

The background features a vibrant, abstract design with a color gradient from dark blue on the left to bright yellow and white on the right. The design consists of overlapping, wavy horizontal bands and a radial pattern of lines emanating from a bright white point on the right side, creating a sense of motion and energy.

CISCO *Live!*

Let's go



The bridge to possible

Introduction to SRv6 uSID Technology

Jakub Horn, Principal Technical Marketing Engineer

CISCO *Live!*

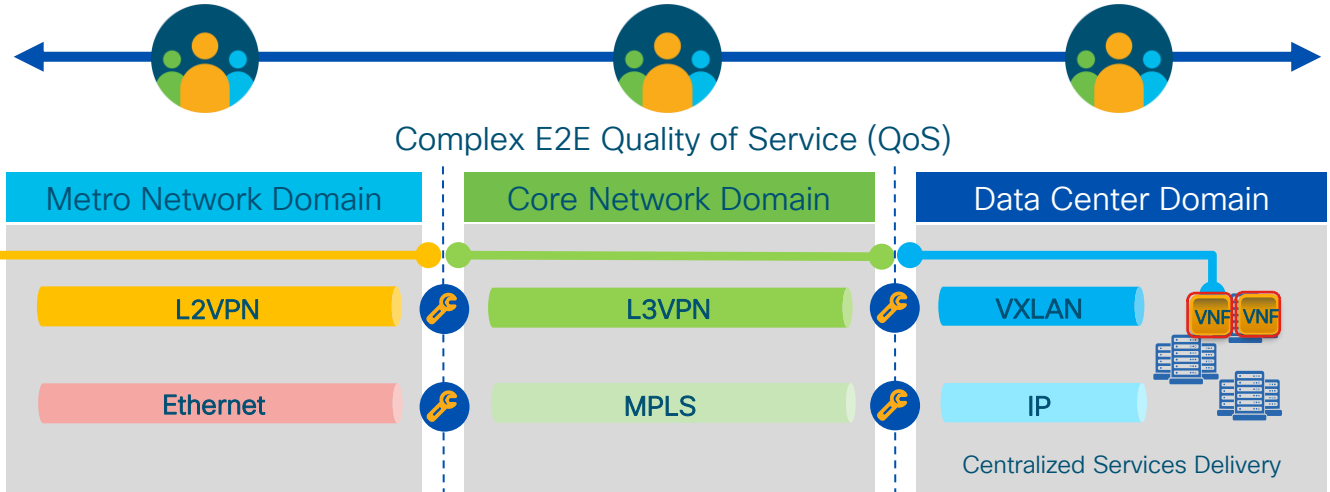
BRKSPG-2203

Agenda

- SRv6 DataPlane
- SRv6 Network Programming
- SRv6 Control Plane
- Addressing Plan for SRv6
- MPLS to SRv6 Migration

Understanding Today's Service Creation

Limited Cross-domain Automation, Cumbersome Service Assurance



End-to-end service provisioning is lengthy and complex

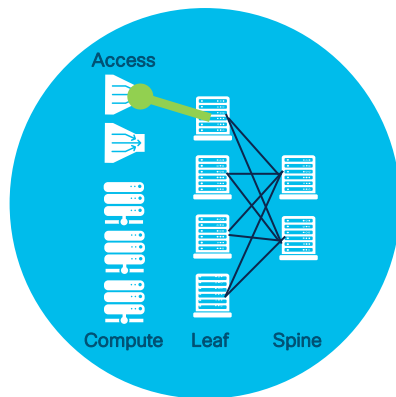
- Multiple network domains under different management teams
- Manual operations
- Heterogeneous underlay and overlay networks

SR-MPLS: SDN ready

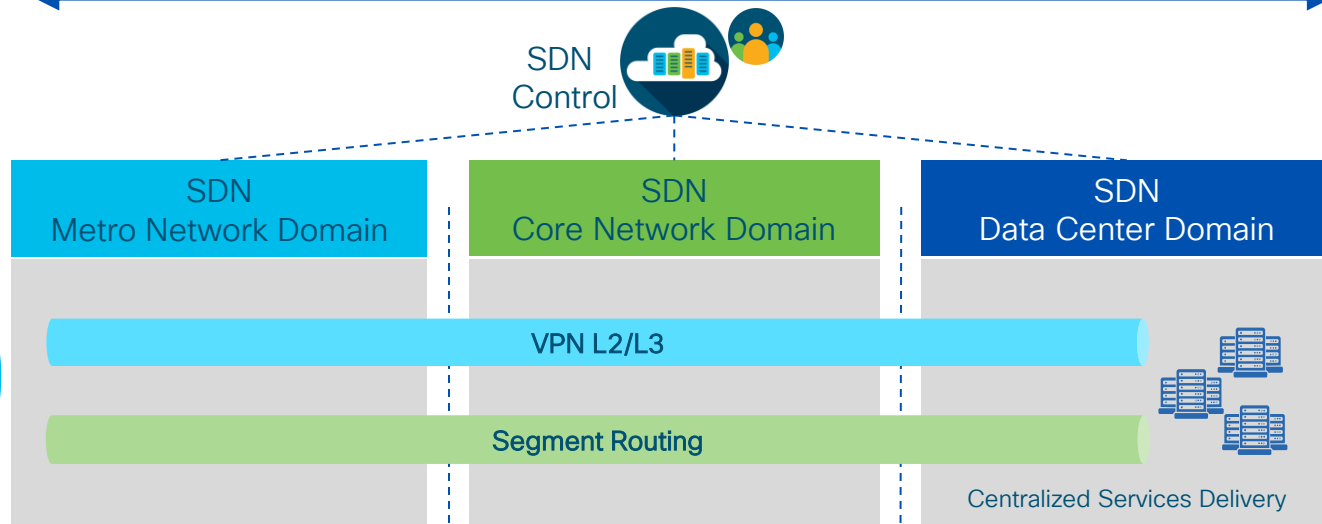
“Network as a Fabric” for Service Creation



Cloud Scale Networking
Central Office



Homogenous Cross-domain Automation & Assurance

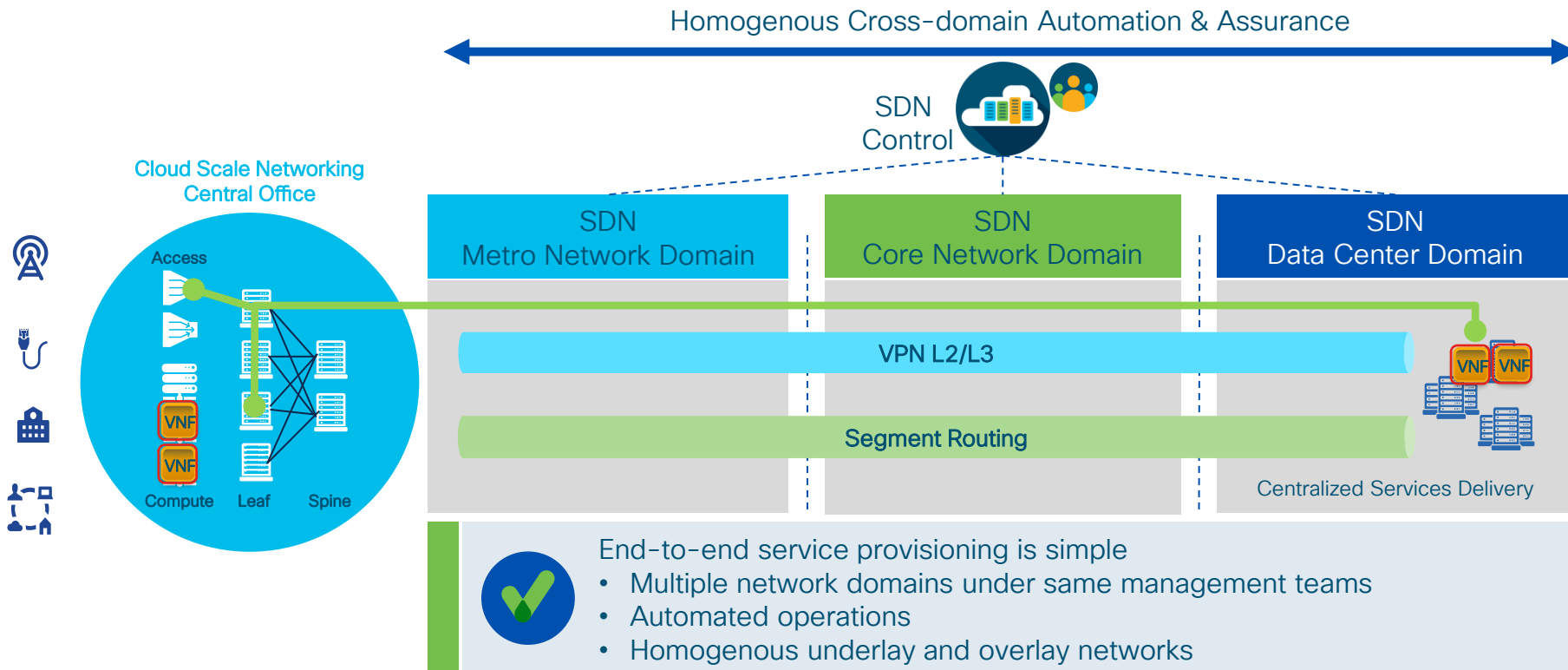


End-to-end service provisioning is simple

- Multiple network domains under same management teams
- Automated operations
- Homogenous underlay and overlay networks

SR-MPLS: SDN ready

“Network as a Fabric” for Service Creation

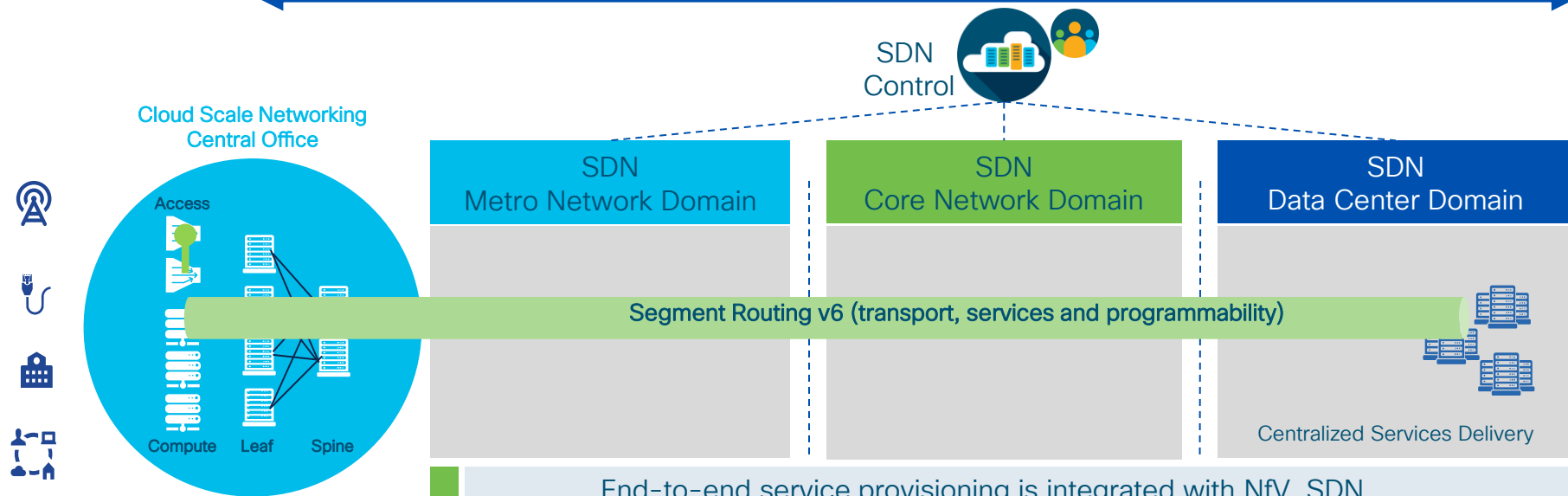


SRv6: SDN, NfV, 5G ready

“Network as an API” for Service Creation



Homogenous Cross-domain Automation & Assurance



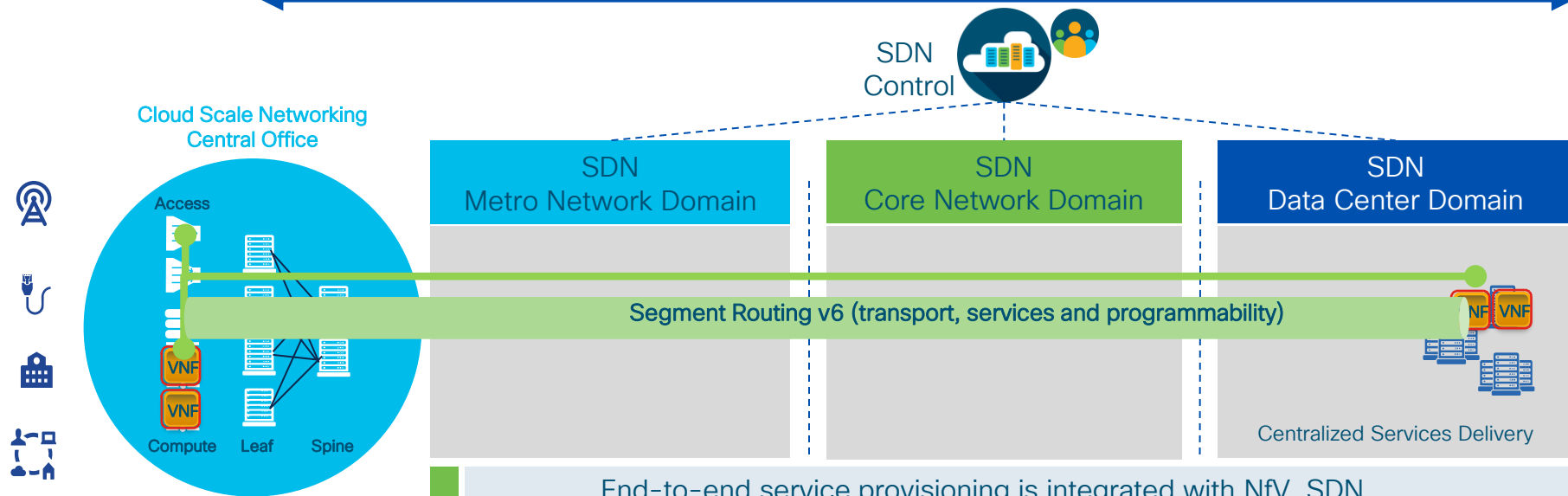
- End-to-end service provisioning is integrated with NfV, SDN
- Multiple network domains under same management teams
 - Automated operations
 - Integrated underlay and overlay networks (NfV)
 - Network as API (NfV)
 - Hyper Scale (5G)

SRv6: SDN, NfV, 5G ready

“Network as an API” for Service Creation

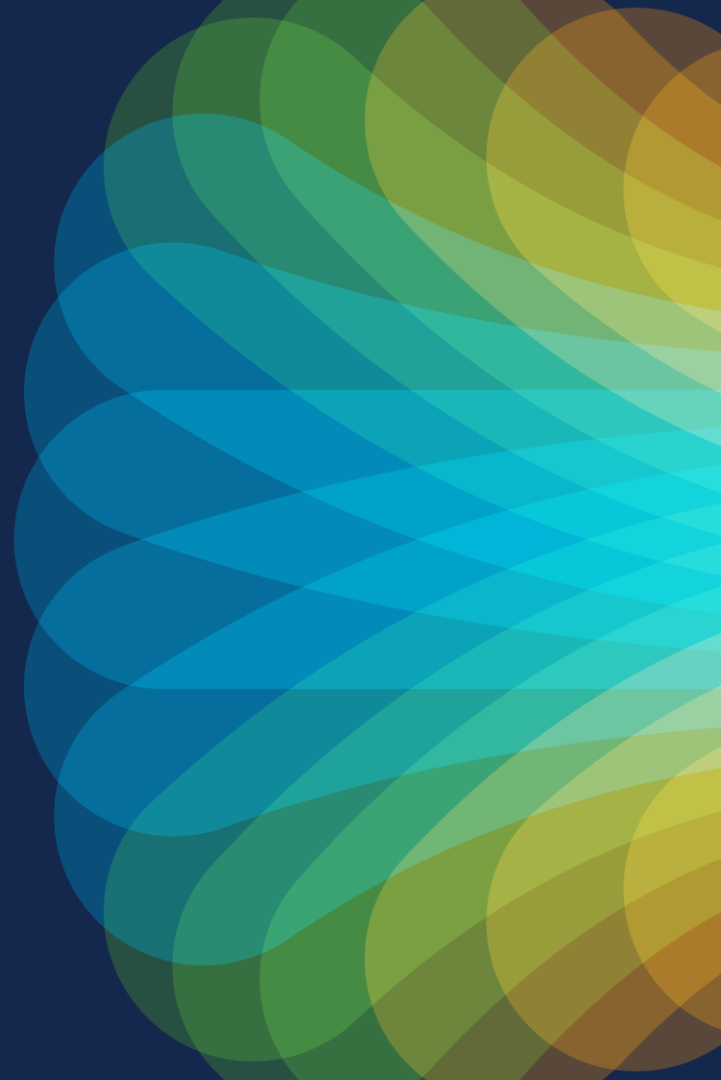


Homogenous Cross-domain Automation & Assurance



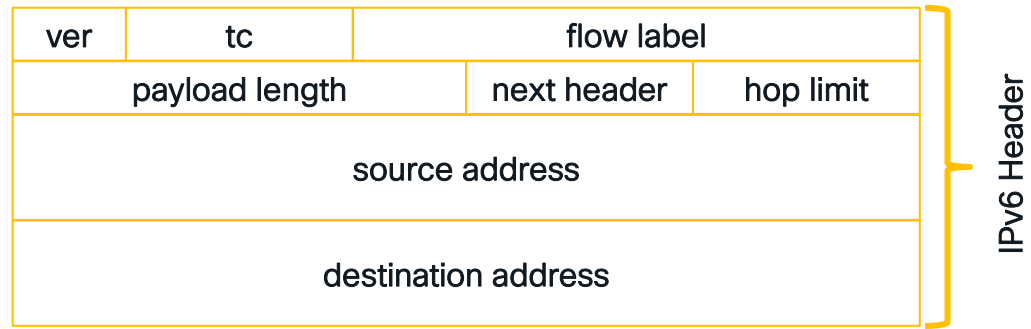
- End-to-end service provisioning is integrated with NfV, SDN
- Multiple network domains under same management teams
 - Automated operations
 - Integrated underlay and overlay networks (NfV)
 - Network as API (NfV)
 - Hyper Scale (5G)

