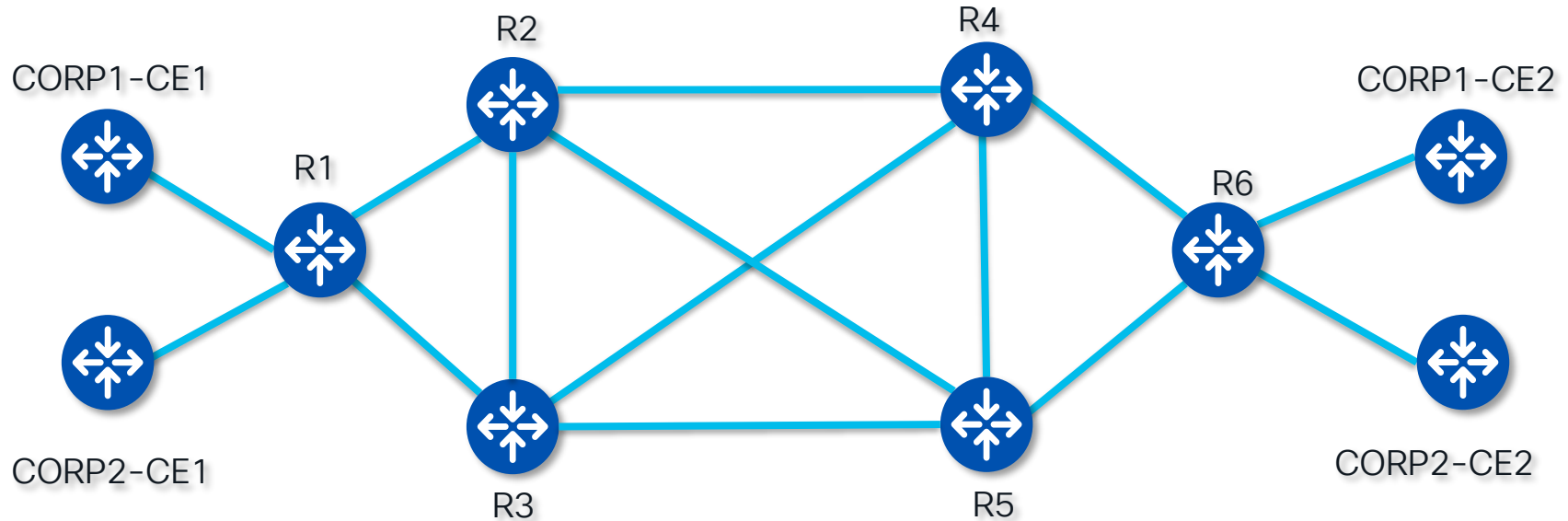




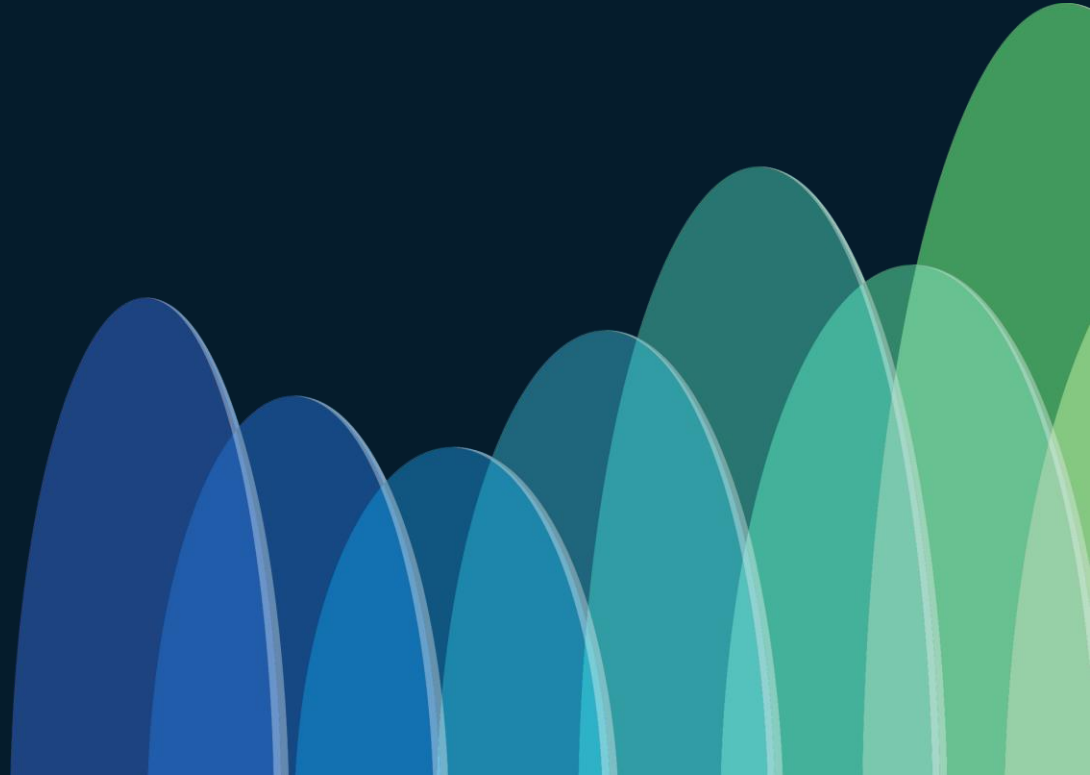
Agenda

- MPLS – History
- What is a Segment
- LAB1 – LDP
- LAB2 – SR PREP
- LAB3 – Migration to SR
- LAB4 – Verify Services
- LAB5 – Configure Ti-LFA
- LAB6 – SR Policy
- LAB7 – Using SR-PCE
- LAB8 – SRTE
- LAB9 – Flex Algorithm

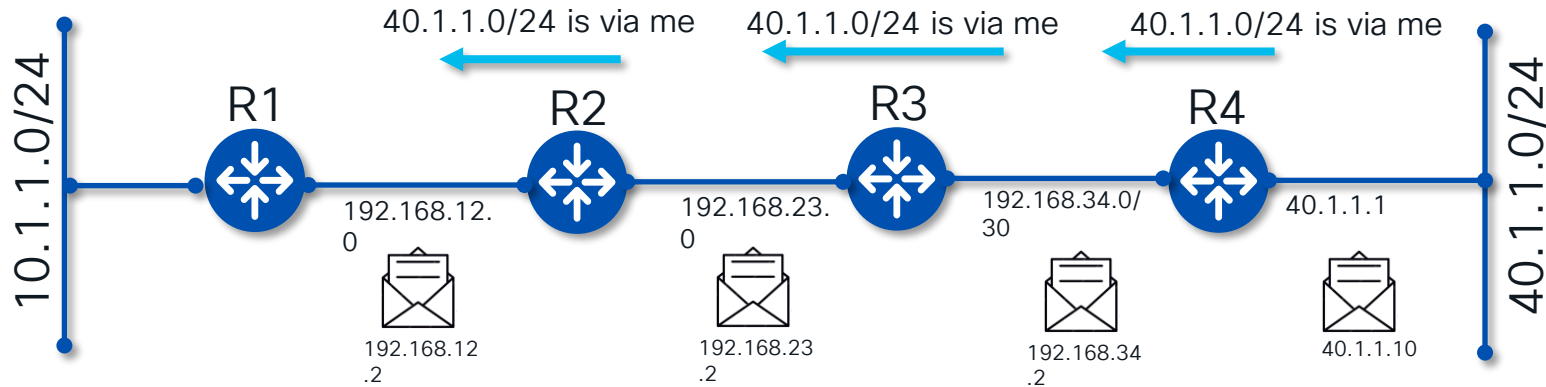
Introduction: Lab Topology



History



Destination Based Routing



MPLS Brief History

Original drivers towards label switching

Designed to make router faster.

- ❑ Routers were originally built to handle forwarding in the software on a single CPU.
- ❑ ATM switches were faster than routers.
- ❑ MPLS allows the device to do same job as router with performance of ATM switch.

