SRv6 uSID Data Center Use Case

Extended Edition ⇔ SRv6 uSID ⇔ Road Show NYC 2023

Case Study

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verizon

SRv6 uSID Data Center use case study (Slide 1)

History & Current Data Center Technologies

- Analysis of historical & current DC technologies.
- Comparison of IP, NVO & MPLS based technologies & SRv6.
- Comparison of encapsulation types used by existing technologies.

Analysis of Traffic Engineering in the Data Center Space

- Analysis of why traffic engineering has not been used in the past.
- Analysis of the benefits of traffic engineering in the Data Center.
- Analysis of SRv6 uSID versus SRv6 Full SID & SRH with steering and how Vanilla middle boxes come into play with SRv6 uSID across CLOS Spine layers with uA Adj-SID.

Linkage of DC fabric to Compute Fabric

- Analysis of the IPv6 global routing table linkage of Data Center fabric to Compute fabric with SRv6.
- Comparison of SRv6 uSID DC fabric extension to host with VXLAN & MPLS.

Analysis of Existing technology Data Center Requirements

- Network Isolation & Multi Tenancy.
- L2 VLAN anywhere capabilities and L3 capabilities.
- Flexibility for L2 and L3 host attachment.

SRv6 uSID Data Center use case study (Slide 2)

Applicability of SRv6 to Data Center Space

- Why is SRv6 a good fit for the Data Center and why is it a state of the art ground breaking discovery.
- How SRv6 is an improvement over existing technologies.
- Segment Routing mantra with SRv6 uSID ⇔ DC fabric Simplicity and Cleanliness ⇔ "KISS-Keep it Simple & Strategic".
- DC fabric focus on ultra low latency high speed forwarding.

SRv6 uSID DC Design Options Analysis

- Research of all the possible L2 & L3 design options and permutations available.

SRv6 uSID Compute Host options for Traffic Steering

- Analyze all host compute options for steering available.

SRv6 uSID Multi Cloud / Hybrid Cloud Analysis

- Analysis of end to end SRv6 uSID flows for 5G Core Telco Cloud to Hyperscler IT Cloud along low latency path inter-DC, DC to 5G Mobile Core steering and network slicing.
- Analysis of 5G Core Telco Cloud to IT Cloud in native SRv6 Multi Cloud scenario with SRv6 uSID end to end traffic steering.
- End to End SRv6 uSID allows for the elimination of complex interworking between todays disparate technologies.

Ground Breaking Innovation & Technological Advancement with SRv6 uSID in the Data Center Space

State of the Art:

- Replacement of current Data Center technologies MPLS & NVO VXLAN & GENEVE.
- Elimination of commodity hardware complex encapsulations MPLS label stack & NVO VXLAN VTEP.
- Tremendous CAPEX & OPEX Saving can now be realized with simple IPv6 Data Plane “Vanilla DC Switch”.
- Segment Routing tactical service chaining simplicity.
- All Carrier Grade features are now ported into the Data Center with simplistic IPv6 Data Plane.
- 5G Telco Cloud simple & seamless extension to IT Cloud Hyperscaler with Multi-Cloud & Hybrid Cloud.

How can this all be realized:

- IPv6 data plane Global table routing provides the critical linkage between the Host Fabric & Data Center fabric.
- VXLAN Layer 2 Centric model can now be replaced with SRv6 uSID Layer 2 Centric model with EVPN.
- VXLAN Layer 2 Centric model can also be replaced with SRv6 uSID Layer 3 Centric model IP-VPN.
- MPLS-VPN Layer 3 Centric model can now be replaced with SRv6 uSID Layer 3 Centric model IP-VPN.
- Customer flexibility of choice of L2 or L3 Centric model for deployment use case.
- Evolution of the Kubernetes K8 CNI (Container Networking Interface) data path.
- All features, functionality & use cases available with existing technologies can all still be realized & more!

Why is SRv6 uSID a MUST for the Data Center Space

Requirements:

- Support for virtualized Cloud Native environments NVF, VNF, CNF containerization.
- Edge computing evolution to all aspects of business move towards cloud native virtualization with containers.
- Kubernetes K8 deployment to Private Cloud & Public Cloud EKS(Amazon), GKE(Google), AKS(Azure).
- Seamless & simplistic low overhead integration to host fabric.
- Compute host steering requirements.

How can this all be realized:

- Simplified IPv6 based Data Center fabric lends itself to virtualized cloud native computing.
- Simplified extension of Data Center fabric to Compute Host fabric without complex encapsulations.
- Kubernets K8 containerization in both Public & Private cloud can seamlessly integrate into the DC fabric.
- Carrier Grade features of Traffic Engineering and more can now be realized.
- Evolution of the CNI (Container Networking Interface) Data Path.

DC Fabric ⇔ Host Fabric ⇔ Critical Linkage

VXLAN Fabric ⇔ Extend to Host

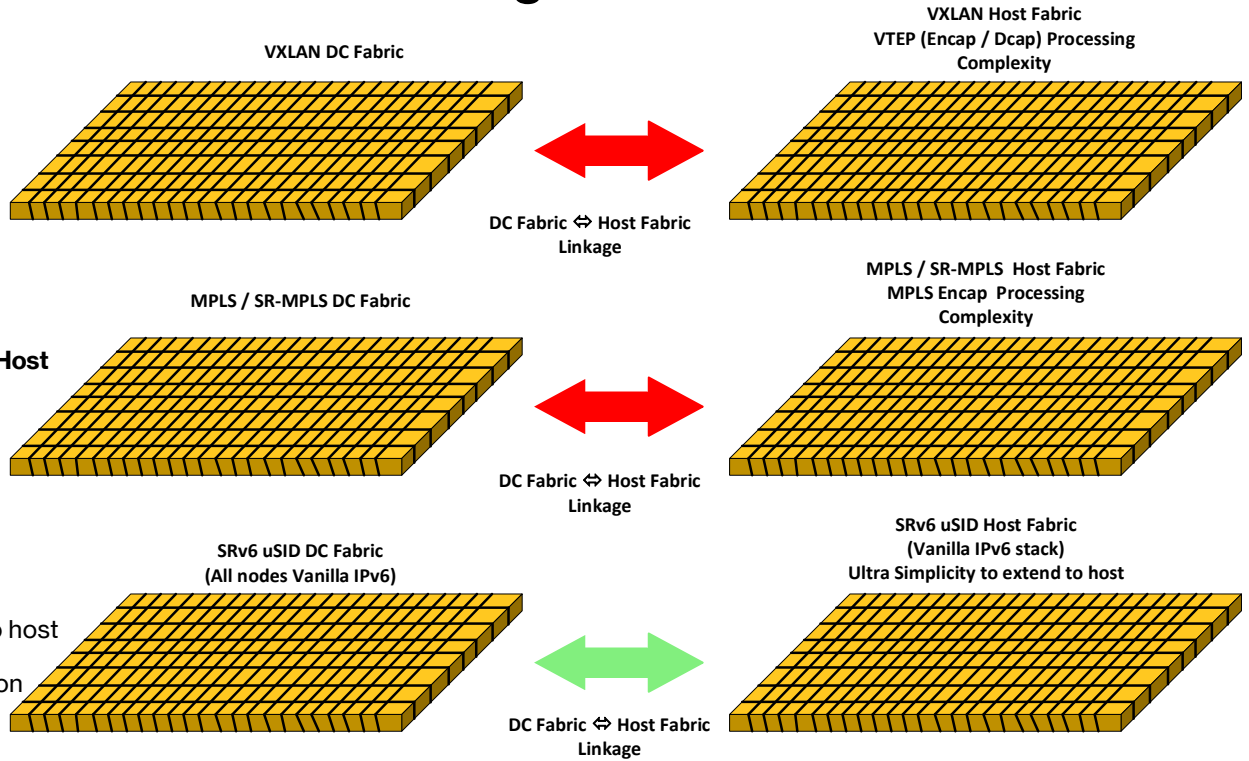
- VTEP Encap/Decap processing overhead
- Requires “capable” commodity hardware