SRv6 Dataplane



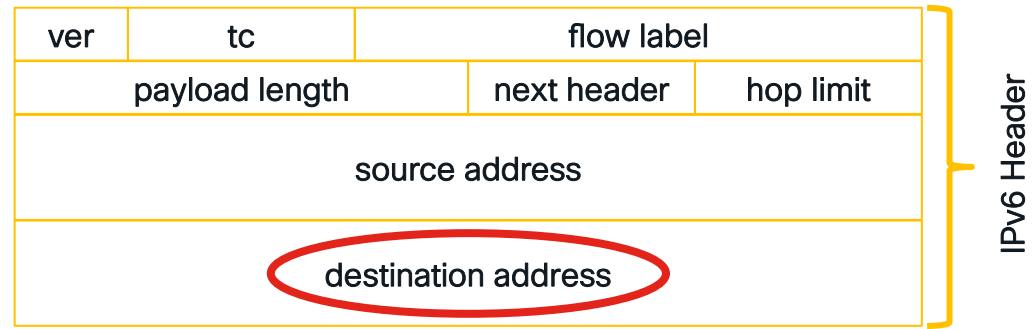
SRv6

- IPv6 Header
- Destination IP address



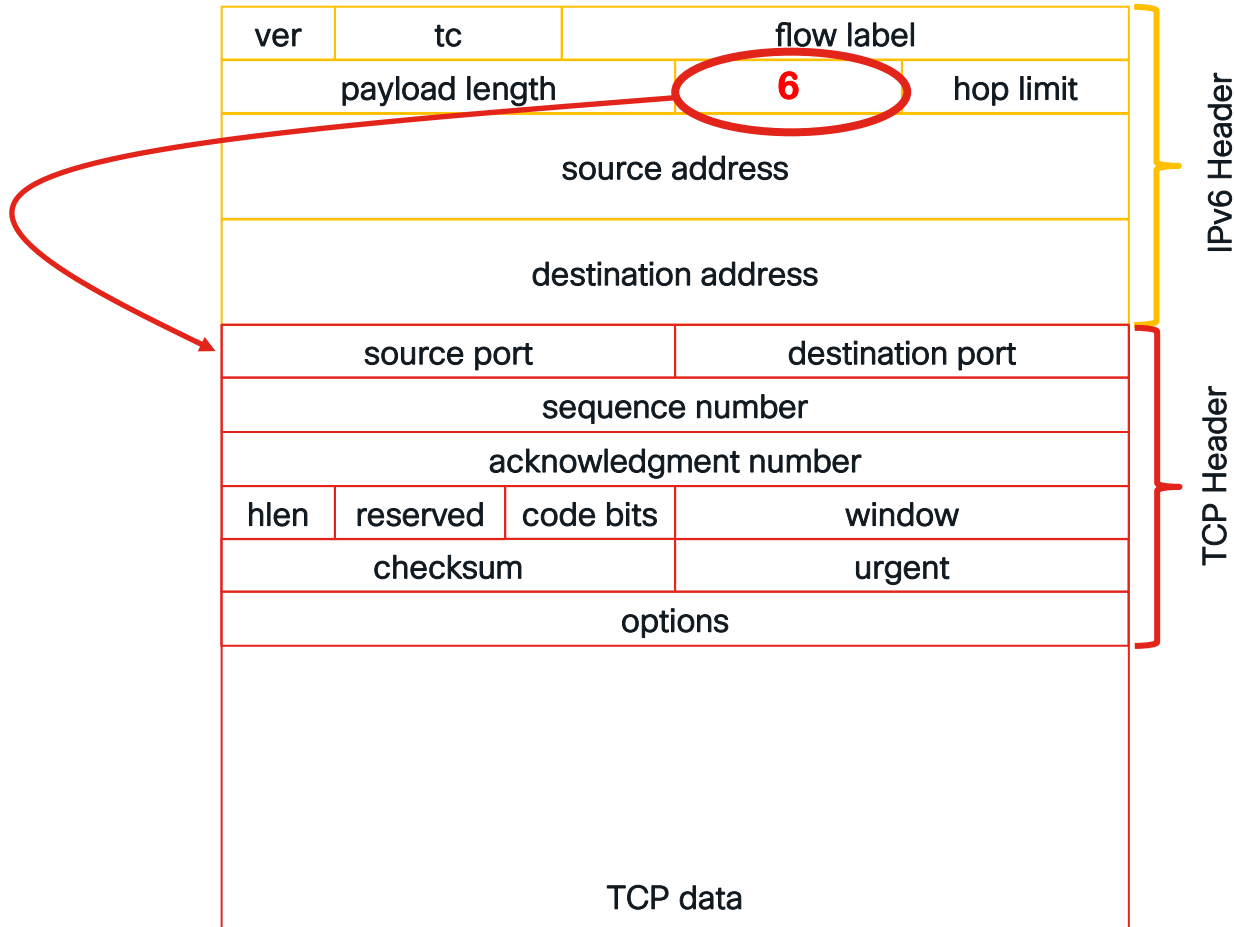
SRv6

- IPv6 Header
- Destination IP address



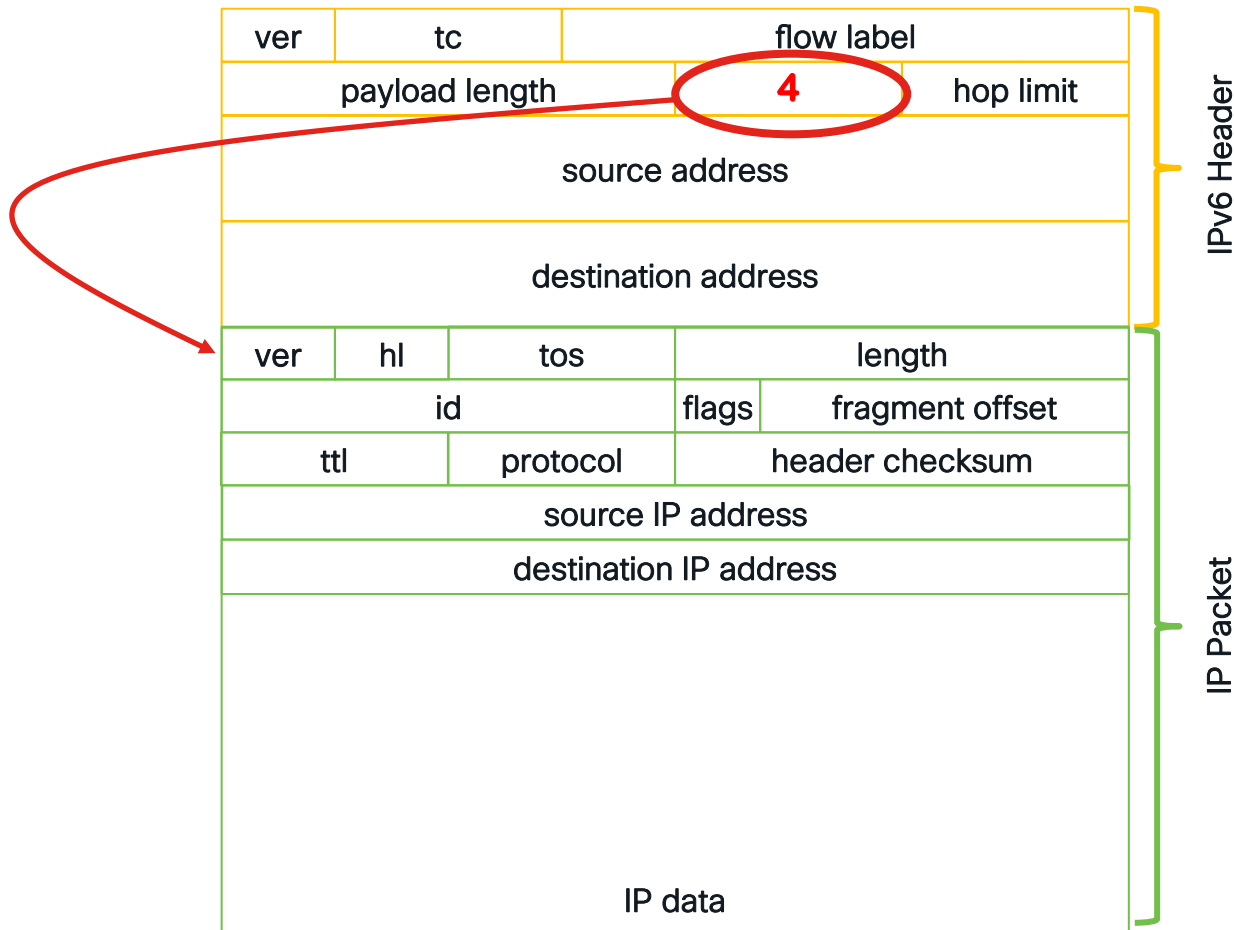
SRv6

- IPv6 Header
- Destination IP address
- Next header field:
 - TCP, UDP, ICMP....



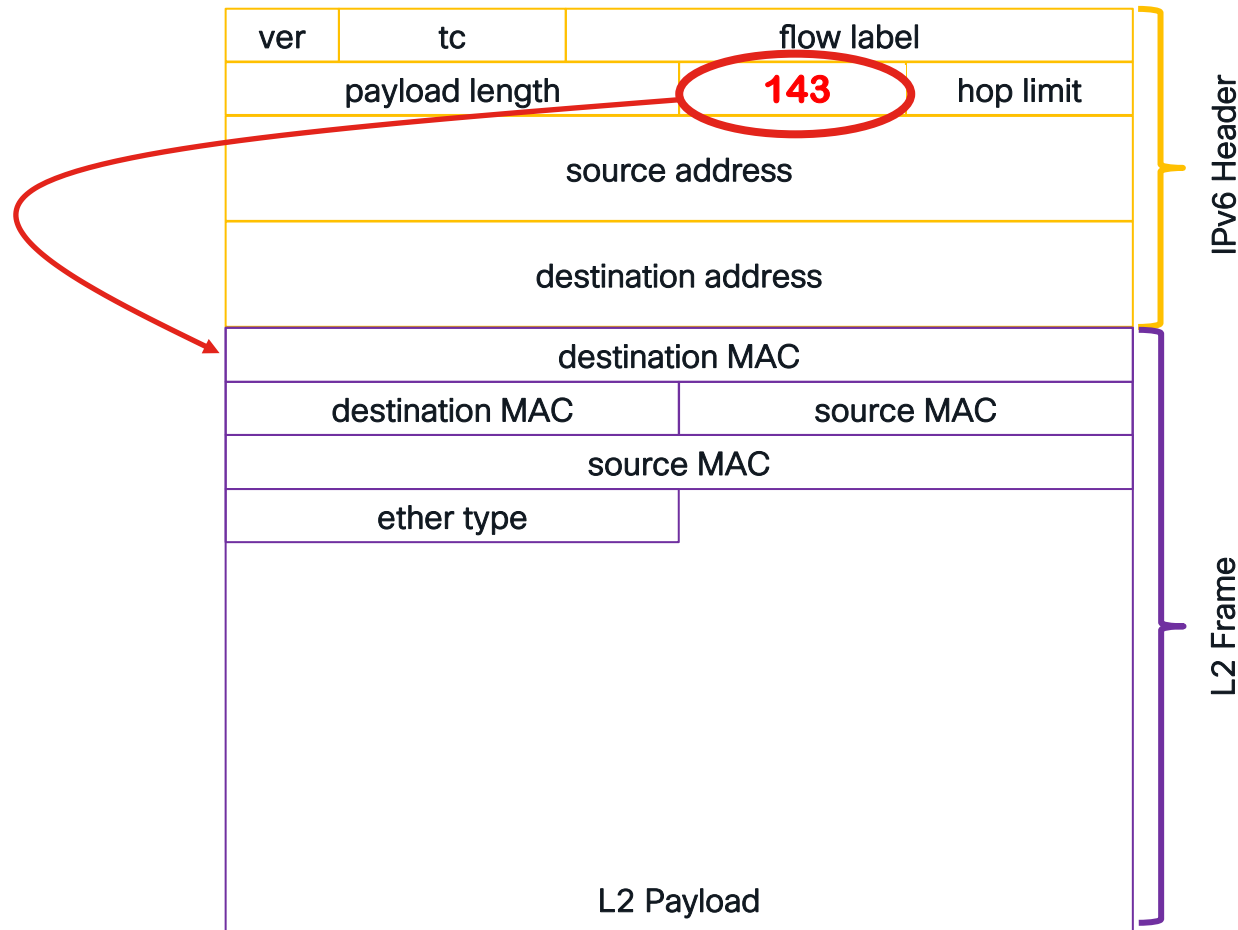
SRv6

- IPv6 Header
- Destination IP address
- Next header field:
 - TCP, UDP, ICMP....
 - IPv4, IPv6



SRv6

- IPv6 Header
- Destination IP address
- Next header field:
 - TCP, UDP, ICMP....
 - IPv4, IPv6, L2



SID Structure -Locator

128 Bits Like IPv6 address but different semantics

1111:2222:3333:4444:5555:6666:7777:8888

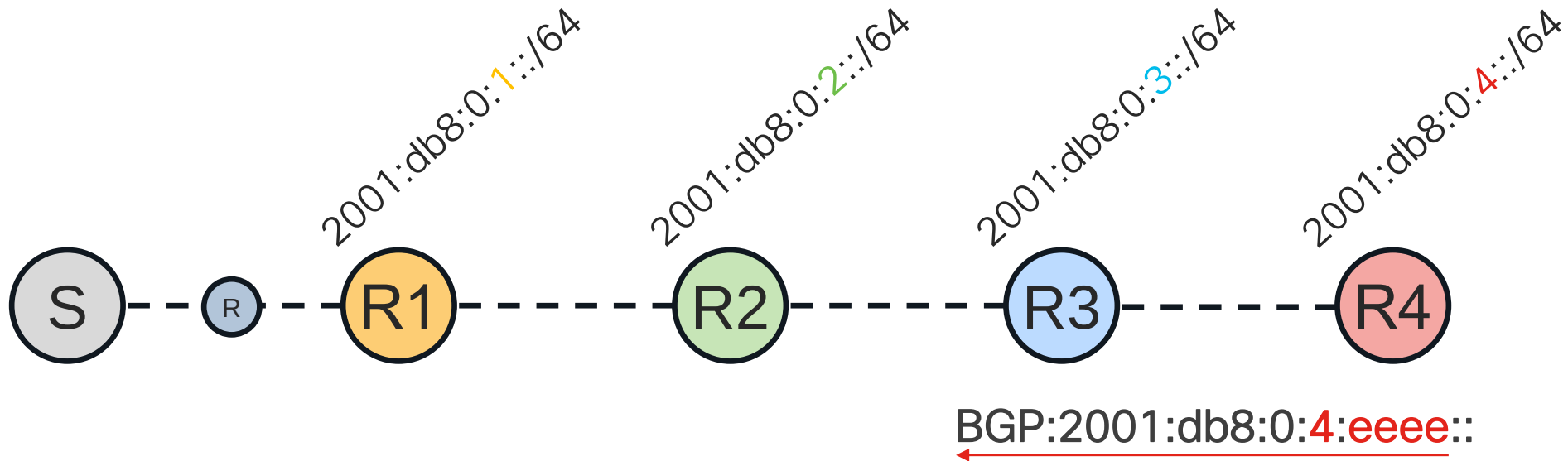


Locator

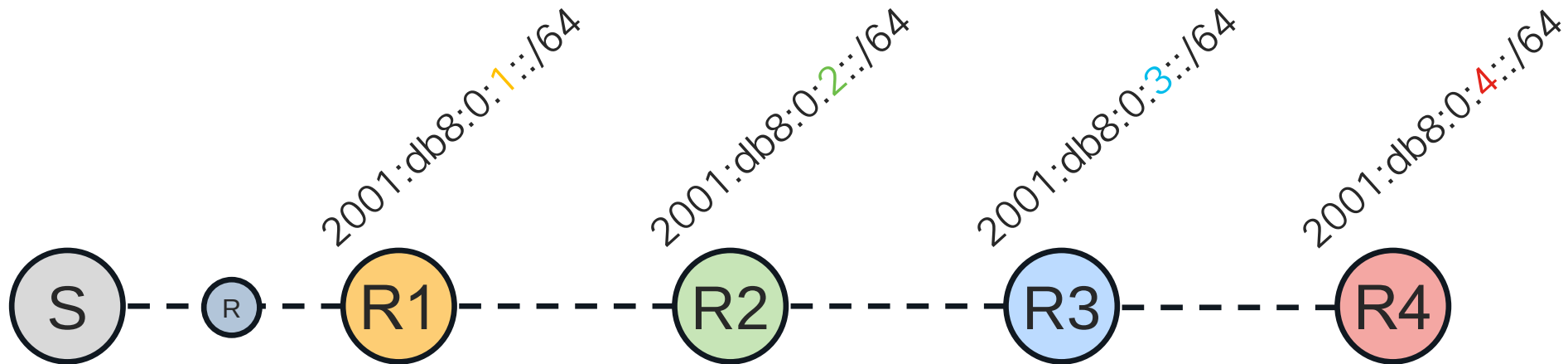


Function

SRv6 Full SID



SRv6 Full SID

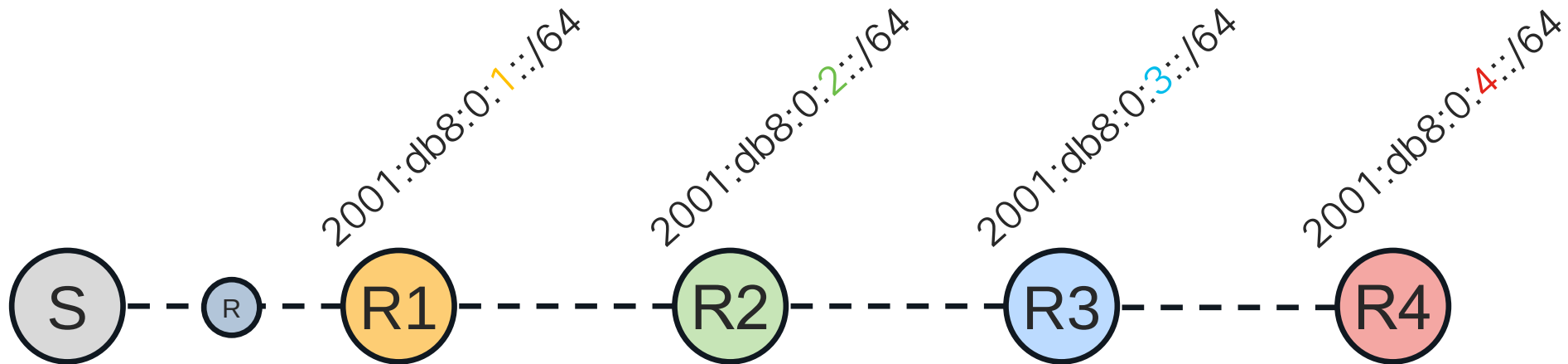


BGP:2001:db8:0:4:eeee::

```
SA:2001::1  
DA:2001:db8:0:1:1::  
NH:RH
```

```
Type:4 (SRH)  
NH:IPv4|SL:3  
Segment List:  
[0]:2001:db8:0:4:eeee::  
[1]:2001:db8:0:3:48::  
[2]:2001:db8:0:2:1::  
[3]:2001:db8:0:1:1::
```

SRv6 Full SID



BGP:2001:db8:0:4:eeee::

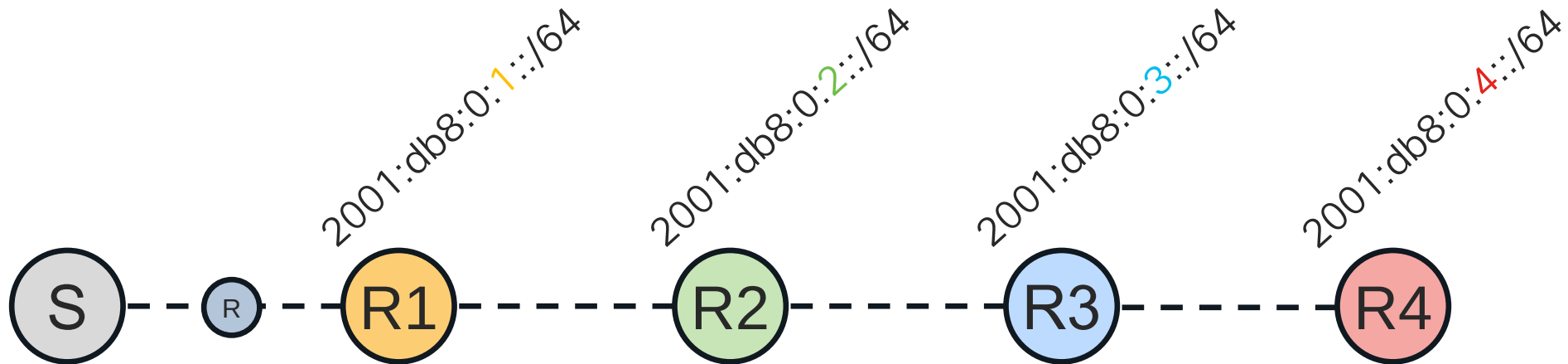
```
SA:2001::1
DA:2001:db8:0:1:1::
NH:RH

Type:4 (SRH)
NH:IPv4|SL:3
Segment List:
[0]:2001:db8:0:4:eeee::
[1]:2001:db8:0:3:48::
[2]:2001:db8:0:2:1::
[3]:2001:db8:0:1:1::
```

```
SA:2001::1
DA:2001:db8:0:2:1::
NH:RH

Type:4 (SRH)
NH:IPv4|SL:2
Segment List:
[0]:2001:db8:0:4:eeee::
[1]:2001:db8:0:3:48::
[2]:2001:db8:0:2:1::
[3]:2001:db8:0:1:1::
```

SRv6 Full SID



BGP:2001:db8:0:4:eeee::



```
SA:2001::1
DA:2001:db8:0:1:1::
NH:RH
```

```
Type:4 (SRH)
NH:IPv4|SL:3
Segment List:
[0]:2001:db8:0:4:eeee::
[1]:2001:db8:0:3:48::
[2]:2001:db8:0:2:1::
[3]:2001:db8:0:1:1::
```

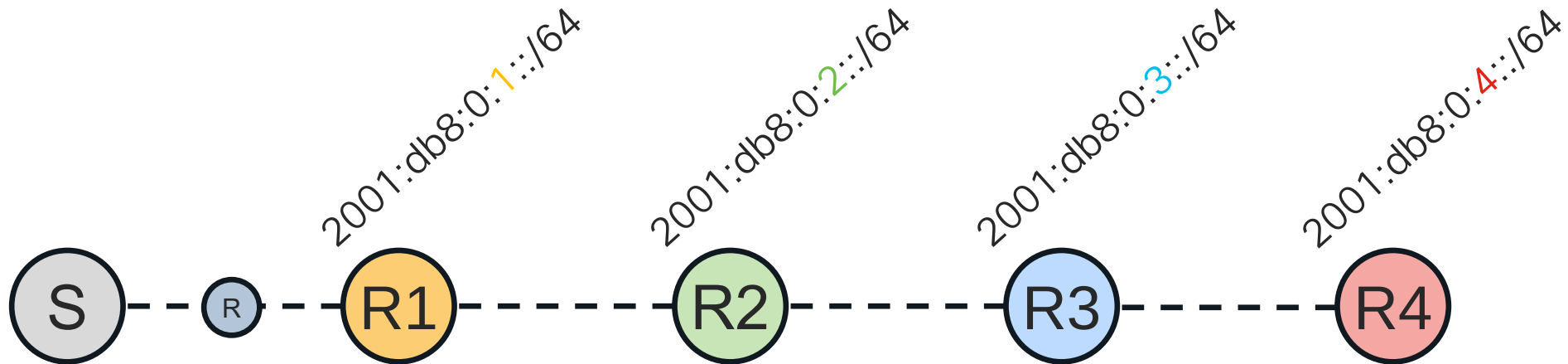
```
SA:2001::1
DA:2001:db8:0:2:1::
NH:RH
```

```
Type:4 (SRH)
NH:IPv4|SL:2
Segment List:
[0]:2001:db8:0:4:eeee::
[1]:2001:db8:0:3:48::
[2]:2001:db8:0:2:1::
[3]:2001:db8:0:1:1::
```

```
SA:2001::1
DA:2001:db8:0:3:48::
NH:RH
```

```
Type:4 (SRH)
NH:IPv4|SL:1
Segment List:
[0]:2001:db8:0:4:eeee::
[1]:2001:db8:0:3:48::
[2]:2001:db8:0:2:1::
[3]:2001:db8:0:1:1::
```

