Design Experience of an SRv6 uSID Data Center

SRv6 uSID DC Landscape

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YouTube Video!!

verizon

Demo time!

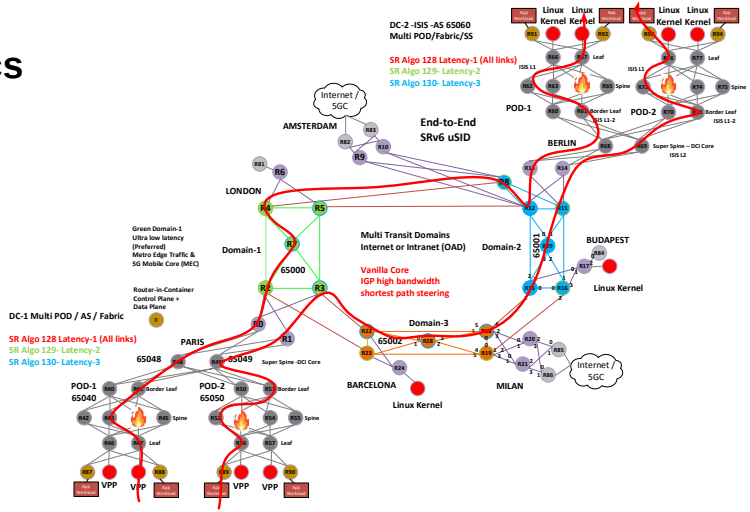
All Demo's @ YouTube Channel SRv6 uSID DC:

https://github.com/segmentrouting/srv6-labs

https://youtube.com/@SRv6_uSID_DC

Use-case 1: SRv6 uSID BGP-Only DC & Single AS DC
Use-case 2: SRv6 uSID w/ Multi POD Fabrics
Use-case 3: SRv6 uSID w/ Multi POD/Domain Fabrics

- ❑ Host-to-Host multi-pod across the metro
- ❑ Policy programmed from Linux Kernel & VPP host
- ❑ Policy programmed from Router-In-Container (XRD)



Real World Use-cases

#1 IPv6 Host Based Networking

#2 Dual Plane MPLS / IPv6 Core Migration

#3 SRv6 uSID End-To-End

#1 IPv6 Host Based Networking

- **Traffic Engineering and Carrier Grade** features are not a requirement in the Data Center.
- Operators can use white box switches or disaggregated hardware and software with Vanilla IPv6 Only DC fabric blindly passing the SRv6 uSID packets. Massive bandwidth **where Multi Petabits** of fiber can be thrown at the DC fabric, with the focus on **High Bandwidth** packet pushing with **Ultra simplified fabric**.
- **Steering** is initiated from the Data Center host attachment using IGP shortest path leaving the entire fabric 100% vanilla IPv6.

#2 Dual Plane MPLS / IPv6 Core Migration

- **Traffic Engineering & Carrier Grade** features are a requirement ONLY in the Data Center.
- **Traffic Engineering capabilities** in the Data Center, and the intermediate domains follow IGP shortest path **blindly forwarding** the SRv6 uSID packets. **Massive scale & resiliency** with full carrier grade features in the Data Center.
- **Steering** is initiated from the DC host attachment and follows IGP shortest path along the intermediate domains to the egress DC or Domain.

#3 SRv6 uSID End-To-End

- **Traffic Engineering** and all the Carrier Grade features are a requirement.
- **Full feature richness.**
- **Steering** is initiated from the Data Center host attachment or could be any switch within the DC fabric for any and all flow types.

This has too much on slide so not using - too busy!

Demo time!

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- IPv6 DC ⇔ *SRv6 uSID Core* ⇔IPv6 DC (1a)
- *SRv6 uSID DC* ⇔ IPv6 Core ⇔ *SRv6 uSID DC (1b)*
- SRv6 uSID End-to-End (1c)

Use-case 2: SRv6 uSID w/ Multi POD Fabrics

- IPv6 DC ⇔ *SRv6 uSID Core* ⇔IPv6 DC (2a)
- *SRv6 uSID DC* ⇔ IPv6 Core ⇔ *SRv6 uSID DC (2b)*
- SRv6 uSID End-to-End (2c)

Use-case 3: SRv6 uSID w/ Multi POD/Domain Fabrics

- IPv6 DC ⇔ *SRv6 uSID Core* ⇔IPv6 DC (3a)
- *SRv6 uSID DC* ⇔ IPv6 Core ⇔ *SRv6 uSID DC (3b)*
- SRv6 uSID End-to-End (3c)

Don't forget to LIKE the video & provide feedback for future Video's on IPv6 DC Arch

This is & ongoing SRv6 uSID DC R&D work By Contributors:

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MPLS WC 2024
SRv6 uSID DC Series

Use-case 1: SRv6 uSID BGP-Only DC & Single AS DC

- IPv6 DC ⇔ *SRv6 uSID Core* ⇔IPv6 DC (1a) ⇔ **YouTube Video #1 (1 of 9)**
- *SRv6 uSID DC* ⇔ IPv6 Core ⇔ *SRv6 uSID DC (1b)* ⇔ **YouTube Video #2 (2 of 9)**
- SRv6 uSID uSID End-to-End (1c) ⇔ **YouTube Video #3 (3 of 9)**

Use-case 2: SRv6 uSID w/ Multi POD Fabrics

- IPv6 DC ⇔ *SRv6 uSID Core* ⇔IPv6 DC (2a) ⇔ **YouTube Video #4 (4 of 9)**
- *SRv6 uSID DC* ⇔ IPv6 Core ⇔ *SRv6 uSID DC (2b)* ⇔ **YouTube Video #5 (5of 9)**
- SRv6 uSID End-to-End (2c) ⇔ **YouTube Video #6 (6 of 9)**

Use-case 3: SRv6 uSID w/ Multi POD/Domain Fabrics

- IPv6 DC ⇔ *SRv6 uSID Core* ⇔IPv6 DC (3a) ⇔ **YouTube Video #7 (7 of 9)**
- *SRv6 uSID DC* ⇔ IPv6 Core ⇔ *SRv6 uSID DC (3b)* ⇔ **YouTube Video #8 (8of 9)**
- SRv6 uSID End-to-End (3c) ⇔ **YouTube Video #9 (9 of 9)**

SILOED Networking ⇔ Complexity Tax

Each siloed network Domain has its own Hardware, Software, SDN Stack, Operations & Automation Ecosystem

IPv4 Transport

OVERLAY/SEGMENTATION

PRIVATE IP SCALE

TRAFFIC ENGINEERING

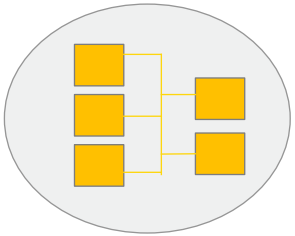
MPLS Transport

NOT WIDELY ADOPTED IN DATA CENTER

LABEL SUMMARIZATION

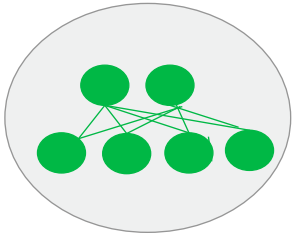
TRAFFIC ENGINEERING

VXLAN / GENEVE



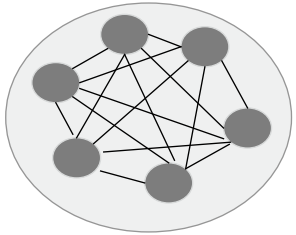
DC OVERLAYS

IPv4



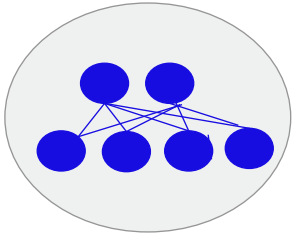
DC FABRICS (UNDERLAY)

MPLS



METRO WAN FABRICS

IPv4, IPv6



EDGE PEERING FABRICS

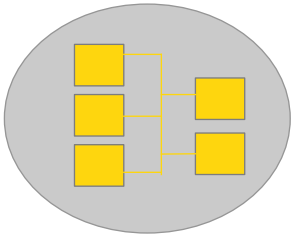
SRv6 uSID ⇔ Simplicity, Functionality, Ultra Scale

A Common End-to-End Forwarding Architecture Enables Common HW, SW, SDN, Ops ⇔ **Massive Scale**

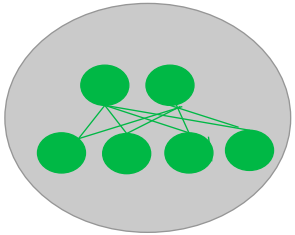
SRv6 uSID

- OVERLAY/SEGMENTATION
- IPv6 UNDERLAY SCALE
- TRAFFIC ENGINEERING
- COMPATIBILITY WITH BROWN FIELD FABRICS
- SERVICE INSERTION / CHAINING
- COMMON HARDWARE, SOFTWARE, SDN, Ops

SRv6 uSID ⇔ Translates into Ultra Massive Scale

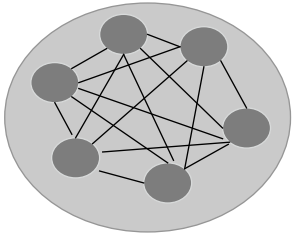


DC OVERLAYS

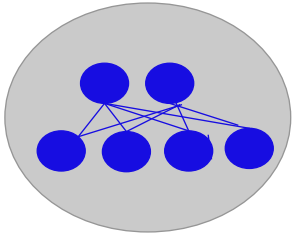


UNDERLAY
DC FABRICS

“End-to-End Inter-Domain Routing via SRv6 uSID”

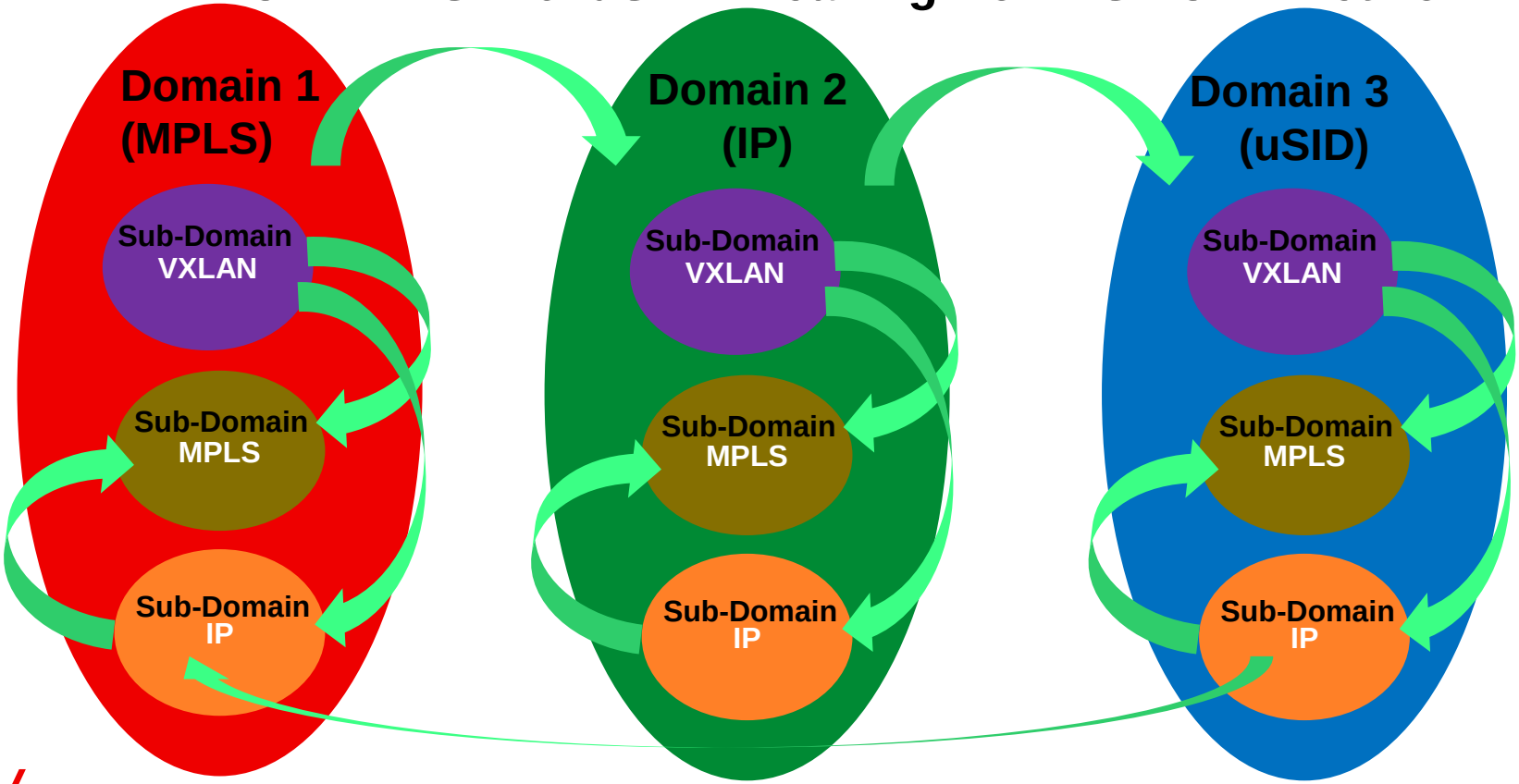


METRO
WAN FABRICS

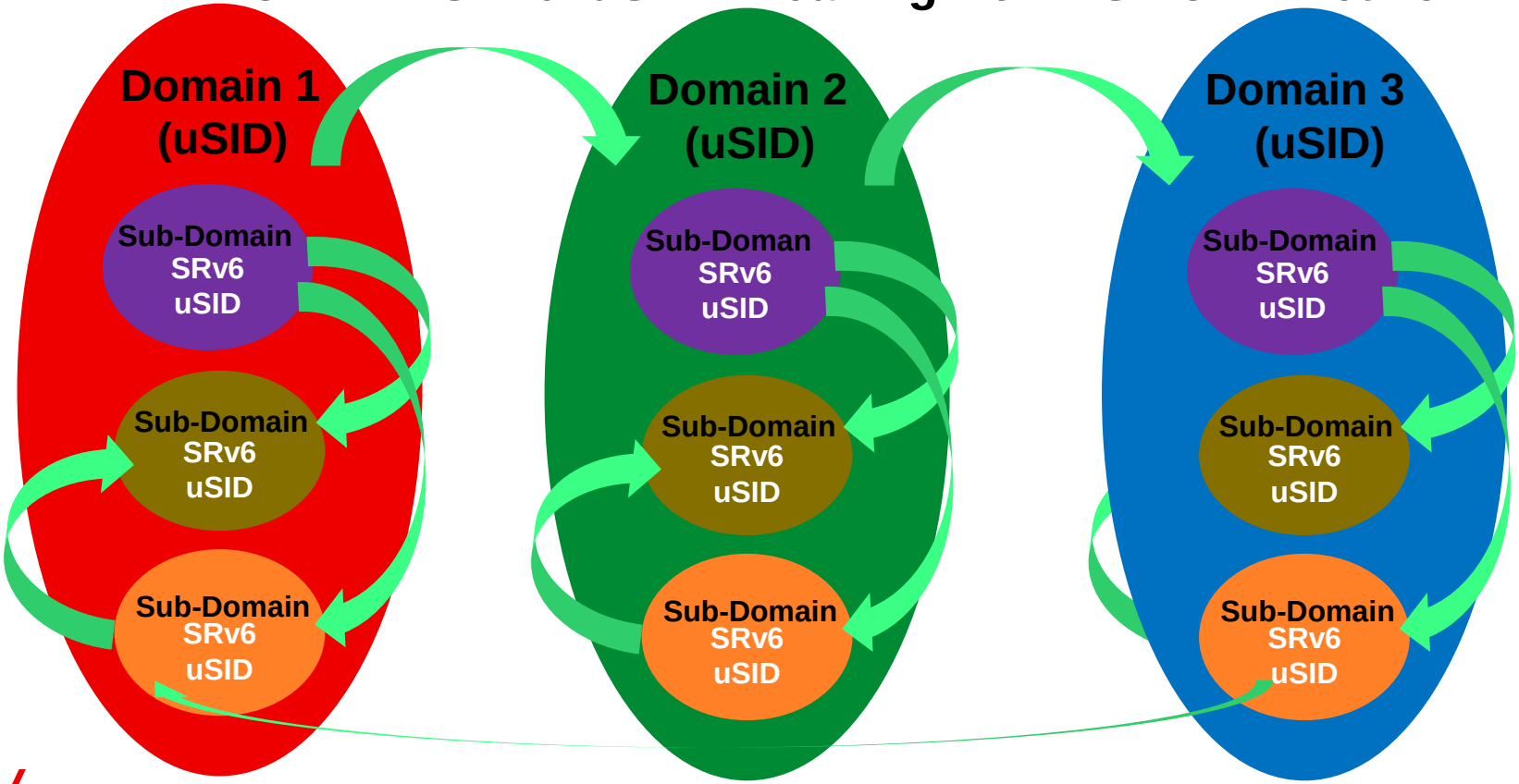


EDGE PEERING
FABRICS

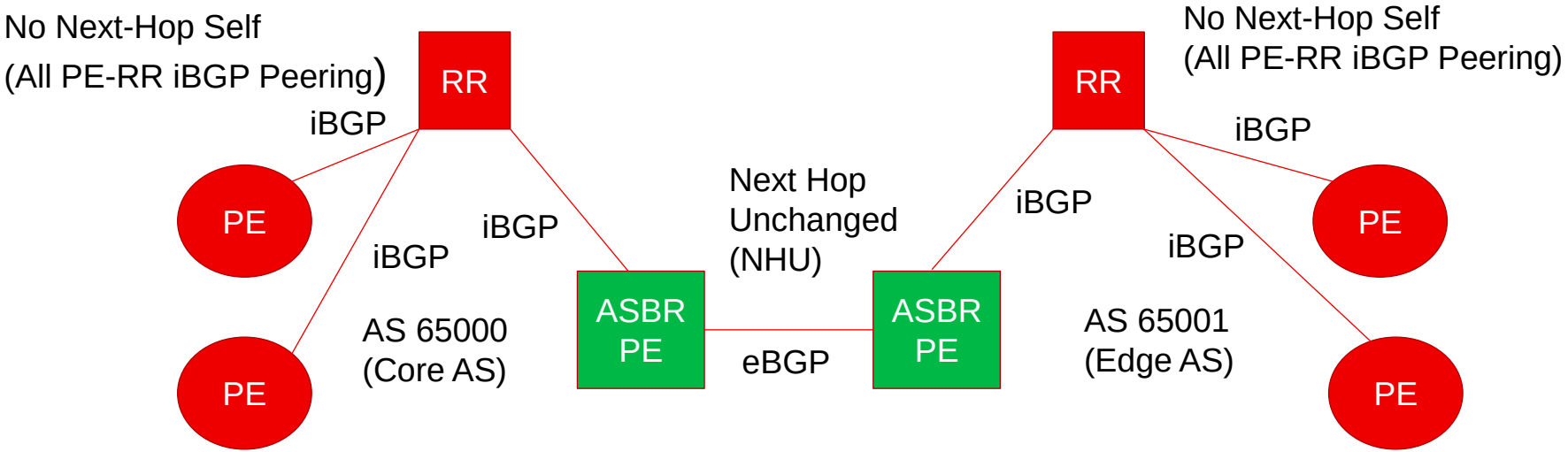
INTER DOMAIN SRv6 uSID Breaking Down SILOED Networking



INTER DOMAIN SRv6 uSID Breaking Down SILOED Networking



INTER DOMAIN SRv6 uSID

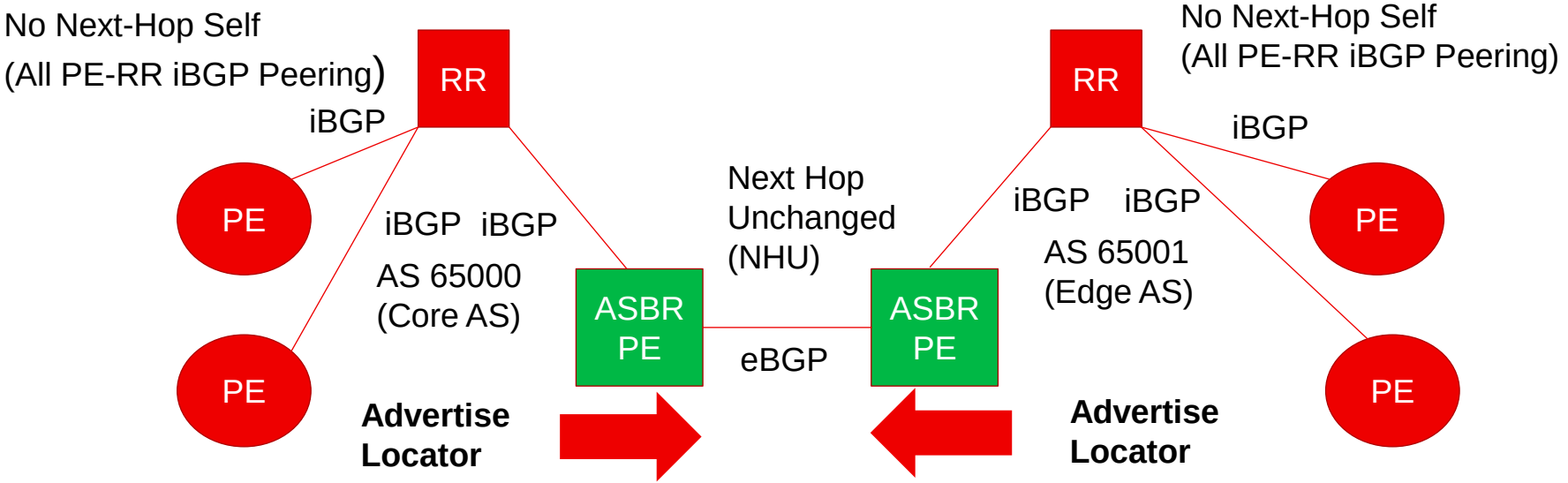


Rule for Inter Domain Peering

- iBGP -No Next-Hop Self
- eBGP –Next Hop Unchanged

(Requirement to Preserve L2 VPN & L3 VPN Service SID across INTER-AS Boundary)