SR-MPLS/ MPLS Fabric ⇔ Extend to Host

- MPLS Label stack encapsulation overhead
- Requires “capable” commodity hardware

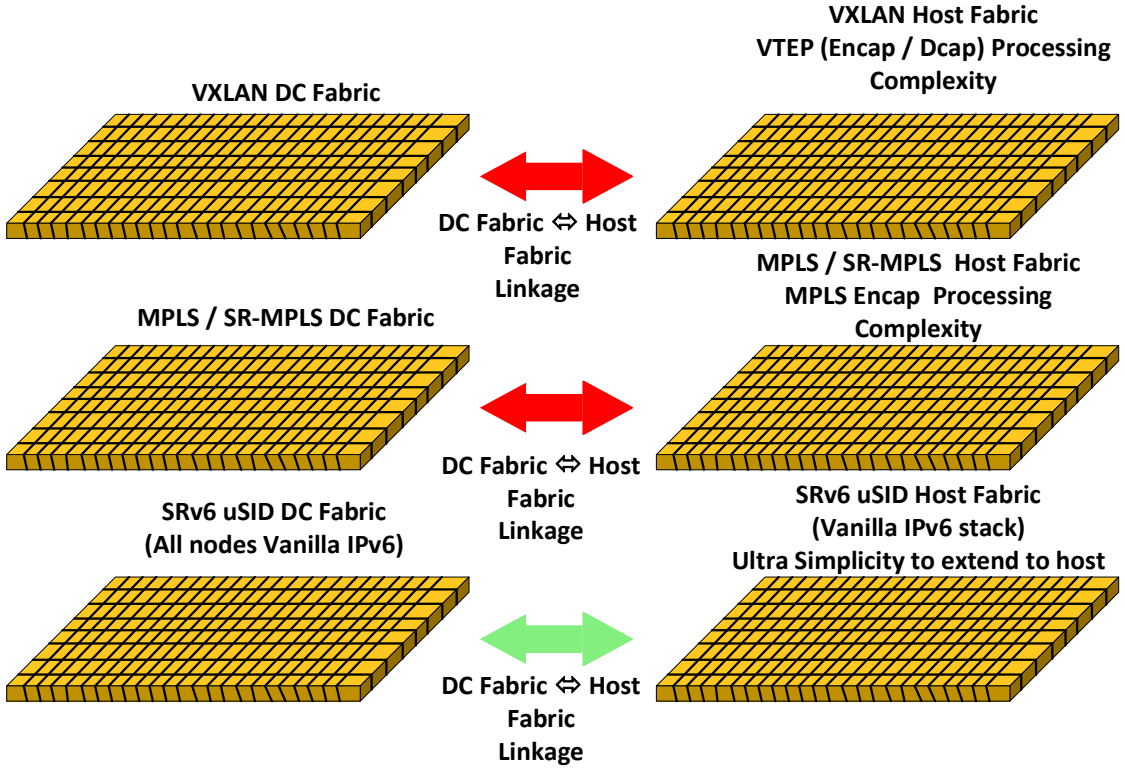
SRv6 uSID Fabric ⇔ Extend to Host

- Vanilla IPv6 data plane extended to host
- Simple IPv6-in-IPv6 encapsulation on SRv6 source node



DC Fabric ⇔ Host Fabric ⇔ Critical Linkage ⇔ Fabric comparison

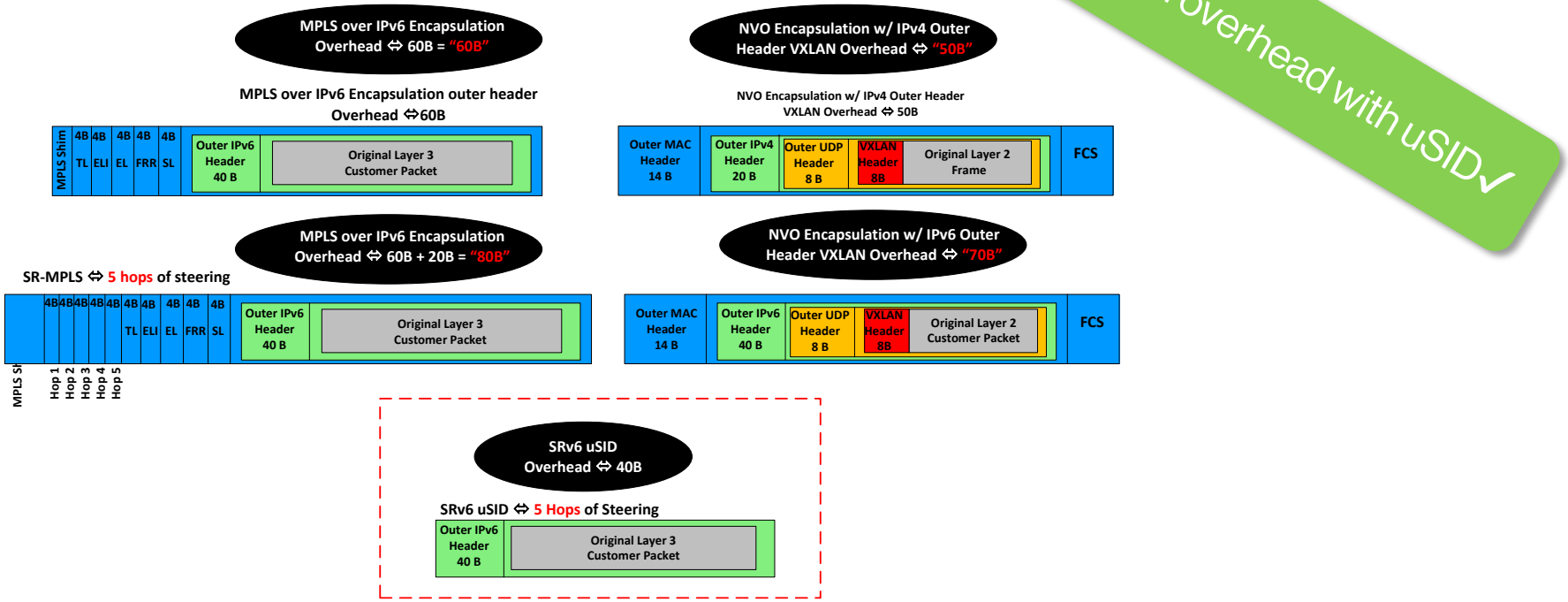
NVO (VXLAN / GENEVE)		SRv6 uSID
Commonalities		
• VTEP Encapsulation / Decapsulation • Overlay / Underlay (VTEP/IP) • IPv6 Forwarding plane • L2 VNI – Network Isolation • L3 VNI – Multi Tenancy • Layer 2 Centric -VLAN Anywhere		• SRv6 Encapsulation / Decapsulation • Overlay/Underlay (SRv6-VPN / SRv6-EVPN) • Vanilla IPv6 Data Plane • SRv6-VPN-L3 Multi Tenancy/Isolation • SRv6-EVPN-L2 Multi Tenancy/Isolation
Differences		
		• Layer 3 centric (L2 / L3 capable) • Traffic Engineering
Pros & Cons		
Pros		**Pros**
• Layer 2 centric – VLAN Anywhere		• Carrier Grade features • Native IPv6 Data Plane • SRv6-VPN, SRv6-EVPN • Simplicity of Service Chaining • Protocol Stack Simplification
Cons		**Cons**
• Complexity of Service Chaining • VTEP Encap/Decap Processing Overhead • Lose Advances of Full L3 while focus is on L2		• Ongoing Building of Ecosystem



Fiber tax (MTU overhead)

- **NVO encapsulations incur in expensive MTU overhead**

Minimal overhead with uSID✓



IP-VPN versus NVO VXLAN & GENEVE for Tenant Isolation

NVO VXLAN & GENEVE:

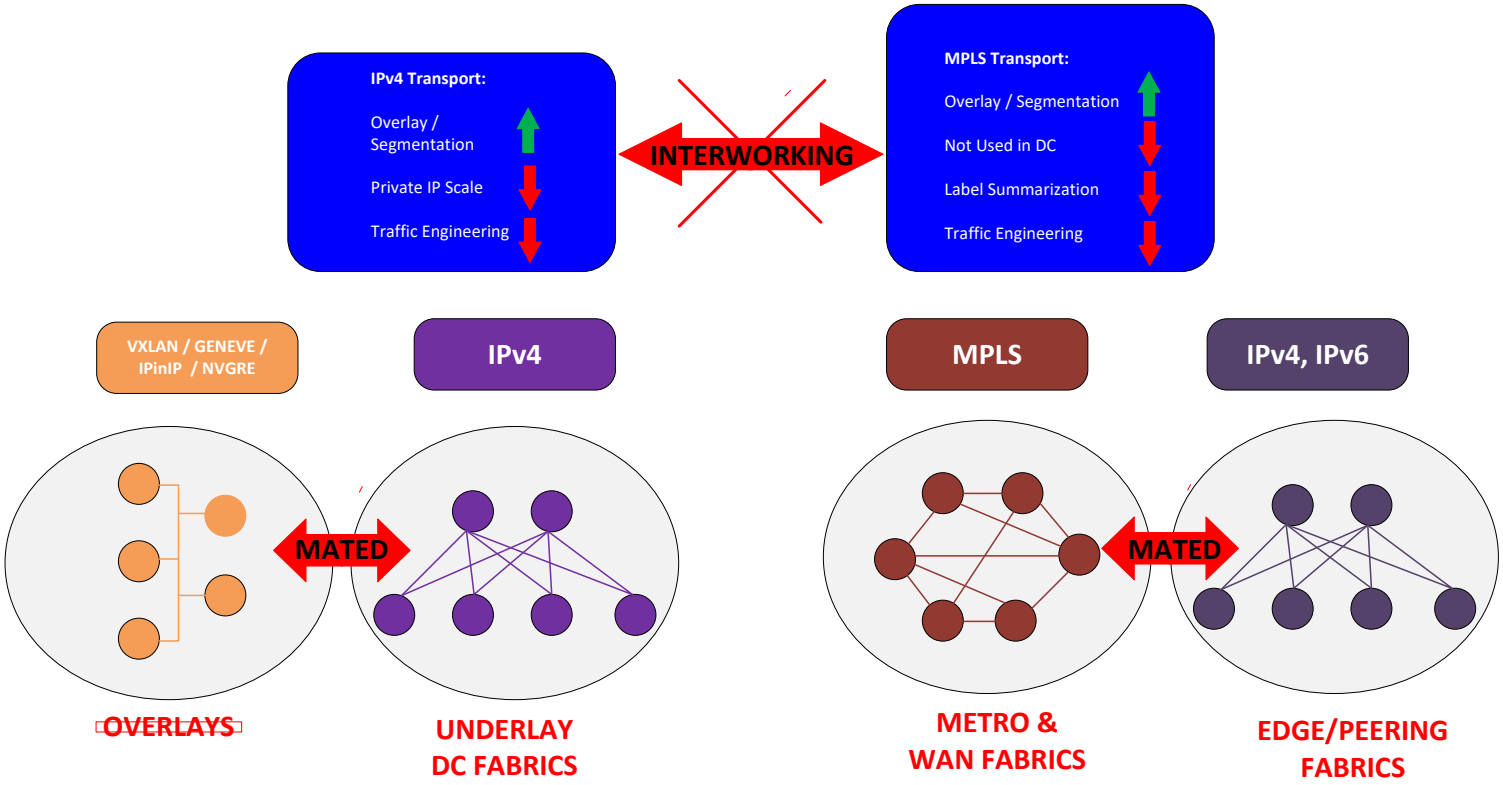
- Uses Auto RT to import & export of RTs between L3 VNI VRF's which makes it not impossible for extranet or internet style VRF capability used commonly with IP-VPN.
- Requires a Fusion router that is connected to Global table to merge the Tenant VRFs together.
- In cases where a Fusion router in the DC is not possible in some cases requires troboning of traffic outside the Data Center externally to route traffic between tenant VRFs.
- Bleeding RTs between Tenant VRFs can lead to routing loops.

SRv6 uSID ⇔IP-VPN:

- SRv6 IP-VPN Any-to-Any VRF & Half Duplex Hub-Spoke capability.
- Extranet VRF capability of bleeding RT between VRFs inter-VRF communication for E-W flows without having to rely on a Fusion router to Layer 3 bridge the tenant VRF's together.
- Commonly used RT manipulation "additive" community tacking on additional RT's to a Data Center "Services VRF" prefix that is required to be part of many tenant VRFs by exporting services RT that can now be imported by other tenant VRFs requiring access to services.

SILOED NETWORKING Yields ⇔
"INTERWORKING COMPLEXITY TAX"

Each Network Domain has its own hardware, software, SDN Stack, Operations and Automation Ecosystem



SRv6 uSID == “Simplicity, Functionality, Scale, Carrier Grade Feature Richness

A Common End to End forwarding data plane architecture == Common HW, SW, SDN, OPS, Massive Scale

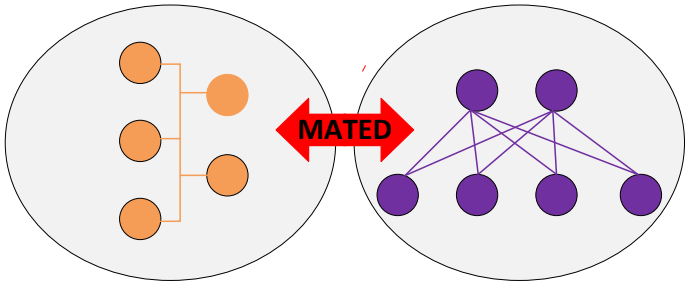
SRv6 uSID Transport:

- Overlay / Segmentation
- Used in DC
- Summarization
- Traffic Engineering

- Service Insertion/Chaining
- No complex interworking
- No more Siloed networking
- Ultra Flexibility
- Compatibility with Brown Field IP Fabrics

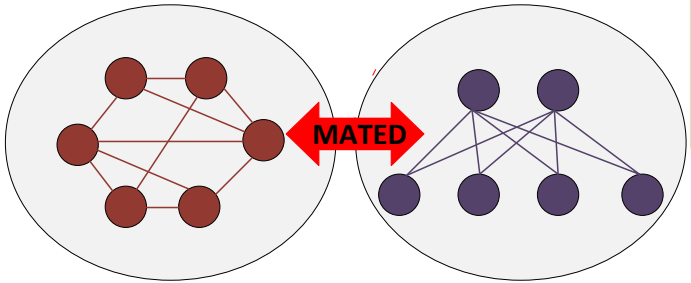
Solved with SRv6 uSID ✓

SRv6 uSID



OVERLAYS

UNDERLAY
DC FABRICS



METRO &
WAN FABRICS

EDGE/PEERING
FABRICS

SRv6 uSID in DC =< 5 hops & why?