SRv6 Full SID



BGP:2001:db8:0:4:eeee::



```
SA:2001::1
DA:2001:db8:0:1:1::
NH:RH

Type:4 (SRH)
NH:IPv4|SL:3
Segment List:
[0]:2001:db8:0:4:eeee::
[1]:2001:db8:0:3:48::
[2]:2001:db8:0:2:1::
[3]:2001:db8:0:1:1::
```

```
SA:2001::1
DA:2001:db8:0:2:1::
NH:RH

Type:4 (SRH)
NH:IPv4|SL:2
Segment List:
[0]:2001:db8:0:4:eeee::
[1]:2001:db8:0:3:48::
[2]:2001:db8:0:2:1::
[3]:2001:db8:0:1:1::
```

```
SA:2001::1
DA:2001:db8:0:3:48::
NH:RH

Type:4 (SRH)
NH:IPv4|SL:1
Segment List:
[0]:2001:db8:0:4:eeee::
[1]:2001:db8:0:3:48::
[2]:2001:db8:0:2:1::
[3]:2001:db8:0:1:1::
```

```
SA:2001::1
DA:2001:db8:0:4:eeee::
NH:IPv4
```

SID Structure

128 Bits Like IPv6 address but different semantics

1111:2222:3333:4444:5555:6666:7777:8888



Locator



Function

SID Structure

128 Bits Like IPv6 address but different semantics

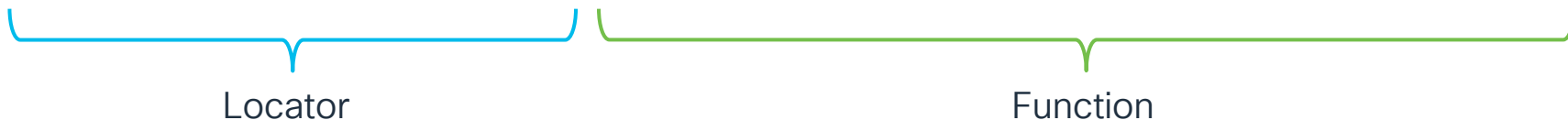
1111:2222:3333:4444:5555:6666:7777:8888



SID Structure

128 Bits Like IPv6 address but different semantics

1111:2222:3333:4444:5555:6666:7777:8888



SID Structure

128 Bits Like IPv6 address but different semantics

1111:2222:3333:4444:5555:6666:7777:8888



SID Structure

128 Bits Like IPv6 address but different semantics

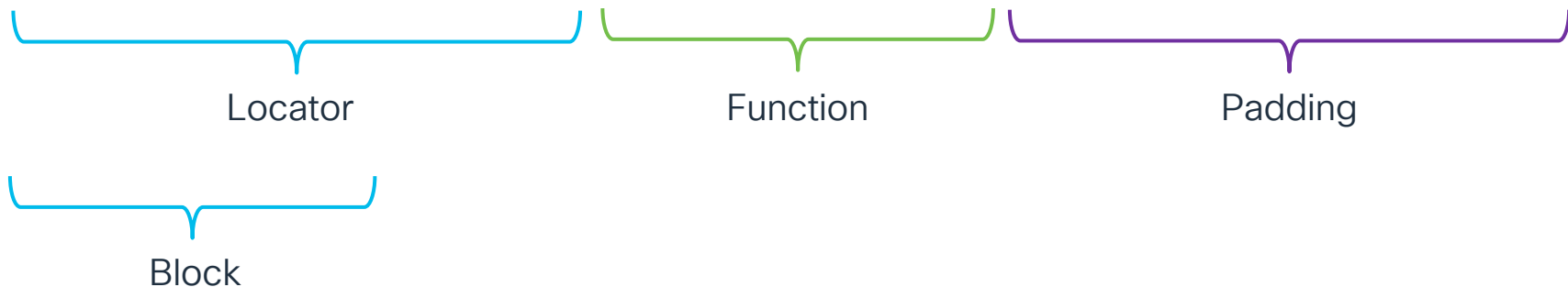
1111:2222:3333:4444:5555:6666:7777:8888



SID Structure

128 Bits Like IPv6 address but different semantics

1111:2222:3333:4444:5555:6666:7777:8888



SID Structure

128 Bits Like IPv6 address but different semantics

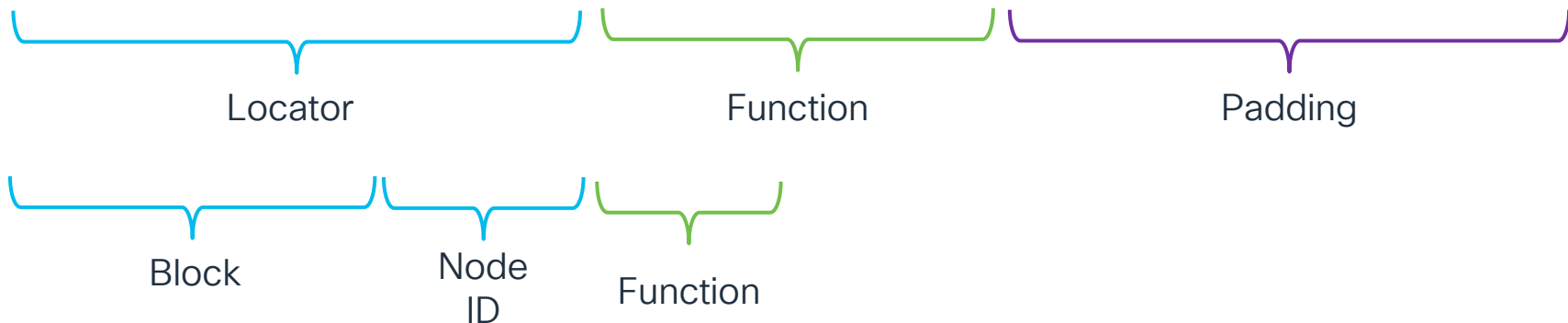
1111:2222:3333:4444:5555:6666:7777:8888



SID Structure

128 Bits Like IPv6 address but different semantics

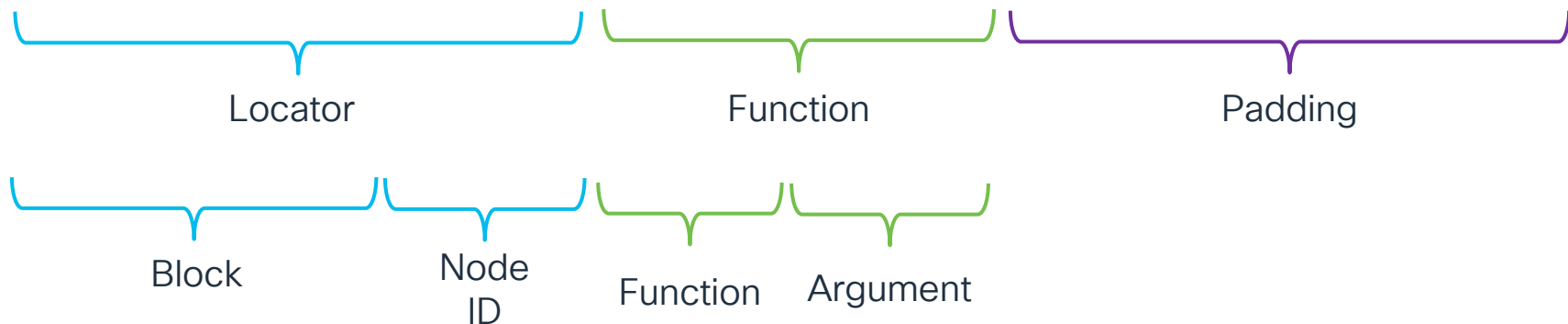
1111:2222:3333:4444:5555:6666:7777:8888



SID Structure

128 Bits Like IPv6 address but different semantics

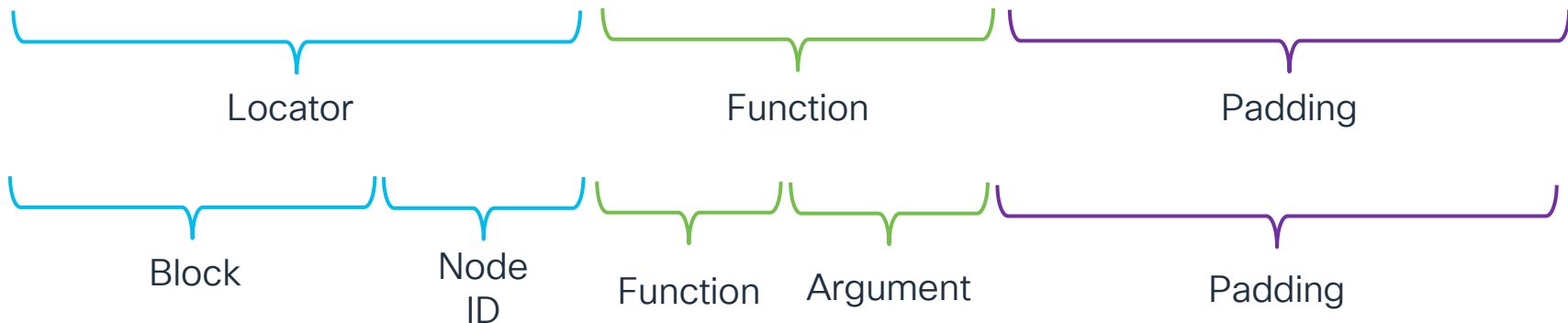
1111:2222:3333:4444:5555:6666:7777:8888



SID Structure

128 Bits Like IPv6 address but different semantics

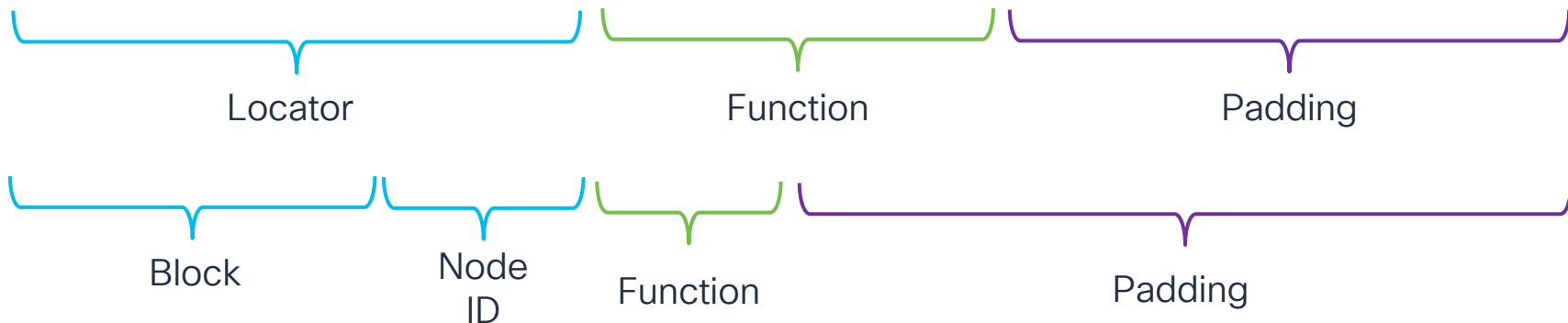
1111:2222:3333:4444:5555:6666:7777:8888



SID Structure

128 Bits Like IPv6 address but different semantics

1111:2222:3333:4444:5555:6666:7777:8888



SRv6 uSID format

SRV6 Encapsulation

```
SA:2001::1  
DA:2001:db8:0:4:1:0:0:0  
NH:RH
```

```
Type:4 (SRH)  
NH:IPv4|SL:1  
Segment List:  
[0]: 2001:db8:0:5:45:0:0:0  
[1]: 2001:db8:0:4:1:0:0:0  
[2]: 2001:db8:0:3:48:0:0:0  
[3]: 2001:db8:0:2:1:0:0:0  
[4]: 2001:db8:0:1:42:0:0:0
```

```
SA:7.5.4.3  
DA:11.6.19.71  
Port:UDP
```

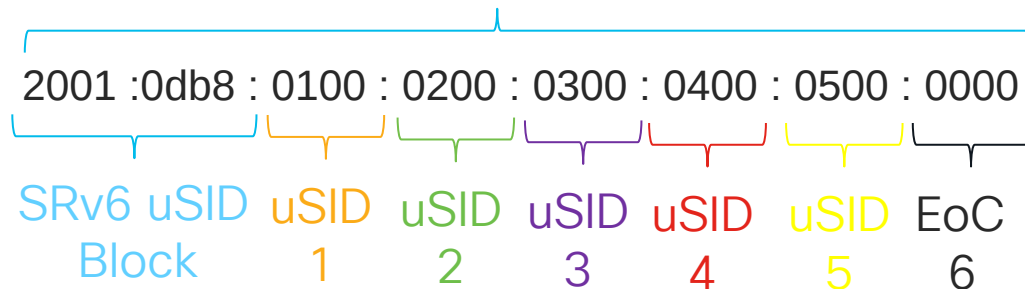
```
UDP Header/Data
```


SRv6 uSID format

: 0100 : =SRV6 uSID

16 bits here, but can be anything

SRV6 uSID Container



32 bits here,
but can be anything

CISCO *Live!*

SRV6 Encapsulation

SA: 2001::1
DA: 2001:db8:0:4:1:0:0:0
NH: RH

Type: 4 (SRH)
NH: IPv4 | SL: 1
Segment List:
[0]: 2001:db8:0:5:45:0:0:0
[1]: 2001:db8:0:4:1:0:0:0
[2]: 2001:db8:0:3:48:0:0:0
[3]: 2001:db8:0:2:1:0:0:0
[4]: 2001:db8:0:1:42:0:0:0

SA: 7.5.4.3
DA: 11.6.19.71
Port: UDP

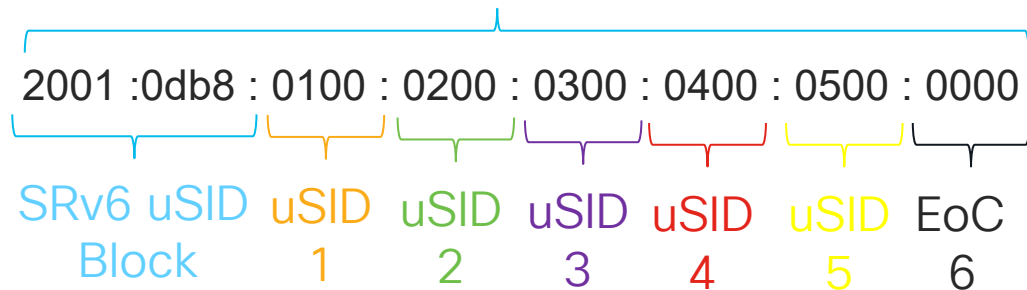
UDP Header/Data

SRv6 uSID format

: 0100 : =SRV6 uSID

16 bits here, but can be anything

SRV6 uSID Container



32 bits here,
but can be anything

CISCO *Live!*

SRV6 Encapsulation

SA: 2001::1
DA: 2001:db8:0:4:1:0:0:0
NH: RH

Type: 4 (SRH)
NH: IPv4 | SL: 1
Segment List:
[0]: 2001:db8:0:5:45:0:0:0
[1]: 2001:db8:0:4:1:0:0:0
[2]: 2001:db8:0:3:48:0:0:0
[3]: 2001:db8:0:2:1:0:0:0
[4]: 2001:db8:0:1:42:0:0:0