Late 1996, proprietary multilayer solutions emerged with integrated ATM switching and IP routing:

- ❑ IP Switching—Ipsilon/Nokia
- ❑ Tag Switching—Cisco Systems
- ❑ Cell Switching Router (CSAggregate Route-Based IP Switching (ARIS)—IBM

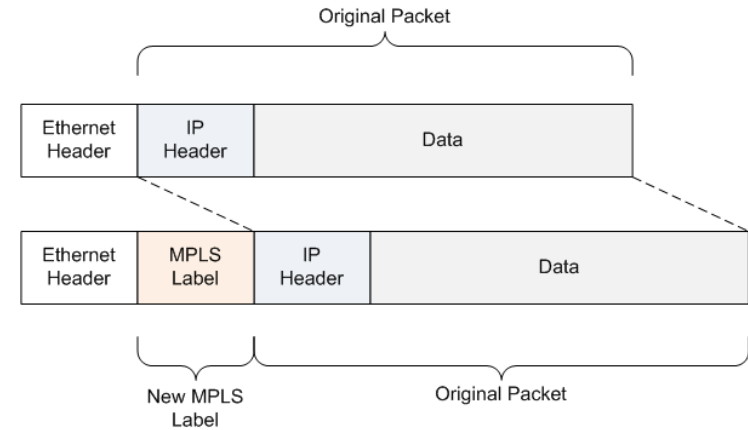
These were all similar technologies but were NOT interoperable.

IETF worked to standardize the solutions and develop MPLS:-

- ❑ First IETF RFC on MPLS published in Jan 2001
 - ❖ RFC 3031 specifies “MPLS Architecture” (<https://tools.ietf.org/html/rfc3031>)
 - ❖ RFC 3032 specify “Label Stack Encoding”(<https://tools.ietf.org/html/rfc3032>)

What is a MPLS label

- It's a simple encapsulation at "layer 2.5"
- MPLS forwards packets by switching labels [push, pop] based on a forwarding database.
- Forwarding is based on simple look-up.



{incoming interface, incoming label} → {outgoing interface, outgoing label}

If you are to construct a label

General Frame Groups Rx Port Preview

Preview:

EthernetII Mpls IPv4 ☒ Show All Fields ☐ Allow Invalid Packets

Frames

Create new Frame >

Save Frame as Template...

Manage Frame Templates...

Actions

Add Header(s)...

Link Modifiers/VFDs...

Insert Modifier...