- SRv6 uSID Format F3216 ⇔ 32 bit uSID block, 16 bit uSID ID
- uSID ⇔ Identifier that specifies the micro segment
- uSID Carrier ⇔ 128-bit IPv6 address carried in DA or SRH

uSID Carrier ⇔ {<uSID Block><Active uSID><Next uSID>…<Last uSID><End of Carrier>…<End of Carrier>}

SRv6 uSID Endpoint Behaviors

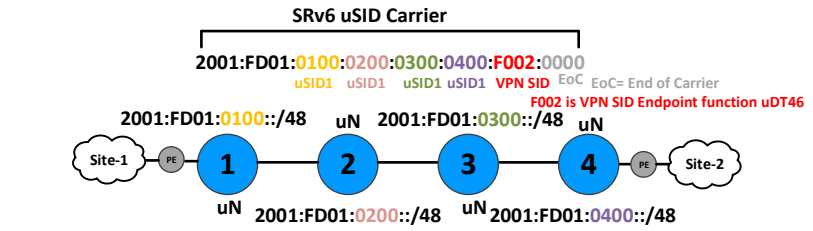
- **uN** ⇔ Next C-SID ⇔shift & lookup function (Node SID)
- **uA** ⇔ Next C-SID End.X ⇔ shift & xconnect function (Adj-SID)
- **uDT** ⇔ Next C-SID End.DT ⇔ IP VPN endpoint behaviors End.DT4, End.DT6, End.DT46, EVPN endpoint behaviors End.DT2U, End.DT2M "uDT4, uDT6, uDT46, uDT2U, uDT2M"
- **uDX** ⇔ Next C-SID End.DX ⇔ IP VPN endpoint behaviors End.DX4, End.DX6, EVPN endpoint behavior End.DX2 "uDX4, uDX6, uDX2"

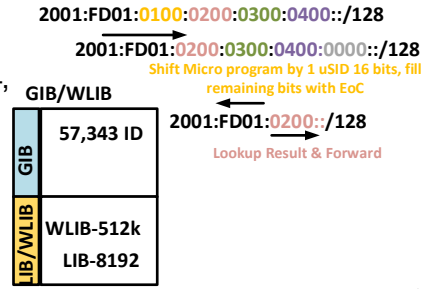
GIB / LIB

GIB ⇔ Global Segments similar to SR-MPLS SRGB

LIB ⇔ Local Segments similar to SR-MPLS SRLB

WLIB ⇔ Expands the 8192 range to 512k for SRv6 Service SIDs





Focus of SRv6 uSID DC Study

Less then 6 uSID hops to stay within DA

Greater then 5 uSID hops requires SRH

SRH ⇔ Example of 17 hops

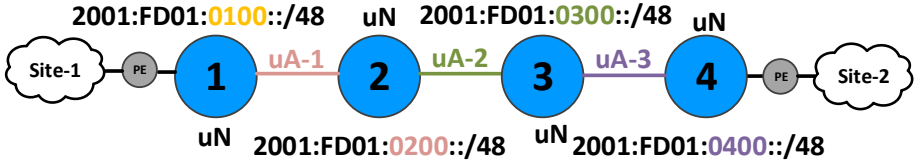
SRH
uSID Carrier 1 ⇔ 2001:FD01:0100:0200:0300:0400:0500:0600
uSID Carrier 1 ⇔ 2001:FD01:0700:0800:0900:0A00:0B02:0C00
uSID Carrier 1 ⇔ 2001:FD01:0D00:0E00:0F00:1000:1102:F002

SRv6 uSID and Vanilla Fabric ?

SRv6 uSID Simplicity & Vanilla fabric explained

uA endpoint behavior

- The crux of the idea behind the uA is to be able to leverage so to forward around the next node the path that is “SRv6 unware”.
- This idea can be leveraged in any SRv6 uSID deployment to be able to support legacy hardware.
- This idea also helps tremendously in the Data Center where the focus is on a high speed forwarding plane on disaggregated open NOS white box switches and not focus on feature rich fabric.



Focus of SRv6 uSID DC Study

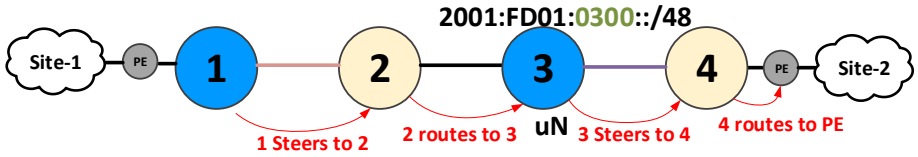
uA-1 =2001:FD01:0100:e000::/48

uA-2 =2001:FD01:0300:e002::/48

uA-2 =2001:FD01:0200:e001::/48

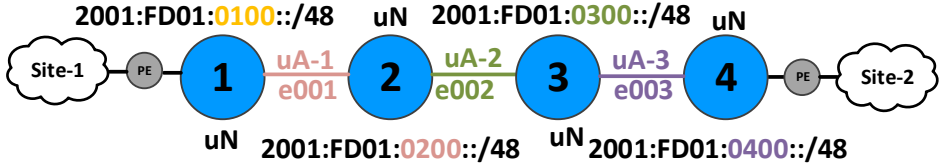
Node 2 & 4 are Vanilla ⇔ “Not SRv6 Capable”

Node 1 & 3 are SRv6 uSID capable



SRv6 uSID Carrier {2001:FD01:0100:e000:e001:F002:0000:0000}

SRv6 uSID Data Center "Vanilla" Fabric Explained

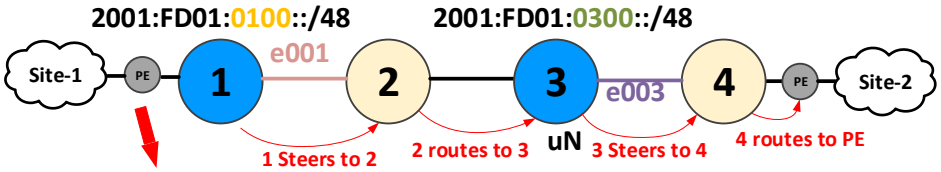


Focus of SRv6 uSID DC Study

SRv6 uSID "uA" Adj-SID End.X

uA-1 =2001:FD01:0100:e001::/48
uA-2 =2001:FD01:0200:e002::/48
uA-3 =2001:FD01:0300:e003::/48

Node 1 & 3 are SRv6 uSID capable
Node 2 & 4 are Vanilla ⇔ "Not SRv6 Capable"



SRv6 uSID Carrier {2001:FD01:0100:e001:0300:e003:F002:0000}

Node 1 forwards to e001 with DA set to 0300

Today's Existing Data Center Topologies

There are 3 flavors of Data Center fabrics that exist today

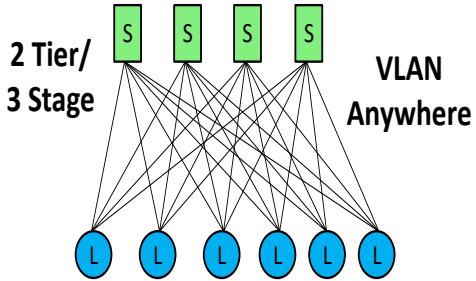
- Network Virtualization Overlay (NVO3) encapsulation VLXAN, VXLAN-GPE, NVGRE, GENEVE CLOS based folded spine fabric, multi-tier multi stage.
- MPLS / SR-MPLS DC core in a CLOS folded spine fabric where Leaf is PE node and Spine is P node, multi-tier, multi-stage.
- IP / BGP based DC core in a CLOS folded spine fabric where Leaf is PE node and Spine is P node, multi-tier, multi-stage.