SA: 7.5.4.3
DA: 11.6.19.71
Port: UDP

UDP Header/Data

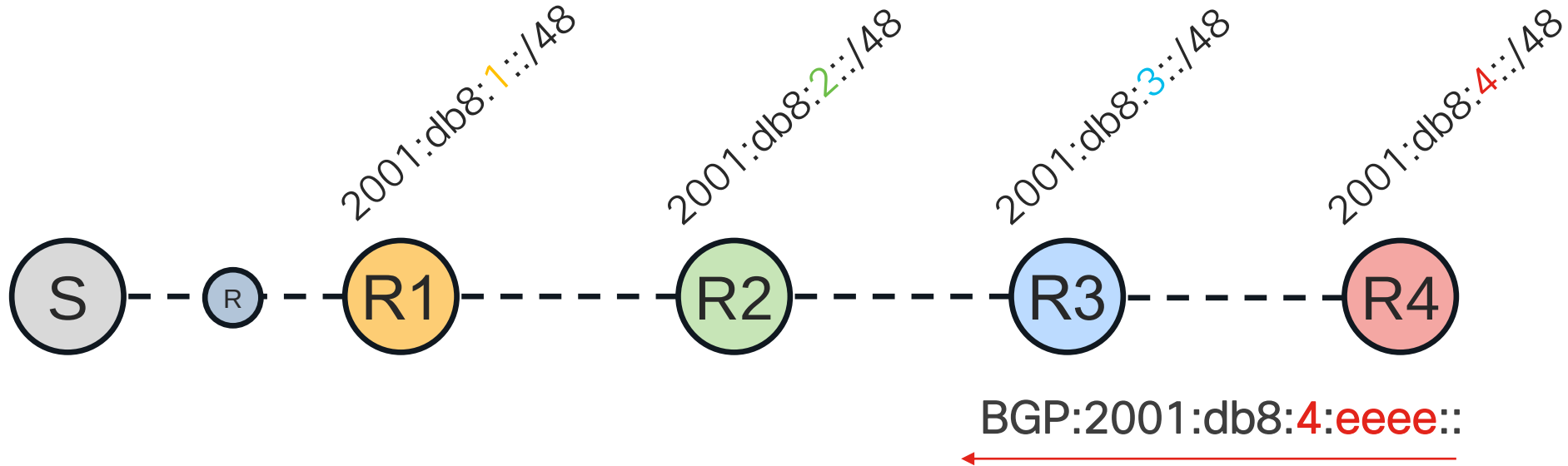
SRV6 uSID Encapsulation

SA: 2001::1
DA: 2001:db8:100:200:300:400:500::
NH: IPv4

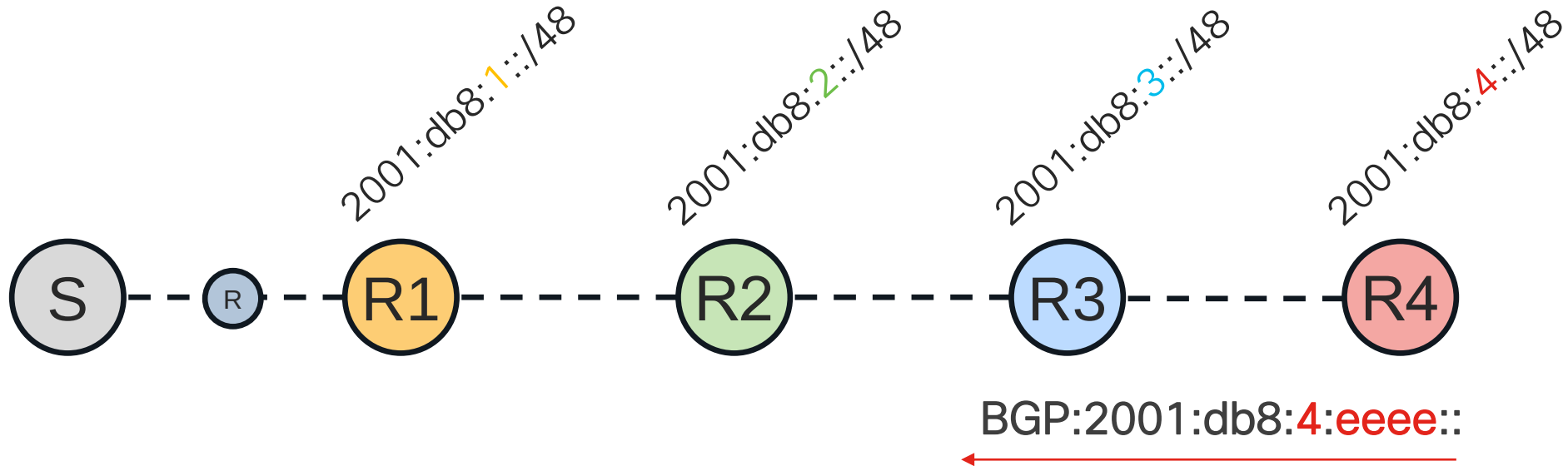
SA: 7.5.4.3
DA: 11.6.19.71
Port: UDP

UDP Header/Data

SRv6 uSID F3216

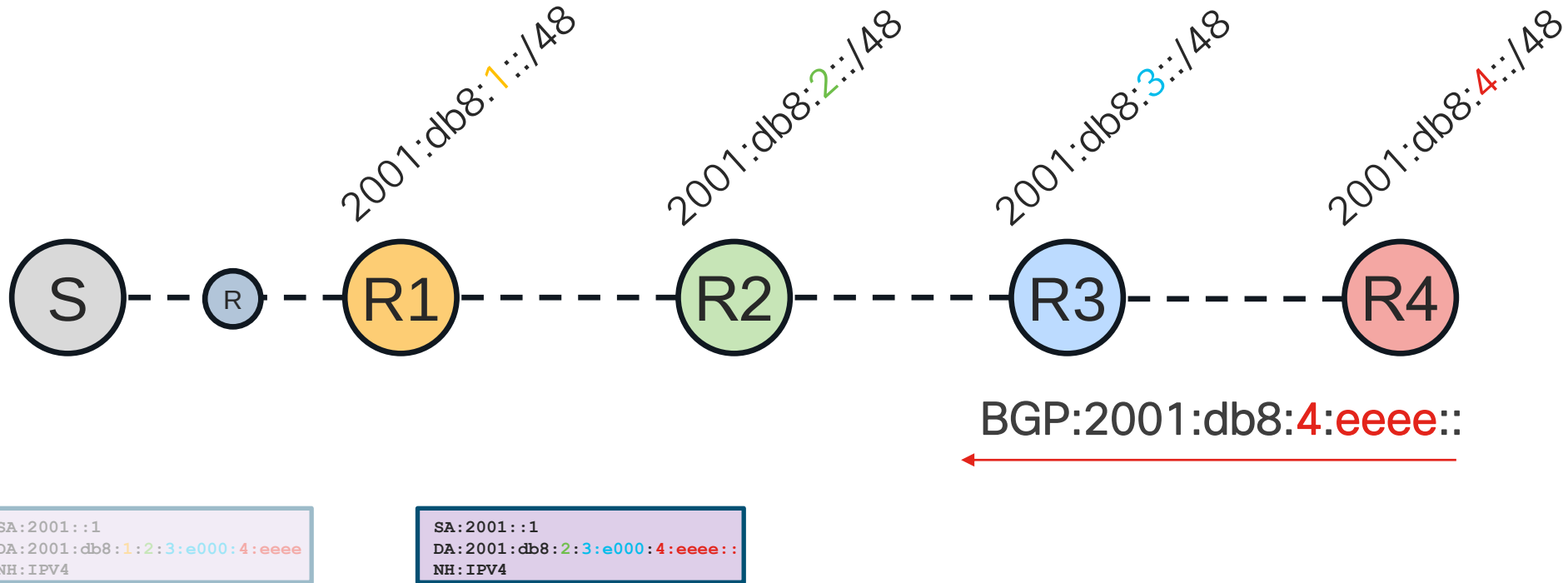


SRv6 uSID F3216

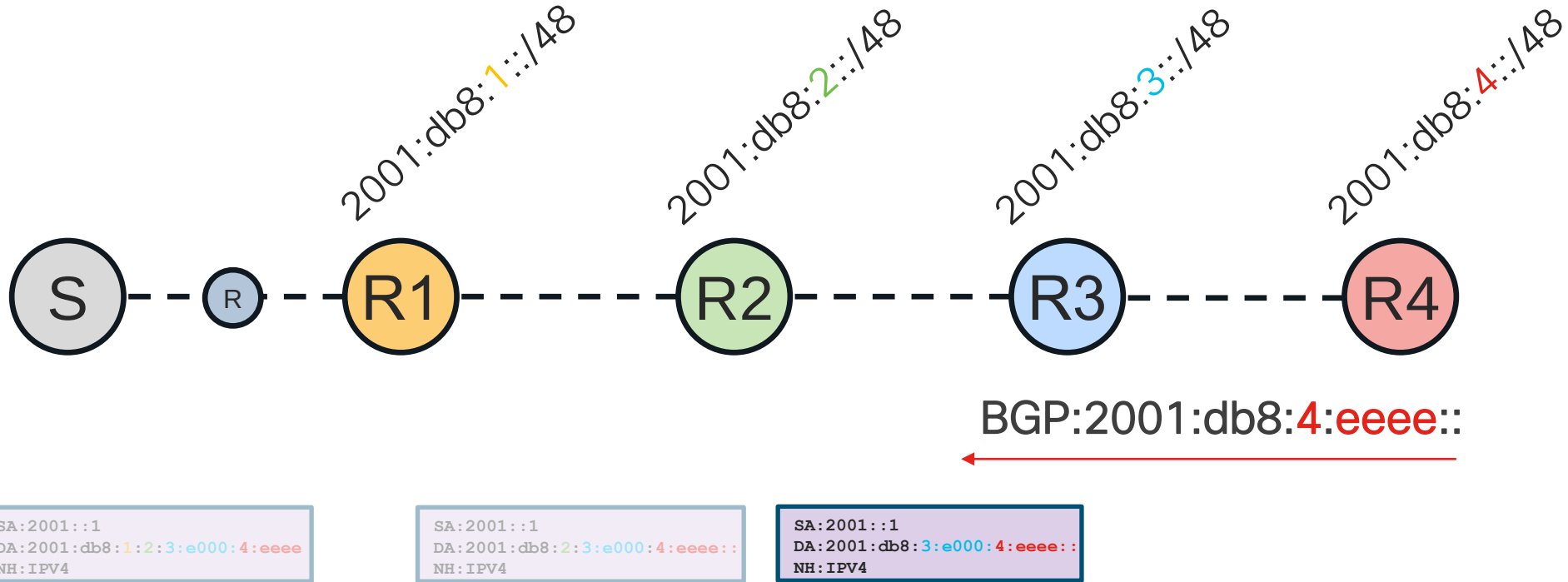


SA:2001::1
DA:2001:db8:1:2:3:e000:4:eeee
NH:IPv4

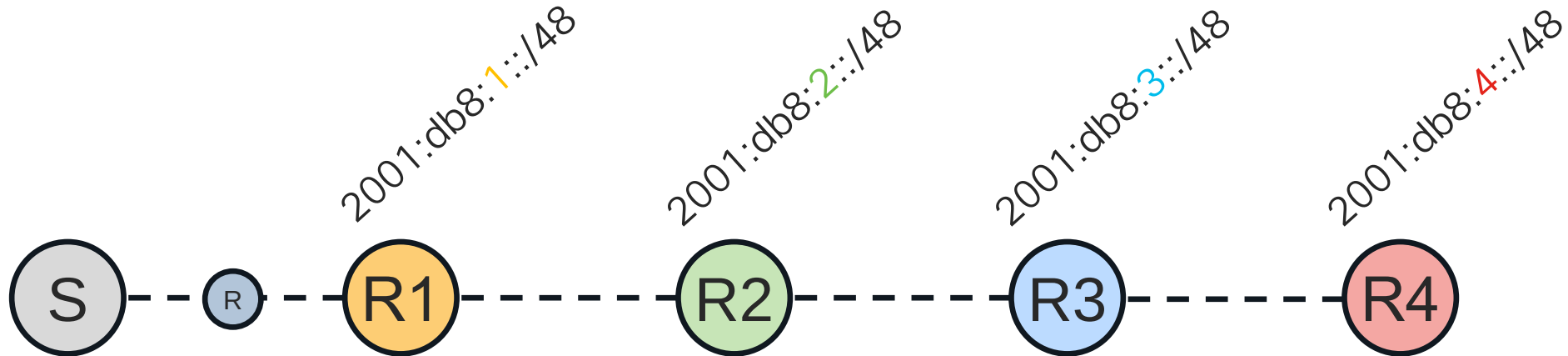
SRv6 uSID F3216



SRv6 uSID F3216



SRv6 uSID F3216



BGP:2001:db8:4:eeee::



```
SA:2001::1  
DA:2001:db8:1:2:3:e000:4:eeee  
NH:IPv4
```

```
SA:2001::1  
DA:2001:db8:2:3:e000:4:eeee::  
NH:IPv4
```

```
SA:2001::1  
DA:2001:db8:3:e000:4:eeee::  
NH:IPv4
```

```
SA:2001::1  
DA:2001:db8:4:eeee::  
NH:IPv4
```

SRv6 uSID More Than 6 SIDs?

100->200->300->400->500->600->700->800->900->a00->b00



SRv6 uSID More Than 6 SIDs?

100->200->300->400->500->600->700->800->900->a00->b00

Container 1 2001 : 0db8 : 0100 : 0200 : 0300 : 0400 : 0500 : 0600

Container 2 2001 : 0db8 : 0700 : 0800 : 0900 : 0a00 : 0b00 : 0000



SRv6 uSID More Than 6 SIDs?

100->200->300->400->500->600->700->800->900->a00->b00

Container 1 2001 : 0db8 : 0100 : 0200 : 0300 : 0400 : 0500 : 0600

Container 2 2001 : 0db8 : 0700 : 0800 : 0900 : 0a00 : 0b00 : 0000

```
SA:2001::1
DA:2001:db8:100:200:300:400:500:600
NH: RH
```

```
Type: 4 (SRH)
NH: IPv4 | SL: 1
Segment List:
[0]: 2001:db8:700:800:900:a00:b00::
```

```
SA:7.5.4.3
DA:11.6.19.71
Port:UDP
```

```
UDP Header/Data
```



SRv6 uSID More Than 6 SIDs?



100->200->300->400->500->600->700->800->900->a00->b00

Container 1 **2001 : 0db8** : 0100 : 0200 : 0300 : 0400 : 0500 : 0600

Container 2 **2001 : 0db8** : 0700 : 0800 : 0900 : 0a00 : 0b00 : 0000

SA:2001::1

DA:**2001:db8:100:200:300:400:500:600**

NH: RH

Type: 4 (SRH)

NH: IPv4 | **SL: 1**

Segment List:

[0] : 2001:db8:700:800:900:a00:b00::

SA:7.5.4.3

DA:11.6.19.71

Port:UDP

UDP Header/Data

SRv6 uSID More Than 6 SIDs?



100->200->300->400->500->600->700->800->900->a00->b00

Container 1 **2001 : 0db8** : 0100 : 0200 : 0300 : 0400 : 0500 : 0600

Container 2 **2001 : 0db8** : 0700 : 0800 : 0900 : 0a00 : 0b00 : 0000

SA:2001::1
DA:**2001:db8:200:300:400:500:600:0**
NH: RH

Type: 4 (SRH)
NH: IPv4 | **SL: 1**
Segment List:
[0] : 2001:db8:700:800:900:a00:b00::

SA: 7.5.4.3
DA: 11.6.19.71
Port: UDP

UDP Header/Data

Shift & Forward

SRv6 uSID More Than 6 SIDs?

100->200->300->400->500->600->700->800->900->a00->b00

Container 1 **2001 : 0db8** : 0100 : 0200 : 0300 : 0400 : 0500 : 0600

Container 2 **2001 : 0db8** : 0700 : 0800 : 0900 : 0a00 : 0b00 : 0000

SA:2001::1

DA:**2001:db8:200:300:400:500:600:0**

NH: RH

Type: 4 (SRH)

NH: IPv4 | **SL: 1**

Segment List:

[0] : 2001:db8:700:800:900:a00:b00::

SA:7.5.4.3

DA:11.6.19.71

Port:UDP

UDP Header/Data

Shift & Forward



SRv6 uSID More Than 6 SIDs?

100->200->300->400->500->600->700->800->900->a00->b00

Container 1 **2001 : 0db8** : 0100 : 0200 : 0300 : 0400 : 0500 : 0600

Container 2 **2001 : 0db8** : 0700 : 0800 : 0900 : 0a00 : 0b00 : 0000

SA:2001::1

DA:2001:db8:300:400:500:600:0::

NH: RH

Type: 4 (SRH)

NH: IPv4 | SL: 1

Segment List:

[0]: 2001:db8:700:800:900:a00:b00::

SA:7.5.4.3

DA:11.6.19.71

Port:UDP

UDP Header/Data

Shift & Forward



SRv6 uSID More Than 6 SIDs?

100->200->300->400->500->600->700->800->900->a00->b00

Container 1 2001 : 0db8 : 0100 : 0200 : 0300 : 0400 : 0500 : 0600

Container 2 2001 : 0db8 : 0700 : 0800 : 0900 : 0a00 : 0b00 : 0000



SA:2001::1

DA:2001:db8:300:400:500:600:0::

NH: RH

Type: 4 (SRH)

NH: IPv4 | SL: 1

Segment List:

[0]: 2001:db8:700:800:900:a00:b00::

SA:7.5.4.3

DA:11.6.19.71

Port:UDP

UDP Header/Data

Shift & Forward

SRv6 uSID More Than 6 SIDs?

100->200->300->400->500->600->700->800->900->a00->b00

Container 1 2001 : 0db8 : 0100 : 0200 : 0300 : 0400 : 0500 : 0600

Container 2 2001 : 0db8 : 0700 : 0800 : 0900 : 0a00 : 0b00 : 0000



SA:2001::1

DA:2001:db8:400:500:600:0::

NH: RH

Type: 4 (SRH)

NH: IPv4 | SL: 1

Segment List:

[0]: 2001:db8:700:800:900:a00:b00::

SA:7.5.4.3

DA:11.6.19.71

Port:UDP

UDP Header/Data

Shift & Forward

SRv6 uSID More Than 6 SIDs?

100->200->300->400->500->600->700->800->900->a00->b00

Container 1 2001 : 0db8 : 0100 : 0200 : 0300 : 0400 : 0500 : 0600

Container 2 2001 : 0db8 : 0700 : 0800 : 0900 : 0a00 : 0b00 : 0000



SA:2001::1

DA:2001:db8:400:500:600:0::

NH: RH

Type: 4 (SRH)

NH: IPv4 | SL: 1

Segment List:

[0]: 2001:db8:700:800:900:a00:b00::

SA: 7.5.4.3

DA: 11.6.19.71

Port: UDP

UDP Header/Data

Shift & Forward

SRv6 uSID More Than 6 SIDs?

100->200->300->400->500->600->700->800->900->a00->b00

Container 1 **2001 : 0db8** : 0100 : 0200 : 0300 : 0400 : 0500 : 0600

Container 2 **2001 : 0db8** : 0700 : 0800 : 0900 : 0a00 : 0b00 : 0000



SA:2001::1

DA:2001:db8:500:600:0::

NH: RH

Type: 4 (SRH)

NH: IPv4 | SL: 1

Segment List:

[0]: 2001:db8:700:800:900:a00:b00::

SA: 7.5.4.3

DA: 11.6.19.71

Port: UDP

UDP Header/Data

Shift & Forward

SRv6 uSID More Than 6 SIDs?

100->200->300->400->500->600->700->800->900->a00->b00

Container 1 2001 : 0db8 : 0100 : 0200 : 0300 : 0400 : 0500 : 0600

Container 2 2001 : 0db8 : 0700 : 0800 : 0900 : 0a00 : 0b00 : 0000

SA:2001::1

DA:2001:db8:500:600:0::

NH: RH

Type: 4 (SRH)

NH: IPv4 | SL: 1

Segment List:

[0]: 2001:db8:700:800:900:a00:b00::

SA: 7.5.4.3

DA: 11.6.19.71

Port: UDP

UDP Header/Data

Shift & Forward



SRv6 uSID More Than 6 SIDs?

100->200->300->400->500->600->700->800->900->a00->b00

Container 1 **2001 : 0db8** : 0100 : 0200 : 0300 : 0400 : 0500 : 0600

Container 2 **2001 : 0db8** : 0700 : 0800 : 0900 : 0a00 : 0b00 : 0000

SA:2001::1
DA:**2001:db8:600:0::**
NH: RH

Type: 4 (SRH)
NH: IPv4 | **SL: 1**
Segment List:
[0]: 2001:db8:700:800:900:a00:b00::

SA: 7.5.4.3
DA: 11.6.19.71
Port: UDP

UDP Header/Data

Shift & Forward



SRv6 uSID More Than 6 SIDs?

100->200->300->400->500->600->700->800->900->a00->b00

Container 1 **2001 : 0db8** : 0100 : 0200 : 0300 : 0400 : 0500 : 0600

Container 2 **2001 : 0db8** : 0700 : 0800 : 0900 : 0a00 : 0b00 : 0000

SA:2001::1
DA:2001:db8:600:0::
NH: RH

Type: 4 (SRH)
NH: IPv4 | SL: 1
Segment List:
[0]: 2001:db8:700:800:900:a00:b00::

SA: 7.5.4.3
DA: 11.6.19.71
Port: UDP

UDP Header/Data



SRv6 uSID More Than 6 SIDs?

100->200->300->400->500->600->700->800->900->a00->b00

Container 1 **2001 : 0db8** : 0100 : 0200 : 0300 : 0400 : 0500 : 0600

Container 2 **2001 : 0db8** : 0700 : 0800 : 0900 : 0a00 : 0b00 : 0000

SA:2001::1
DA:2001:db8:600:0::
NH: RH

Type: 4 (SRH)
NH: IPv4 | SL: 1
Segment List:
[0]: 2001:db8:700:800:900:a00:b00::

SA: 7.5.4.3
DA: 11.6.19.71
Port: UDP

UDP Header/Data



END of Container
-> is there SRH?
Decrement SL
Copy New SID (Container)
PSP



SRv6 uSID More Than 6 SIDs?

100->200->300->400->500->600->700->800->900->a00->b00

Container 1 **2001 : 0db8** : 0100 : 0200 : 0300 : 0400 : 0500 : 0600

Container 2 **2001 : 0db8** : 0700 : 0800 : 0900 : 0a00 : 0b00 : 0000

SA:2001::1
DA:2001:db8:600:0::
NH: RH

Type: 4 (SRH)
NH: IPv4 | SL: 0
Segment List:
[0]: 2001:db8:700:800:900:a00:b00::

SA: 7.5.4.3
DA: 11.6.19.71
Port: UDP

UDP Header/Data



END of Container
-> is there SRH?
Decrement SL
Copy New SID (Container)
PSP



SRv6 uSID More Than 6 SIDs?

100->200->300->400->500->600->700->800->900->a00->b00

Container 1 **2001 : 0db8** : 0100 : 0200 : 0300 : 0400 : 0500 : 0600

Container 2 **2001 : 0db8** : 0700 : 0800 : 0900 : 0a00 : 0b00 : 0000

SA:2001::1
DA:**2001:db8:700:800:900:a00:b00::**
NH: RH

Type: 4 (SRH)
NH: IPv4 | **SL: 0**
Segment List:
[0]: 2001:db8:700:800:900:a00:b00::

SA: 7.5.4.3
DA: 11.6.19.71
Port: UDP

UDP Header/Data

END of Container
-> is there SRH?
Decrement SL
Copy New SID (Container)
PSP



SRv6 uSID More Than 6 SIDs?

100->200->300->400->500->600->700->800->900->a00->b00

Container 1 **2001 : 0db8** : 0100 : 0200 : 0300 : 0400 : 0500 : 0600

Container 2 **2001 : 0db8** : 0700 : 0800 : 0900 : 0a00 : 0b00 : 0000

SA:2001::1

DA:2001:db8:700:800:900:a00:b00::

NH:IPv4

SA:7.5.4.3

DA:11.6.19.71

Port:UDP

UDP Header/Data

END of Container

-> is there SRH?

Decrement SL

Copy New SID (Container)

PSP



SRv6 uSID More Than 6 SIDs?

100->200->300->400->500->600->700->800->900->a00->b00

Container 1 **2001 : 0db8** : 0100 : 0200 : 0300 : 0400 : 0500 : 0600

Container 2 **2001 : 0db8** : 0700 : 0800 : 0900 : 0a00 : 0b00 : 0000

SA:2001::1

DA:2001:db8:700:800:900:a00:b00::

NH:IPv4

SA:7.5.4.3

DA:11.6.19.71

Port:UDP

UDP Header/Data



SRv6 uSID More Than 6 SIDs?

100->200->300->400->500->600->700->800->900->a00->b00

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SA:2001::1

DA:2001:db8:700:800:900:a00:b00::

NH:IPv4

SA:7.5.4.3

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Port:UDP

UDP Header/Data

Shift & Forward



SRv6 uSID More Than 6 SIDs?

100->200->300->400->500->600->700->800->900->a00->b00

Container 1 **2001 : 0db8** : 0100 : 0200 : 0300 : 0400 : 0500 : 0600

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SA:2001::1

DA:2001:db8:800:900:a00:b00::

NH:IPv4

SA:7.5.4.3

DA:11.6.19.71

Port:UDP

UDP Header/Data

Shift & Forward



SRv6 uSID More Than 6 SIDs?

100->200->300->400->500->600->700->800->900->a00->b00

Container 1 **2001 : 0db8** : 0100 : 0200 : 0300 : 0400 : 0500 : 0600

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SA:2001::1

DA:2001:db8:800:900:a00:b00::

NH:IPv4

SA:7.5.4.3

DA:11.6.19.71

Port:UDP

UDP Header/Data

Shift & Forward



SRv6 uSID More Than 6 SIDs?

100->200->300->400->500->600->700->800->900->a00->b00

Container 1 **2001 : 0db8** : 0100 : 0200 : 0300 : 0400 : 0500 : 0600

Container 2 **2001 : 0db8** : 0700 : 0800 : 0900 : 0a00 : 0b00 : 0000

SA:2001::1

DA:2001:db8:900:a00:b00::

NH:IPv4

SA:7.5.4.3

DA:11.6.19.71

Port:UDP

UDP Header/Data

Shift & Forward



SRv6 uSID More Than 6 SIDs?

100->200->300->400->500->600->700->800->900->a00->b00

Container 1 **2001 : 0db8** : 0100 : 0200 : 0300 : 0400 : 0500 : 0600

Container 2 **2001 : 0db8** : 0700 : 0800 : 0900 : 0a00 : 0b00 : 0000

SA:2001::1

DA:2001:db8:900:a00:b00::

NH:IPv4

SA:7.5.4.3

DA:11.6.19.71

Port:UDP

UDP Header/Data

Shift & Forward



SRv6 uSID More Than 6 SIDs?

100->200->300->400->500->600->700->800->900->a00->b00

Container 1 **2001 : 0db8** : 0100 : 0200 : 0300 : 0400 : 0500 : 0600

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SA:2001::1

DA:2001:db8:a00:b00::

NH:IPv4

SA:7.5.4.3

DA:11.6.19.71

Port:UDP

UDP Header/Data

Shift & Forward



SRv6 uSID More Than 6 SIDs?

100->200->300->400->500->600->700->800->900->a00->b00

Container 1 **2001 : 0db8** : 0100 : 0200 : 0300 : 0400 : 0500 : 0600

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SA:2001::1

DA:2001:db8:a00:b00::

NH:IPv4

SA:7.5.4.3

DA:11.6.19.71

Port:UDP

UDP Header/Data

Shift & Forward



SRv6 uSID More Than 6 SIDs?

100->200->300->400->500->600->700->800->900->a00->b00

Container 1 **2001 : 0db8** : 0100 : 0200 : 0300 : 0400 : 0500 : 0600

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SA:2001::1

DA:2001:db8:b00::

NH:IPv4

SA:7.5.4.3

DA:11.6.19.71

Port:UDP

UDP Header/Data

Shift & Forward



SRv6 uSID More Than 6 SIDs?