INTER DOMAIN SRv6 uSID ROUTING SIMPLICITY



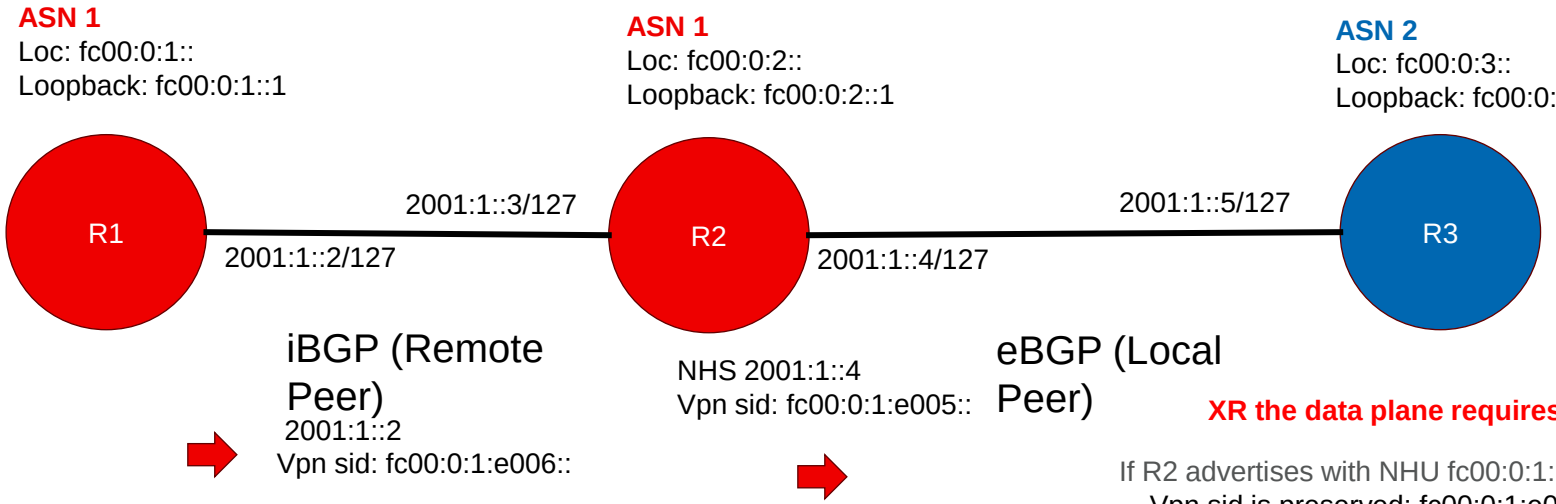
Rule for Inter Domain Peering

- Locator Reachability (That's it!!)

This allows host endpoints to provide static steering capabilities without PCE across any SR Algo cross domain

INTER DOMAIN SRv6 uSID

eBGP direct peering (NHU) – (Remote PE)

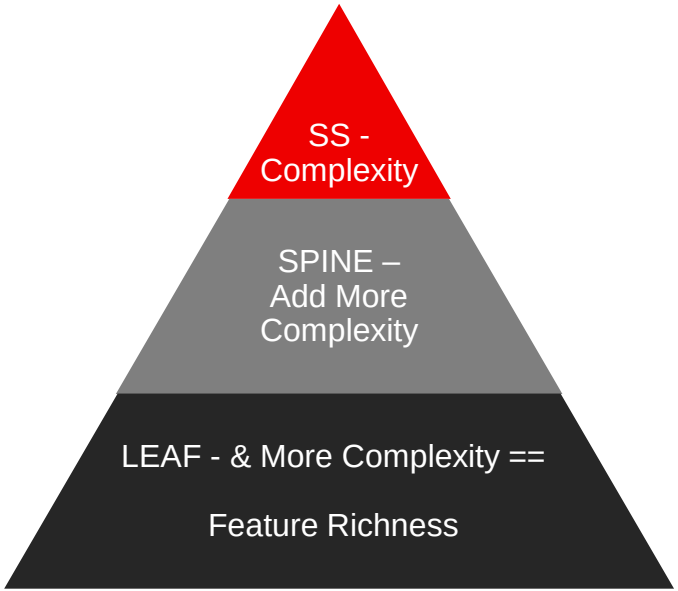


XR the data plane requires knob

If R2 advertises with NHU fc00:0:1::1
Vpn sid is preserved: fc00:0:1:e005::
but R3 sees it as *inaccessible*
BGP knob fixes the inaccessible
"IGNORE CONNECTED CHECK"
neighbor w.x.y.z
ignore-connected-check

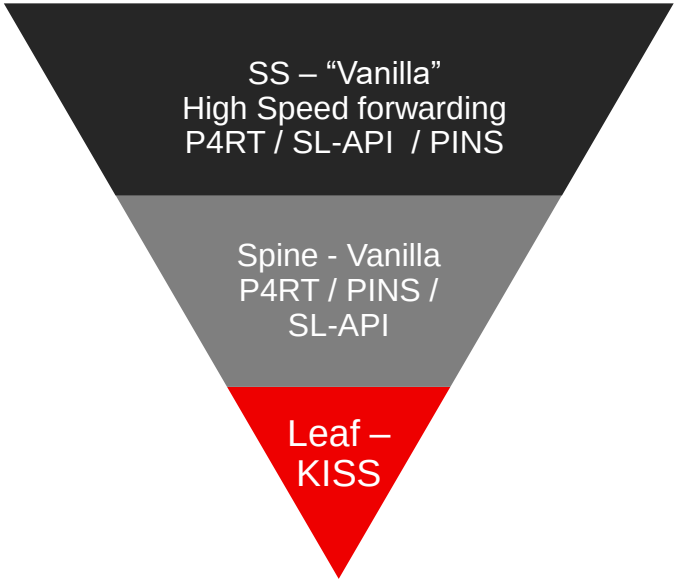
SRv6 uSID Design ⇔ “Top ⇔ Down” & “Bottom ⇔ Up” Approach

Top ⇔ Down



Traditional mindset has been for feature richness & complexity across the Data Center Fabric

Bottom ⇔ UP



SRv6 KISS ⇔ “Keep it Simple & Strategic” approach ⇔ Focus on High speed forwarding plane packet pushing throughput

Real World Use Cases of SRv6 uSID DC Landscape Experience

Real World Use Case #1 IPv6 Host Based Networking

Source DC or Domain (IPv6 Only) ⇔ Core Domain / Multi Domain OAD (One Administrative Domain) / Internet (SRv6 uSID Capable) ⇔ Destination Data Center or Domain(IPv6 Only) ⇔ Bottom-UP (KISS**) [END STATE] or [INTERMEDIATE STATE]**

- **Traffic Engineering and Carrier Grade** features are not a requirement in the Data Center.
- Operators can use white box switches or disaggregated hardware and software with Vanilla IPv6 Only DC fabric blindly passing the SRv6 uSID packets. Massive bandwidth **where Multi Petabits** of fiber can be thrown at the DC fabric, with the focus on **High Bandwidth** packet pushing with **Ultra simplified fabric**.
- **Steering** is initiated from the Data Center host attachment using IGP shortest path leaving the entire fabric 100% vanilla IPv6.

Real World Use Cases of SRv6 uSID DC Landscape Experience

Real World Use Case #2 Dual Plane MPLS / IPv6 Core Migration

Source DC or Domain (SRv6 uSID Capable) ⇔ Core Domain / Multi Domain OAD (One Administrative Domain) / Internet (IPv6 Only) ⇔ Destination Data Center or Domain (SRv6 uSID Capable) ⇔ Top-Down Feature Rich **[INTERMEDIATE STATE]**

- **Traffic Engineering & Carrier Grade** features are a requirement ONLY in the Data Center.
- **Traffic Engineering capabilities** in the Data Center, and the intermediate domains follow IGP shortest path **blindly forwarding** the SRv6 uSID packets. **Massive scale & resiliency** with full carrier grade features in the Data Center.
- **Steering** is initiated from the DC host attachment and follows IGP shortest path along the intermediate domains to the egress DC or Domain.

Real World Use Cases of SRv6 uSID DC Landscape Experience

Real World Use Case #3 SRv6 uSID End-To-End

Source DC or Domain (SRv6 uSID Capable) ⇔ Core Domain / Multi Domain OAD (One Administrative Domain) / Internet (SRv6 uSID Capable) ⇔ Destination Data Center or Domain (SRv6 uSID Capable) ⇔ Top-Down Feature Rich **[END STATE]**

- **Traffic Engineering** and all the Carrier Grade features are a requirement.
- **Full feature richness.**
- **Steering** is initiated from the Data Center host attachment or could be any switch within the DC fabric for any and all flow types.

SRv6 uSID Host Based Networking Traffic Engineering

Options for Host Based Networking

- eBPF/Cilium (Cilium BGP control plane) CNI or Standalone (Option-1)
- Native Linux Kernel (FRR BGP control plane) –Host Routing with Native Kernel (Option-2)
- FD.io VPP (FRR BGP control plane) -Host Routing via VPP (Option-3)
- Router-in-container (Control Plane & Data Plane) (xRD, SONiC, Nokia, Juniper cRPD) CNF (Option-4)

- Options are listed in order of desirability by operators
- Next few slides we will go into each option in detail

Option #1 eBPF/Cilium

- ❑ CNI Connects to global table ⇔ linkage of host fabric to DC fabric
- ❑ CNI Provides Traffic Engineering capabilities via SRv6 uSID
- ❑ CNI Provides VPN overlay - Workload Container, VM, CNF, VNF

Details

- ❑ Data plane programming
- ❑ FRR BGP for bgp control plane advertisement
- ❑ Cilium is one of the most popular CNI's to date and eBPF with its origins in the Linux kernel with its rich policy features & programmability provides seamless integration to compute nodes making it a powerful win-win for developers

Option #2 Native Linux Kernel

- Host Connects to global table ⇔ linkage of host fabric to DC fabric
- Host Provides Traffic Engineering capabilities via SRv6 uSID
- Host VPN overlay - Workload Container, VM, CNF, VNF

Details

- Data plane programming
- FRR BGP for control plane advertisement
- FRR can program the control plane & via Linux Kernel API call program the data plane FIB entries
- Alternatively, FRR can program the control plane with hook back to Linux Kernel to program the data plane FIB entries

Option #3 FD.IO VPP

- VPP Connects to global table ⇔ linkage of host fabric to DC fabric
- VPP Provides Traffic Engineering capabilities via SRv6 uSID
- VPP Provides VPN overlay - Workload Container, VM, CNF, VNF

Details

- Data plane programming
- FRR BGP for Control Plane Advertisement
- VPP ceases control of the Linux Hosts NIC
- Requires Netlink or other method to program VPP FIB
- VPP requires application flows to hair-pinned through the Linux Kernel which can become a bottleneck (Not for bandwidth & CPU intensive apps)

Option #4 Router-in-Container

- CNF Connects to global table ⇔ linkage of host fabric to DC fabric
- CNF Provides Traffic Engineering capabilities via SRv6 uSID
- CNF Provides VPN overlay - Workload Container, VM, CNF, VNF

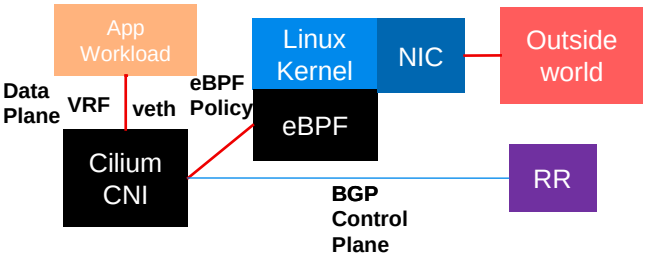
Details

Router-in-container options (xRD, SONiC, Nokia, Juniper cRPD)

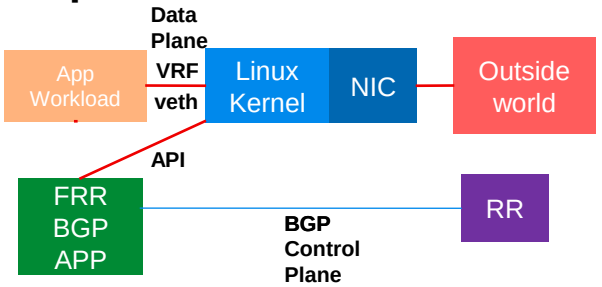
- Control plane & Data plane programming
- Requires Linux bridge stitching between Linux Kernel & CNF
- Container runs in user space so is beneficial for cases where only certain application requires traffic engineering capabilities
- Very difficult to create linkage of Router in container back to kernel space so all application workloads can take advantage of steering

Host Networking Drawing

Option #1 eBPF/Cilium



Option #2 Linux Kernel



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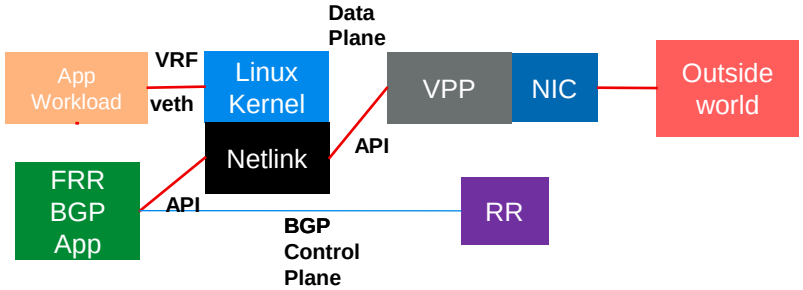
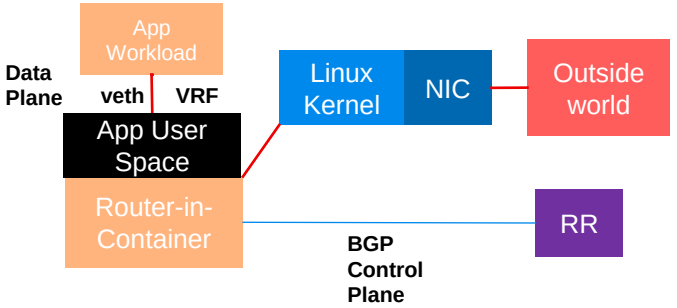


Option #4 Router-in-Container



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  - *SRv6 uSID DC* ⇔ IPv6 Core ⇔ *SRv6 uSID DC (1b)*
  - SRv6 uSID End-to-End (1c)

✓

Use-Case 1a: SRv6 uSID E2E w/ IPv6 DC & SRv6 uSID Core

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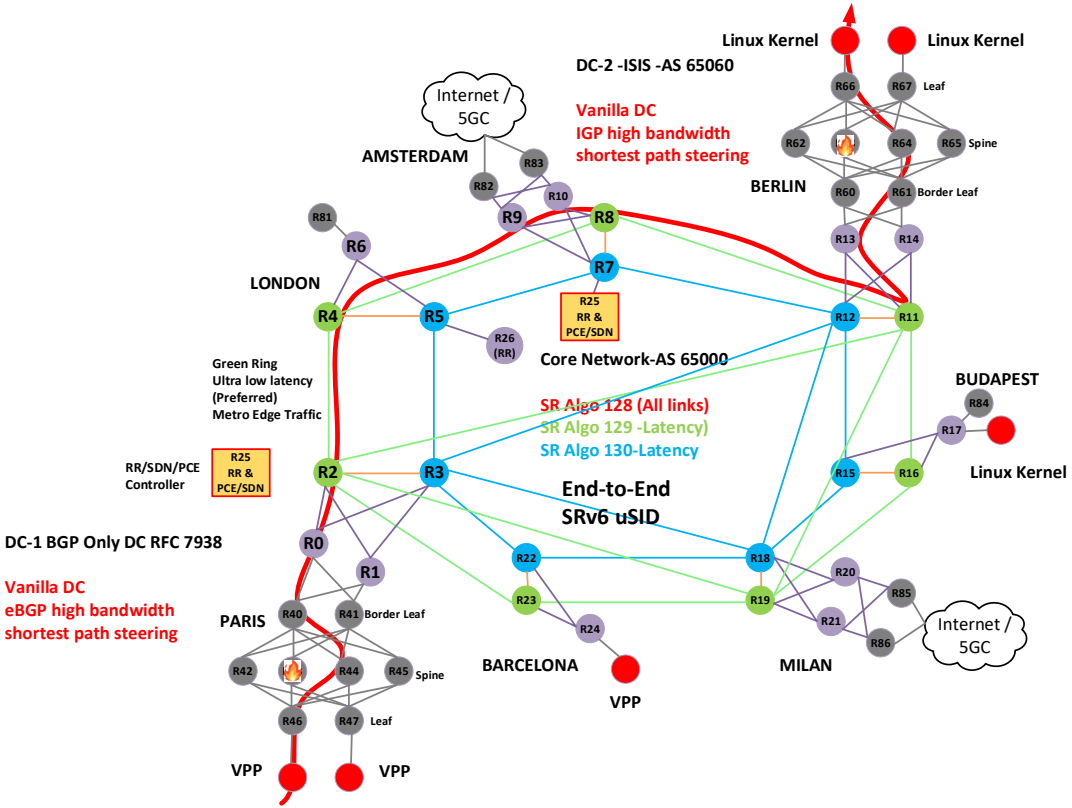
- **Use-case 1: SRv6 uSID BGP-Only DC & Single AS DC**
  - **IPv6 DC ⇔ *SRv6 uSID Core* ⇔IPv6 DC (1a)**

✓

Use-Case 1a: SRv6 uSID E2E w/ IPv6 DC & SRv6 uSID Core



Use-Case 1b: SRv6 uSID E2E w/ SRv6 uSID DC & IPv6 Core

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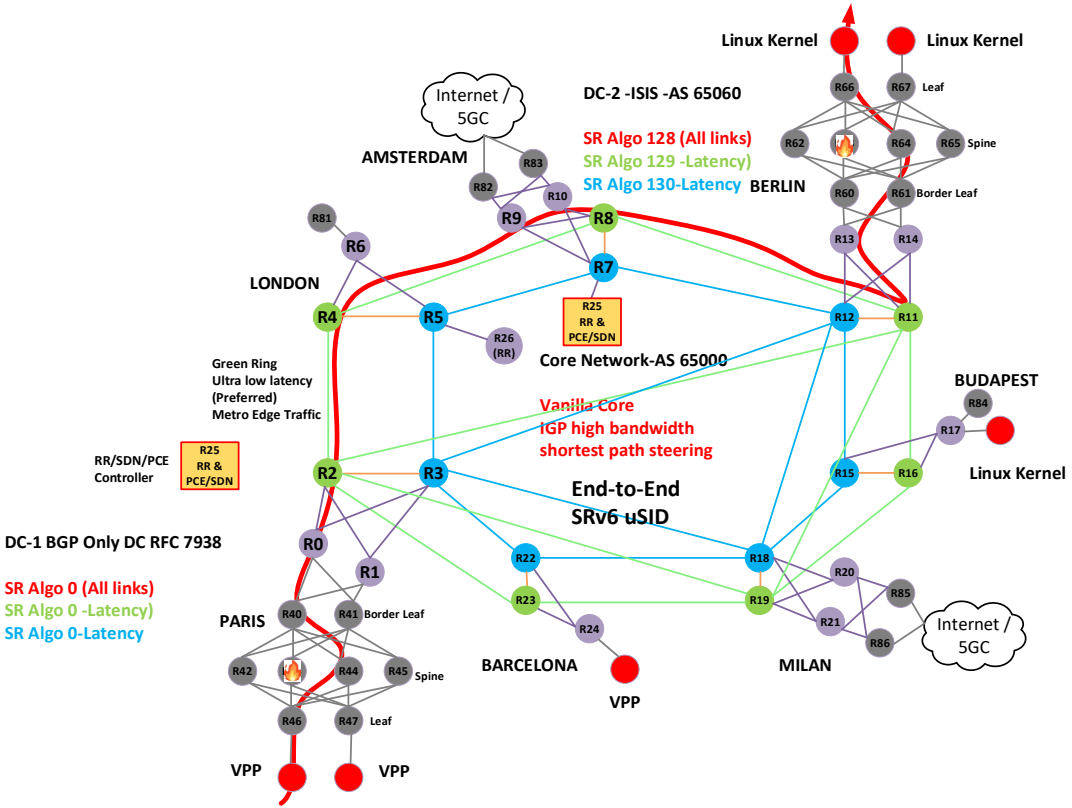
- ❑ Policy programmed from Router-In-Container (XRD)