Edit Value

Others

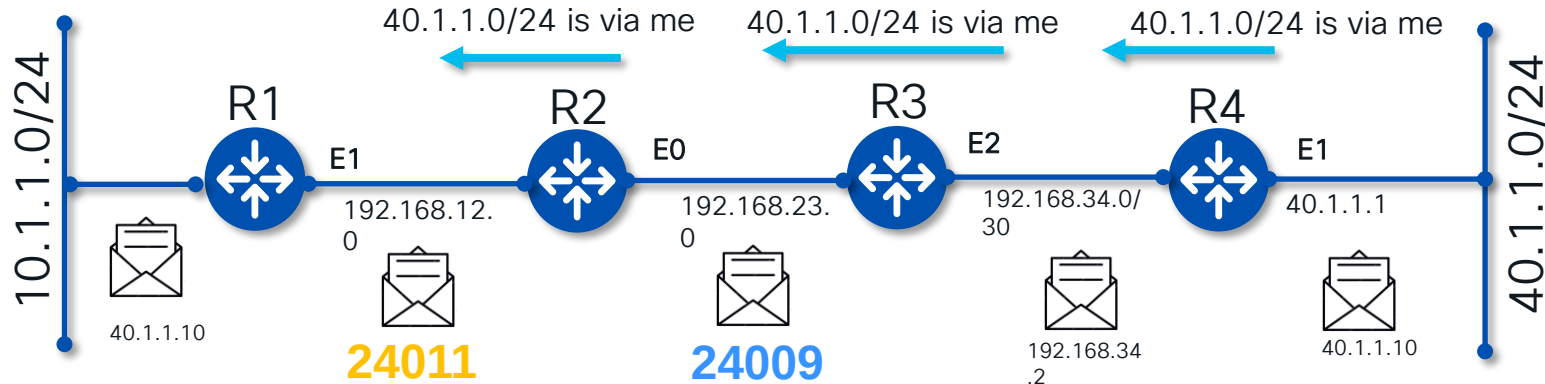
Expand All

Collapse All

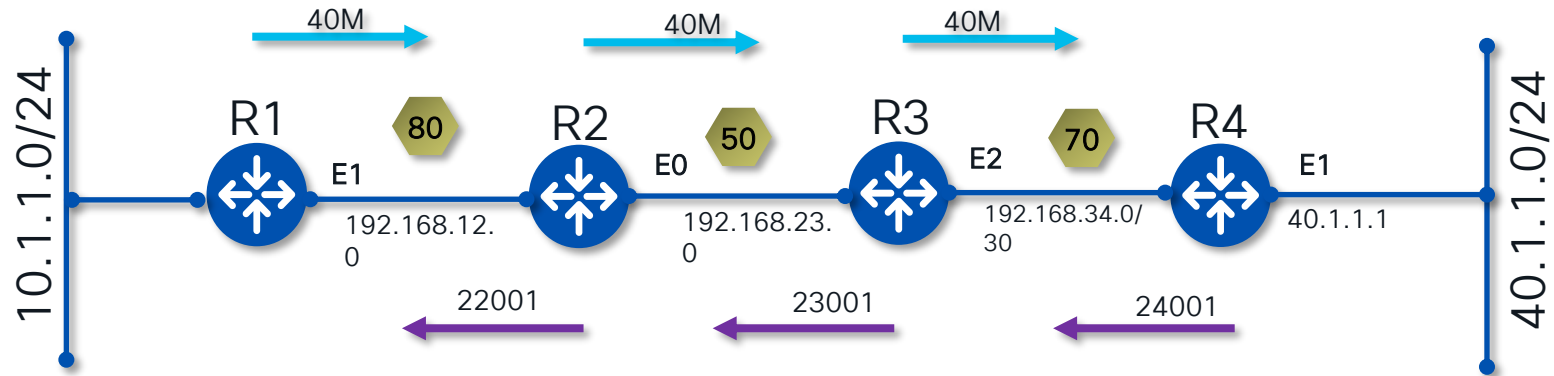
Name	Value
[-] Frame	
[-] EthernetII	
Preamble (hex)	fb555555555555d5
Destination MAC	00:00:01:00:00:01
Source MAC	00:10:94:00:00:02
EtherType (hex)	<auto> MPLS Unicast
[-] MPLS Header	
Label (int)	Router Alert Label
Experimental Bits (bits)	<auto> 000
Bottom of stack (bit)	<auto> 0
Time to live (int)	64
[-] IPv4 Header	
Version (int)	<auto> 4
Header length (int)	<auto> 5
ToS/DiffServ	tos (0x00)
Total length (int)	<auto> calculated
Identification (int)	0
[-] Control Flags	

MPLS forwarding in action.

Prefix: 40.1.1.0/24		Prefix: 40.1.1.0/24		Prefix: 40.1.1.0/24		Prefix: 40.1.1.0/24	
Local Label	24029	Local Label	24011	Local Label	24009	Local Label	imp-null
Out Interface	E1	Out Interface	E0	Out Interface	E2	Out Interface	E1
Out Label	24011	Out Label	24009	Out Label	Imp-null	Out Label	--
Operation	IPv4 forward	Operation	IPv4 forward	Operation	IPv4 forward	Operation	IPv4 forward