100->200->300->400->500->600->700->800->900->a00->b00

Container 1 **2001 : 0db8** : 0100 : 0200 : 0300 : 0400 : 0500 : 0600

Container 2 **2001 : 0db8** : 0700 : 0800 : 0900 : 0a00 : 0b00 : 0000

SA:2001::1

DA:2001:db8:b00::

NH:IPv4

SA:7.5.4.3

DA:11.6.19.71

Port:UDP

UDP Header/Data

Shift & Forward



SRv6 uSID More Than 6 SIDs?

100->200->300->400->500->600->700->800->900->a00->b00

Container 1 **2001 : 0db8** : 0100 : 0200 : 0300 : 0400 : 0500 : 0600

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SA:2001::1

DA:2001:db8:b00::

NH:IPv4

SA:7.5.4.3

DA:11.6.19.71

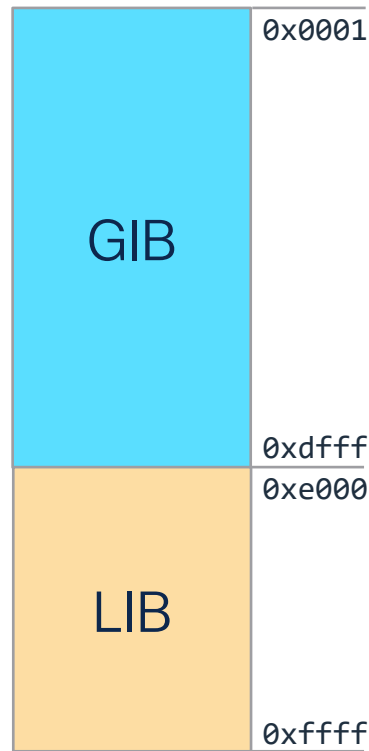
Port:UDP

UDP Header/Data



Sets, Global ID Block (GIB), Local ID Block (LIB)

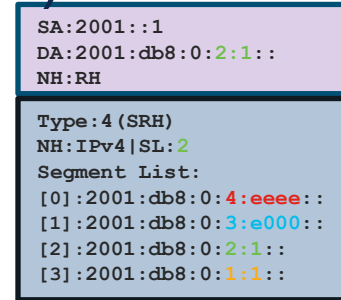
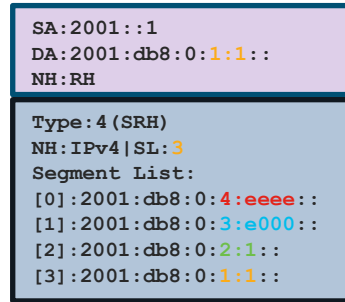
- Within a Block, SIDs are allocated: `FCBB:BB00:XXXX::/48`
- SID can be:
 - Global: shortest path to a node – globally unique
 - Local: a local function – not globally unique



SRv6 Network Programming

END- Default endpoint (Node SID)

- *Decrement SL*
- *Copy Active SID*
- *Forward*



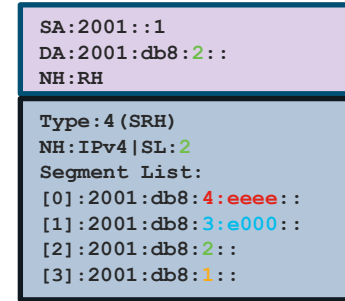
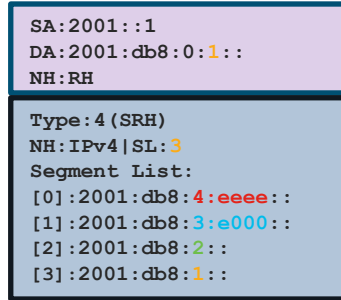
• Different Flavors:

- End
- End with PSP
- End with USP
- End with PSP & USP
- End with USD
- End with PSP & USD
- End with USP & USD
- End with PSP, USP & USD

- End with **NEXT**-ONLY-CSID
- End with **NEXT**-CSID
- End with **NEXT**-CSID & PSP
- End with **NEXT**-CSID & USP
- End with **NEXT**-CSID, PSP & USP
- End with **NEXT**-CSID & USD
- End with **NEXT**-CSID, PSP & USD
- End with **NEXT**-CSID, USP & USD
- End with **NEXT**-CSID, PSP, USP & USD

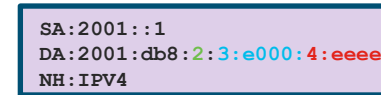
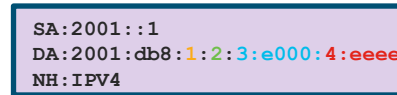
uN=END with Next – Default endpoint (Node SID)

- *Decrement SL*
- *Copy Active SID*
- *Forward*

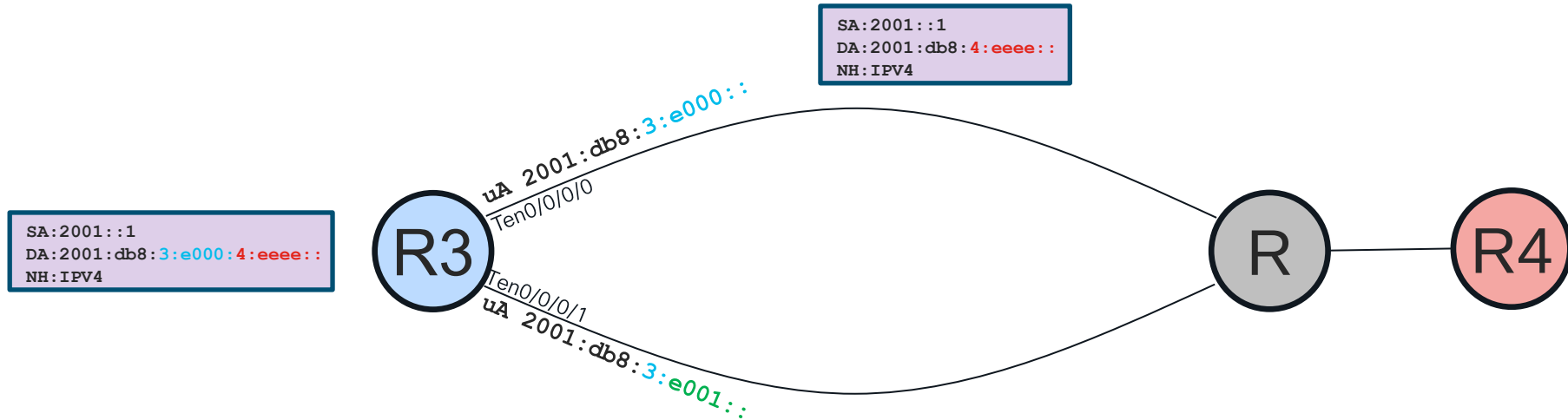


Better way:

- *Shift & Forward*



uA=END.X with Next – (Adjacency SID)



- *Shift & Forward to SPECIFIC INTERFACE*

uDX4=END.DX4, uDX6=END.DX6, uDX2=END.DX2 Endpoint with Decapsulation and Xconnect

- *Decapsulate and Forward to SPECIFIC INTERFACE*
- *Same as Per CE Label Allocation*
- *Must be last function in SID list*



uDT4=END.DT4, uDT6=END.DT6

Endpoint with Decapsulation and Table Lookup

- *Decapsulate and Table Lookup (VRF)*
- *Same as Per VRF Label Allocation (aggregate label)*
- *Must be last function in SID list*



SRv6 functions: Steering and Services

Codename		Behavior	
End	uN	Endpoint	[Node SID]
End.X	uA	Endpoint with Layer-3 cross-connect	[Adj SID]
End.B6.Insert	uB6.Insert	Endpoint bound to an SRv6 policy	[BSID]
End.B6.Encap	uB6.Encaps	Endpoint bound to an SRv6 encapsulation policy	[BSID]
End.DX6	uDX6	Endpoint with decapsulation and IPv6 cross-connect	[L3VPN Per-CE]
End.DX4	uDX4	Endpoint with decapsulation and IPv4 cross-connect	[L3VPN Per-CE]
End.DT6	uDT6	Endpoint with decapsulation and specific IPv6 table lookup	[L3VPN Per-VRF]
End.DT4	uDT4	Endpoint with decapsulation and specific IPv4 table lookup	[L3VPN Per-VRF]
End.DX2	uDX2	Endpoint with decapsulation and L2 cross-connect	[E-LINE]
End.DT2U/M	uDT2U/M	Endpoint with decapsulation and L2 unicast lookup / flooding	[E-LAN]
End.DTM	uDTM	Endpoint with decapsulation and MPLS table lookup	[Interworking]
H.Insert / H.Encaps		Headend with Insertion / Encapsulation of / into an SRv6 policy	[TiLFA]
H. Encaps.L2		H.Encaps Applied to Received L2 Frames	[L2 Port Mode]
H.Encaps.M		H.Encaps Applied to MPLS Label Stack	[Interworking]

SRv6 Control Plane

Functions might be signaled differently

Signalling	IGP	BGP-LS	BGP-IP/VPN
End, uN	Yes	Yes	
End.X, uA	Yes	Yes	
End.T	Yes	Yes	
End.DX4,uDX4		Yes	Yes
End.DX6,uDX6	Yes	Yes	Yes
End.DX2,uDX2		Yes	Yes
END.DT4,uDT4		Yes	Yes
End.DT6,uDT6	Yes	Yes	Yes
End.B		Yes	

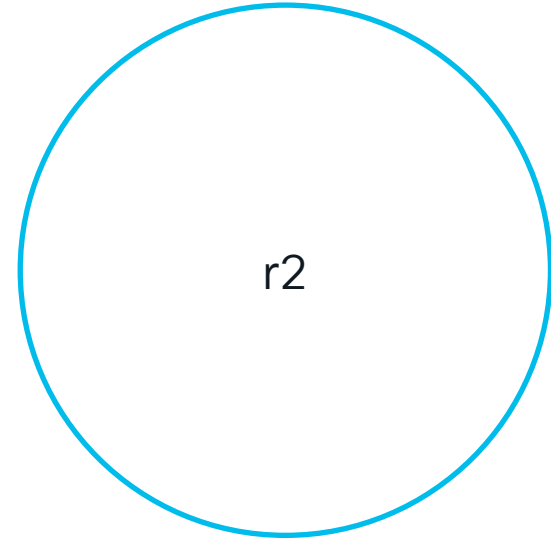
Signalling	IGP	BGP-LS	BGP-IP/VPN
H.insert		Yes	
H.Encap		Yes	

Locator – routing table

ISIS for SRv6

ISIS for SRv6

LSP (Link State Packet):



ISIS for SRv6

LSP (Link State Packet):

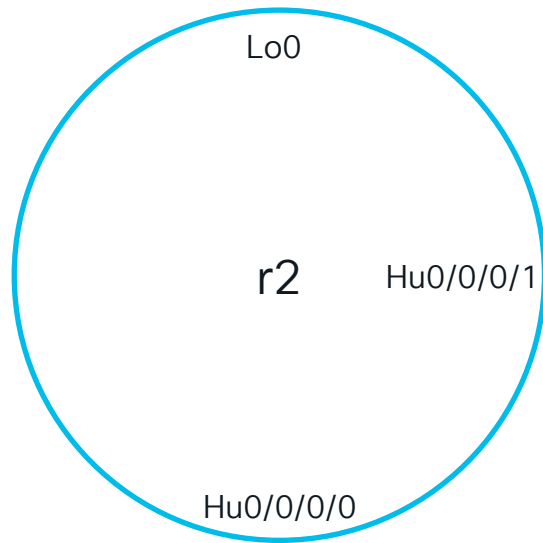
TLVs:

Hostname: r2

Interfaces: Hu0/0/0/0

Hu0/0/0/1

Lo0



ISIS for SRv6

LSP (Link State Packet):

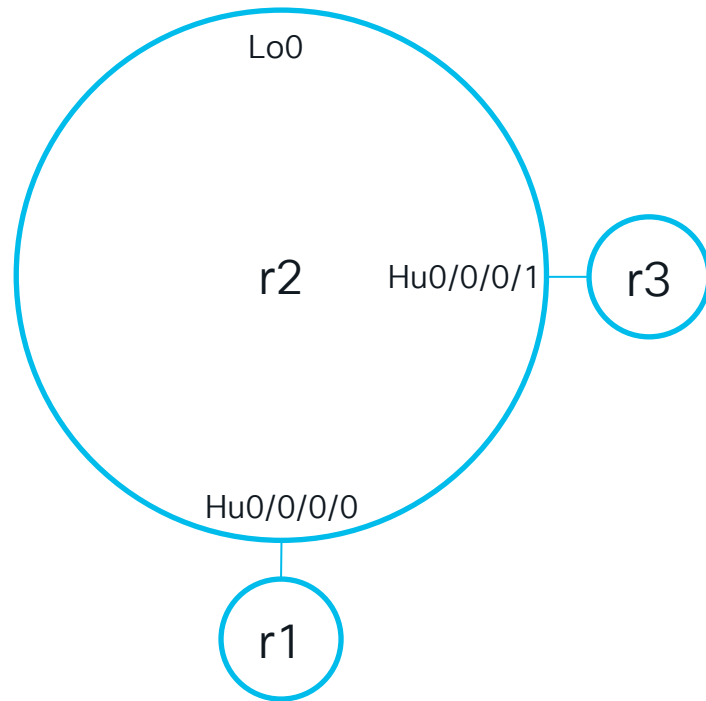
TLVs:

Hostname: r2

Interfaces: Hu0/0/0/0

Hu0/0/0/1

Neighbors: Lo0
r1
r3



ISIS for SRv6

LSP (Link State Packet):

TLVs:

Hostname: r2

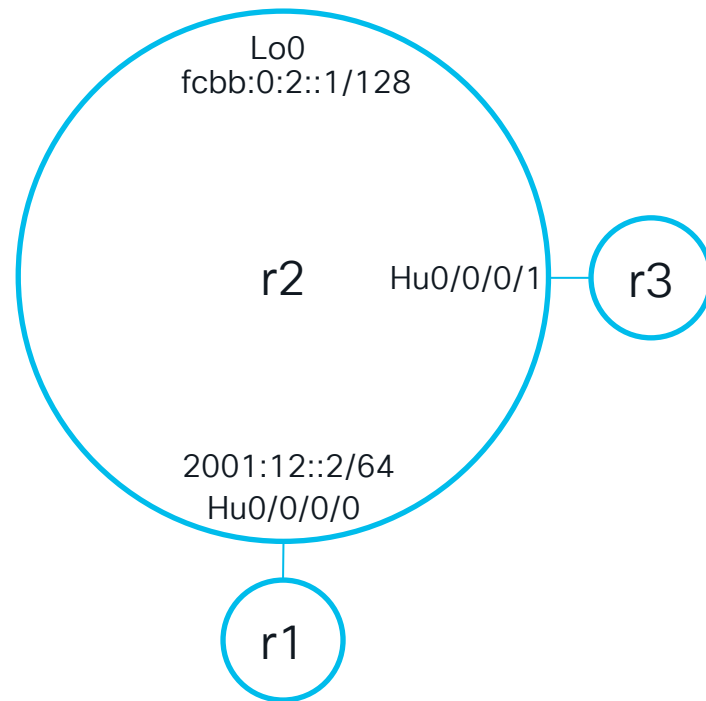
Interfaces: Hu0/0/0/0

Hu0/0/0/1

Neighbors: Lo0
r1

r3

IP addresses: fcbb:0:2::1/128
2001:12::2/64



ISIS for SRv6

LSP (Link State Packet):

TLVs:

Hostname: r2

Interfaces: Hu0/0/0/0

Hu0/0/0/1

Lo0

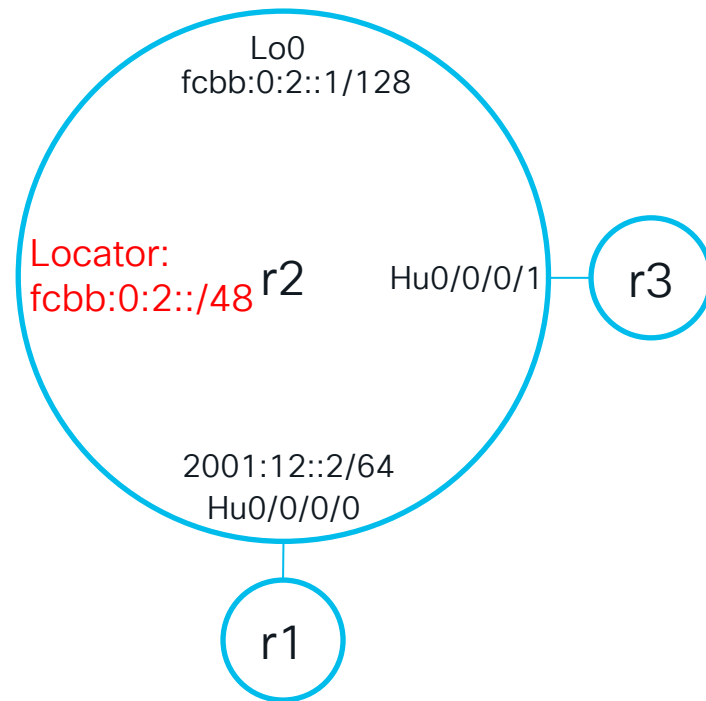
Neighbors: r1

r3

IP addresses: fcbb:0:2::1/128

2001:12::2/64

Locator: fcbb:0:2::/48



ISIS for SRv6

LSP (Link State Packet):

TLVs:

Hostname: r2

Interfaces: Hu0/0/0/0

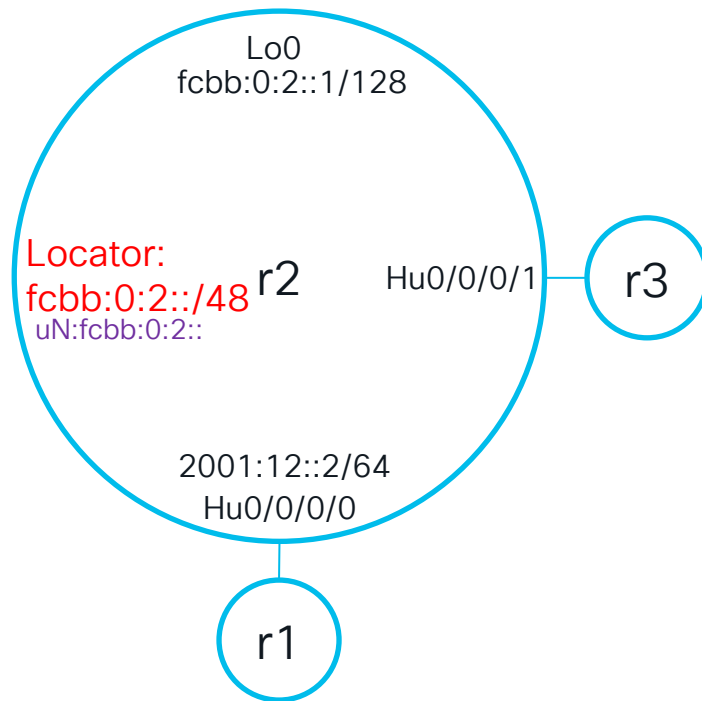
Hu0/0/0/1

Neighbors: Lo0
r1

r3

IP addresses: fcbb:0:2::1/128
2001:12::2/64

Locator: fcbb:0:2::/48
uN:fcbb:0:2::



ISIS for SRv6

LSP (Link State Packet):

TLVs:

Hostname: r2

Interfaces: Hu0/0/0/0

Hu0/0/0/1

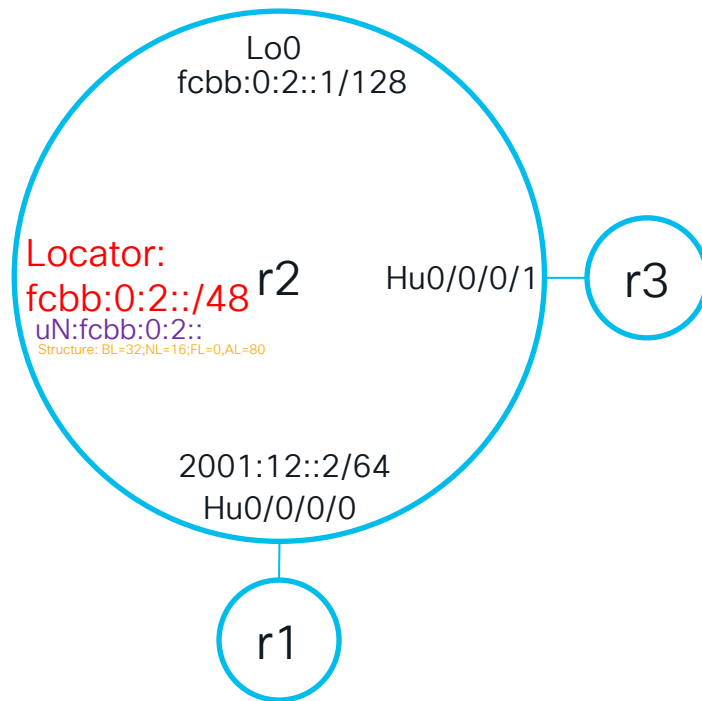
Neighbors: r1

r3

IP addresses: fcbb:0:2::1/128
2001:12::2/64

Locator: fcbb:0:2::/48
uN:fcbb:0:2::

Structure: BL=32;NL=16;FL=0,AL=80



ISIS for SRv6

LSP (Link State Packet):

TLVs:

Hostname: r2

Interfaces: Hu0/0/0/0 uA:fcbb:0:2:e001::