Breaking down the three Data Center topologies further

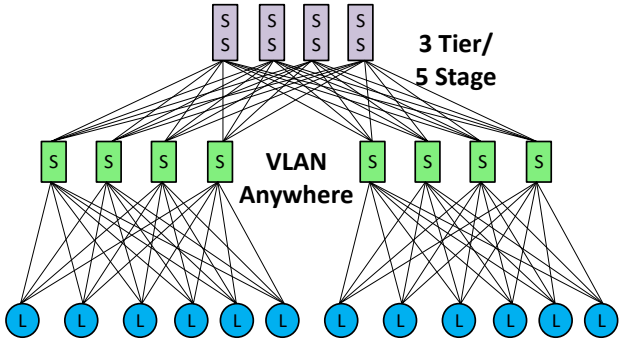
- NVO3 CLOS fabric (Multi Tenant)
  - 2 Tier, 3 Stage CLOS fabric (most common)
  - 3 Tier, 5 Stage with Super Spine CLOS fabric (traditional)
  - 3 Tier, 5 Stage Multi POD fabric where each POD is a separate fabric stitched over L3 DCI core.
  - 3 Tier, 5 Stage with Super Spine CLOS fabric BGP only DC RFC 7938
- IP / BGP CLOS fabric (Single fabric – Single tenant)
  - 2 Tier, 3 Stage CLOS fabric (most common)
  - 3 Tier, 5 Stage with Super Spine CLOS fabric (traditional)
- MPLS / SR-MPLS IP VPN CLOS fabric (Multi Tenant)
  - 2 Tier, 3 Stage CLOS fabric (most common)
  - 3 Tier, 5 Stage with Super Spine CLOS fabric (traditional)

Existing Data Center Technologies (Slide-1)

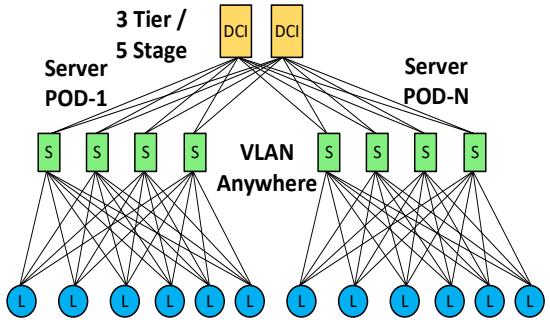
DC Use Case #1 NVO -VXLAN Single Fabric



DC Use Case #2 NVO-VXLAN Single Fabric SS



DC Use Case #3 NVO VXLAN Multi POD N-Fabric's Stitched



2 Tier, 3 Stage CLOS is typical CLOS fabric used for VXLAN for a single CLOS fabric design or used with Multi POD CLOS fabric

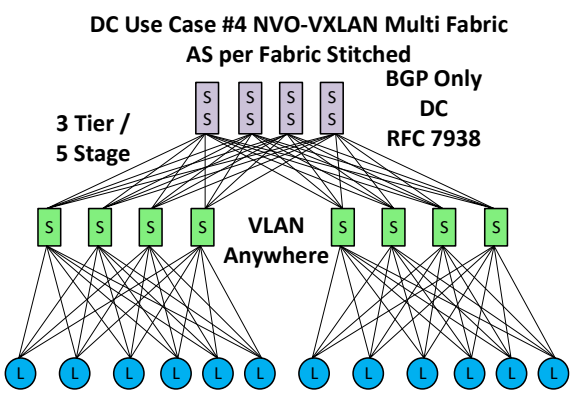
Large Single CLOS fabric with multiple individual fabrics collapsed into a single super spine

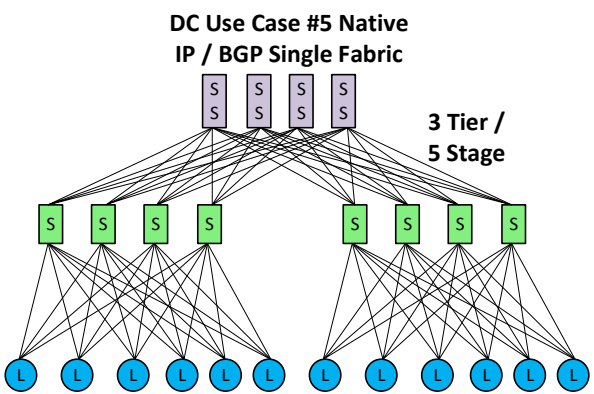
This style was popular with initial VXLAN deployments, but has faded away due to scale issues

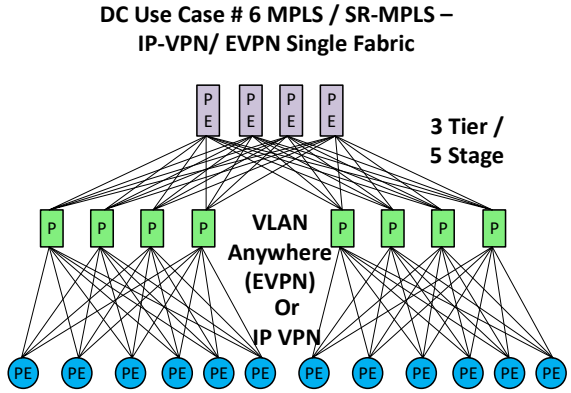
This is the current model for MSDC & Hyperscaler designs for Very large and Mega Data Centers that require massive scale

This topology carves up the DC into individual fabrics one per POD which are stitched together into a unified multi POD fabric architecture

Existing Data Center Technologies (Slide-2)







Multiple DC fabrics collapsed into a Super Spine Single fabric design using BGP Only DC RFC 7938

With BGP Only design each Leaf, Spine & SS node is a separate BGP AS. Spine nodes can also be placed into a single AS as well

Multiple DC fabrics collapsed into a Super Spine single fabric design using IGP underlay with BGP single AS

Single Tenant design with no overlay.

MPLS or SR-MPLS design used in the Data Center to provide L2 VPN EVPN L2 VLAN Anywhere with L2 attached compute services or IP VPN with L3 attached compute services

Existing Data Center Technologies & Gaps

Existing MPLS / SR-MPLS DC use cases Gaps (RFC 7432 BGP/MPLS EVPN Focus)

Encapsulation overhead
- MPLS / SR-MPLS mpls shim label stack overhead

Service Chaining
- SR-MPLS has the mechanics for building the service chain with label stack however does not have a way to carry the Metadata

MTTR (Mean time to Recovery) and Troubleshooting complexity
- Control-Plane & Data Plane (CP-DP) mismatch issues troubleshooting complexity

Existing NVO Encapsulation Data Center use cases Gaps (RFC 8365 NVO Focus)

Encapsulation overhead
- NVO overhead encapsulation VXLAN, NVGRE, GENEVE etc

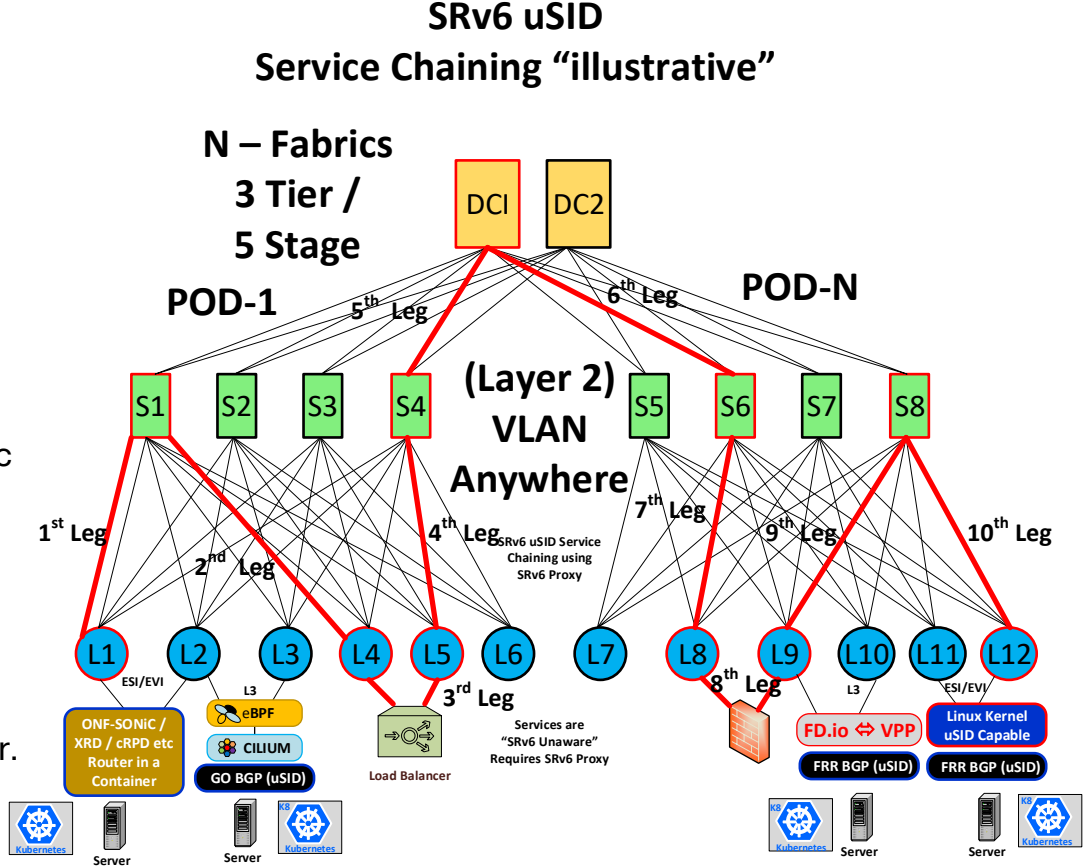
Service Chaining
- Service chaining complexity requiring complex PBR engineering & processing to link services together in a service chain