- **Use-case 1: SRv6 uSID BGP-Only DC & Single AS DC**
  - ***SRv6 uSID DC*** **⇔ IPv6 Core ⇔** ***SRv6 uSID DC (1b)***

✓

Use-Case 1b: SRv6 uSID E2E w/ SRv6 uSID DC & IPv6 Core



Use-Case 1c: SRv6 uSID E2E BGP Only & Single AS DC

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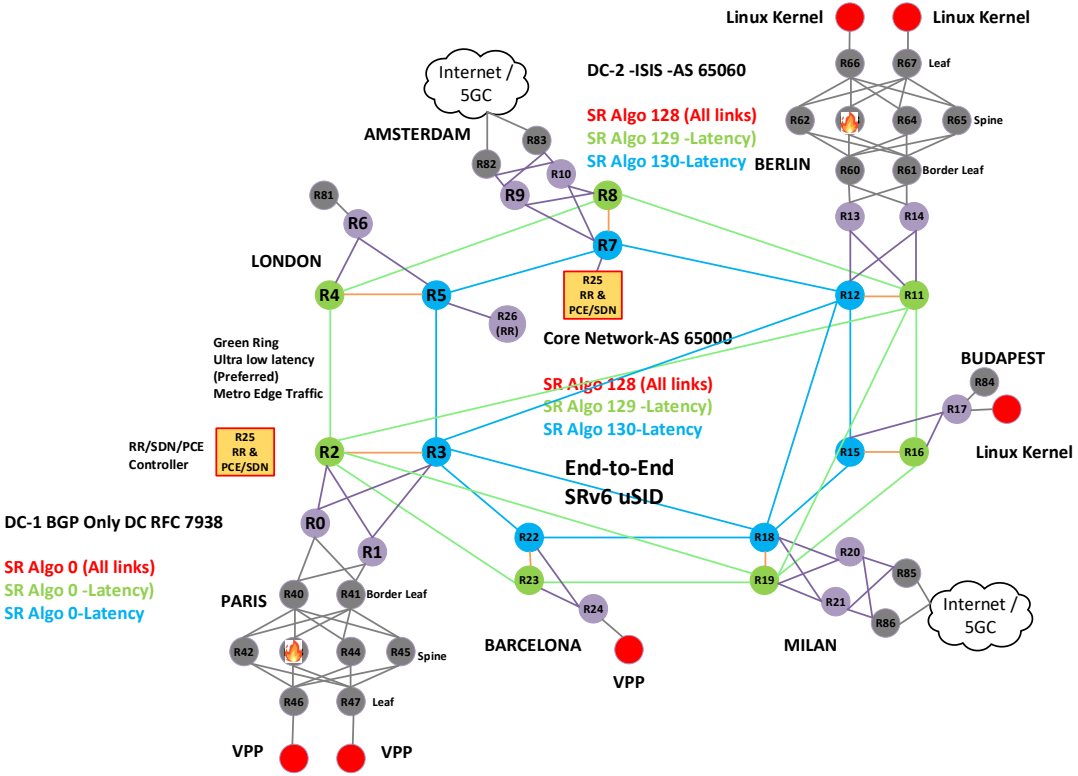
- **Use-case 1: SRv6 uSID BGP-Only DC & Single AS DC**
  - **SRv6 uSID End-to-End (1c)**

Use-Case 1c: SRv6 uSID E2E BGP Only & Single AS DC



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- *SRv6 uSID DC* ⇔ IPv6 Core ⇔ *SRv6 uSID DC (1b)*
- SRv6 uSID uSID End-to-End (1c)

Use-case 2: SRv6 uSID w/ Multi POD Fabrics

- IPv6 DC ⇔ *SRv6 uSID Core* ⇔IPv6 DC (2a)
- *SRv6 uSID DC* ⇔ IPv6 Core ⇔ *SRv6 uSID DC (2b)*
- SRv6 uSID End-to-End (2c)

Use-case 3: SRv6 uSID w/ Multi POD/Domain Fabrics

- IPv6 DC ⇔ *SRv6 uSID Core* ⇔IPv6 DC (3a)
- *SRv6 uSID DC* ⇔ IPv6 Core ⇔ *SRv6 uSID DC (3b)*
- SRv6 uSID End-to-End (3c)

SILOED Networking ⇔ Complexity Tax

Each siloed network Domain has its own Hardware, Software, SDN Stack, Operations & Automation Ecosystem

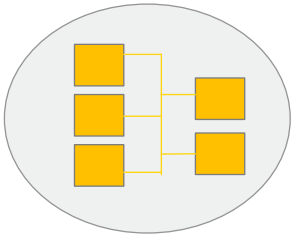
IPv4 Transport

- OVERLAY/SEGMENTATION
- PRIVATE IP SCALE
- TRAFFIC ENGINEERING

MPLS Transport

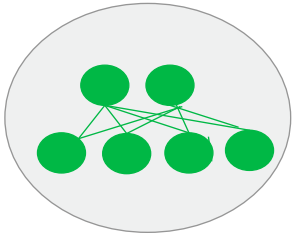
- NOT WIDELY ADOPTED IN DATA CENTER
- LABEL SUMMARIZATION
- TRAFFIC ENGINEERING

VXLAN / GENEVE



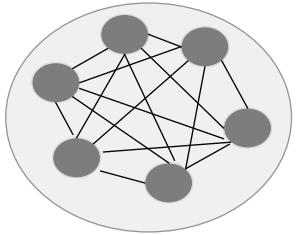
DC OVERLAYS

IPv4



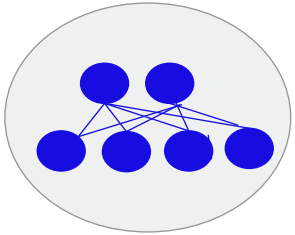
DC FABRICS (UNDERLAY)

MPLS



METRO WAN FABRICS

IPv4, IPv6



EDGE PEERING FABRICS

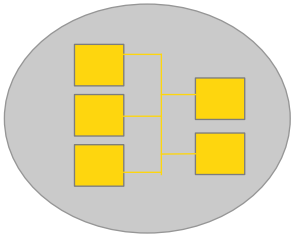
SRv6 uSID ⇔ Simplicity, Functionality, Ultra Scale

A Common End-to-End Forwarding Architecture Enables Common HW, SW, SDN, Ops ⇔ **Massive Scale**

SRv6 uSID

- OVERLAY/SEGMENTATION
- IPv6 UNDERLAY SCALE
- TRAFFIC ENGINEERING
- COMPATIBILITY WITH BROWN FIELD FABRICS
- SERVICE INSERTION / CHAINING
- COMMON HARDWARE, SOFTWARE, SDN, Ops

SRv6 uSID ⇔ Translates into Ultra Massive Scale



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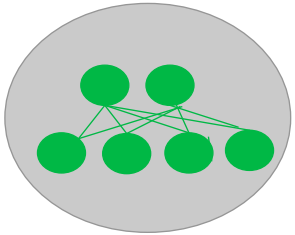
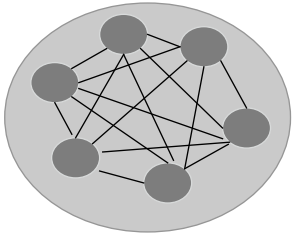
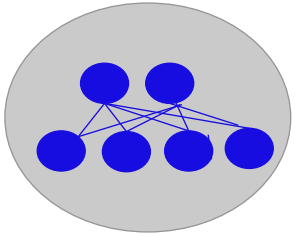


UNDERLAY
DC FABRICS

“End-to-End Inter-Domain Routing via SRv6 uSID”

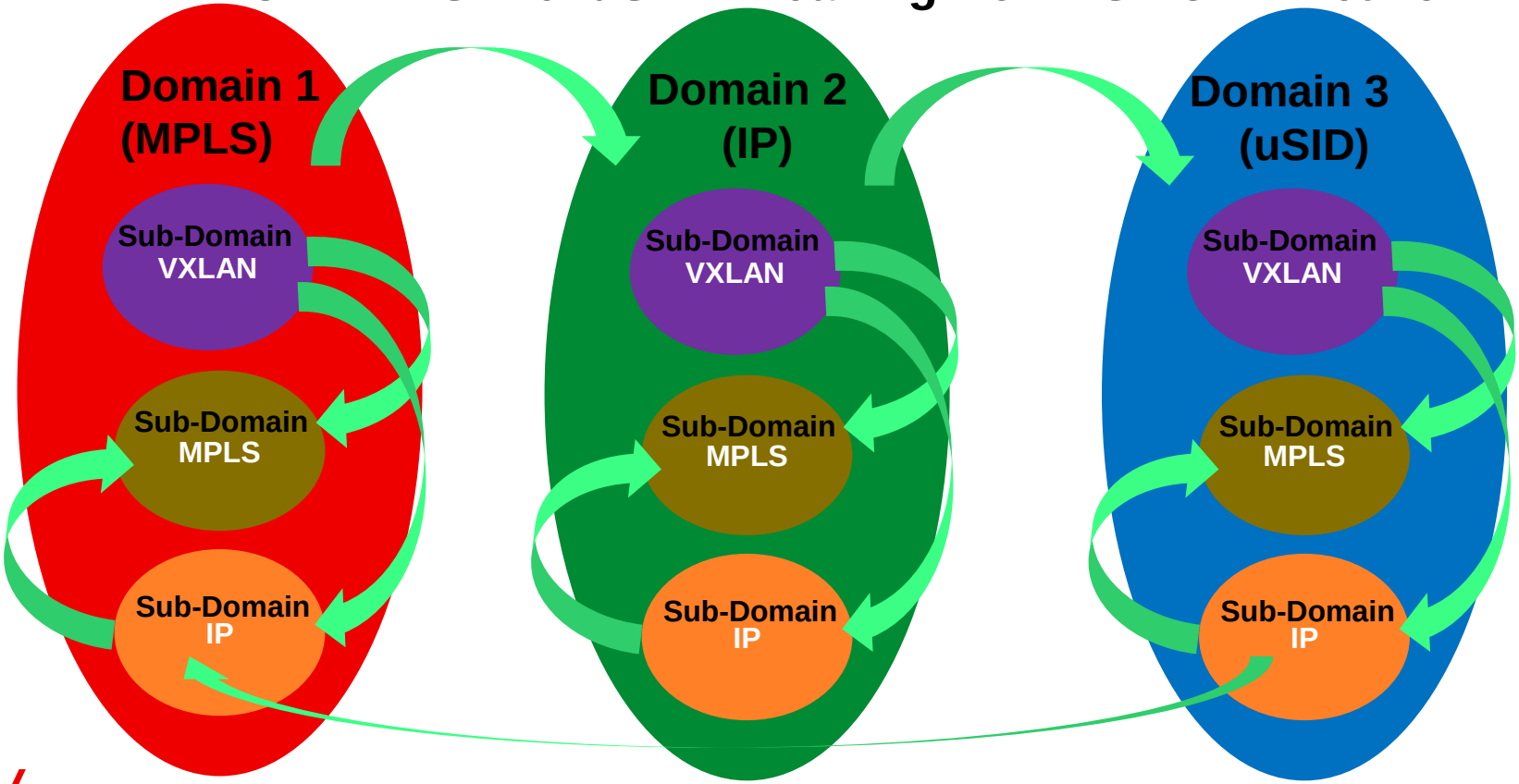


METRO
WAN FABRICS



EDGE PEERING
FABRICS

INTER DOMAIN SRv6 uSID Breaking Down SILOED Networking



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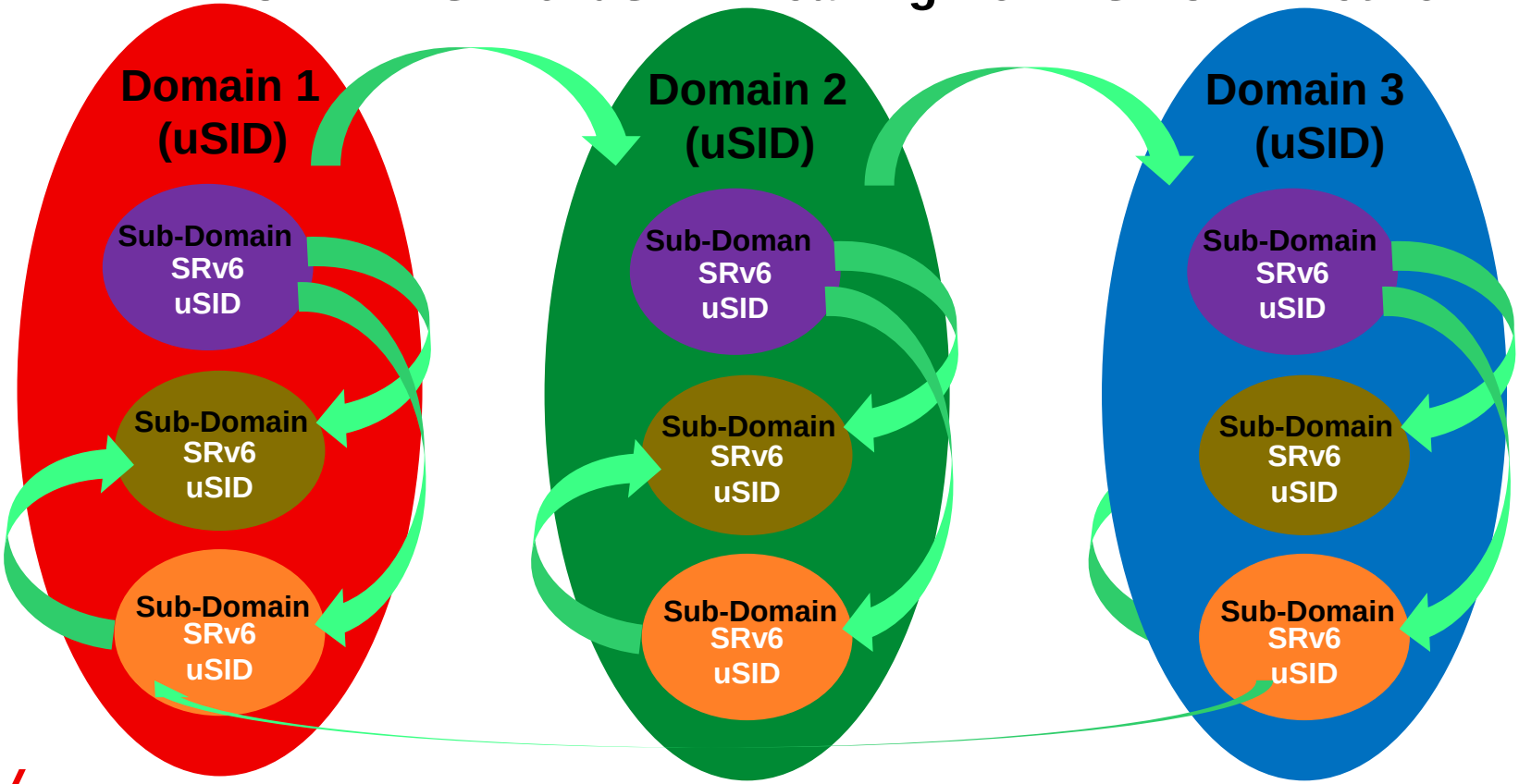
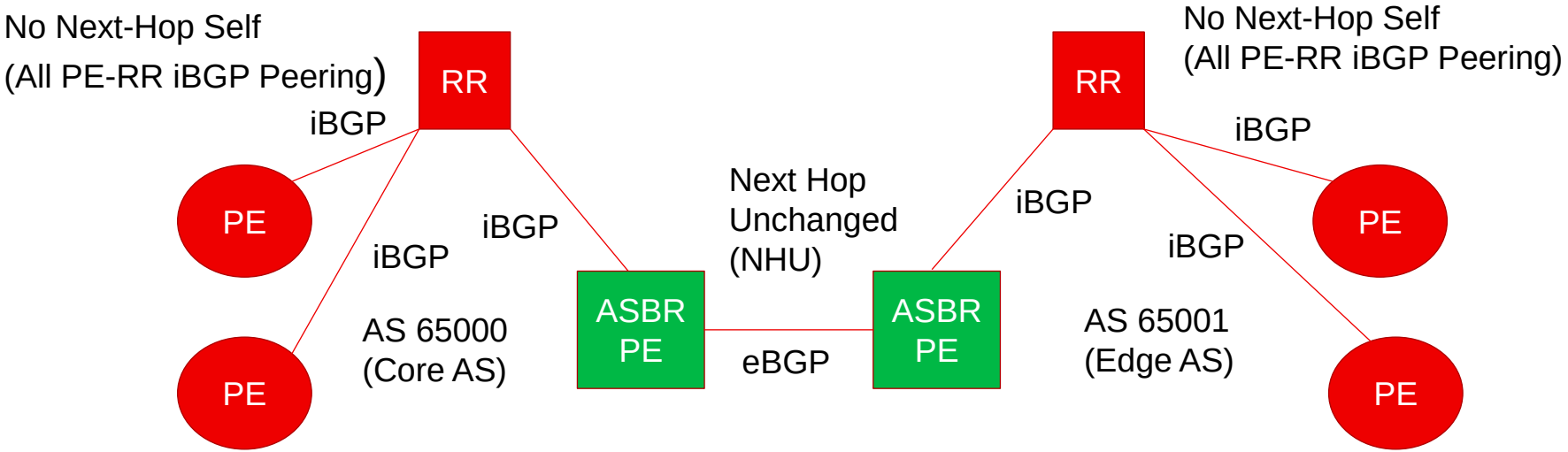


INTER DOMAIN SRv6 uSID

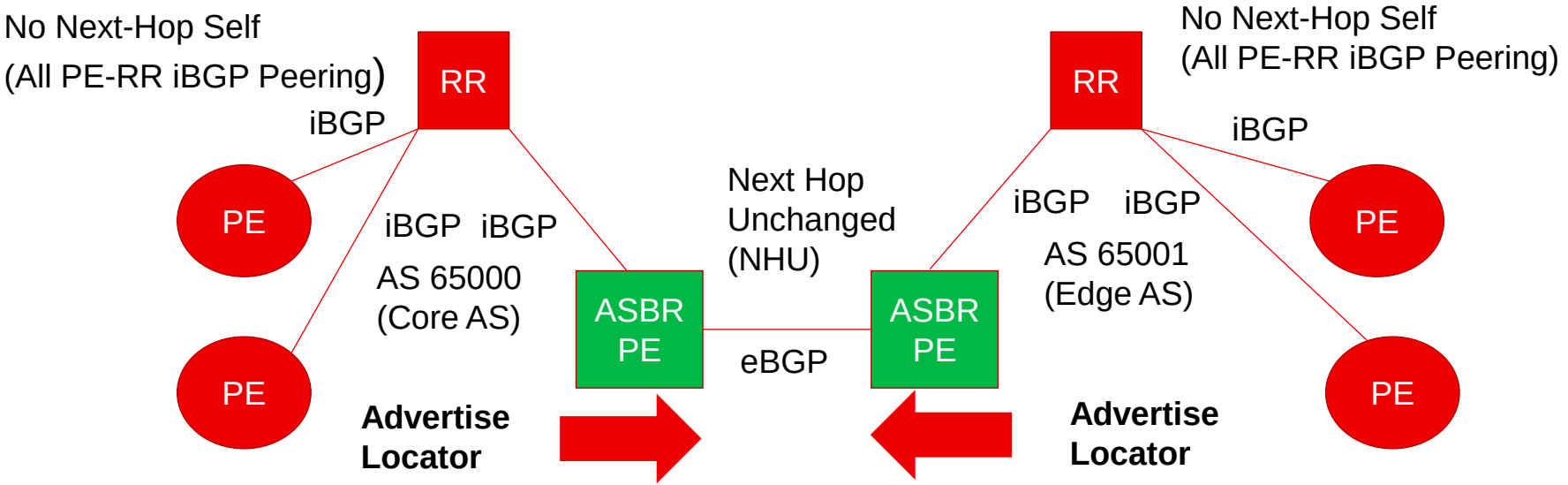


Rule for Inter Domain Peering

- iBGP -No Next-Hop Self
- eBGP –Next Hop Unchanged

(Requirement to Preserve L2 VPN & L3 VPN Service SID across INTER-AS Boundary)

INTER DOMAIN SRv6 uSID ROUTING SIMPLICITY



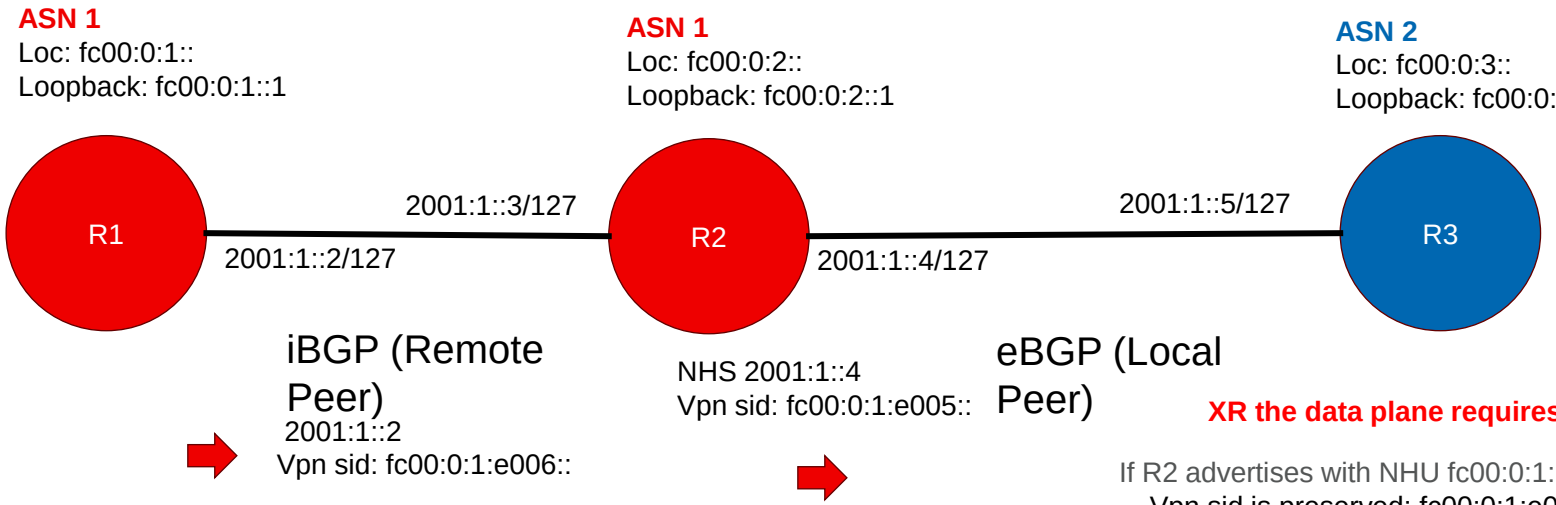
Rule for Inter Domain Peering

- Locator Reachability (That's it!!)