Hu0/0/0/1 uA:fcbb:0:2:e002::

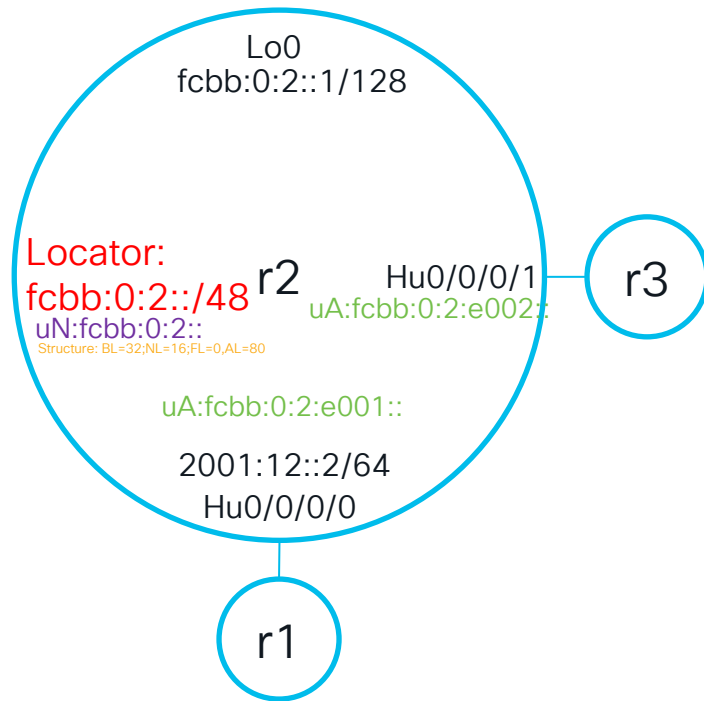
Neighbors: Lo0
r1

r3

IP addresses: fcbb:0:2::1/128
2001:12::2/64

Locator: fcbb:0:2::/48
uN:fcbb:0:2::

Structure: BL=32;NL=16;FL=0,AL=80



ISIS for SRv6

LSP (Link State Packet):

TLVs:

Hostname: r2

Interfaces: Hu0/0/0/0 **uA:fcbb:0:2:e001::**
Structure: BL=32;NL=16;FL=16;AL=0

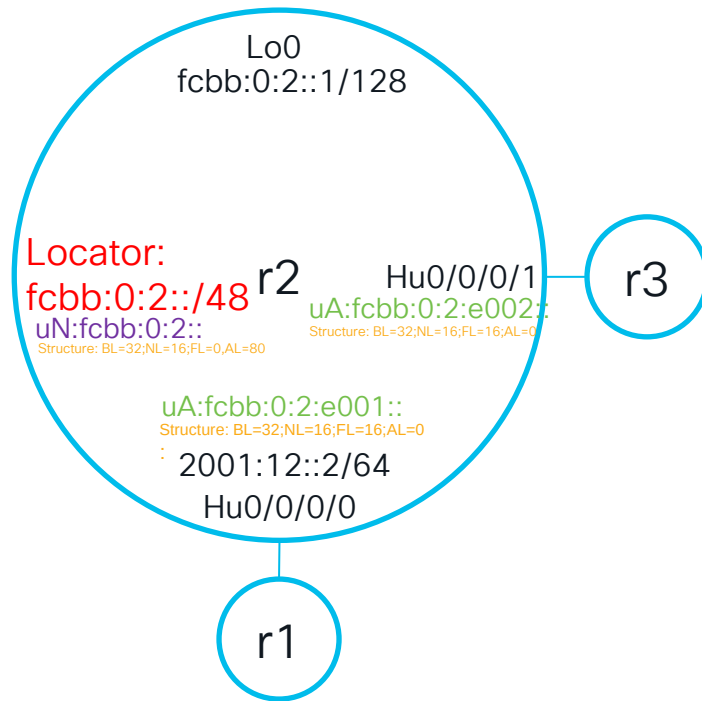
Hu0/0/0/1 **uA:fcbb:0:2:e002::**
Structure: BL=32;NL=16;FL=16;AL=0

Neighbors: Lo0
r1

r3

IP addresses: fcbb:0:2::1/128
2001:12::2/64

Locator: **fcbb:0:2::/48**
uN:fcbb:0:2::
Structure: BL=32;NL=16;FL=0;AL=80



ISIS for SRv6

LSP (Link State Packet):

TLVs:

Hostname: r2

Interfaces: Hu0/0/0/0 **uA:fcbb:0:2:e001::**
Structure: BL=32;NL=16;FL=16;AL=0

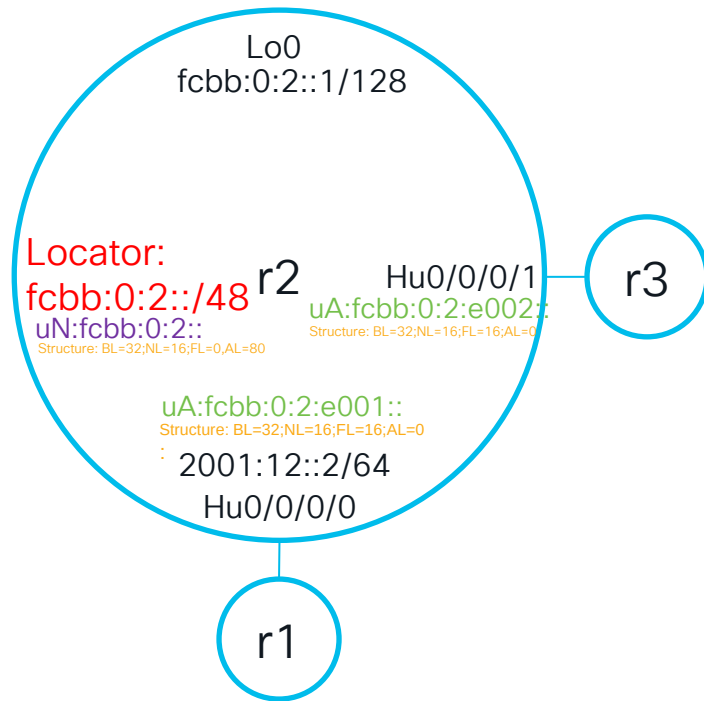
Hu0/0/0/1 **uA:fcbb:0:2:e002::**
Structure: BL=32;NL=16;FL=16;AL=0

Neighbors:
Lo0
r1
r3

IP addresses: fcbb:0:2::1/128
2001:12::2/64

Locator: **fcbb:0:2::/48**
uN:fcbb:0:2::
Structure: BL=32;NL=16;FL=0;AL=80

Capabilities: Algorithms
SIDs can insert
SIDs can decap
.....



ISIS LSP Example

```
IS-IS 1 (Level-2) Link State Database
LSPID          LSP Seq Num  LSP Checksum  LSP Holdtime/Rcvd  ATT/P/OL
r2.00-00       0x00000009  0x4f06       1145 /1200       0/0/0
Area Address:   49
NLPID:         0x8e
Hostname:       r1
IPv6 Address:   2001::2
Metric: 10      MT (IPv6 Unicast) IPv6 fcbb:bb00:2::1/128
Prefix Attribute Flags: X:0 R:0 N:1 E:0 A:0
Metric: 1      MT (IPv6 Unicast) IPv6 fcbb:bb00:2::/48
Prefix Attribute Flags: X:0 R:0 N:0 E:0 A:0
MT:             IPv6 Unicast                                0/0/0
SRv6 Locator: MT (IPv6 Unicast) fcbb:bb00:2::/48 D:0 Metric: 0 Algorithm: 0
Prefix Attribute Flags: X:0 R:0 N:0 E:0 A:0
END SID: fcbb:bb00:2:: uN (PSP/USD)
  SID Structure:
    Block Length: 32, Node-ID Length: 16, Func-Length: 0, Args-Length: 0
Router Cap:     0.0.0.0 D:0 S:0
IPv6 Router ID: 2001::2
SR Algorithm:
  Algorithm: 0
  Algorithm: 1
SRv6: 0:0
Node Maximum SID Depth:
  SRH Max SL:      3
  SRH Max End Pop:  3
  SRH Max T.insert: 3
  SRH Max T.encaps: 4
  SRH Max End D:   4
Metric: 10      MT (IPv6 Unicast) IS-Extended r1.00
Local Interface ID: 6, Remote Interface ID: 6
Interface IPv6 Address: 2001:12::2
Neighbor IPv6 Address: 2001:12::1
END.X SID: fcbb:bb00:2:e001:: B:0 S:0 P:0 uA (PSP/USD) Alg:0
  SID Structure:
    Block Length: 32, Node-ID Length: 16, Func-Length: 16, Args-Length: 0
Total Level-2 LSP count: 1      Local Level-2 LSP count: 0
```

Locator
Capabilities
END
END.X
SID Structure

SRv6 ISIS Configuration

```
router isis 1
 address-family ipv6 unicast
  segment-routing srv6
   locator MAIN
```

Name of the Locator

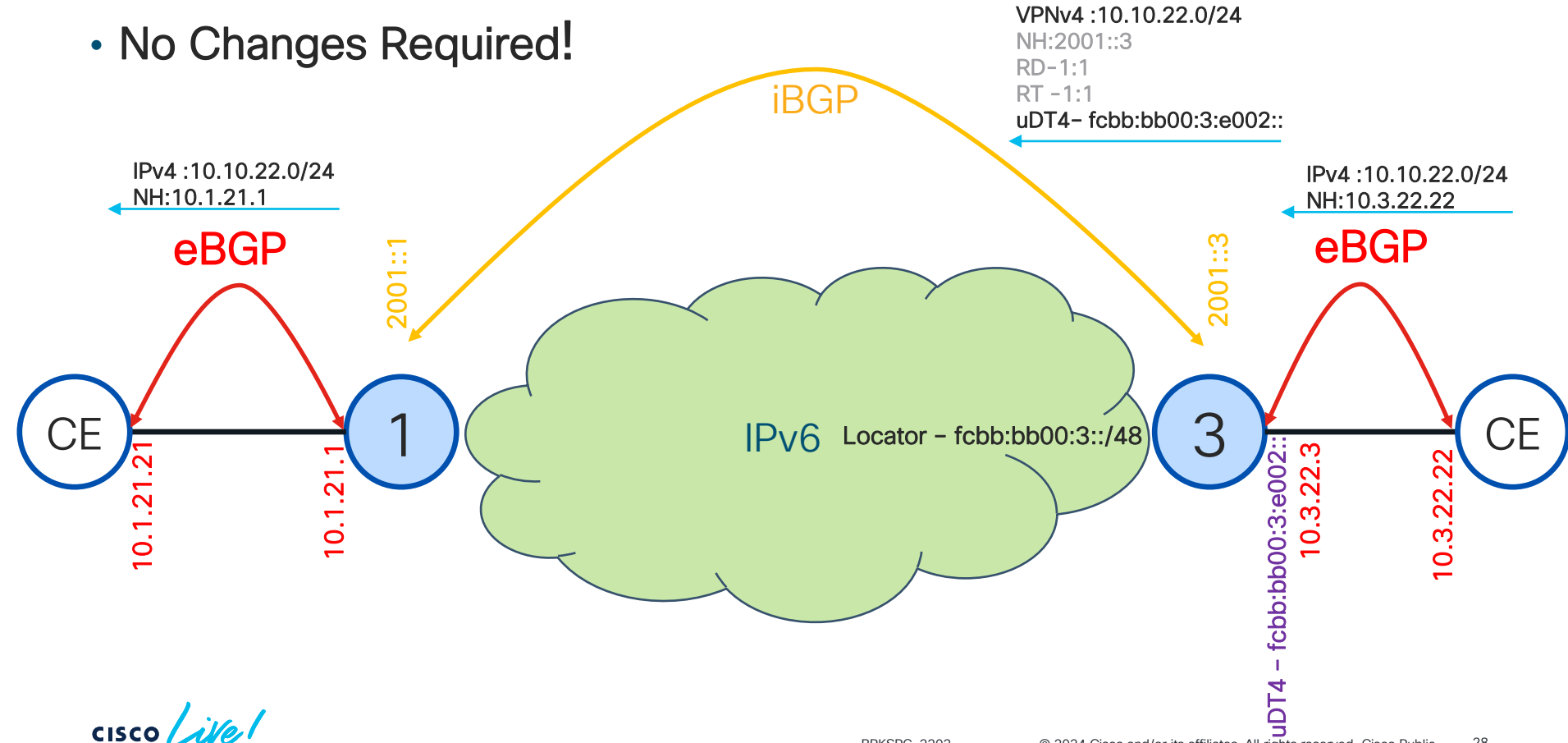


This will result in:

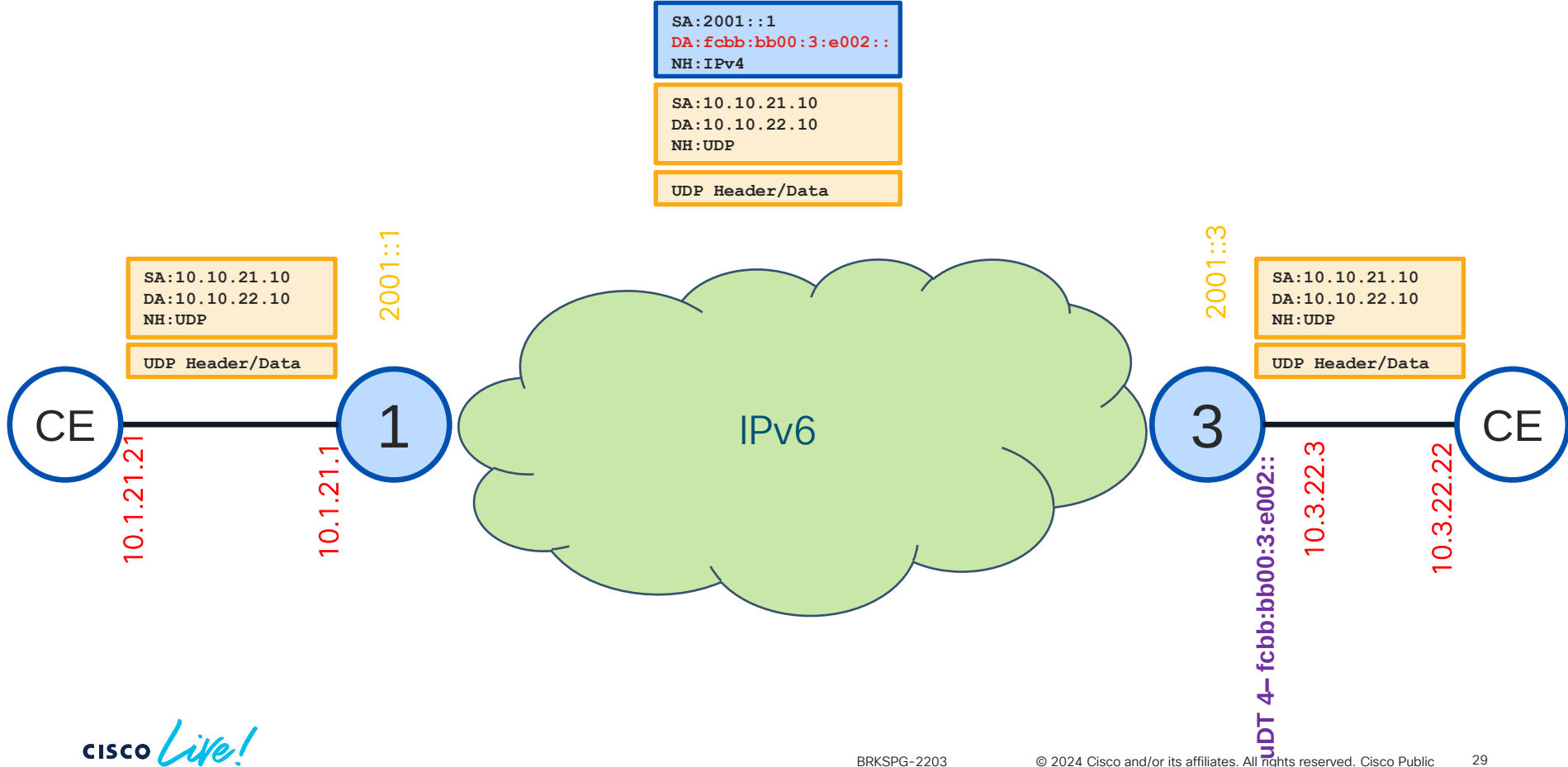
- Locator is advertised
- uN function is advertised
- uA for each ISIS interface is allocated and advertised

BGP

- No Changes Required!



L3 VPN Dataplane



SRv6 L3 VPN Configuration

```
router bgp 1
  address-family vpnv4 unicast
  vrf BestEffort
    rd 1:1
    address-family ipv4 unicast
    segment-routing srv6
    locator MAIN
    alloc mode per-vrf
```

Name of the Locator

Single DT function is allocated
per VRF and AF

This will result in:

- uDT4 function is allocated
- All prefixes are advertised with uDT4 function

EVPN

- No Changes Required!

EVPN :EVI 7543
NH:2001::3
RD-1:1
RT -1:1
uDX2- fcbb:bb00:3:e002::

iBGP

2001::1

2001::3

EVI 7543

1

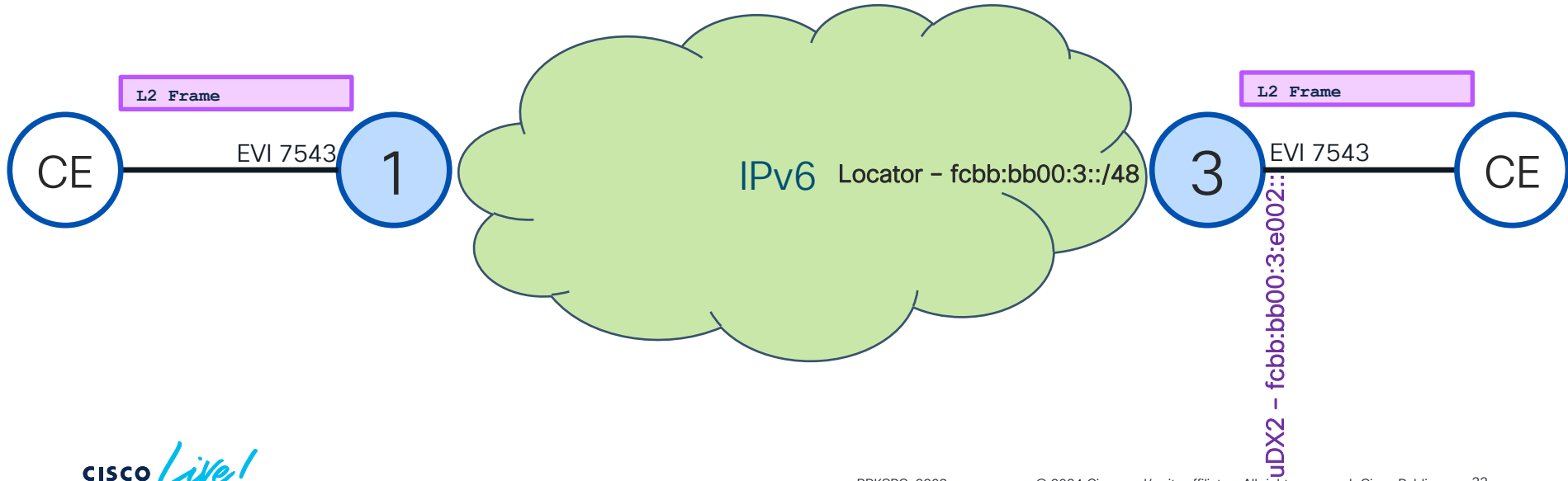
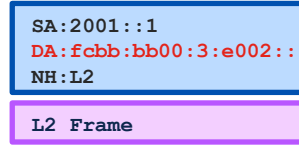
IPv6 Locator - fcbb:bb00:3::/48

3

EVI 7543

uDX2 - fcbb:bb00:3:e002::

EVPN Dataplane



SRv6 L2 VPWS

```
interface TenGigE0/0/0/0.7543 l2transport
  encapsulation dot1q 7543
  rewrite ingress tag pop 1 symmetric
```

```
l2vpn
  xconnect group P2P
    p2p 13-14
      interface TenGigE0/0/0/0.7543
        neighbor evpn evi 7543 service 7543
segment-routing srv6
```

```
evpn
  evi 7543 segment-routing srv6
    locator MAIN
segment-routing srv6
!
```

This will result in:

- uDX2 function is allocated per EVI
- EVI is advertised with uDX2 function

Name of the Locator

Addressing Plan for SRv6

Separation between SIDs and addresses

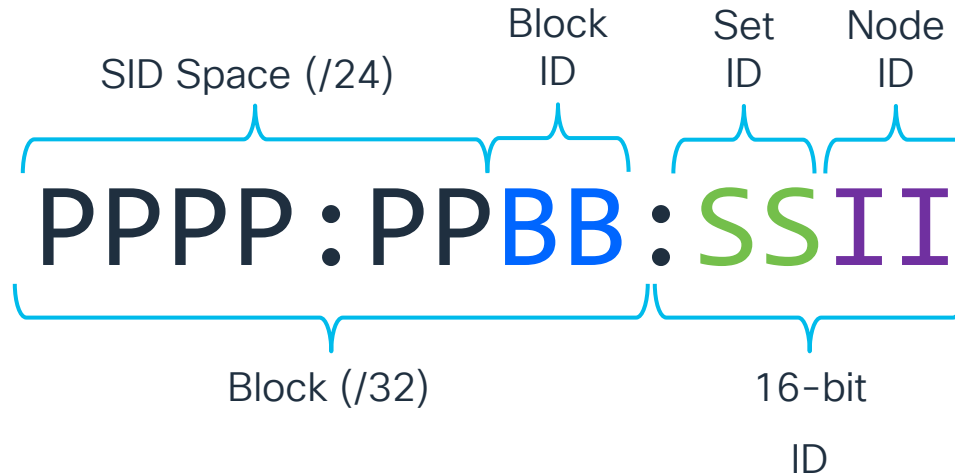
- Infrastructure addressing and SRv6 SID allocation belong to two different planes and **are different**
 - Infrastructure IP addresses (e.g., link interfaces, loopbacks) are allocated on the management plane
 - SRv6 SIDs are allocated on the service plane
- SRv6 SIDs are assigned to a node independently from the IP addressing of that node
- Even if they are both represented as IPv6 addresses, infrastructure addresses and SIDs cannot be merged and should be allocated off different blocks.