MTTR (Mean time to Recovery) and Troubleshooting complexity
- Control-Plane & Data Plane (CP-DP) mismatch issues troubleshooting complexity
- Data Center fabric stitching complexity exacerbated with BGP only Data Center hop by hop stitching

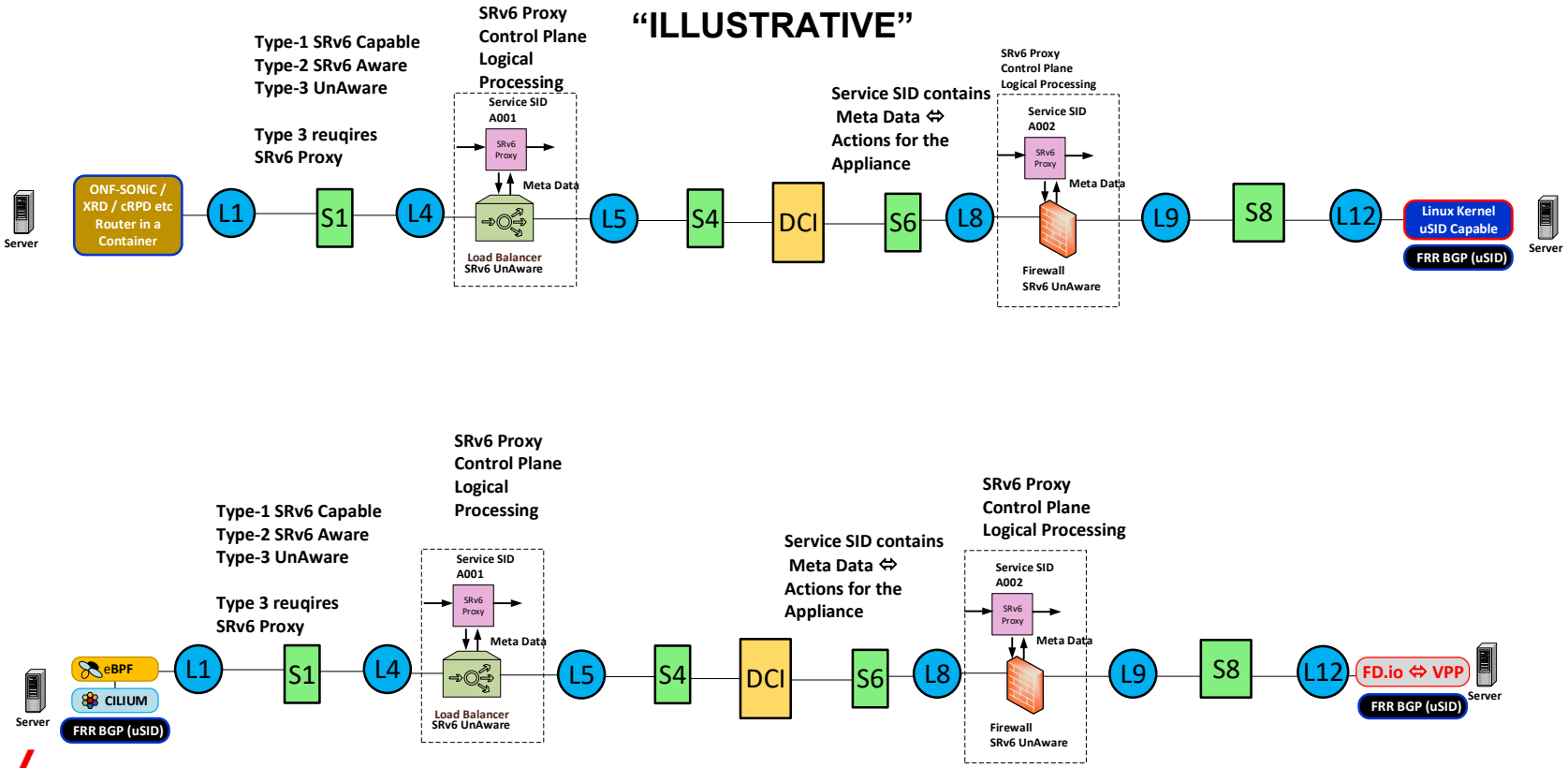
Traffic Engineering to avoid Hot spots in the Data Center

SRv6 uSID Service Chaining

- Illustrative slide of service chaining
- Segment Routing showing native steering capabilities can now be leveraged for service chaining.
- In this example we use SRv6 uSID to create a hop by hop “strict” mode static SID list of 11 nodes for the end to end traffic engineered path to be instantiated.
- In this example an SRH is required to steer as the number of hops is greater then 5 hops which is the maximum number of uSIDs within the uSID carrier.

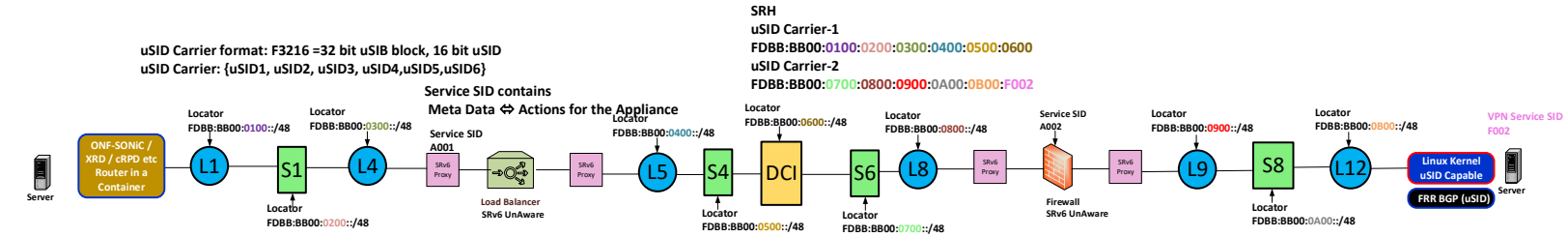


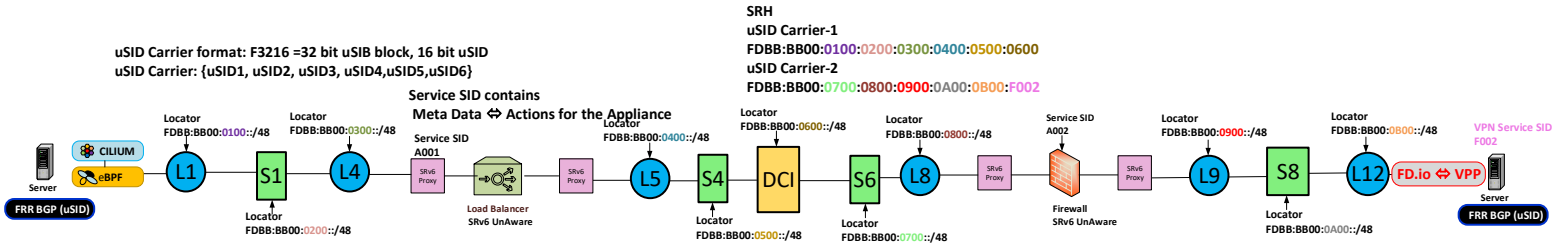
SRv6 uSID Service Chaining ⇔Showing SRv6 Proxy Functionality