This allows host endpoints to provide static steering capabilities without PCE across any SR Algo cross domain

INTER DOMAIN SRv6 uSID

eBGP direct peering (NHU) – (Remote PE)

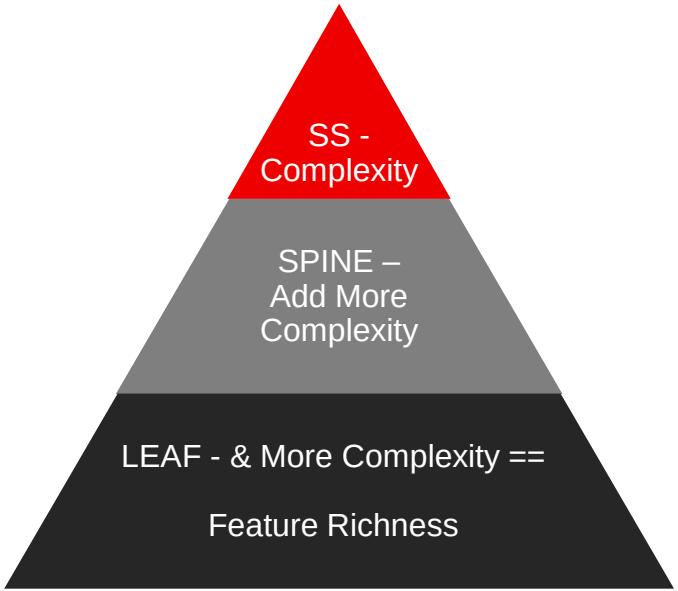


XR the data plane requires knob

If R2 advertises with NHU fc00:0:1::1
Vpn sid is preserved: fc00:0:1:e005::
but R3 sees it as *inaccessible*
BGP knob fixes the inaccessible
"IGNORE CONNECTED CHECK"
neighbor w.x.y.z
ignore-connected-check

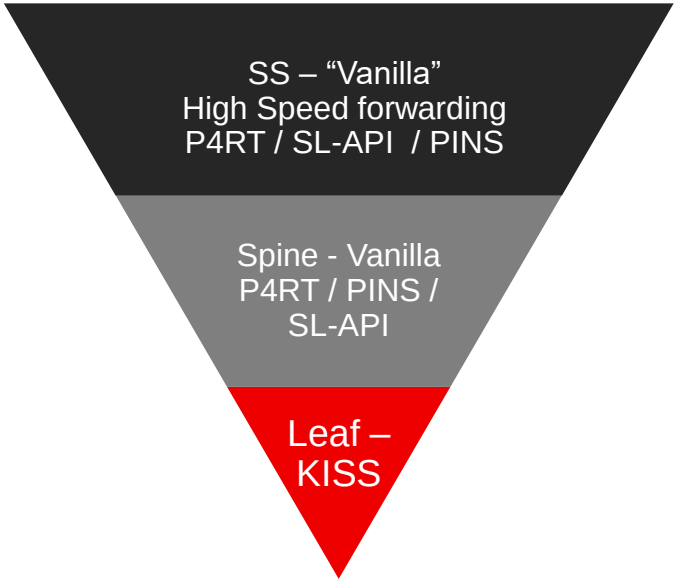
SRv6 uSID Design ⇔ “Top ⇔ Down” & “Bottom ⇔ Up” Approach

Top ⇔ Down



Traditional mindset has been for feature richness & complexity across the Data Center Fabric

Bottom ⇔ UP



SRv6 KISS ⇔ “Keep it Simple & Strategic” approach ⇔ Focus on High speed forwarding plane packet pushing throughput

Real World Use Cases of SRv6 uSID DC Landscape Experience

Real World Use Case #1 IPv6 Host Based Networking

Source DC or Domain (IPv6 Only) ⇔ Core Domain / Multi Domain OAD (One Administrative Domain) / Internet (SRv6 uSID Capable) ⇔ Destination Data Center or Domain(IPv6 Only) ⇔ Bottom-UP (KISS**) [END STATE] or [INTERMEDIATE STATE]**

- **Traffic Engineering and Carrier Grade** features are not a requirement in the Data Center.
- Operators can use white box switches or disaggregated hardware and software with Vanilla IPv6 Only DC fabric blindly passing the SRv6 uSID packets. Massive bandwidth **where Multi Petabits** of fiber can be thrown at the DC fabric, with the focus on **High Bandwidth** packet pushing with **Ultra simplified fabric**.
- **Steering** is initiated from the Data Center host attachment using IGP shortest path leaving the entire fabric 100% vanilla IPv6.

Real World Use Cases of SRv6 uSID DC Landscape Experience

Real World Use Case #2 Dual Plane MPLS / IPv6 Core Migration

Source DC or Domain (SRv6 uSID Capable) ⇔ Core Domain / Multi Domain OAD (One Administrative Domain) / Internet (IPv6 Only) ⇔ Destination Data Center or Domain (SRv6 uSID Capable) ⇔ Top-Down Feature Rich **[INTERMEDIATE STATE]**

- **Traffic Engineering & Carrier Grade** features are a requirement ONLY in the Data Center.
- **Traffic Engineering capabilities** in the Data Center, and the intermediate domains follow IGP shortest path **blindly forwarding** the SRv6 uSID packets. **Massive scale & resiliency** with full carrier grade features in the Data Center.
- **Steering** is initiated from the DC host attachment and follows IGP shortest path along the intermediate domains to the egress DC or Domain.

Real World Use Cases of SRv6 uSID DC Landscape Experience

Real World Use Case #3 SRv6 uSID End-To-End

Source DC or Domain (SRv6 uSID Capable) ⇔ Core Domain / Multi Domain OAD (One Administrative Domain) / Internet (SRv6 uSID Capable) ⇔ Destination Data Center or Domain (SRv6 uSID Capable) ⇔ Top-Down Feature Rich **[END STATE]**

- **Traffic Engineering** and all the Carrier Grade features are a requirement.
- **Full feature richness.**
- **Steering** is initiated from the Data Center host attachment or could be any switch within the DC fabric for any and all flow types.

SRv6 uSID Host Based Networking Traffic Engineering

Options for Host Based Networking

- eBPF/Cilium (Cilium BGP control plane) CNI or Standalone (Option-1)
- Native Linux Kernel (FRR BGP control plane) –Host Routing with Native Kernel (Option-2)
- FD.io VPP (FRR BGP control plane) -Host Routing via VPP (Option-3)
- Router-in-container (Control Plane & Data Plane) (xRD, SONiC, Nokia, Juniper cRPD) CNF (Option-4)

- Options are listed in order of desirability by operators
- Next few slides we will go into each option in detail

Option #1 eBPF/Cilium

- ❑ CNI Connects to global table ⇔ linkage of host fabric to DC fabric
- ❑ CNI Provides Traffic Engineering capabilities via SRv6 uSID
- ❑ CNI Provides VPN overlay - Workload Container, VM, CNF, VNF

Details

- ❑ Data plane programming
- ❑ FRR BGP for bgp control plane advertisement
- ❑ Cilium is one of the most popular CNI's to date and eBPF with its origins in the Linux kernel with its rich policy features & programmability provides seamless integration to compute nodes making it a powerful win-win for developers

Option #2 Native Linux Kernel

- Host Connects to global table ⇔ linkage of host fabric to DC fabric
- Host Provides Traffic Engineering capabilities via SRv6 uSID
- Host VPN overlay - Workload Container, VM, CNF, VNF

Details

- Data plane programming
- FRR BGP for control plane advertisement
- FRR can program the control plane & via Linux Kernel API call program the data plane FIB entries
- Alternatively, FRR can program the control plane with hook back to Linux Kernel to program the data plane FIB entries

Option #3 FD.IO VPP

- ❑ VPP Connects to global table ⇔ linkage of host fabric to DC fabric
- ❑ VPP Provides Traffic Engineering capabilities via SRv6 uSID
- ❑ VPP Provides VPN overlay - Workload Container, VM, CNF, VNF

Details

- ❑ Data plane programming
- ❑ FRR BGP for Control Plane Advertisement
- ❑ VPP ceases control of the Linux Hosts NIC
- ❑ Requires Netlink or other method to program VPP FIB
- ❑ VPP requires application flows to hair-pinned through the Linux Kernel which can become a bottleneck (Not for bandwidth & CPU intensive apps)

Option #4 Router-in-Container

- CNF Connects to global table ⇔ linkage of host fabric to DC fabric
- CNF Provides Traffic Engineering capabilities via SRv6 uSID
- CNF Provides VPN overlay - Workload Container, VM, CNF, VNF

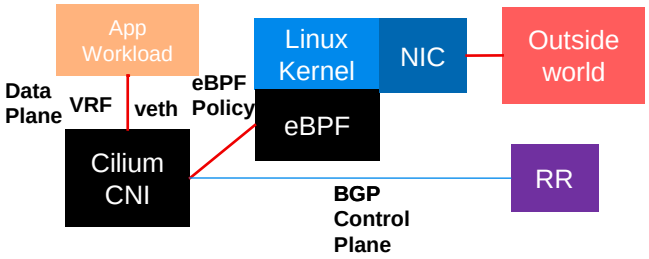
Details

Router-in-container options (xRD, SONiC, Nokia, Juniper cRPD)

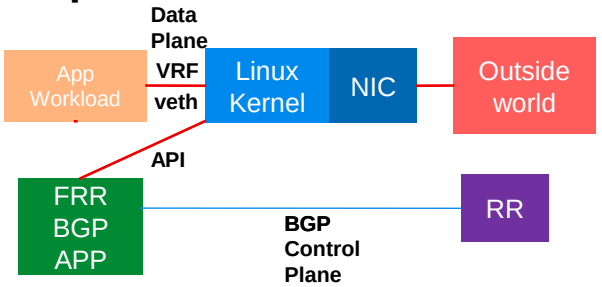
- Control plane & Data plane programming
- Requires Linux bridge stitching between Linux Kernel & CNF
- Container runs in user space so is beneficial for cases where only certain application requires traffic engineering capabilities
- Very difficult to create linkage of Router in container back to kernel space so all application workloads can take advantage of steering

Host Networking Drawing

Option #1 eBPF/Cilium



Option #2 Linux Kernel



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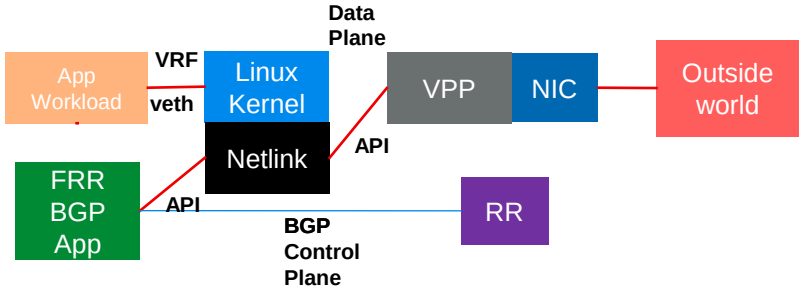
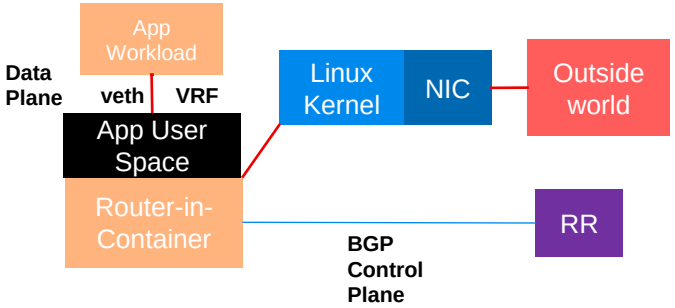


Option #4 Router-in-Container



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- ❑ Policy programmed from Linux Kernel & VPP host
- ❑ Policy programmed from Router-In-Container (XRD)

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  - IPv6 DC ⇔ *SRv6 uSID Core* ⇔IPv6 DC (2a)
  - *SRv6 uSID DC* ⇔ IPv6 Core ⇔ *SRv6 uSID DC (2b)*
  - SRv6 uSID End-to-End (2c)

✓

Use-Case 2a: SRv6 uSID E2E Multi POD w/ IPv6 DC & SRv6 uSID Core

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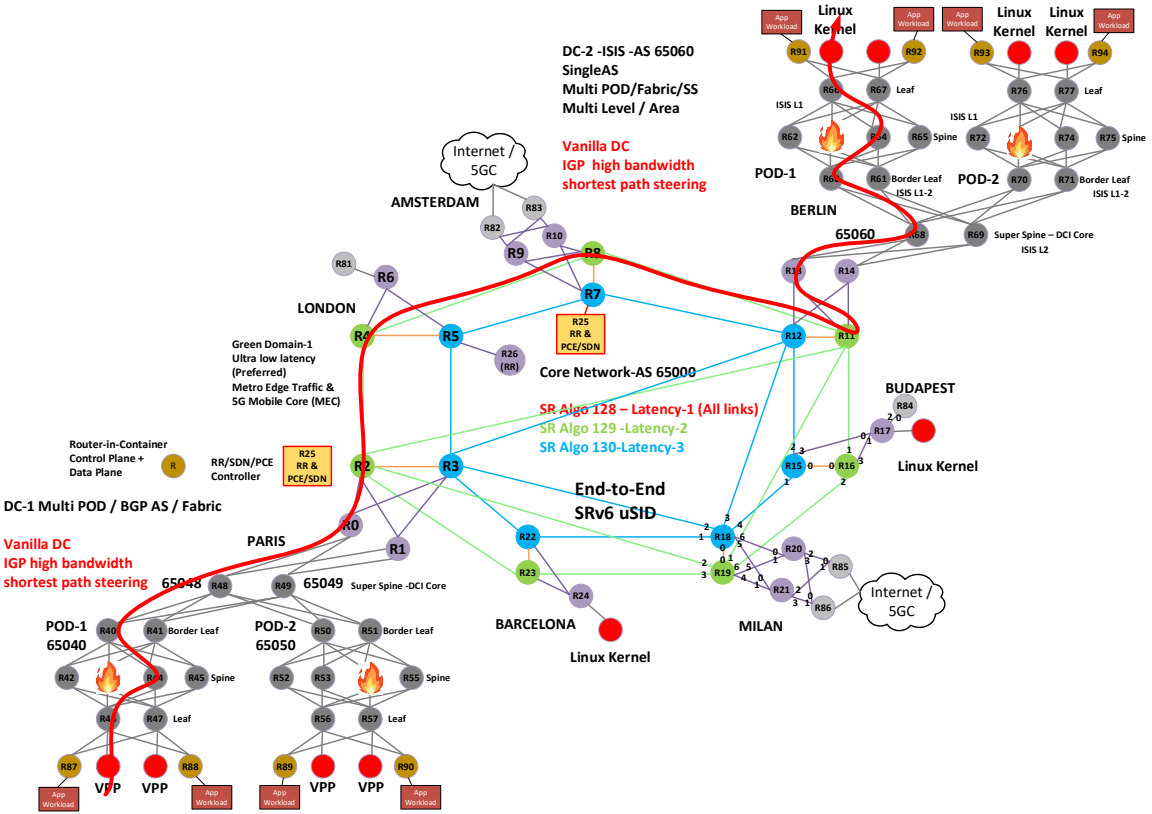
  - ❖ **IPv6 DC ⇔ *SRv6 uSID Core* ⇔IPv6 DC (2a)**

Use-Case 2a: SRv6 uSID E2E Multi POD w/ IPv6 DC & SRv6 uSID Core



Use-Case 2b: SRv6 uSID E2E Multi POD w/ SRv6 uSID DC & IPv6 Core

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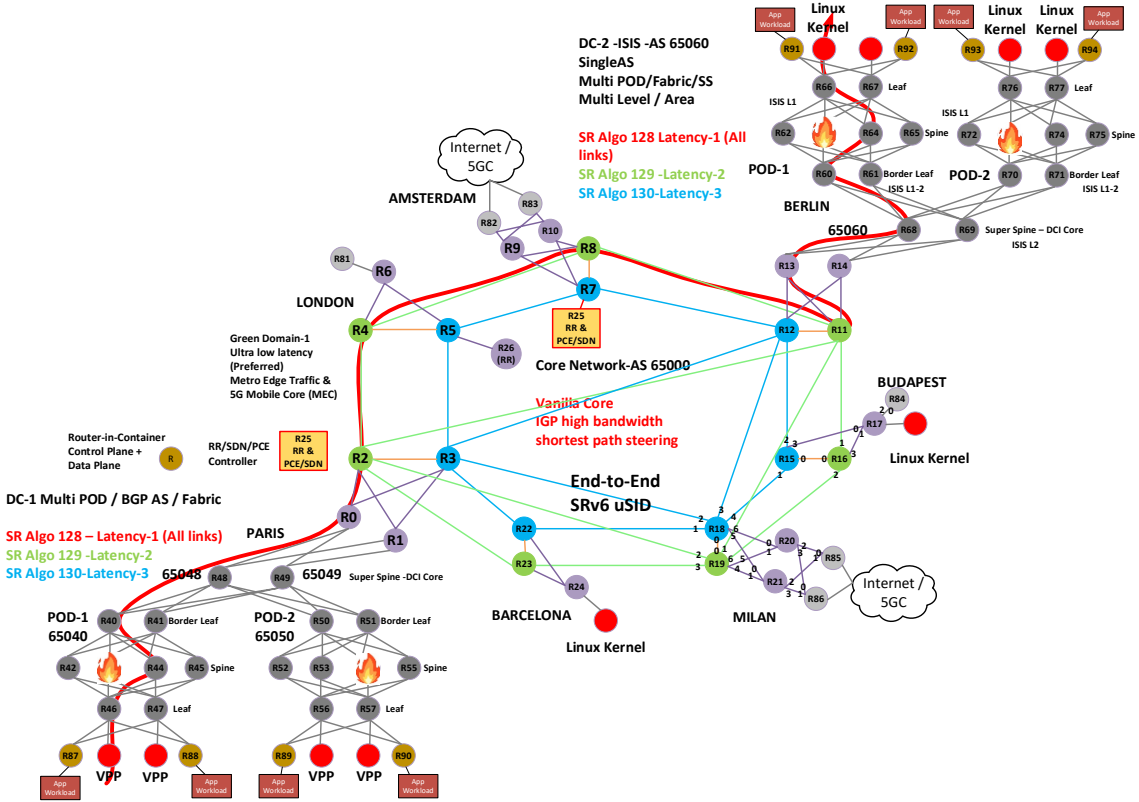
- **Use-case 2: SRv6 uSID with Multi POD Fabrics**
  - ***SRv6 uSID DC*** ⇔ **IPv6 Core** ⇔ ***SRv6 uSID DC (2c)***