RSVP Operation

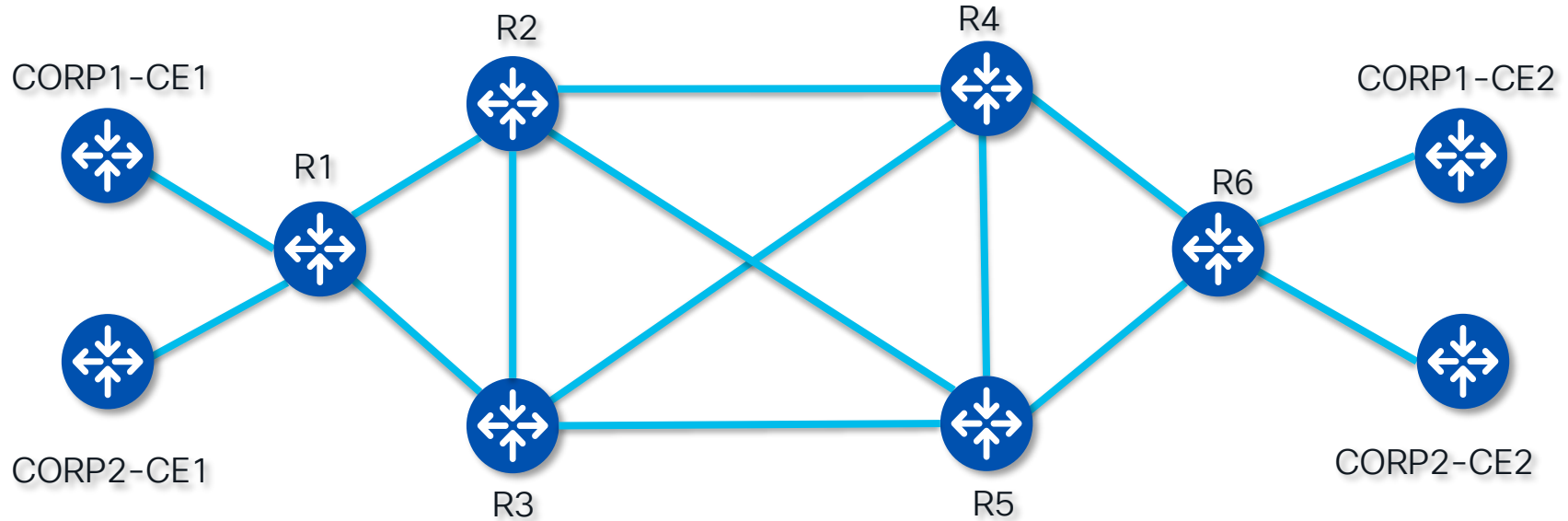


LAB: TASK 1

EXPLORE LDP BASED NETWORK

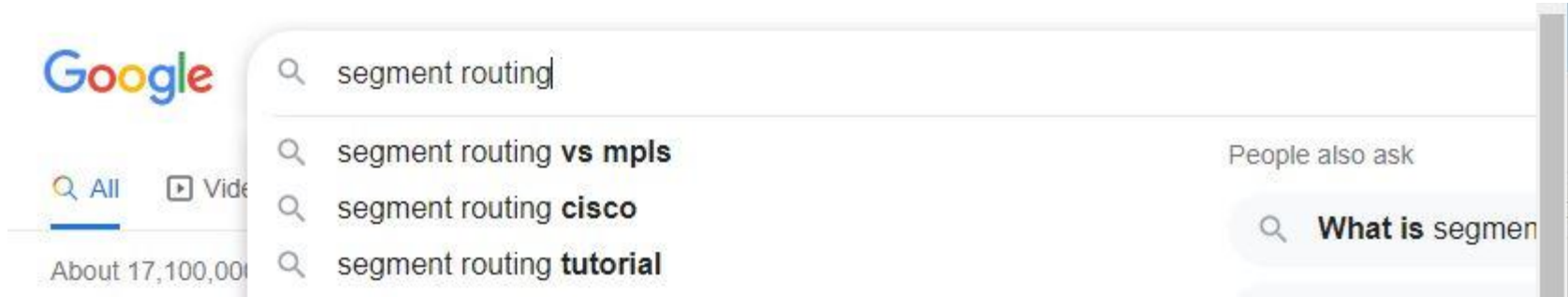


Lab Topology



What is a "Segment" ?

Myth: SR is not a MPLS replacement



VPNv4

VPNv6

VPWS

VPLS

EVPN

Everything
Used to
Work with LDP

The overlay services will work as usual, including Inter-AS Options 1,2,3

”Segment”

an instruction a node
executes on the incoming
packet.

Internet Engineering Task Force (IETF)
Request for Comments: **8402**
Category: Standards Track
ISSN: 2070-1721

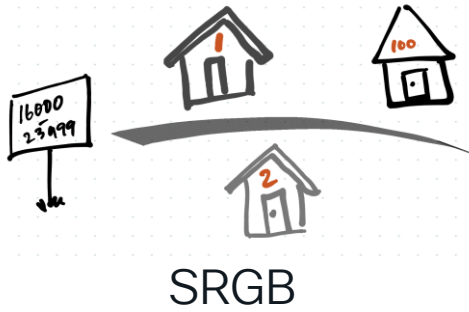
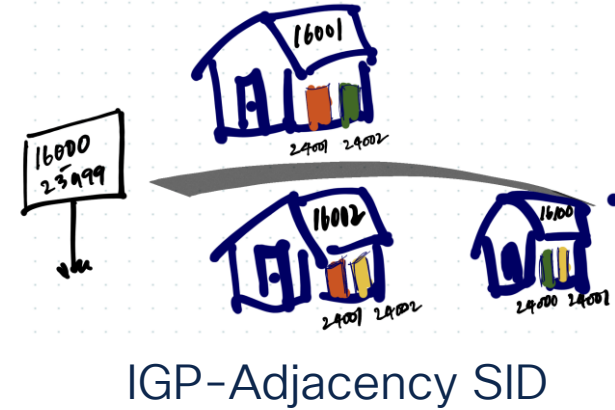
C. Filsfils, Ed.
S. Previdi, Ed.
L. Ginsberg
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B. Decraene
S. Litkowski
Orange
R. Shakir
Google, Inc.
July 2018

Segment Routing Architecture

Abstract

Segment Routing (SR) leverages the source routing paradigm. A node steers a packet through an ordered list of **instructions**, called **"segments"**. A segment can represent any **instruction**, **topological** or **service based**.