SRv6 uSID Service Chaining ⇔ Showing in-line data plane forwarding

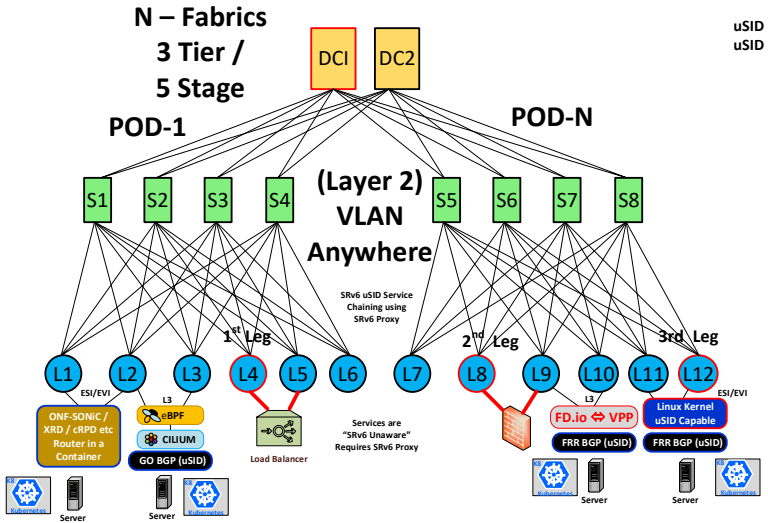
“ILLUSTRATIVE”





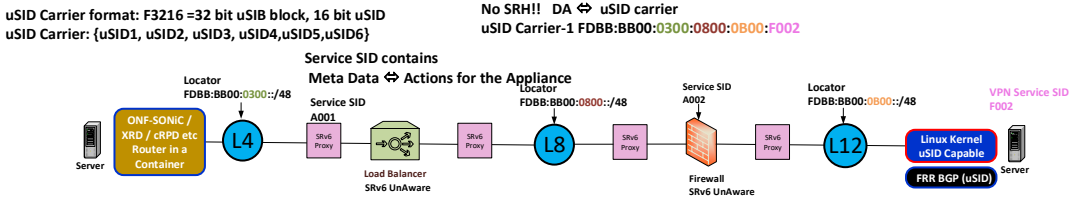
SRv6 uSID Service Chaining ⇔Ultra Simplicity

SRv6 uSID
Service Chaining Simplicity



- SRv6 uSID steering with the segment list crafted with 5 loose hops is enough to steer across even the MSDC of Hyperscalers.

SRv6 uSID ⇔ Ultra Simplicity
Service Chaining



- Service chaining with SRv6 uSID using SRv6 Proxy endpoint behavior for SRv6 unware nodes.
- SRv6 can carry the SF metadata in a 16 bit uSID.
- SR-MPLS does not have a way to carry the metadata.

SRv6 uSID Service Chaining ⇔ SRv6 Proxy function ⇔ programming options

SRv6 Proxy Service chaining was done by Bell Canada vision by Daniel Bernier for a SRv6 5G Mobile Core Solution Using Lanner white box & Noviflow using P4 programming. (Presented MPLS WC 2022)

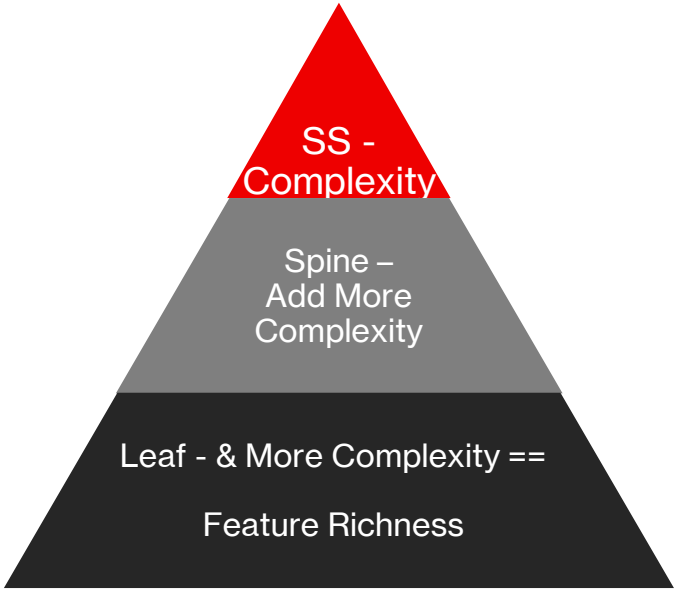
There are 3 ways of programming the SRv6 Proxy function into hardware

SRv6 proxy function can be done in programmable ASIC's or NPU however to avoid recirculation performance hit the following options are available.

- Vendor programming proprietary API's dependent on ASIC SDK features
- P4RT (P4 Run Time) custom pipeline programming to program explicit behaviors necessary
- P4 PINS (Programmable in Network Stack) extending SONiC capabilities for programmable pipeline

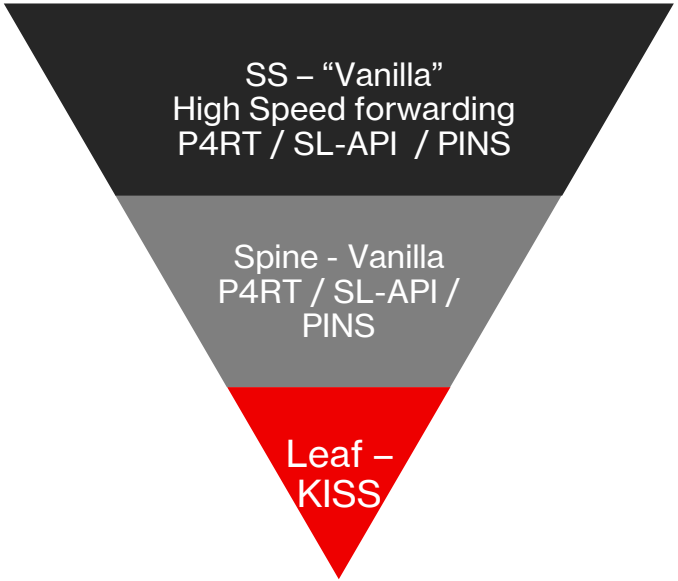
SRv6 uSID Design ⇔ “Top ⇔ Down” & “Bottom ⇔ Up” Approach