Use-Case 2b: SRv6 uSID E2E Multi POD w/ SRv6 uSID DC & IPv6 Core



Use-Case 2c: SRv6 uSID E2E Multi POD

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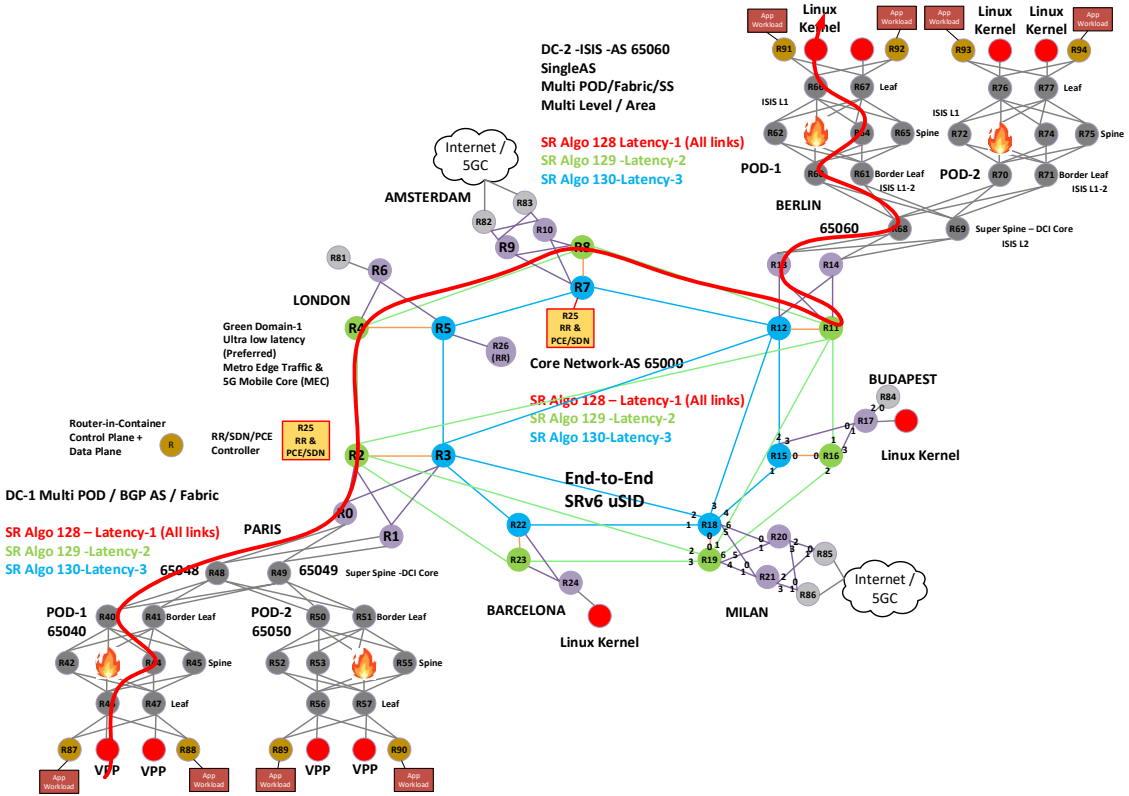
- **Use-case 2: SRv6 uSID with Multi POD Fabrics**
  - ❖ **SRv6 uSID End-to-End (2c)**

Use-Case 2c: SRv6 uSID E2E Multi POD



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- SRv6 uSID End-to-End (3c)

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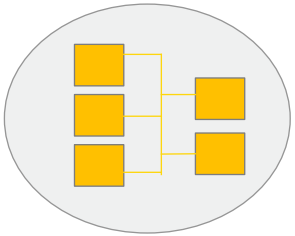
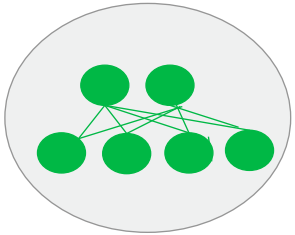


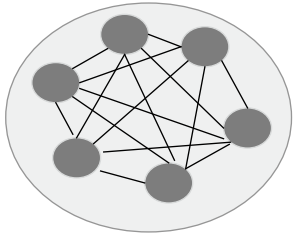
DC OVERLAYS

IPv4



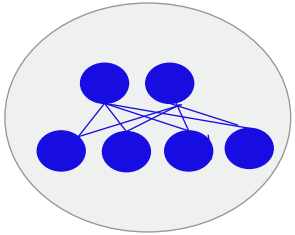
DC FABRICS (UNDERLAY)

MPLS



METRO WAN FABRICS

IPv4, IPv6



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A Common End-to-End Forwarding Architecture Enables Common HW, SW, SDN, Ops ⇔ **Massive Scale**

SRv6 uSID

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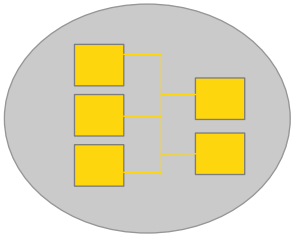
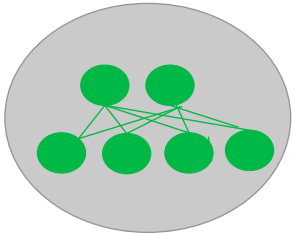
SRv6 uSID ⇔ Translates into Ultra Massive Scale

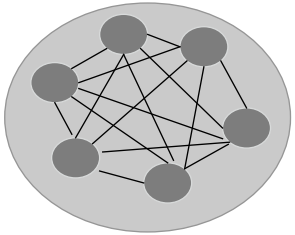


DC OVERLAYS

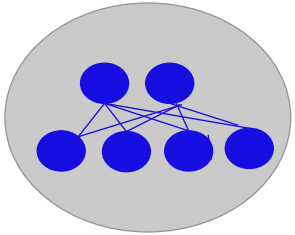


UNDERLAY
DC FABRICS

“End-to-End Inter-Domain Routing via SRv6 uSID”

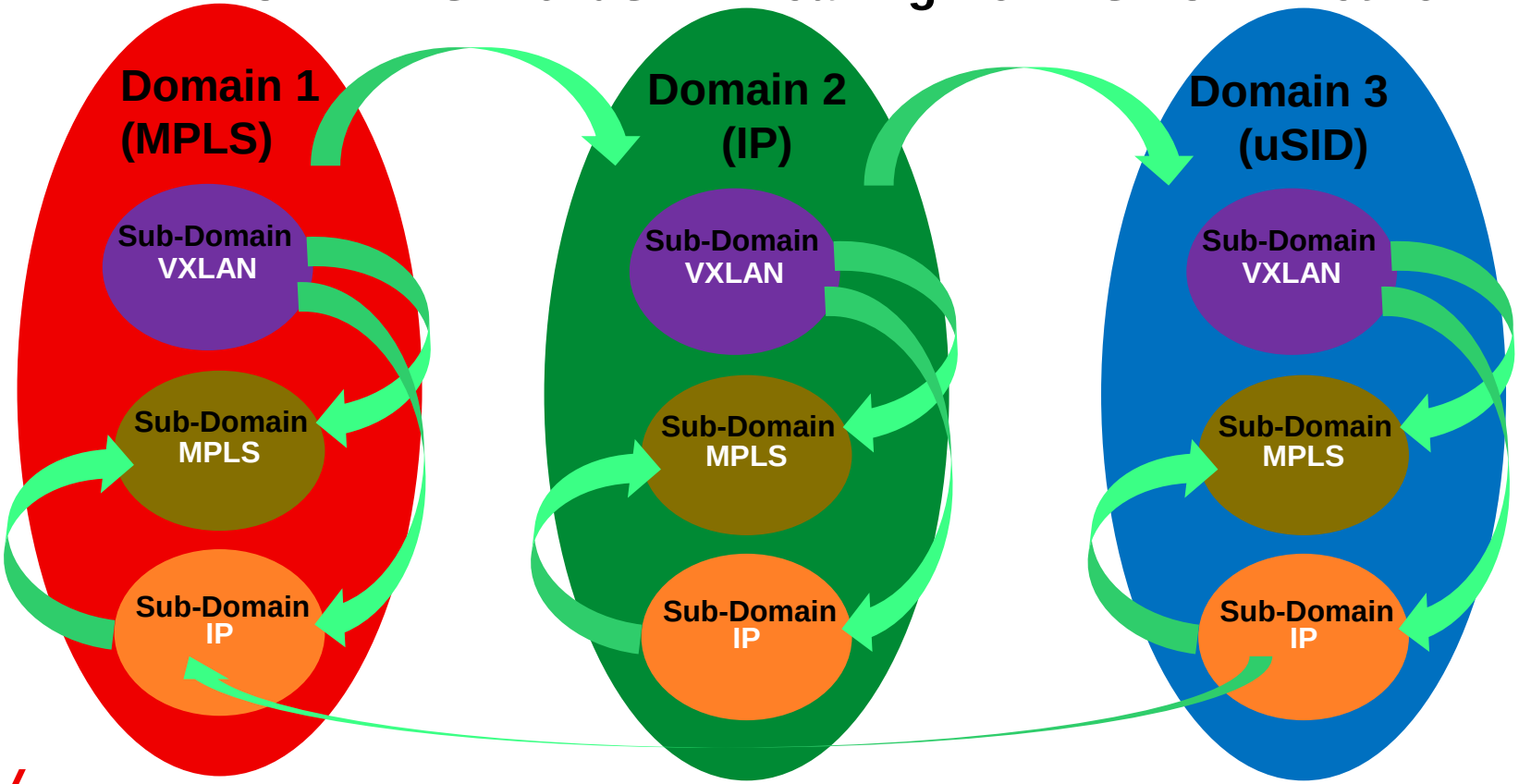


METRO
WAN FABRICS

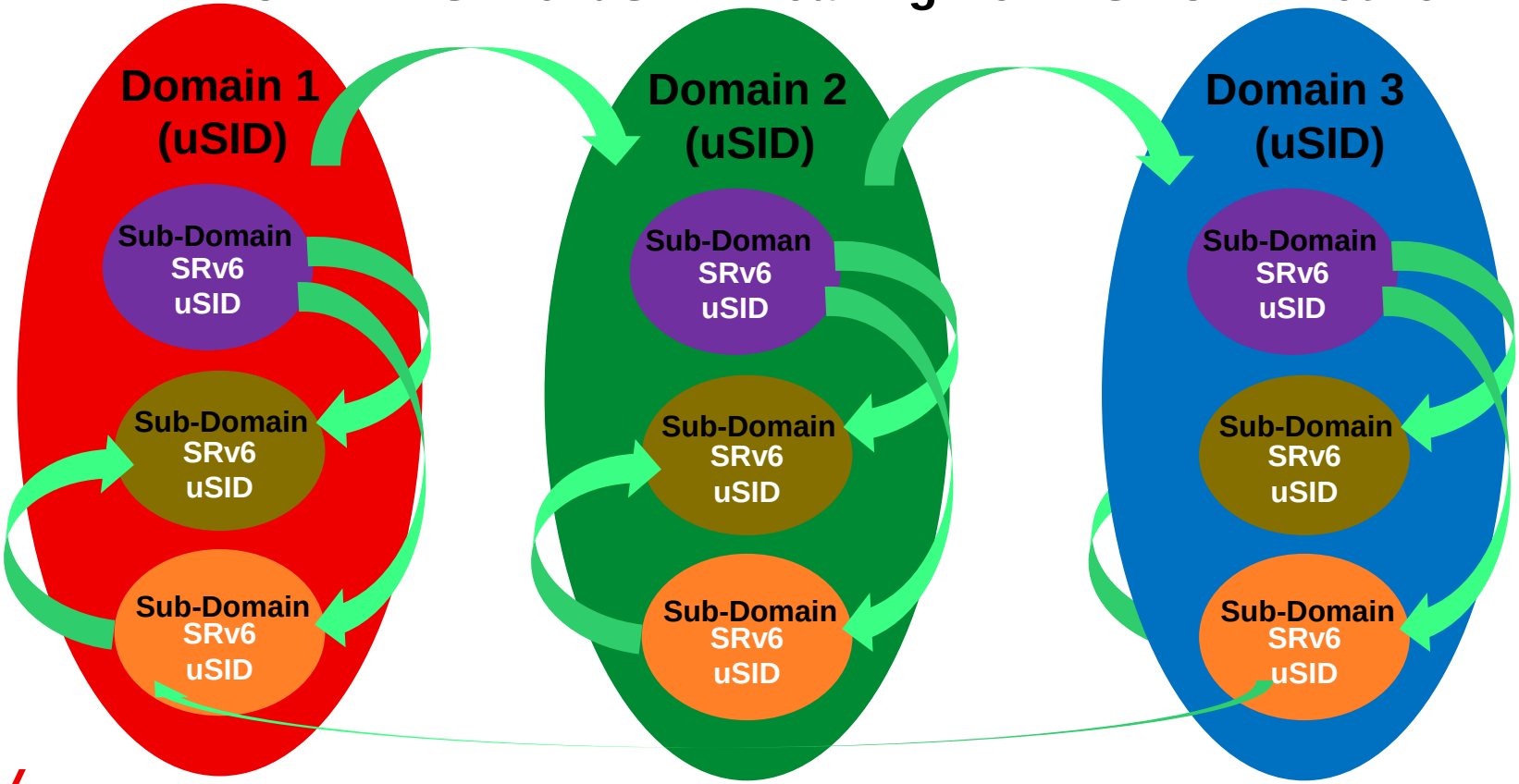


EDGE PEERING
FABRICS

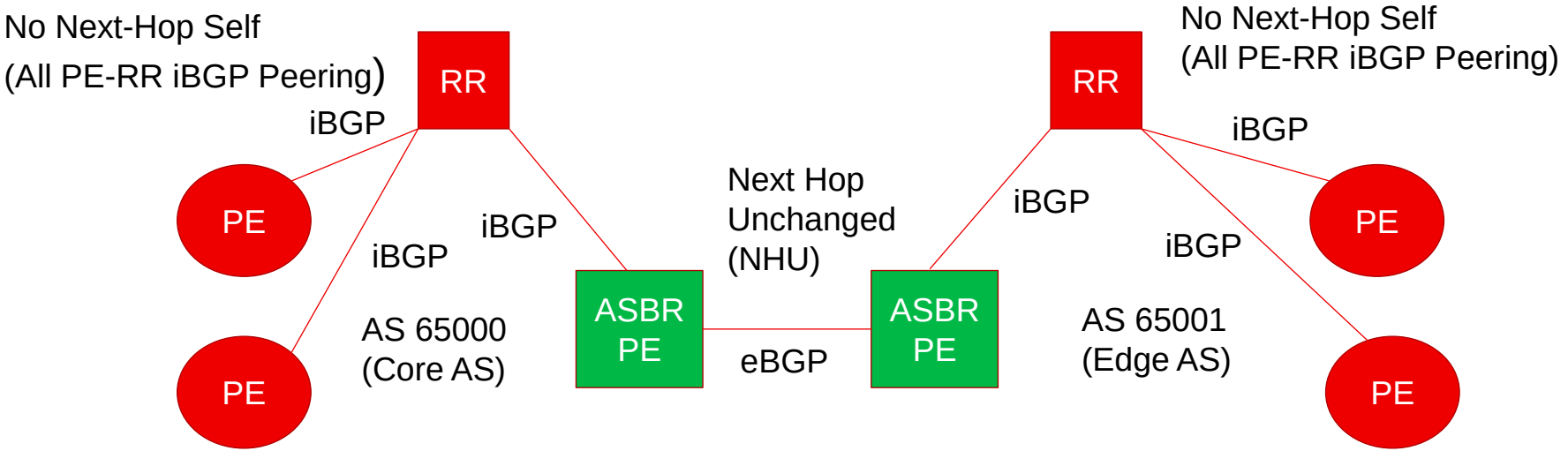
INTER DOMAIN SRv6 uSID Breaking Down SILOED Networking



INTER DOMAIN SRv6 uSID Breaking Down SILOED Networking



INTER DOMAIN SRv6 uSID

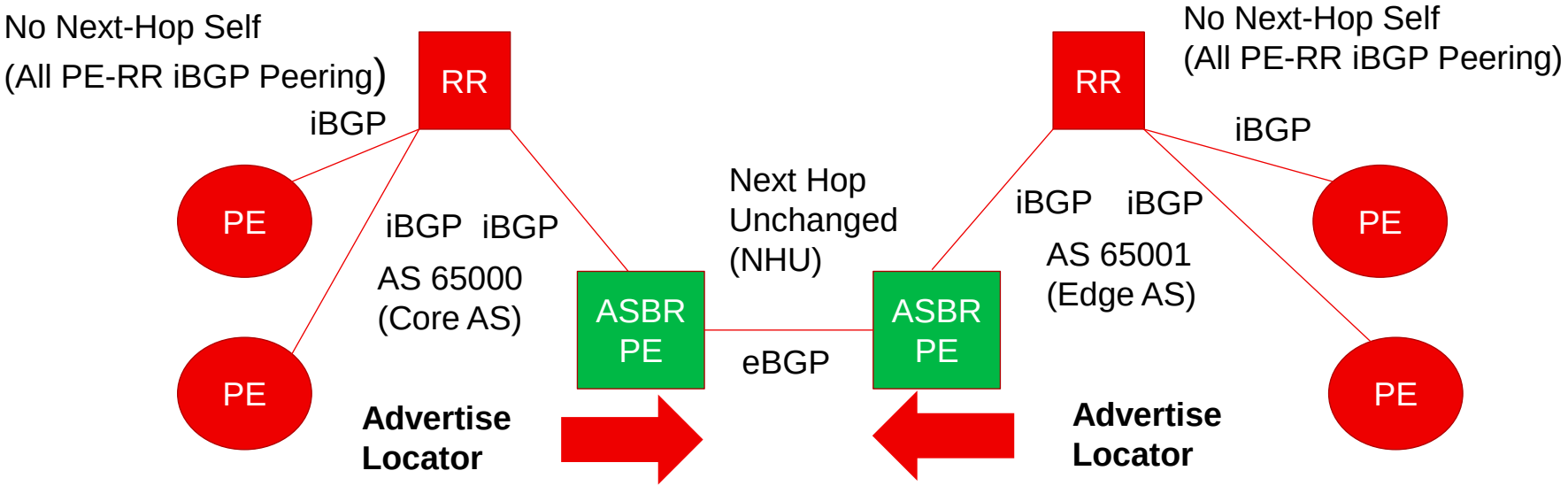


Rule for Inter Domain Peering

- iBGP -No Next-Hop Self
- eBGP –Next Hop Unchanged

(Requirement to Preserve L2 VPN & L3 VPN Service SID across INTER-AS Boundary)

INTER DOMAIN SRv6 uSID ROUTING SIMPLICITY



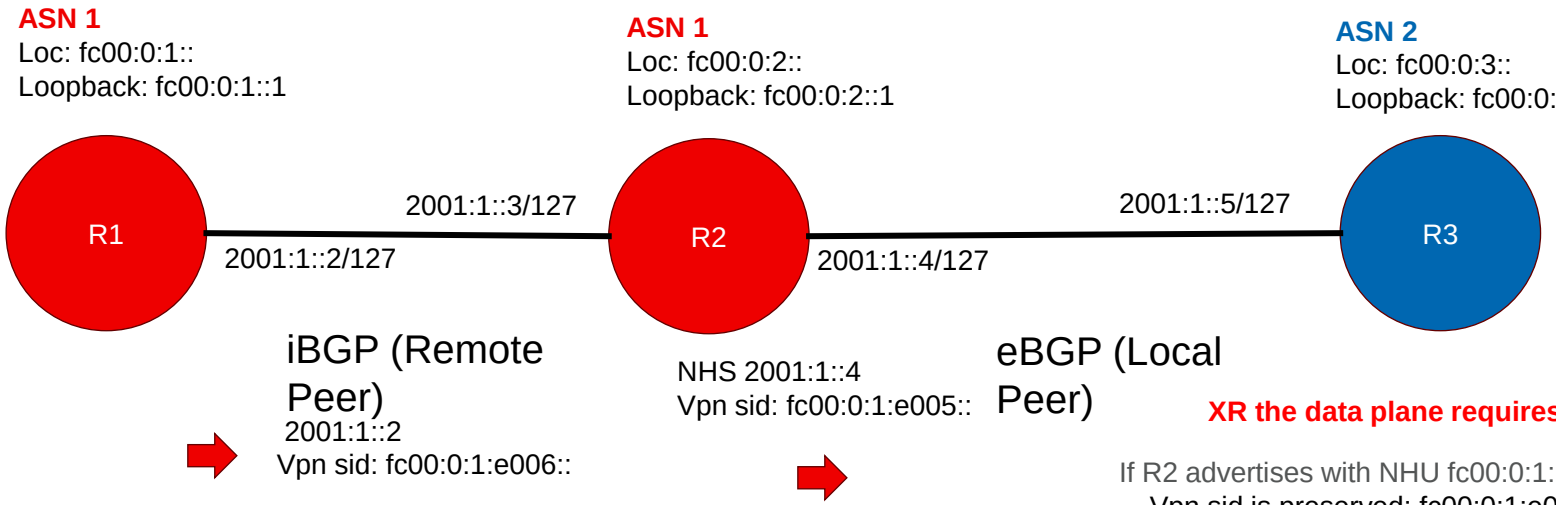
Rule for Inter Domain Peering

- Locator Reachability (That's it!!)