Are there different types of Segments



Are there different types of Segments?

IGP Prefix SID

GLOBAL segment representing an IGP prefix
Forward packet along shortest-path (ECMP-aware) to reach the prefix associated with the segment

IGP Node SID

An IGP-Prefix segment identifying a specific router (for example its loopback prefix)

IGP Anycast SID

An IGP-Prefix segment assign to an IGP prefix advertised by multiple routers (anycast prefix)

IGP Adjacency SID

LOCAL segment representing an IGP adjacency
Forward packet over the interface where the adjacency is formed

BGP Prefix SID

GLOBAL segment representing a BGP prefix
Forward packet along best-path to reach the prefix associated with the segment

BGP Peering SID

LOCAL segment representing a BGP neighbor
Forward packet over the interface where the neighbor is formed

Are there different types of Segments?

Global Segments

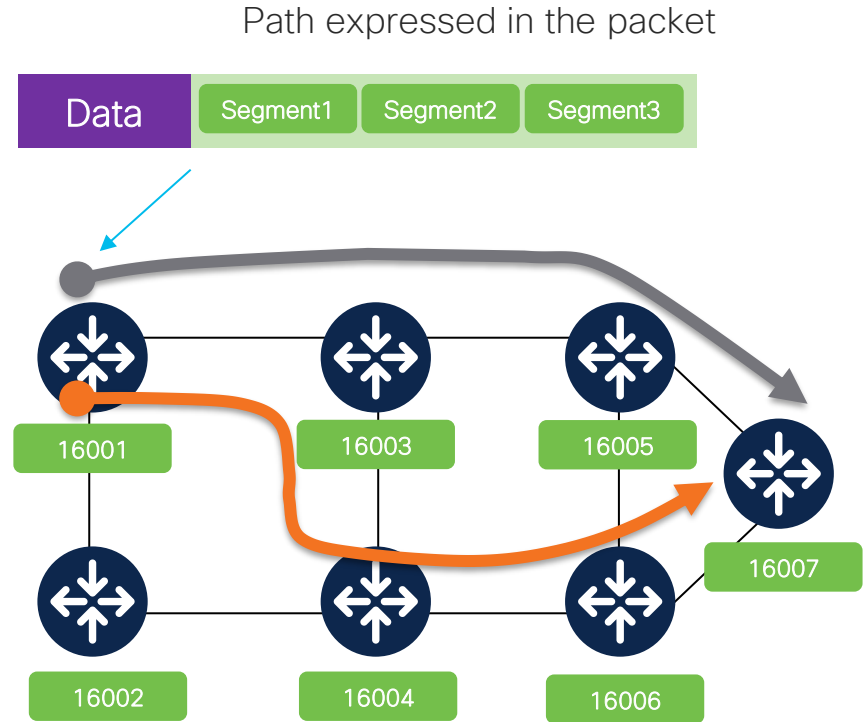
- Segments learnt and **programmed by all nodes** in the SR domain
- SID is **operator-assigned** within the **SR Global Block (SRGB)**
- Example: prefix segment