**An existing IPv6 address plan is not a constraint
for a future SRv6 SID allocation plan.**

Terminology – uSID F3216

- **uSID F3216**: uSID format with
 - uSID Block size: 32 bits
 - ID size: 16 bits

- **uSID F3216** structure:



SRv6 Space allocation recommendation

- Private range allocation 
 - **Recommended allocation**
 - Use /24 sub-range from ULA FC00::/8 space
 - FCBB:BB00::/24, with B indicating a nibble value picked by operator
- Public range allocation 
 - **Supported, not advised**
 - From allocated public GUA range

uSID Block per slice (Flex Algo) if possible

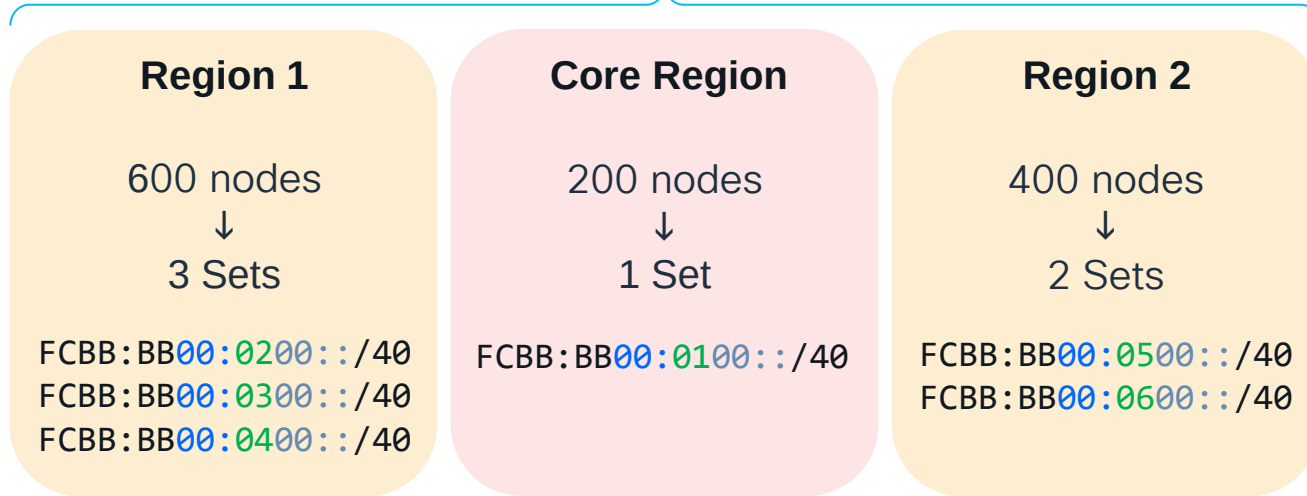
- 256 Blocks are available in the SRv6 Space:

FCBB:BB TT :::/32, with TT = slice ID

- Multiple Blocks can be concurrently used on a node
- 63 Blocks available on DNX1 platforms (TT = 00 to 3E)
- We assume 2 slices (Blocks), e.g.:
 - FCBB:BB00:::/32 Low-cost slice (algo 0) ← focus, other Blocks are similar
 - FCBB:BB01:::/32 Low-delay slice (algo 128)

Set Allocation Example

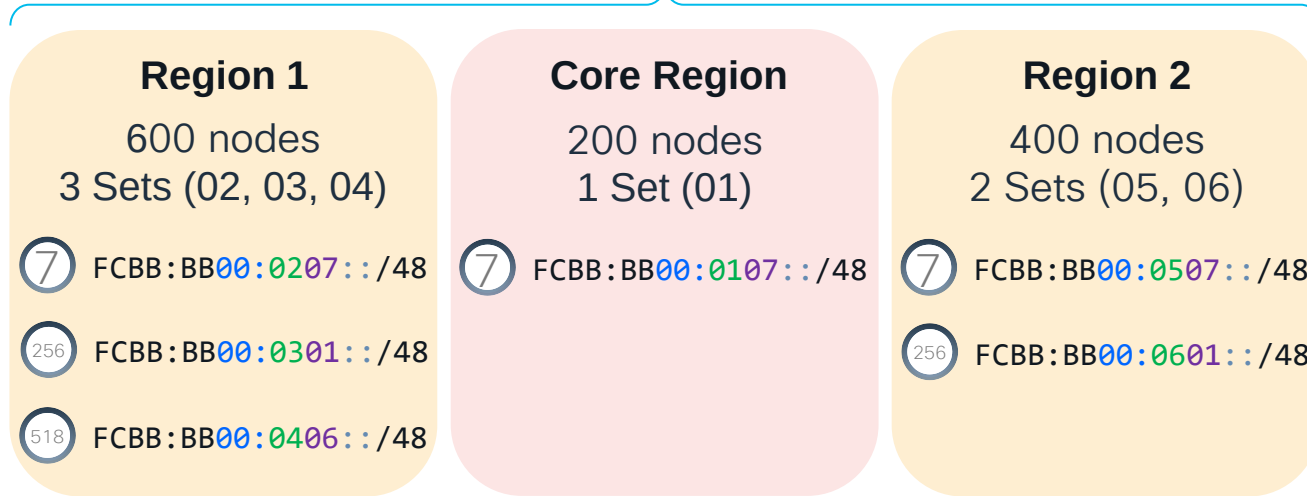
Block: FCBB:BB00::/32



- If a region outgrows its allocated Sets, then allocate more Sets to this region

uSID Allocation Example

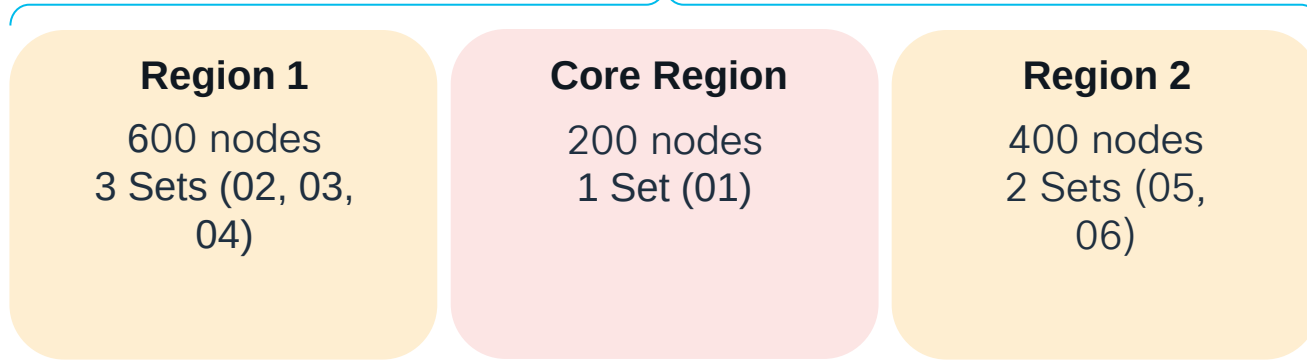
Block: FCBB:BB00::/32



- Remaining unallocated uSIDs in Sets are for future growth

Summarization

Block: FCBB:BB00::/32



summarize →
FCBB:BB00:0200::/40
FCBB:BB00:0300::/40
FCBB:BB00:0400::/40

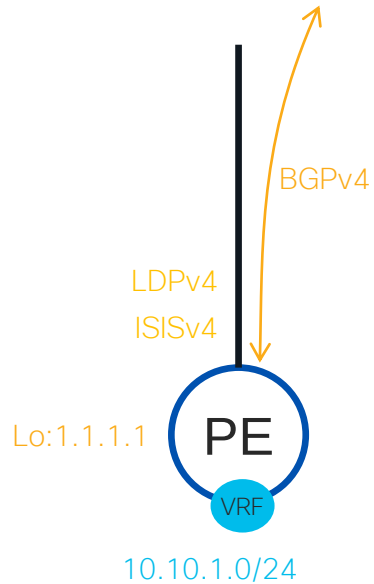
← summarize
FCBB:BB00:0500::/40
FCBB:BB00:0600::/40