This allows host endpoints to provide static steering capabilities without PCE across any SR Algo cross domain

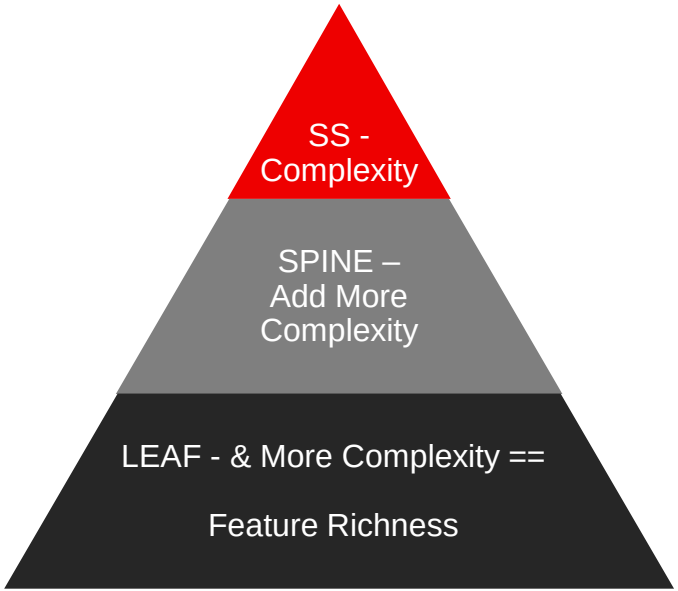
INTER DOMAIN SRv6 uSID

eBGP direct peering (NHU) – (Remote PE)



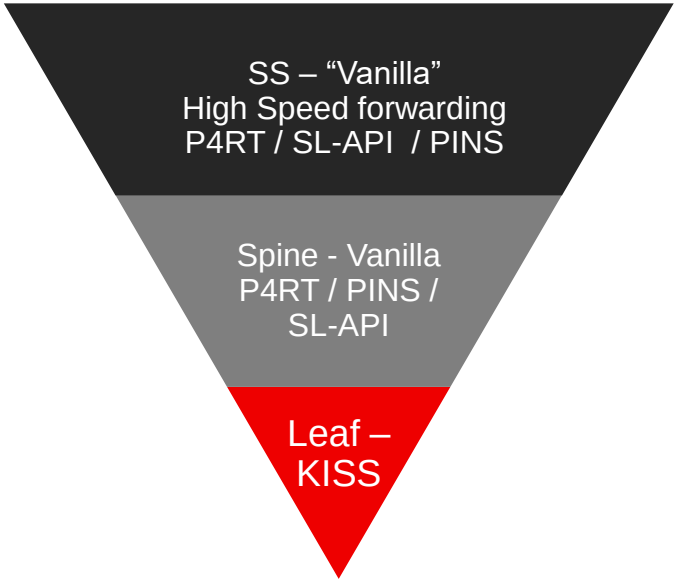
SRv6 uSID Design ⇔ “Top ⇔ Down” & “Bottom ⇔ Up” Approach

Top ⇔ Down



Traditional mindset has been for feature richness & complexity across the Data Center Fabric

Bottom ⇔ UP



SRv6 KISS ⇔ “Keep it Simple & Strategic” approach ⇔ Focus on High speed forwarding plane packet pushing throughput

Real World Use Cases of SRv6 uSID DC Landscape Experience

Real World Use Case #1 IPv6 Host Based Networking

Source DC or Domain (IPv6 Only) ⇔ Core Domain / Multi Domain OAD (One Administrative Domain) / Internet (SRv6 uSID Capable) ⇔ Destination Data Center or Domain(IPv6 Only) ⇔ Bottom-UP (KISS**) [END STATE] or [INTERMEDIATE STATE]**

- **Traffic Engineering and Carrier Grade** features are not a requirement in the Data Center.
- Operators can use white box switches or disaggregated hardware and software with Vanilla IPv6 Only DC fabric blindly passing the SRv6 uSID packets. Massive bandwidth **where Multi Petabits** of fiber can be thrown at the DC fabric, with the focus on **High Bandwidth** packet pushing with **Ultra simplified fabric**.
- **Steering** is initiated from the Data Center host attachment using IGP shortest path leaving the entire fabric 100% vanilla IPv6.

Real World Use Cases of SRv6 uSID DC Landscape Experience

Real World Use Case #2 Dual Plane MPLS / IPv6 Core Migration

Source DC or Domain (SRv6 uSID Capable) ⇔ Core Domain / Multi Domain OAD (One Administrative Domain) / Internet (IPv6 Only) ⇔ Destination Data Center or Domain (SRv6 uSID Capable) ⇔ Top-Down Feature Rich **[INTERMEDIATE STATE]**

- **Traffic Engineering & Carrier Grade** features are a requirement ONLY in the Data Center.
- **Traffic Engineering capabilities** in the Data Center, and the intermediate domains follow IGP shortest path **blindly forwarding** the SRv6 uSID packets. **Massive scale & resiliency** with full carrier grade features in the Data Center.
- **Steering** is initiated from the DC host attachment and follows IGP shortest path along the intermediate domains to the egress DC or Domain.

Real World Use Cases of SRv6 uSID DC Landscape Experience

Real World Use Case #3 SRv6 uSID End-To-End

Source DC or Domain (SRv6 uSID Capable) ⇔ Core Domain / Multi Domain OAD (One Administrative Domain) / Internet (SRv6 uSID Capable) ⇔ Destination Data Center or Domain (SRv6 uSID Capable) ⇔ Top-Down Feature Rich **[END STATE]**

- **Traffic Engineering** and all the Carrier Grade features are a requirement.
- **Full feature richness.**
- **Steering** is initiated from the Data Center host attachment or could be any switch within the DC fabric for any and all flow types.

SRv6 uSID Host Based Networking Traffic Engineering

Options for Host Based Networking

- eBPF/Cilium (Cilium BGP control plane) CNI or Standalone (Option-1)
- Native Linux Kernel (FRR BGP control plane) –Host Routing with Native Kernel (Option-2)
- FD.io VPP (FRR BGP control plane) -Host Routing via VPP (Option-3)
- Router-in-container (Control Plane & Data Plane) (xRD, SONiC, Nokia, Juniper cRPD) CNF (Option-4)

- Options are listed in order of desirability by operators
- Next few slides we will go into each option in detail

Option #1 eBPF/Cilium

- ❑ CNI Connects to global table ⇔ linkage of host fabric to DC fabric
- ❑ CNI Provides Traffic Engineering capabilities via SRv6 uSID
- ❑ CNI Provides VPN overlay - Workload Container, VM, CNF, VNF

Details

- ❑ Data plane programming
- ❑ FRR BGP for bgp control plane advertisement
- ❑ Cilium is one of the most popular CNI's to date and eBPF with its origins in the Linux kernel with its rich policy features & programmability provides seamless integration to compute nodes making it a powerful win-win for developers

Option #2 Native Linux Kernel

- Host Connects to global table ⇔ linkage of host fabric to DC fabric
- Host Provides Traffic Engineering capabilities via SRv6 uSID
- Host VPN overlay - Workload Container, VM, CNF, VNF

Details

- Data plane programming
- FRR BGP for control plane advertisement
- FRR can program the control plane & via Linux Kernel API call program the data plane FIB entries
- Alternatively, FRR can program the control plane with hook back to Linux Kernel to program the data plane FIB entries

Option #3 FD.IO VPP

- ❑ VPP Connects to global table ⇔ linkage of host fabric to DC fabric
- ❑ VPP Provides Traffic Engineering capabilities via SRv6 uSID
- ❑ VPP Provides VPN overlay - Workload Container, VM, CNF, VNF

Details

- ❑ Data plane programming
- ❑ FRR BGP for Control Plane Advertisement
- ❑ VPP ceases control of the Linux Hosts NIC
- ❑ Requires Netlink or other method to program VPP FIB
- ❑ VPP requires application flows to hair-pinned through the Linux Kernel which can become a bottleneck (Not for bandwidth & CPU intensive apps)

Option #4 Router-in-Container

- CNF Connects to global table ⇔ linkage of host fabric to DC fabric
- CNF Provides Traffic Engineering capabilities via SRv6 uSID
- CNF Provides VPN overlay - Workload Container, VM, CNF, VNF

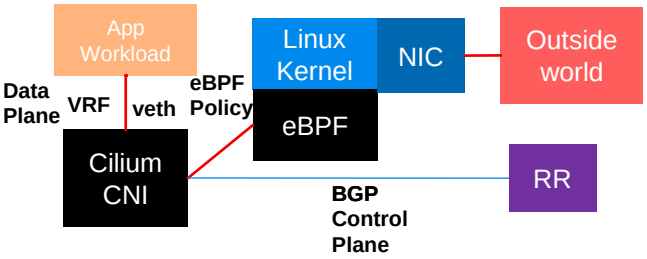
Details

Router-in-container options (xRD, SONiC, Nokia, Juniper cRPD)

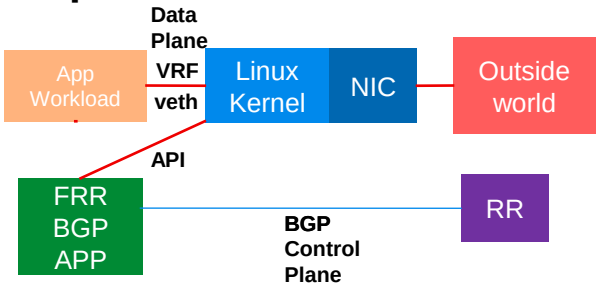
- Control plane & Data plane programming
- Requires Linux bridge stitching between Linux Kernel & CNF
- Container runs in user space so is beneficial for cases where only certain application requires traffic engineering capabilities
- Very difficult to create linkage of Router in container back to kernel space so all application workloads can take advantage of steering

Host Networking Drawing

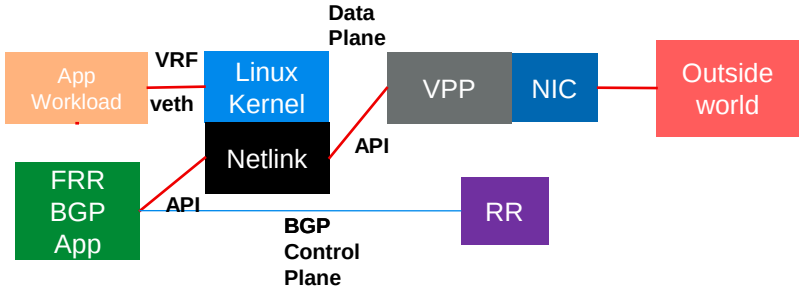
Option #1 eBPF/Cilium



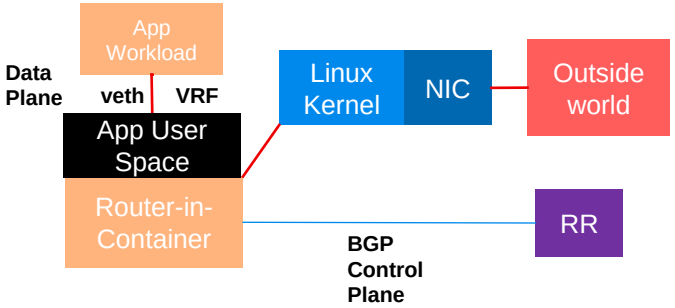
Option #2 Linux Kernel



Option #3 FD.io VPP



Option #4 Router-in-Container



Demo time!

All Demo's @ YouTube Channel SRv6 uSID DC:

https://github.com/segmentrouting/srv6-labs

https://youtube.com/@SRv6_uSID_DC

- ❑ Host-to-Host multi-pod across the metro
- ❑ Policy programmed from Linux Kernel & VPP host
- ❑ Policy programmed from Router-In-Container (XRD)

- **Use-case 3: SRv6 uSID with Multi POD? Domain Fabrics**
  - IPv6 DC ⇔ *SRv6 uSID Core* ⇔IPv6 DC (3a)
  - *SRv6 uSID DC* ⇔ IPv6 Core ⇔ *SRv6 uSID DC (3b)*
  - SRv6 uSID End-to-End (3c)

✓

Use-Case 3a: SRv6 uSID E2E Multi POD/Domain w/ IPv6 DC & SRv6 uSID Core

Demo time!

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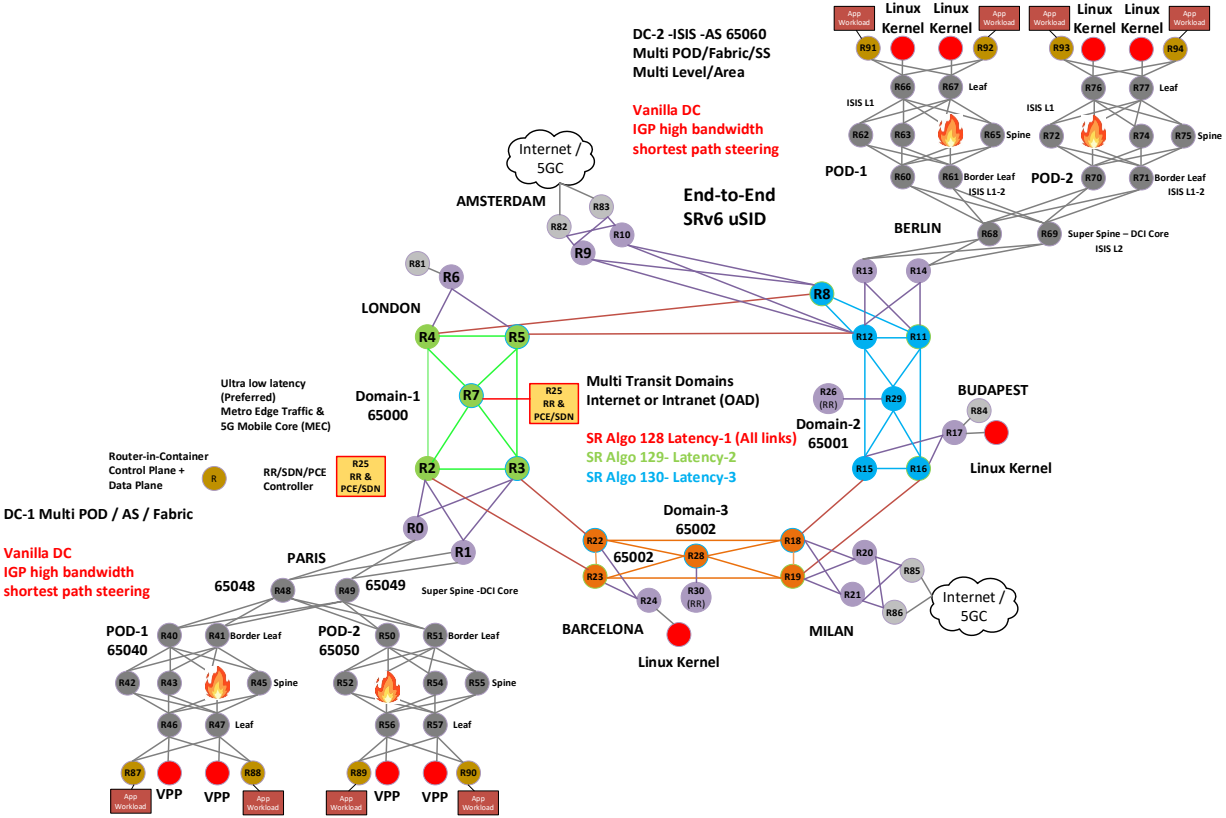
https://youtube.com/@SRv6_uSID_DC

- ❑ Host-to-Host multi-pod across the metro
- ❑ Policy programmed from Linux Kernel & VPP host
- ❑ Policy programmed from Router-In-Container (XRD)

- **Use-case 3: SRv6 uSID with Multi POD? Domain Fabrics**
  - **IPv6 DC ⇔ *SRv6 uSID Core* ⇔IPv6 DC (3a)**

Use-Case 3a: SRv6 uSID E2E Multi POD/Domain w/ IPv6 DC & SRv6 uSID Core



Use-Case 3b: SRv6 uSID E2E Multi POD/Domain w/ SRv6 uSID DC & IPv6 Core

Demo time!

All Demo's @ YouTube Channel SRv6 uSID DC:

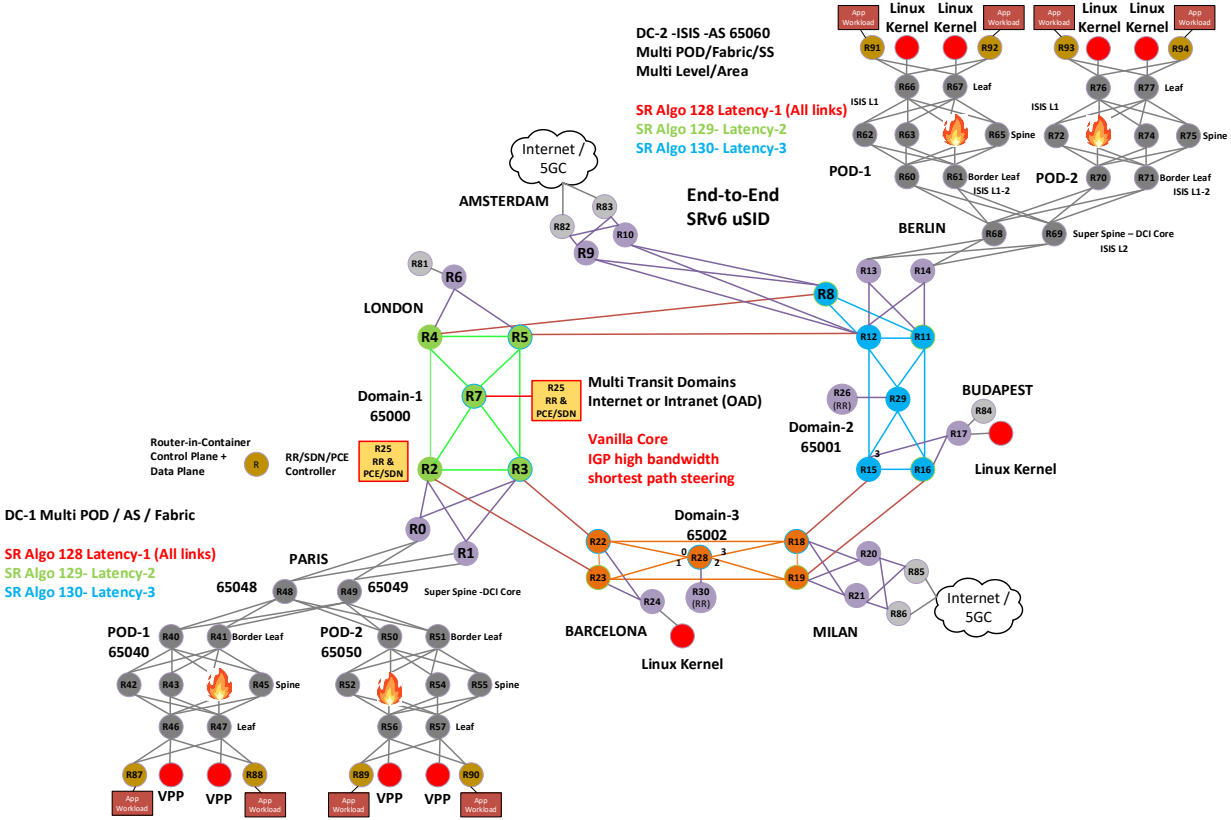
https://github.com/segmentrouting/srv6-labs

https://youtube.com/@SRv6_uSID_DC

- ❑ Host-to-Host multi-pod across the metro
- ❑ Policy programmed from Linux Kernel & VPP host
- ❑ Policy programmed from Router-In-Container (XRD)

- **Use-case 3: SRv6 uSID with Multi POD? Domain Fabrics**
  - *SRv6 uSID DC* ⇔ IPv6 Core ⇔ *SRv6 uSID DC (3b)*

Use-Case 3b: SRv6 uSID E2E Multi POD/Domain w/ SRv6 uSID DC & IPv6 Core



Use-Case 3c: SRv6 uSID E2E Multi POD / Multi Domain

Demo time!