Local Segments

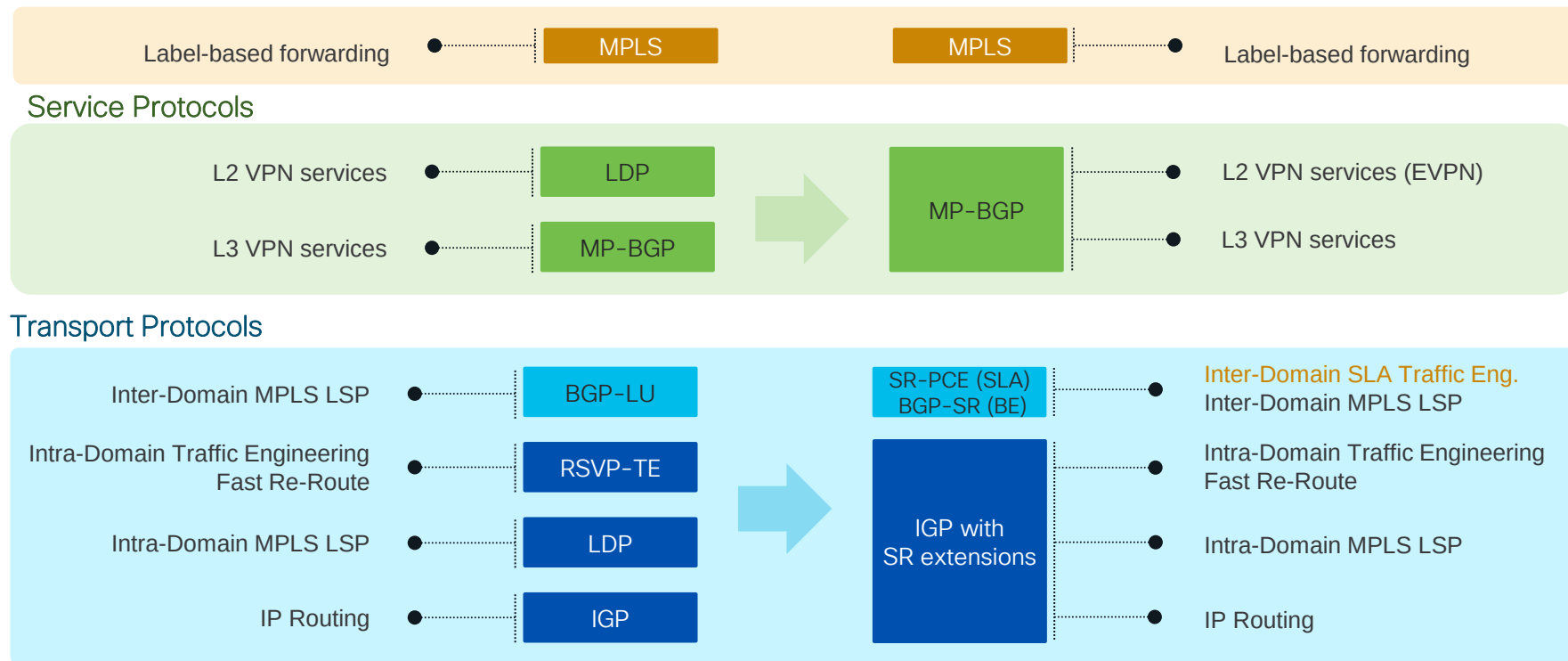
- Segments learnt by all nodes in the SR domain but **only programmed by the advertising node**
- SID is **dynamically allocated** by router and option for operator-assigned within the SR Local Block (SRLB)
- Example: adjacency segment, peering segment

What is Segment Routing?

- SR is an architecture based on the **Source Routing principle**
- It provides a **stateless IP fabric** with uncompromised **simplicity** and **scale**
- It delivers a unified, **end-to-end policy-aware** network infrastructure



Protocol Stack Simplification



LAB: TASK 2

CONFIGURE SR/MPLS



Lab Task 2.x

```
segment-routing
  global-block 16000 23999
!
router isis core
  address-family ipv4 unicast
    segment-routing mpls
```

LAB: TASK 3

MIGRATE TO SR MPLS DATAPLANE



Lab Task 3.0: Migrate to SR/MPLS Dataplane

```
router isis core  
  address-family ipv4 unicast  
    segment-routing mpls sr-prefer
```

LAB: TASK 4

Verify overlay services connectivity over SR/MPLS

LAB: TASK 5

Configure and Verify Topology Independent - Loop Free
Alternate (TI-LFA) routing

TASK 5: Configure and Verify Topology Independent - Loop Free Alternate (TI-LFA) routing

```
group FLEXCLI-ISIS-1G
router isis 'core'
  interface 'GigabitEthernet.*'
    address-family ipv4 unicast
      fast-reroute per-prefix
      fast-reroute per-prefix ti-lfa
  end-group
```

TASK 6: Configure and Verify SR Policy



TASK 7: Configuring Path Computing Element (PCE) server and client

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