Summarization gain:
× 256

MPLS to SRv6 Migration

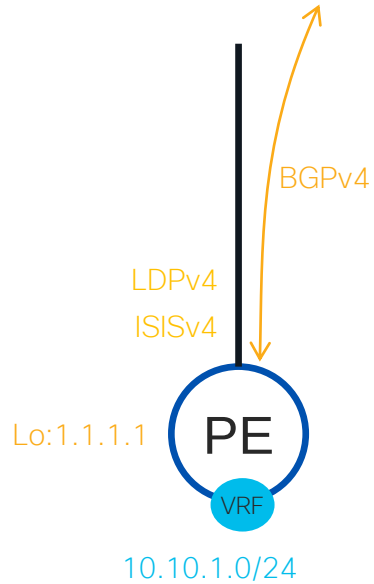
Dual Connected PE

MPLS PE

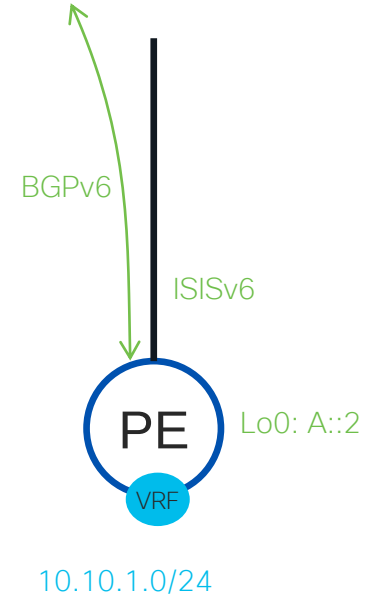


Dual Connected PE

MPLS PE

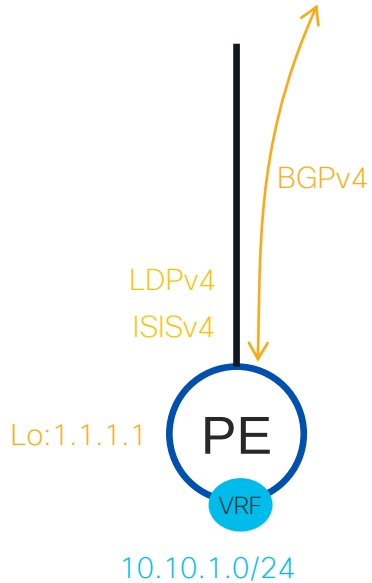


SRv6 PE

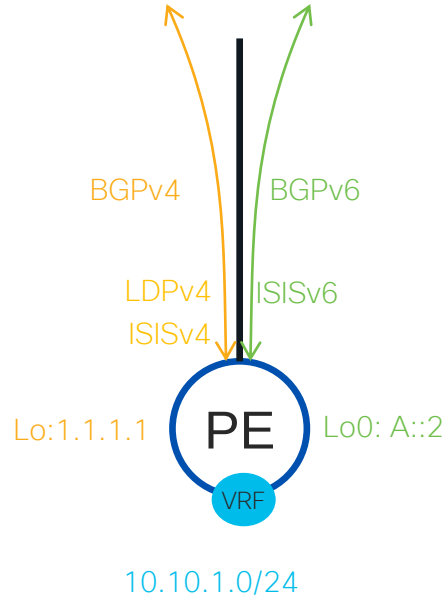


Dual Connected PE

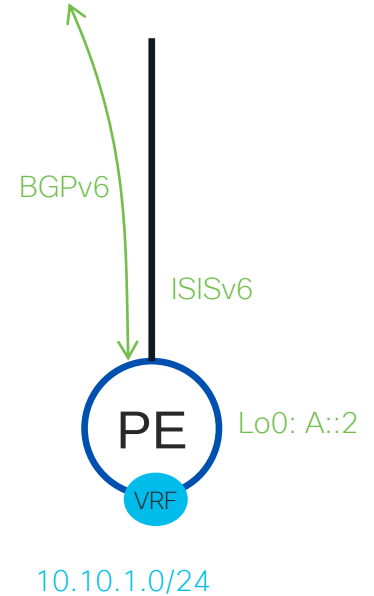
MPLS PE



DUAL Connected PE



SRv6 PE

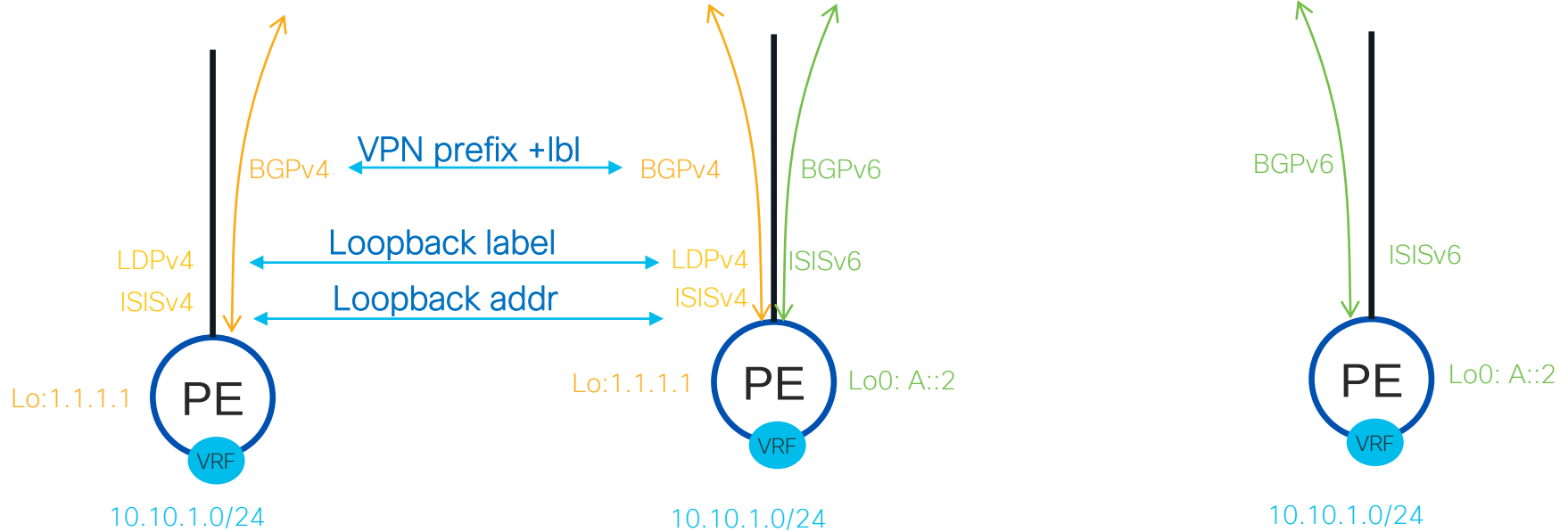


Dual Connected PE

MPLS PE

DUAL Connected PE

SRv6 PE

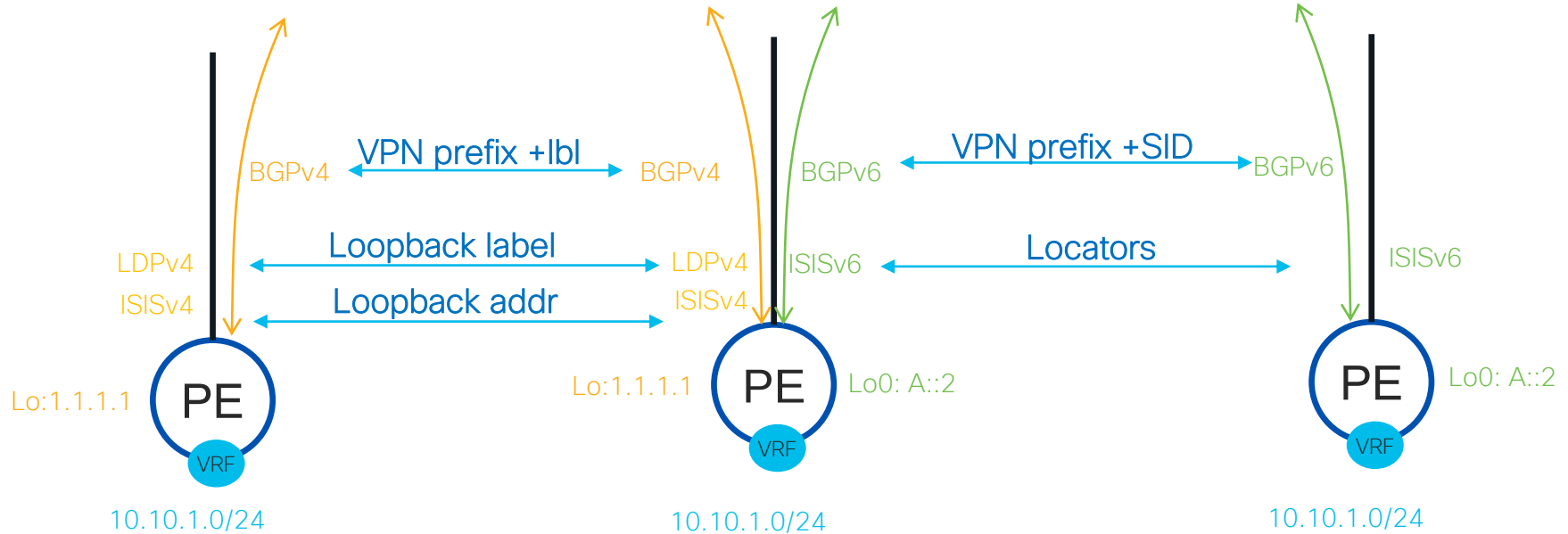


Dual Connected PE

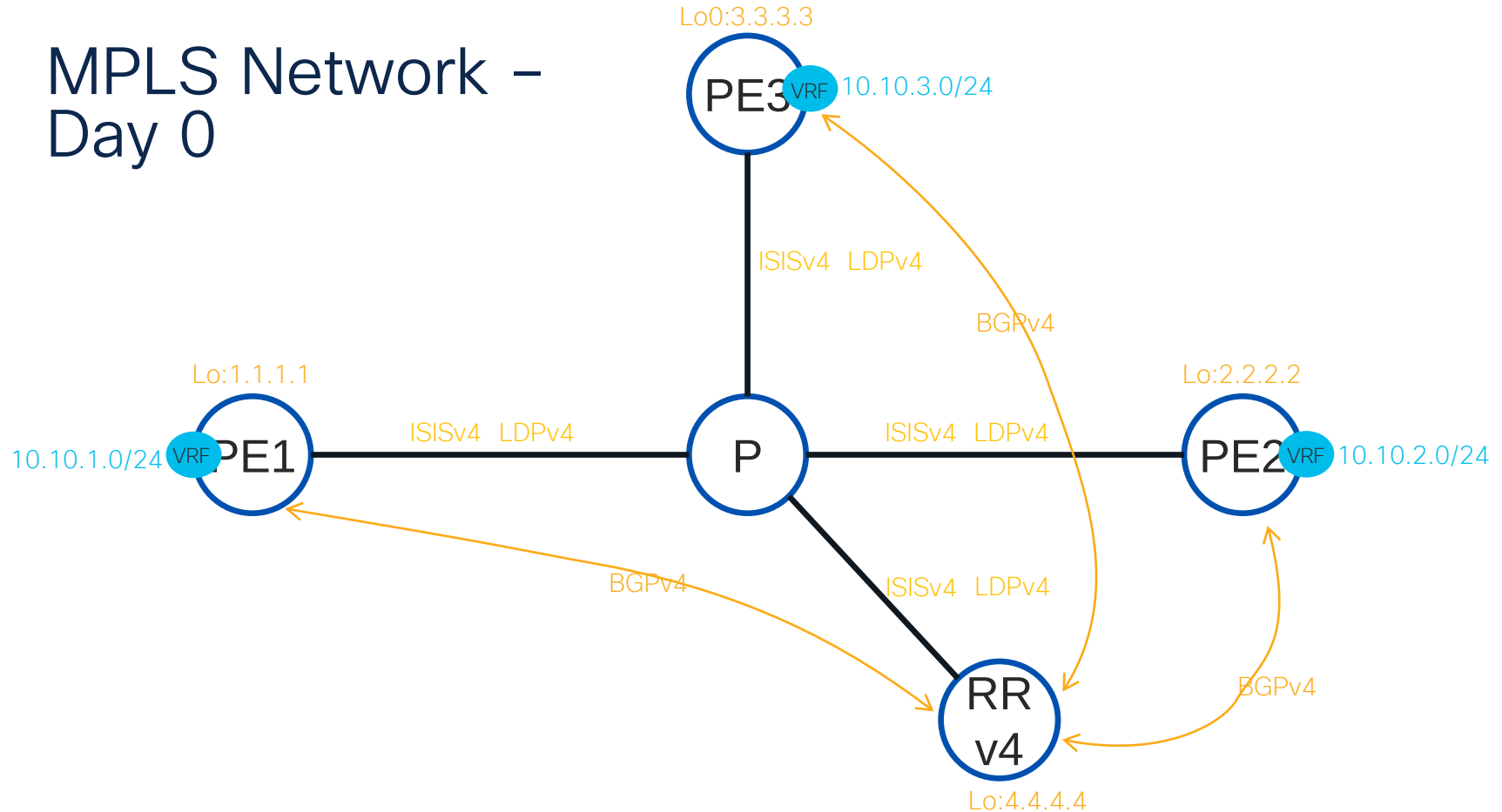
MPLS PE

DUAL Connected PE

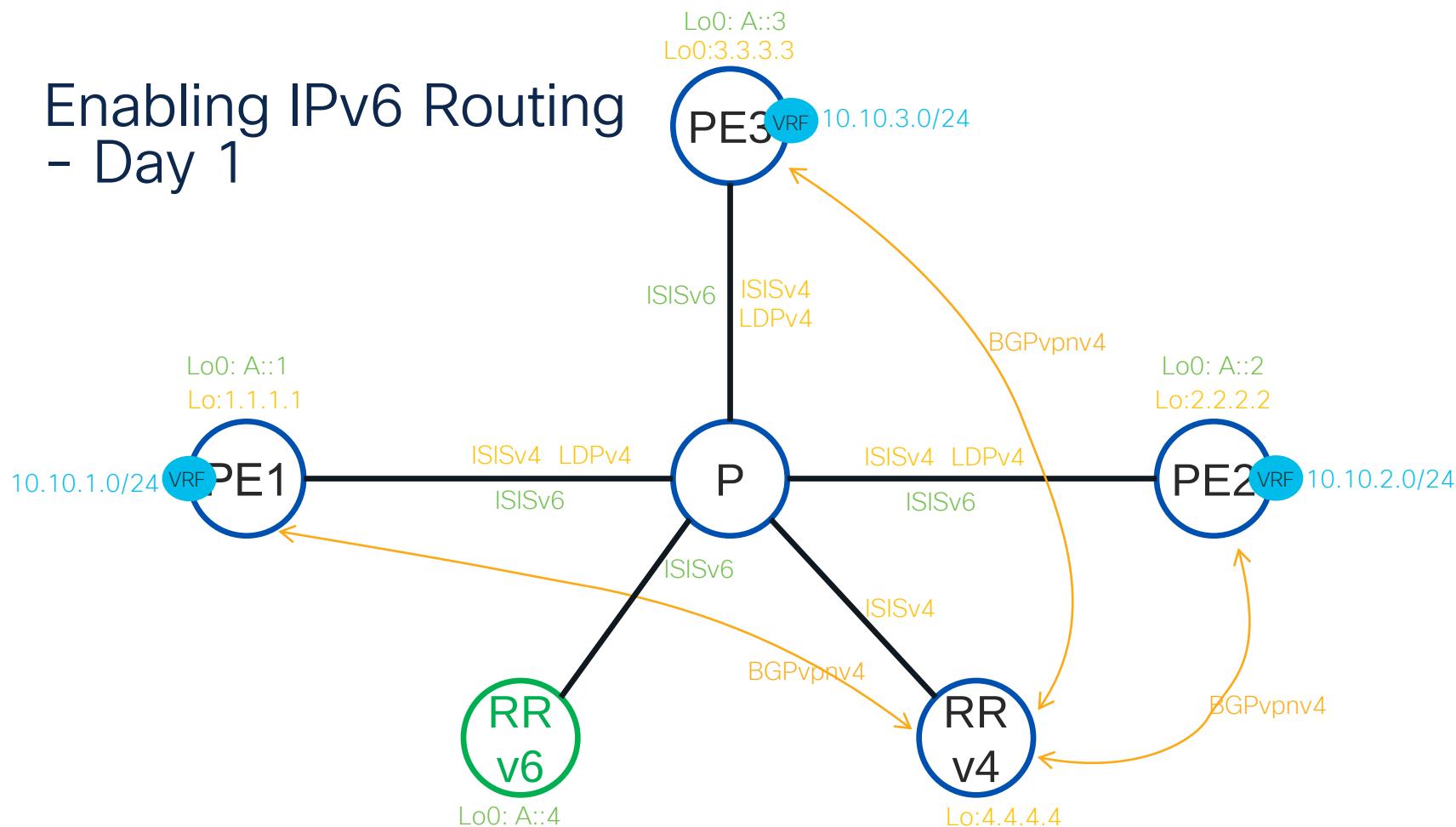
SRv6 PE



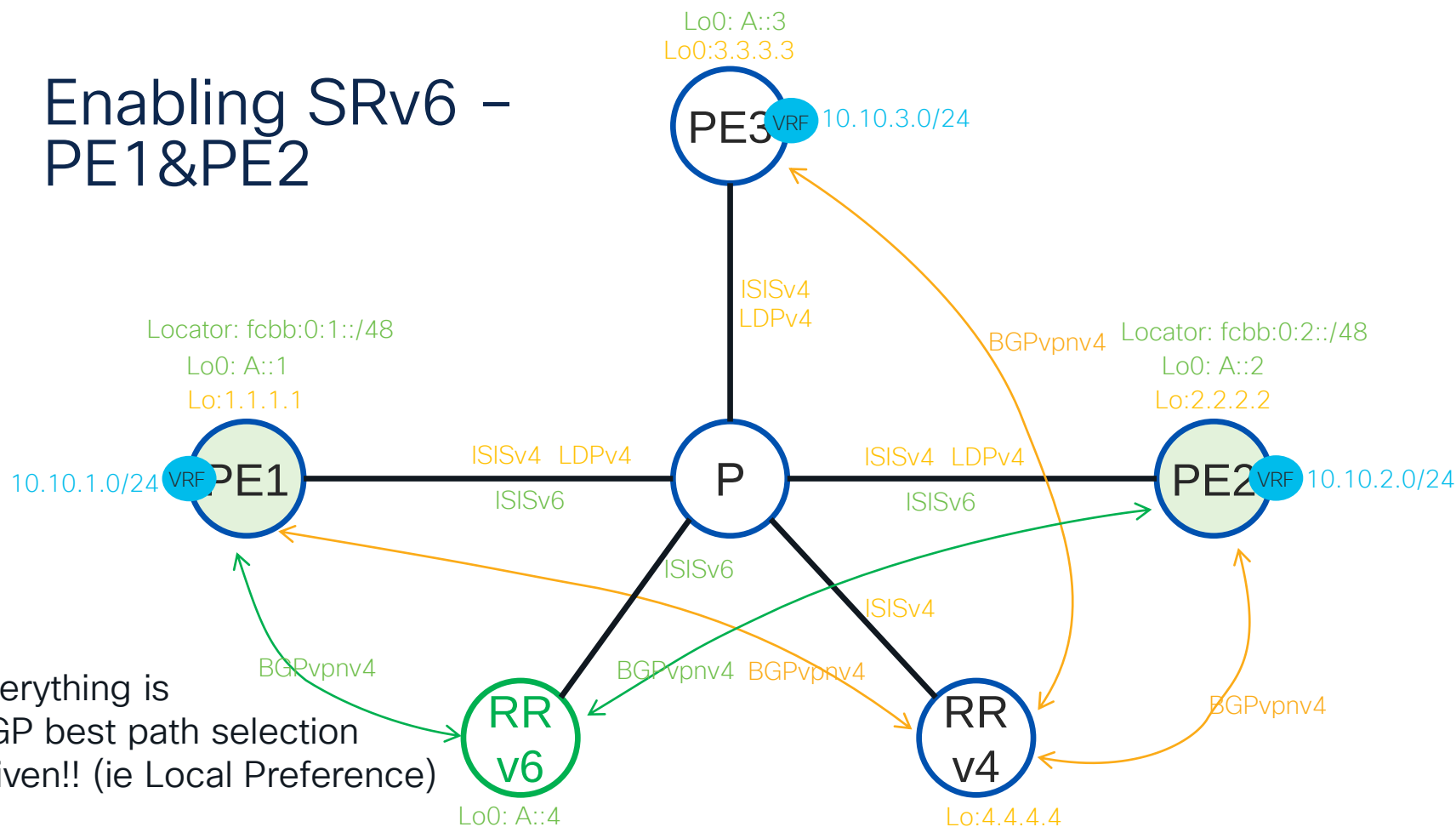
MPLS Network – Day 0



Enabling IPv6 Routing - Day 1

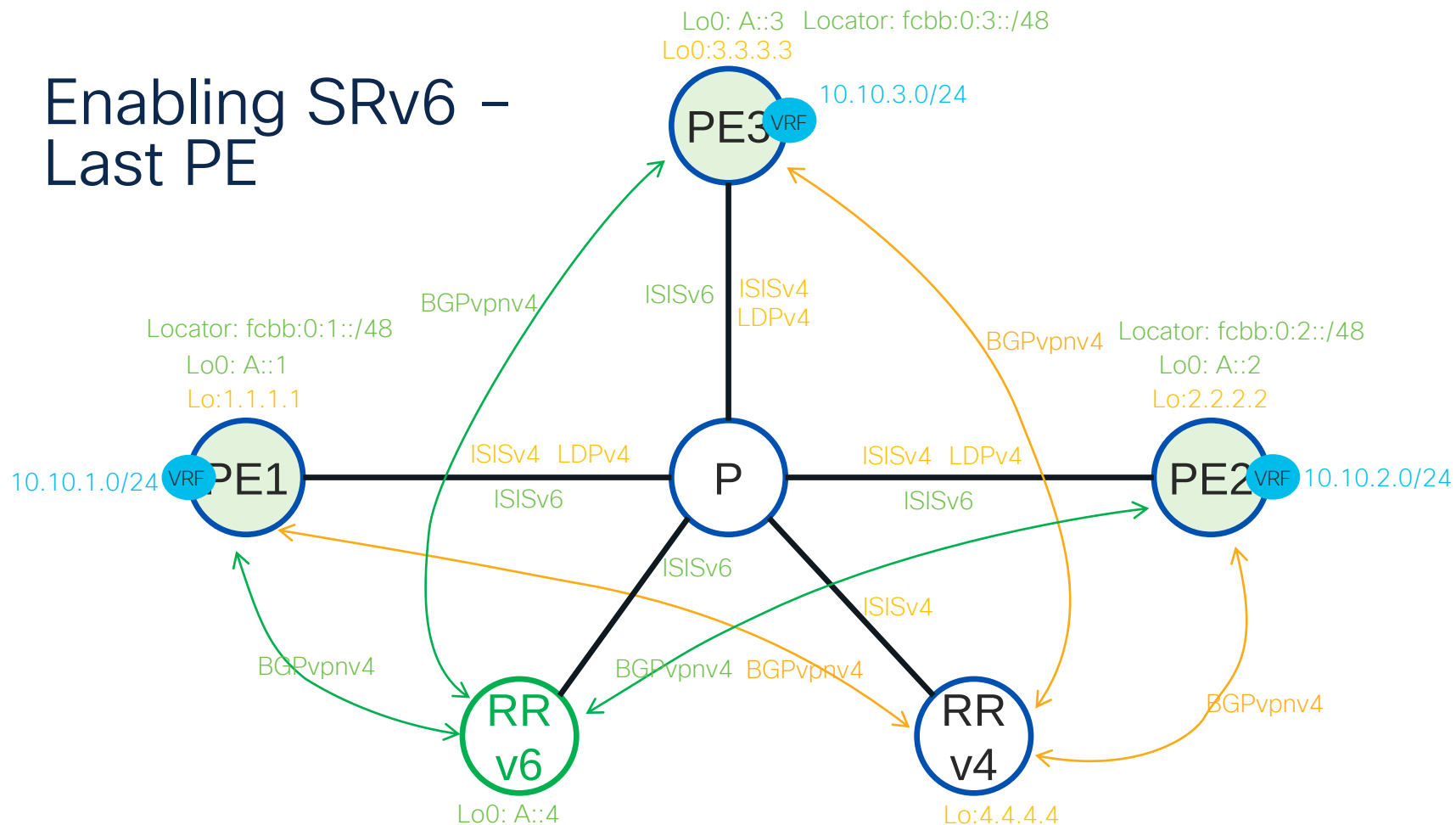


Enabling SRv6 - PE1&PE2



Everything is
BGP best path selection
driven!! (ie Local Preference)

Enabling SRv6 - Last PE



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SRv6 Dual PE Configuration

```
router bgp 1
  neighbor A::4
    address-family vpnv4 unicast
```

```
    encapsulation-type srv6
```

```
    route-policy RRv6 out ← Policy towards v6 RR
```

```
neighbor 4.4.4.4
```

```
  address-family vpnv4 unicast
```

```
  route-policy RRv4 out ← Policy towards v4 RR
```

```
vrf 1
```

```
  address-family ipv4 unicast
```

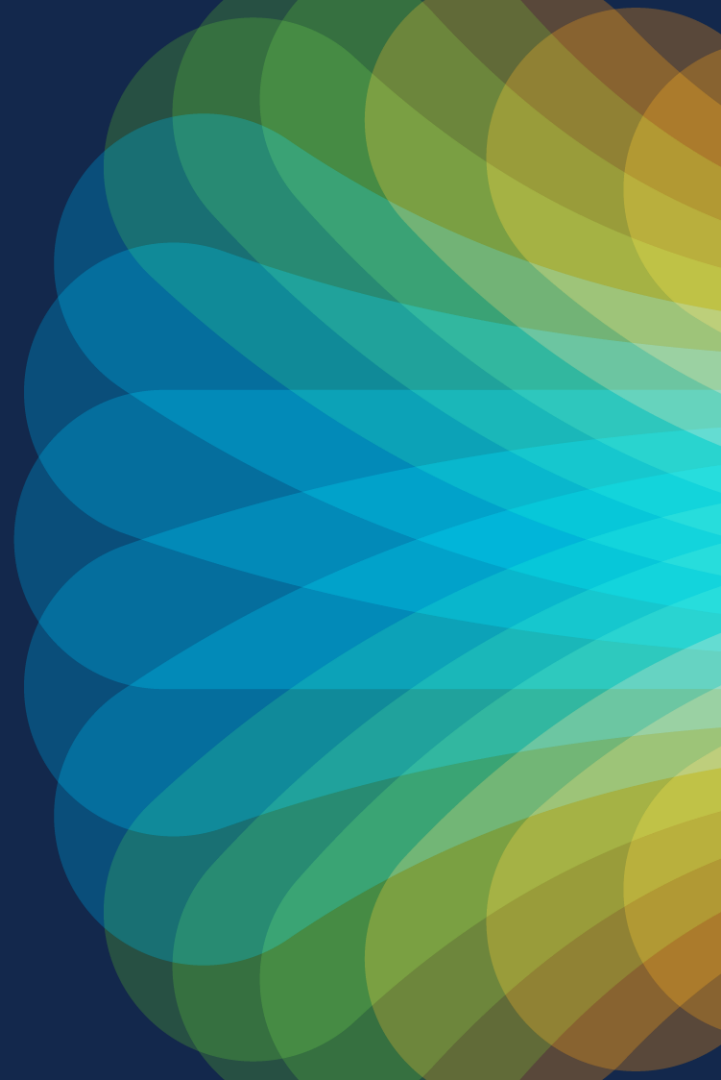
```
  mpls alloc enable ← Allocates Labels for all prefixes in VRF
```

```
  segment-routing srv6
```

```
  locator MAIN ← Allocates SIDs for all prefixes in VRF  
  alloc mode per-vrf from Locator MAIN
```

Via RPL we set specific BGP attributes to prefixes ie Local Preference towards RRv6 and RRv4

Conclusion



SRv6 is Fully Standardized

Architecture

- SR Architecture – RFC 8402
- SRTE Policy Architecture – RFC 9256
- Compressed SRv6 Segment List – WG Draft

Data Plane

- SRv6 Network Programming – RFC 8986
- IPv6 SR header – RFC 8754

Control Plane

- SRv6 BGP Services – RFC 9252
- SRv6 ISIS – RFC 9352
- SR Flex-Algo – RFC 9350

Operation & Management

- SRv6 OAM – RFC 9259
- Performance Management – RFC 5357

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Strong Cisco Commitment and Leadership

Editor of
Co-author of

96% IETF RFCs
100% IETF RFCs

Rich SRv6 uSID Ecosystem

Network Equipment Manufacturers



Merchant Silicon



Open-Source Applications



Open-Source Networking Stacks



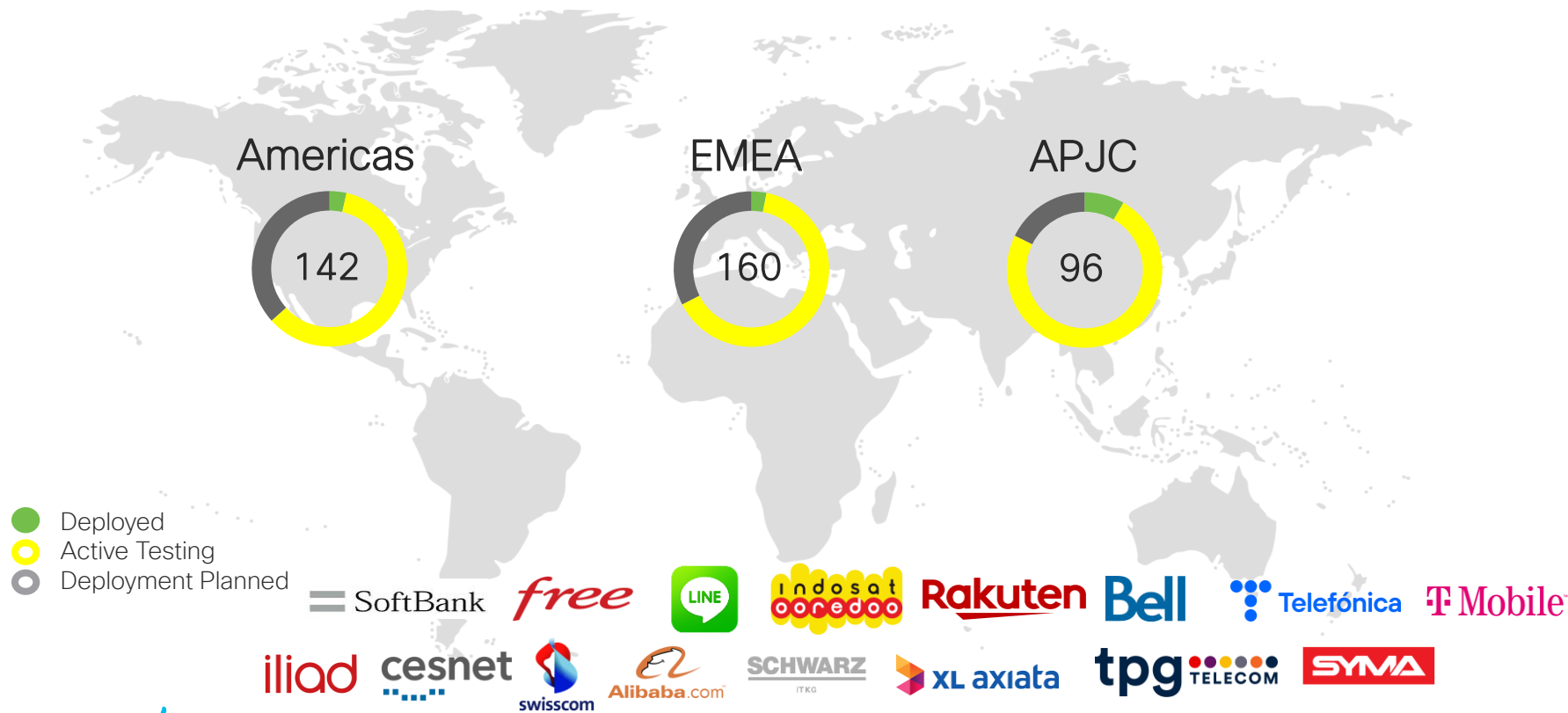
Smart NIC



Partners



SRv6 ... at Record-Speed



Further Study

- **BRKSP-2468:** Migrate Your MPLS Network and Services to SRv6 with Simplicity (Feb 8, 8:30)
- **LABSP-3393:** Implementing Segment Routing v6 (SRv6) Transport on NCS 55xx/5xx Platforms—Advanced
- www.segment-routing.net
- D-cloud:
 - <https://dcloud-cms.cisco.com/demo/cisco-srv6-l3-vpn-with-flexible-algorithm-and-ti-lfa-v1>
 - <https://dcloud-cms.cisco.com/demo/srv6-usid-traffic-engineering-lab-v1>
 - <https://dcloud-cms.cisco.com/demo/mpls-to-srv6-migration-v1>
 - <https://dcloud2-lon.cisco.com/content/demo/631932?returnPathTitleKey=content-view>

Simplicity Always Prevails



Simplicity Always Prevails

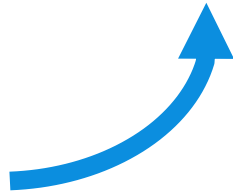


- ~~LDP~~
- ~~RSVP-TE~~
- ~~BGP 3108~~
- ~~MPLS~~
- ~~UDP/VxLAN~~
- ~~NSH~~

Simplicity Always Prevails



Furthermore, with more
scale



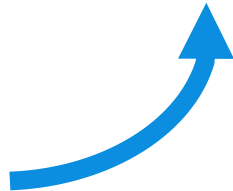
- ~~LDP~~
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Simplicity Always Prevails



- ~~LDP~~
- ~~RSVP-TE~~
- ~~BGP 3108~~
- ~~MPLS~~
- ~~UDP/VxLAN~~
- ~~NSH~~

Furthermore, with more scale and functionality





The bridge to possible

Thank you

CISCO *Live!*

The background features a vibrant, multi-colored abstract design. On the left, there are horizontal, wavy bands of color in shades of red, orange, yellow, and green. On the right, a bright white light source emits a series of sharp, radiating lines in various colors, including blue, green, and yellow, creating a sunburst effect.

cisco *Live!*

Let's go