All Demo's @ YouTube Channel SRv6 uSID DC:

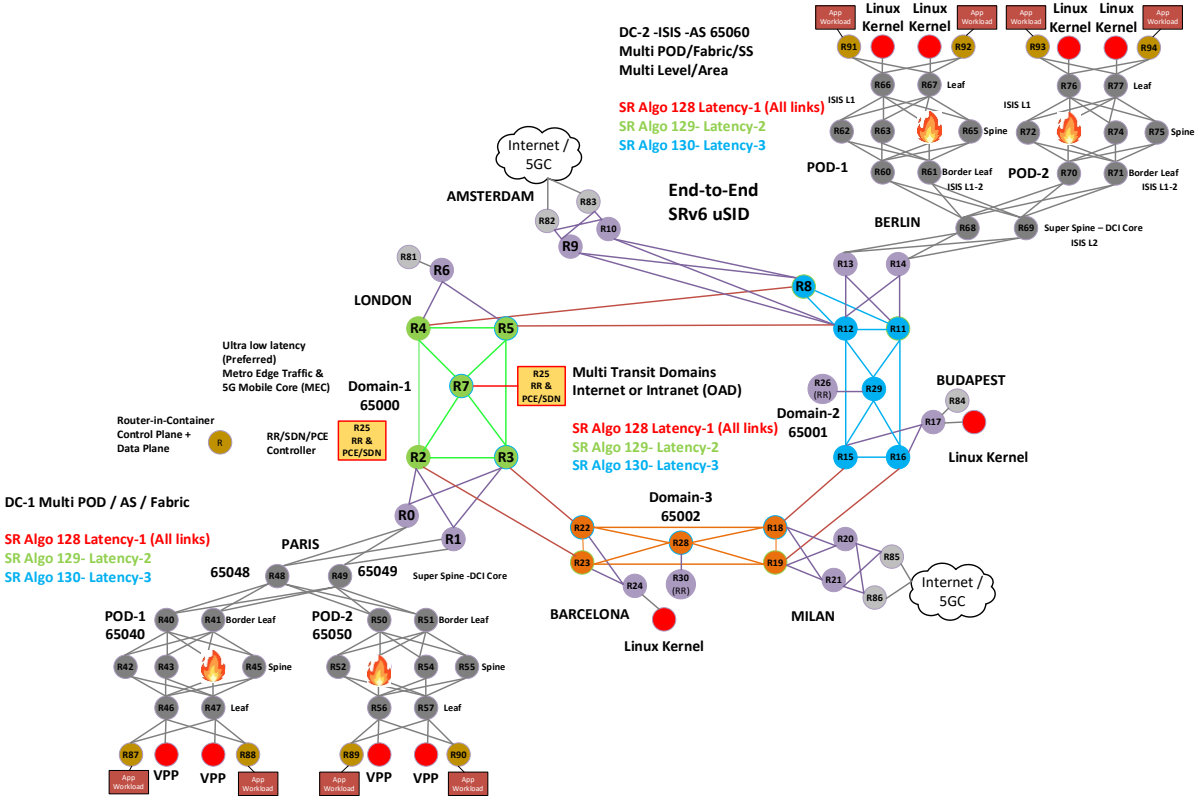
https://github.com/segmentrouting/srv6-labs

https://youtube.com/@SRv6_uSID_DC

- ❑ Host-to-Host multi-pod across the metro
- ❑ Policy programmed from Linux Kernel & VPP host
- ❑ Policy programmed from Router-In-Container (XRD)

- **Use-case 3: SRv6 uSID with Multi POD? Domain Fabrics**
  - **SRv6 uSID End-to-End (3c)**

Use-Case 3c: SRv6 uSID E2E Multi POD / Multi Domain



Use-Case 1: SRv6 uSID DC Fabric Packet Capture & Screen Scrapes

SRv6 uSID IPv4 payload steer DC-2 Paris ⇔ Core ⇔ DC-1 Berlin using VPP Host attached to DC fabric

SRv6 uSID IPv4 payload steering policy

vpp#sr policy add bsid 40::40 next fc00:0:44:40:4:64:66:e000 encap

vpp#sr steer l3 10.0.0.66/32 via bsid 40::40

```
vpp# show sr policies
SR policies:
[0].-   BSID: 40::40
        Behavior: Encapsulation
        EncapSrcIP: fc00:0:46:1::3
        Type: Default
        FIB table: 0
        Segment Lists:
        [0].- < fc00:0:44:40:4:64:66:e000 > weight: 1

vpp# show sr steering-policies
SR steering policies:
Traffic         SR policy BSID
L3 10.0.0.66/32 40::40
```

SRv6 uSID IPv6 payload steer:

vpp#sr policy add bsid 41::41 next fc00:0:44:40:4:64:66:e000 encap

vpp# sr steer l3 fc00:0:66::1/128 via bsid 41::41

```
vpp# show sr policies
SR policies:
[1].-   BSID: 94::94
        Behavior: Encapsulation
        EncapSrcIP: fc00:0:46:1::3
        Type: Default
        FIB table: 0
        Segment Lists:
        [1].- < fc00:0:45:41:66:e000:: > weight: 1
-----------
vpp# show sr steering-policies
SR steering policies:
Traffic         SR policy BSID
L3 fc00:0:66::1/128     41::41
```

IPv4 payload packet capture xrd61-xrd64

```
04:41:56.724814 IP6 fc00:0:46:1::3 > fc00:0:64:66:e000::: IP 10.11.46.2 > 10.0.0.66: ICMP echo request, id 113, seq 463, length 64
04:41:57.724271 IP6 fc00:0:46:1::3 > fc00:0:64:66:e000::: IP 10.11.46.2 > 10.0.0.66: ICMP echo request, id 113, seq 464, length 64
```

IPv6 payload packet capture xrd61-xrd64:

```
04:55:37.285381 IP6 fc00:0:46:1::3 > fc00:0:64:66:e000::: IP6 fc00:0:46:2::2 > fc00:0:66::1: ICMP6, echo request, seq 368, length 64
04:55:38.285012 IP6 fc00:0:46:1::3 > fc00:0:64:66:e000::: IP6 fc00:0:46:2::2 > fc00:0:66::1: ICMP6, echo request, seq 369, length 64
```

Use-Case 2: SRv6 uSID Inter-DC Packet Capture & Screen Scrapes

SRv6 uSID IPv4 payload steer DC-1 Berlin ⇔ Core ⇔ DC-2 Paris using Linux host attached to DC fabric

SRv6 uSID IPv6 payload steering policy:

root@ubuntu-linux-srv6:sudo ip route add 10.0.0.46/32 encap seg6 mode encap segs fc00:0:64:61:4:44:46:e000 dev ens7
root@ubuntu-linux-srv6:/home/cisco# ip route
default via 192.168.122.1 dev ens8 proto dhcp src 192.168.122.88 metric 100
10.0.0.0/24 via 10.10.66.2 dev ens7 proto static
10.0.0.46 encap seg6 mode encap segs 1 [fc00:0:64:61:4:44:46:e000] dev ens7 scope link----------->SRv6 uSID steering programmed IPv4 payload

SRv6 uSID IPv4 payload steer capture DC-2 Paris:

xrd41-xrd44

20:30:23.274808 IP6 fc00:0:66:1:5054:2ff:fe41:b107 > fc00:0:44:46:e000::: srcrt (len=2, type=4, segleft=0[|srcrt]
20:30:24.275510 IP6 fc00:0:66:1:5054:2ff:fe41:b107 > fc00:0:44:46:e000::: srcrt (len=2, type=4, segleft=0[|srcrt]

SRv6 uSID IPv6 payload steering policy:

root@ubuntu-linux-srv6:sudo ip -6 route add fc00:0:46::1 encap seg6 mode encap segs fc00:0:64:61:4:44:46:e000 dev ens7
root@ubuntu-linux-srv6:/home/cisco# ip -6 route
::1 dev lo proto kernel metric 256 pref medium
fc00:0:46::1 encap seg6 mode encap segs 1 [fc00:0:64:61:4:44:46:e000] dev ens7 metric 1024 pref medium--->SRv6 uSID steering programmed IPv6 payload

SRv6 uSID IPv6 payload steer capture DC-2 Paris:

xrd44-xrd46

20:40:32.890109 IP6 fc00:0:66:1:5054:2ff:fe41:b107 > fc00:0:46:e000::: srcrt (len=2, type=4, segleft=0[|srcrt]
20:40:32.890994 IP6 fc00:0:46::1 > fc00:0:66:1:5054:2ff:fe41:b107: ICMP6, parameter problem, code-#4, length 176

Design Experience of an SRv6 uSID Data Center

Gyan Mishra
IT Technologist & Innovation Specialist
Associate-Fellow – Network Design
April 9th 2024

Objectives for Todays SRv6 uSID Data Center Presentation

- Building on the foundation from last year
- Intricate design experience details of an SRv6 uSID Data Center
- Review challenges of the innovative solution
- Highlight the transformational potential for the technology
- Comparative analysis to spotlight the efficiencies and performance enhancements outpacing todays technologies at record speed
- Navigate real world design experiences and possible tangible outcomes to comprehend the sheer power of SRv6 uSID
- In the end the goal is to underscore the immense value proposition with SRv6 uSID in the Data Center landscape

SILOED Networking ⇔ Complexity Tax

Each siloed network Domain has its own Hardware, Software, SDN Stack, Operations & Automation Ecosystem

IPv4 Transport

OVERLAY/SEGMENTATION

PRIVATE IP SCALE

TRAFFIC ENGINEERING

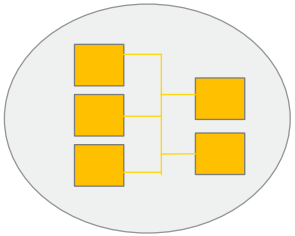
MPLS Transport

NOT WIDELY ADOPTED IN DATA CENTER

LABEL SUMMARIZATION

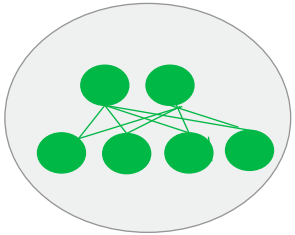
TRAFFIC ENGINEERING

VXLAN / GENEVE



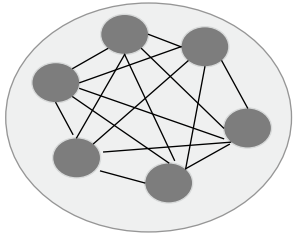
DC OVERLAYS

IPv4



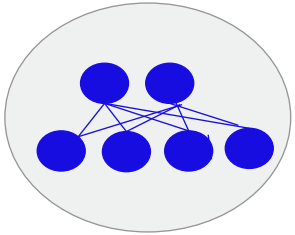
DC FABRICS (UNDERLAY)

MPLS



METRO WAN FABRICS

IPv4, IPv6



EDGE PEERING FABRICS

SRv6 uSID ⇔ Simplicity, Functionality, Ultra Scale

A Common End-to-End Forwardin[illegible]hitecture Enables Common HW, SW, SDN, Ops ⇔ **Massive Scale**

SRv6 uSID

OVERLAY/SEGMENTATION

IPv6 UNDERLAY SCALE

TRAFFIC ENGINEERING

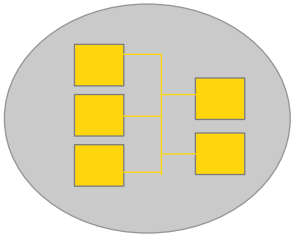
COMPATIBILITY WITH BROWN FIELD FABRICS

[illegible]VICE INSERTION / CHAINING

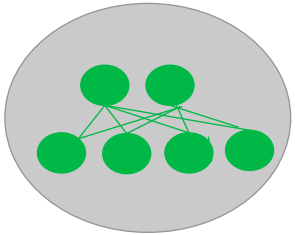
[illegible]RDWARE, SOFTWARE, SDN, Ops

E2E Simplicity with SRv6 uSID✓

SRv6 uSID ⇔ Translates [illegible]a Massive Scale

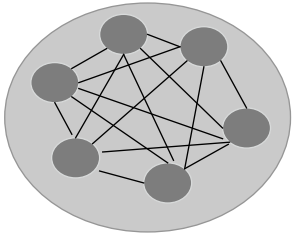


DC OVERLAYS

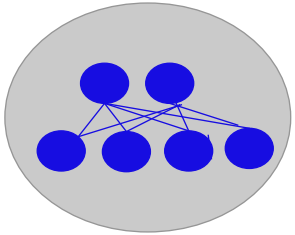


UNDERLAY
DC FABRICS

"End-to-End Inter-Domain Routing via SRv6 uSID"

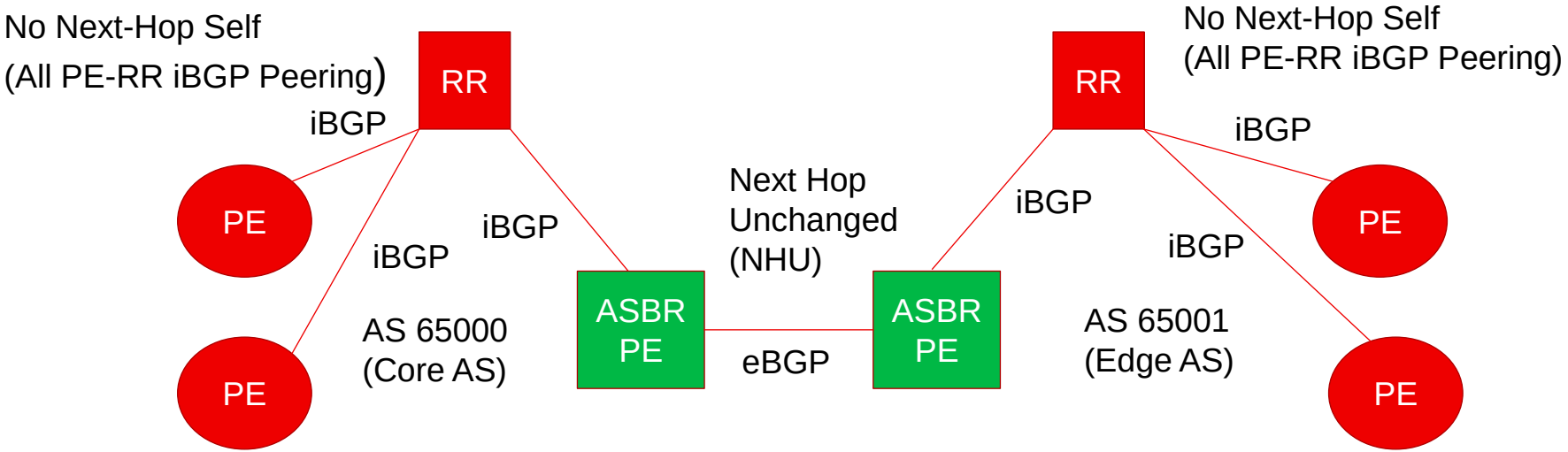


METRO
WAN FABRICS



EDGE PEERING
FABRICS

INTER DOMAIN SRv6 uSID

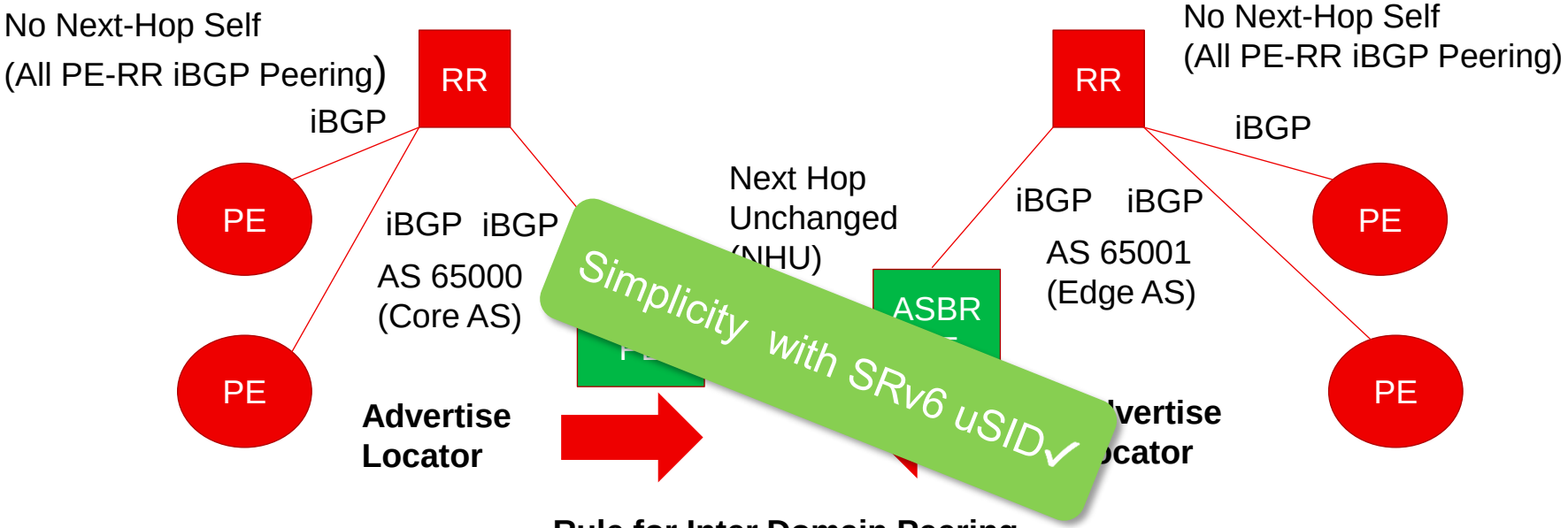


Rule for Inter Domain Peering

- iBGP -No Next-Hop Self
- eBGP –Next Hop Unchanged

(Requirement to Preserve L2 VPN & L3 VPN Service SID across INTER-AS Boundary)

INTER DOMAIN SRv6 uSID ROUTING SIMPLICITY



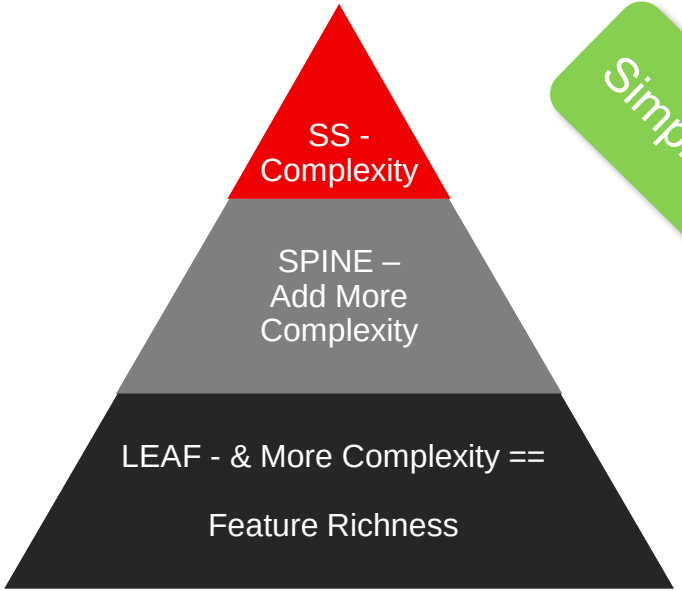
Rule for Inter Domain Peering

- Locator Reachability (That's it!!)

This allows host endpoints to provide static steering capabilities without PCE across any SR Algo cross domain

SRv6 uSID Design ⇔ “Top ⇔ Down” & “Bottom ⇔ Up” Approach

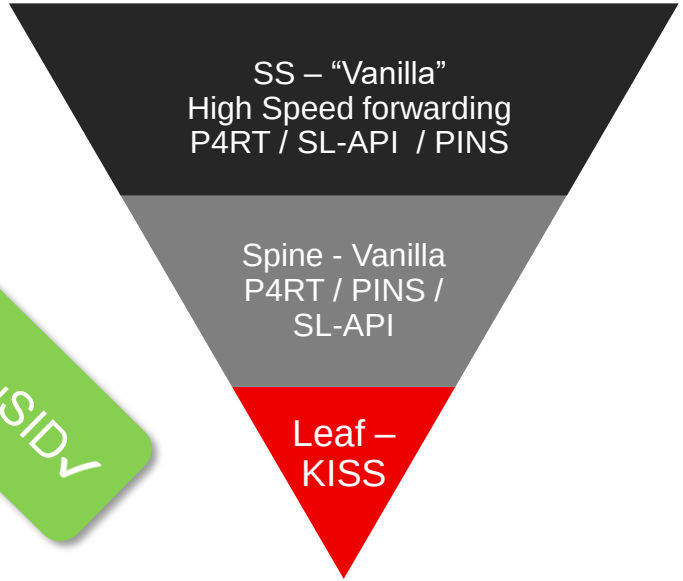
Top ⇔ Down



Traditional mindset has been for feature richness & complexity across the Data Center Fabric

Simplicity with SRv6 uSID✓

Bottom ⇔ UP



SRv6 KISS ⇔ “Keep it Simple & Strategic” approach ⇔ Focus on High speed forwarding plane packet pushing throughput

Real World Use-cases

#1 IPv6 Host Based Networking

#2 Dual Plane MPLS / IPv6 Core Migration

#3 SRv6 uSID End-To-End

#1 IPv6 Host Based Networking

- **Traffic Engineering and Carrier Grade** features are not a requirement in the Data Center.
- Operators can use white box switches or disaggregated hardware and software with Vanilla IPv6 Only DC fabric blindly passing the SRv6 uSID packets. Massive bandwidth **where Multi Petabits** of fiber can be thrown at the DC fabric, with the focus on **High Bandwidth** packet pushing with **Ultra simplified fabric**.
- **Steering** is initiated from the Data Center host attachment using IGP shortest path leaving the entire fabric 100% vanilla IPv6.

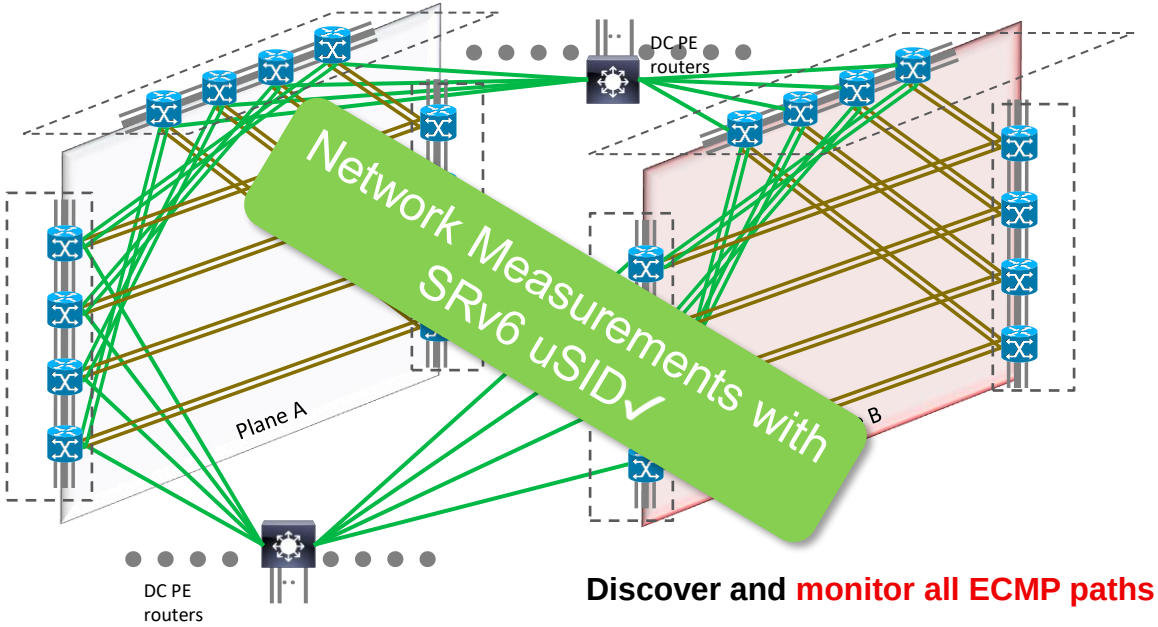
#2 Dual Plane MPLS / IPv6 Core Migration

- **Traffic Engineering & Carrier Grade** features are a requirement ONLY in the Data Center.
- **Traffic Engineering capabilities** in the Data Center, and the intermediate domains follow IGP shortest path **blindly forwarding** the SRv6 uSID packets. **Massive scale & resiliency** with full carrier grade features in the Data Center.
- **Steering** is initiated from the DC host attachment and follows IGP shortest path along the intermediate domains to the egress DC or Domain.

#3 SRv6 uSID End-To-End

- **Traffic Engineering** and all the Carrier Grade features are a requirement.
- **Full feature richness.**
- **Steering** is initiated from the Data Center host attachment or could be any switch within the DC fabric for any and all flow types.

Integrated Performance Monitoring (IPM)



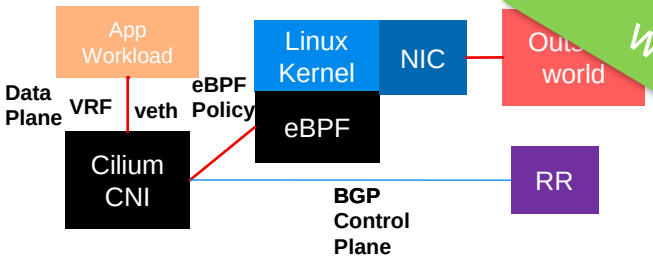
Discover and monitor all ECMP paths

Provide Enough PPS to measure all ECMP paths

Report accurately across paths

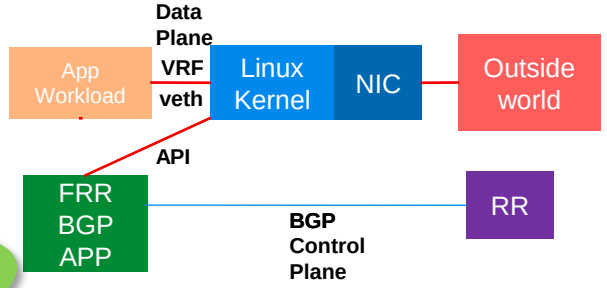
Host Networking Stacks

Option #1 eBPF/Cilium

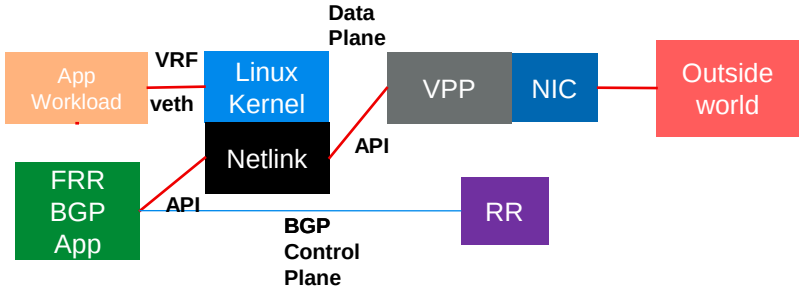


Host Networking Solutions with SRv6 uSID✓

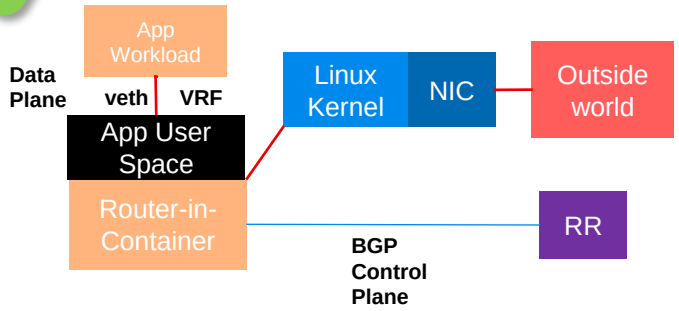
Option #2 Linux Kernel



Option #3 FD.io VPP



Option #4 Router-in-Container



Simplified Host Networking

Lightweight Host Routing:

Linux include its SRv6 Locator (IP[illegible]fix) within the LLDP advertisements

TOR (IOS XR/SONiC) redistrib[illegible]into BGP/ISIS

Host Networking Solved with SRv6 uSID✓

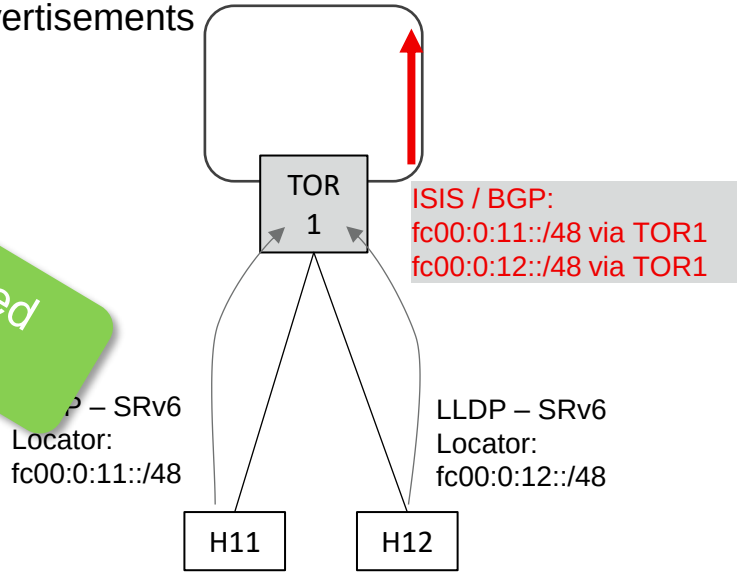
Simpler solution:

Provides reachability (routing) up to the host

Provides visibility into the container (workload IP address)

Provides liveness detection (built-into LLDP)

Lightweight: No need to run BGP stack on the host



Demo time!

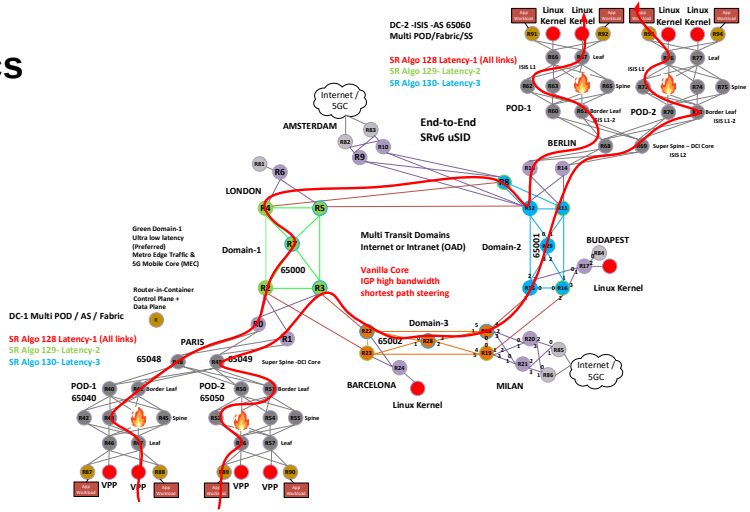
All Demo's @ YouTube Channel SRv6 uSID DC:

https://github.com/segmentrouting/srv6-labs

https://youtube.com/@SRv6_uSID_DC

Use-case 1: SRv6 uSID BGP-Only DC & Single AS DC
Use-case 2: SRv6 uSID w/ Multi POD Fabrics
Use-case 3: SRv6 uSID w/ Multi POD/Domain Fabrics

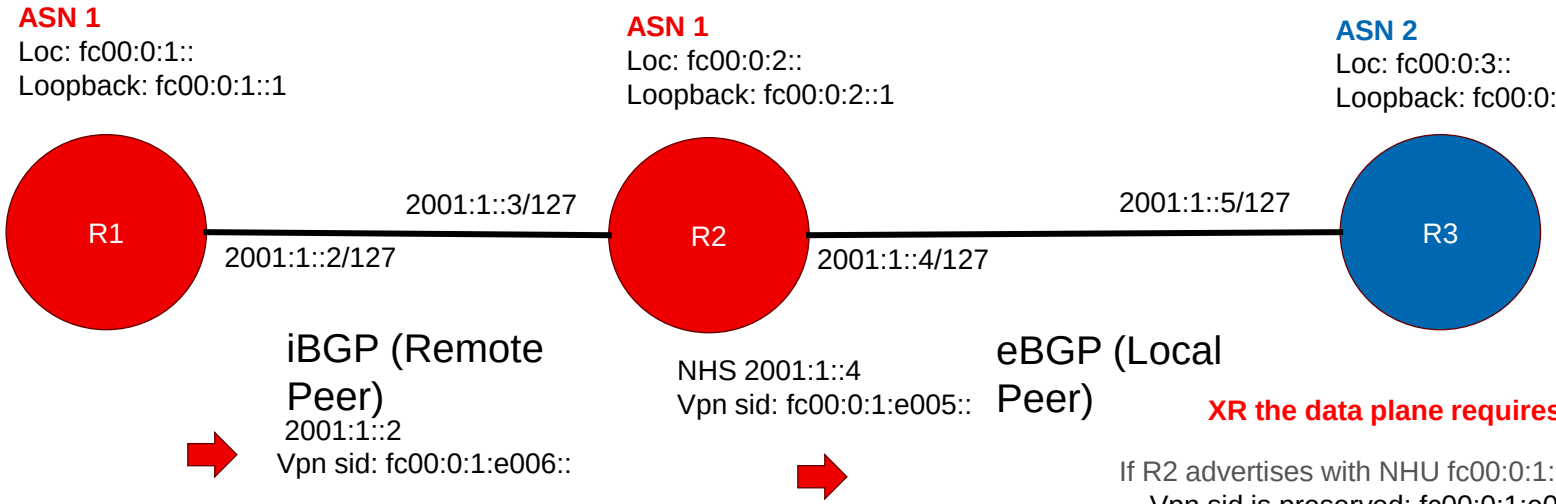
- ❑ Host-to-Host multi-pod across the metro
- ❑ Policy programmed from Linux Kernel & VPP host



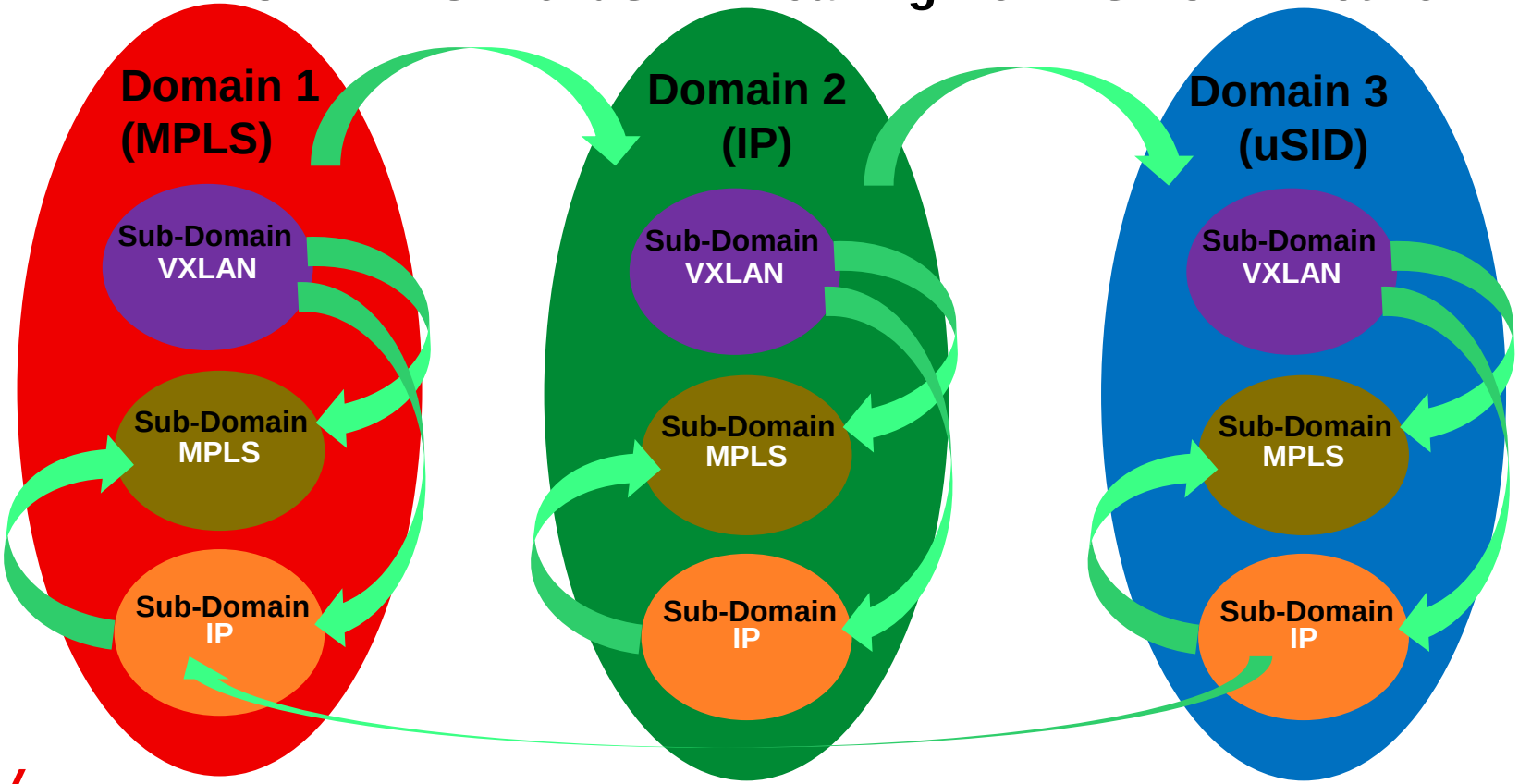

verizon

INTER DOMAIN SRv6 uSID

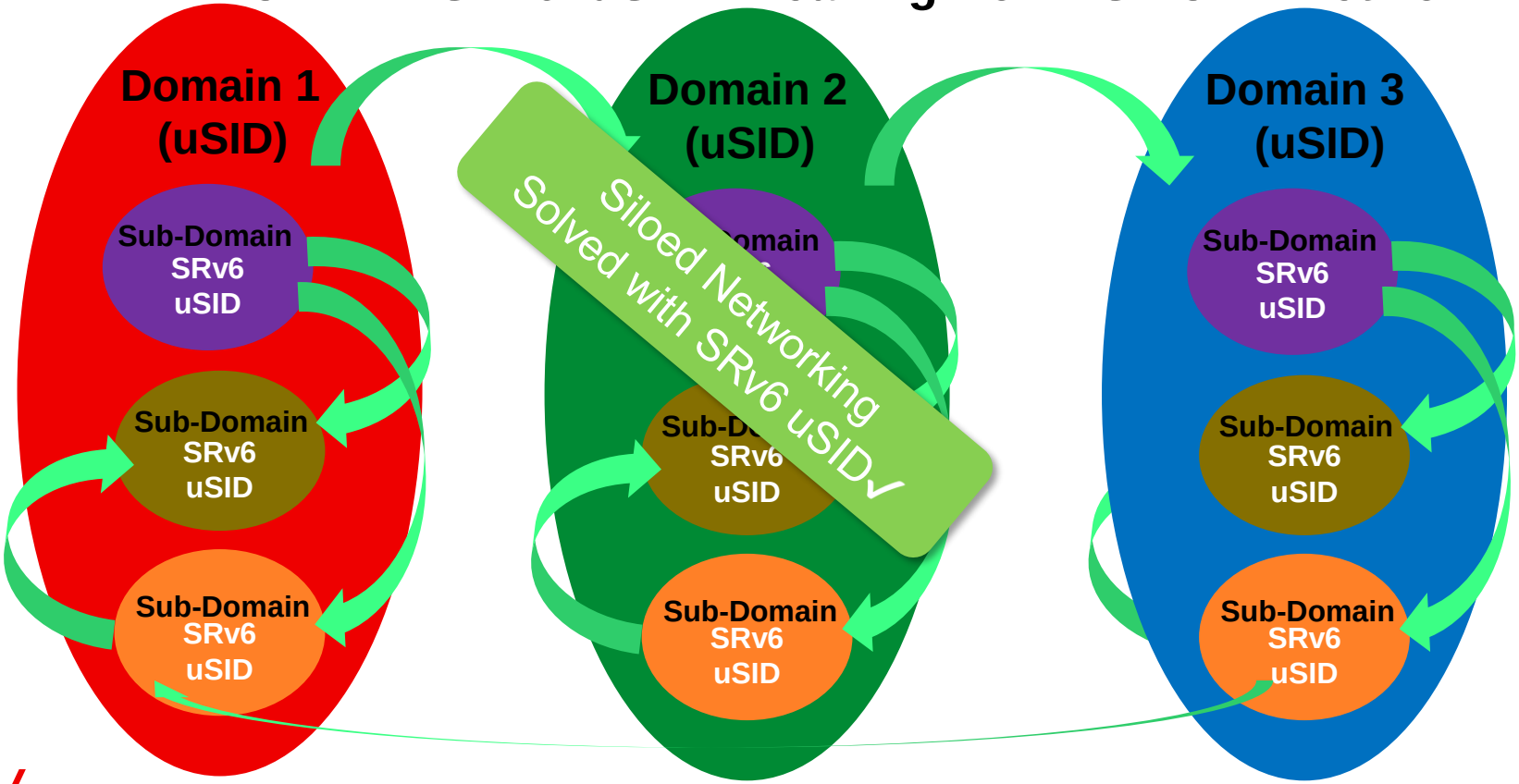
eBGP direct peering (NHU) – (Remote PE)



INTER DOMAIN SRv6 uSID Breaking Down SILOED Networking



INTER DOMAIN SRv6 uSID Breaking Down SILOED Networking



SRv6 uSID Host Based Networking Traffic Engineering

Options for Host Based Networking

- eBPF/Cilium (Cilium BGP control plane) CNI or Standalone (Option-1)
- Native Linux Kernel (FRR BGP control plane) –Host Routing with Native Kernel (Option-2)
- FD.io VPP (FRR BGP control plane) -Host Routing via VPP (Option-3)
- Router-in-container (Control Plane & Data Plane) (xRD, SONiC, Nokia, Juniper cRPD) CNF (Option-4)

- Options are listed in order of desirability by operators
- Next few slides we will go into each option in detail

Option #1 eBPF/Cilium

- CNI Connects to global table ⇔ linkage of host fabric to DC fabric
- CNI Provides Traffic Engineering capabilities via SRv6 uSID
- CNI Provides VPN overlay - Workload Container, VM, CNF, VNF

Details

- Data plane programming
- FRR BGP for bgp control plane advertisement
- Cilium is one of the most popular CNI's to date and eBPF with its origins in the Linux kernel with its rich policy features & programmability provides seamless integration to compute nodes making it a powerful win-win for developers

Option #2 Native Linux Kernel

- Host Connects to global table ⇔ linkage of host fabric to DC fabric
- Host Provides Traffic Engineering capabilities via SRv6 uSID
- Host VPN overlay - Workload Container, VM, CNF, VNF

Details

- Data plane programming
- FRR BGP for control plane advertisement
- FRR can program the control plane & via Linux Kernel API call program the data plane FIB entries
- Alternatively, FRR can program the control plane with hook back to Linux Kernel to program the data plane FIB entries

Option #3 FD.IO VPP

- ❑ VPP Connects to global table ⇔ linkage of host fabric to DC fabric
- ❑ VPP Provides Traffic Engineering capabilities via SRv6 uSID
- ❑ VPP Provides VPN overlay - Workload Container, VM, CNF, VNF

Details

- ❑ Data plane programming
- ❑ FRR BGP for Control Plane Advertisement
- ❑ VPP ceases control of the Linux Hosts NIC
- ❑ Requires Netlink or other method to program VPP FIB
- ❑ VPP requires application flows to hair-pinned through the Linux Kernel which can become a bottleneck (Not for bandwidth & CPU intensive apps)

Option #4 Router-in-Container

- CNF Connects to global table ⇔ linkage of host fabric to DC fabric
- CNF Provides Traffic Engineering capabilities via SRv6 uSID
- CNF Provides VPN overlay - Workload Container, VM, CNF, VNF

Details

Router-in-container options (xRD, SONiC, Nokia, Juniper cRPD)

- Control plane & Data plane programming
- Requires Linux bridge stitching between Linux Kernel & CNF
- Container runs in user space so is beneficial for cases where only certain application requires traffic engineering capabilities
- Very difficult to create linkage of Router in container back to kernel space so all application workloads can take advantage of steering