Top ⇔ Down



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

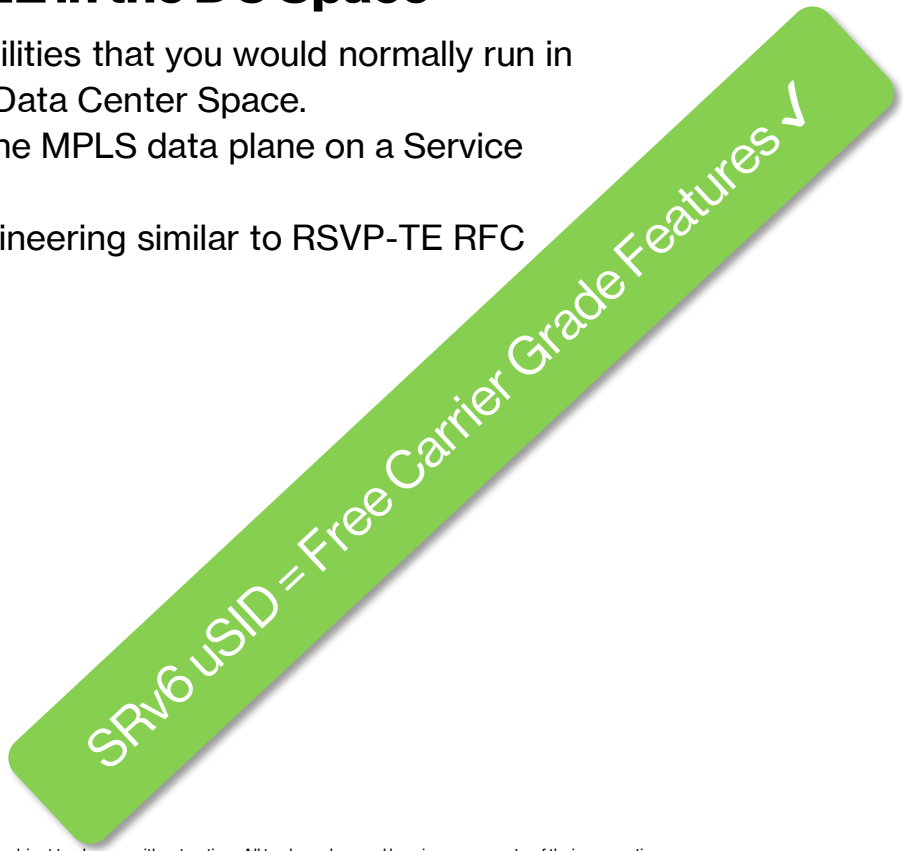
Bottom ⇔ UP



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

SRv6 uSID ⇔"What you get for FREE in the DC Space"

- SRv6 gives you Carrier grade feature rich capabilities that you would normally run in the Core network, you now have available in the Data Center Space.
- With SRv6 you get similar features provided by the MPLS data plane on a Service provider network including:
  - MPLS Data plane capabilities of traffic engineering similar to RSVP-TE RFC 3209
  - IP-VPN capabilities RFC 4364
  - BGP EVPN capabilities RFC 7432
  - BGP NVO overlay capabilities RFC 8365
  - Global Table routing
  - Native IP Data plane
  - Network Slicing
  - Flex Algo
  - SR-PM Performance Measurement
  - Path Tracing
  - Traffic Engineering capabilities



SRv6 uSID Data Center Design Use cases (Case Study)

There are 11 permutations of design options for SRv6 Micro SID Data Center Use cases (This is a non exhaustive list as more combinations may exist)
*****Based on "What you get for Free in the DC Space = L2 & L3 VPN Services and more" ⇔ Basis behind the use cases*****

Layer 3 Centric Model Design options

- **Option-1** SRv6-VPN (Micro SID) RFC 9252 SRv6 BGP VPN Service Overlay (Multi Tenancy)
- **Option-2** SRv6-Global table (Micro SID) RFC 9252 SRv6 BGP Global Service Overlay (Single Tenant)

Layer 2 Centric Model Design options

- **Option-3** SRv6-EVPN (Micro SID) RFC 9252 SRv6 BGP EVPN Service Overlay, Builds on RFC 7432 MPLS/EVPN EVPN (VLAN Anywhere)
- **Option-4** SRv6-EVPN (Micro SID) RFC 9252 SRv6 BGP EVPN Service Overlay, Builds on RFC 8365 NVO3 VXLAN EVPN (VLAN Anywhere)

Layer 2 & Layer 3 Centric Model Mix flavor w/ EVPN & VPN Design options

- **Option-5** SRv6-VPN/EVPN (Micro SID) RFC 9252 SRv6 BGP EVPN & VPN Service Overlay, Builds on RFC 7432 MPLS/EVPN (VLAN Anywhere & Multi Tenancy)
- **Option-6** SRv6-VPN/EVPN (Micro SID) RFC 9252 SRv6 BGP EVPN & VPN Service Overlay, ->RFC 8365 NVO3 VXLAN EVPN (VLAN Anywhere & Multi Tenancy)

Layer 2 & Layer 3 Centric Model Mix flavor w/ EVPN & Global Table Design options

- **Option-7** SRv6-Global/EVPN (Micro SID) RFC 9252 SRv6 BGP EVPN & Global Service Overlay, Builds on RFC 7432 MPLS/EVPN (VLAN Anywhere & Multi Tenancy)
- **Option-8** SRv6-Global/EVPN (Micro SID) RFC 9252 SRv6 BGP EVPN & Global Service Overlay, RFC 8365 NVO3 VXLAN EVPN (VLAN Anywhere & Multi Tenancy)

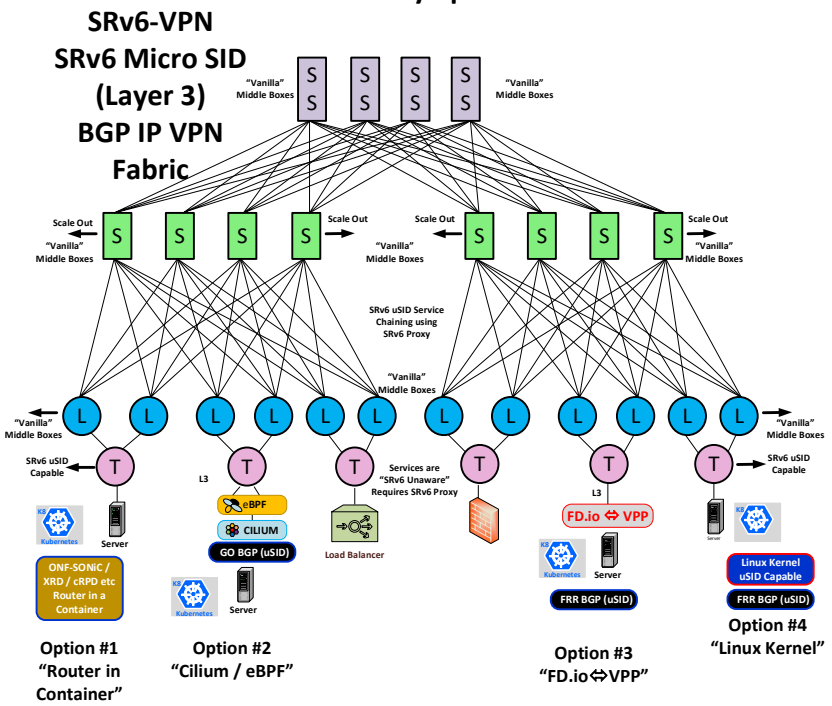
BGP Only DC RFC 7938 Layer 2 & Layer 3 Centric Model Mix Flavor w/ VPN & EVPN Design options

- **Option-9** SRv6-VPN (Micro SID) RFC 9252 SRv6 BGP VPN Service Overlay (Multi Tenancy) Option #1 w/ BGP Only DC RFC 7938
- **Option-10** SRv6-EVPN (Micro SID) RFC 9252 SRv6 BGP EVPN Service Overlay, Builds on RFC 8365 NVO3 VXLAN EVPN (VLAN Anywhere)
  Option #4 w/ BGP Only DC RFC 7938
- **Option-11** SRv6-VPN/EVPN (Micro SID) RFC 9252 SRv6 BGP EVPN & VPN Service Overlay, RFC 8365 NVO3 VXLAN EVPN (VLAN Anywhere)
  Option #6 w/ BGP Only DC RFC 7938

SRv6 uSID Design ⇔ Lines blurred between Compute & Network – Future SDN solution

- ✓ SDN centralized controller based solution that can fix or help the blurred lines network to compute hosts.
- ✓ SDN controller can now program the data plane end to end inter-as from Linux host to linux host on other side of planet can be intra-dc or inter-dc.
- ✓ Today we require PCEP/BGP-LS, however here we don't want the protocol heaviness on Linux host with the lines blurred.
- ✓ New SDN controller based data plane programming simplifies and makes seamless, network and host agnostic and programs the SRv6 uSID forwarding plane for all devices.

SRv6 uSID Design Options1-11
(4) DC Fabric ⇔ Host fabric connectivity options



SRv6 uSID Design ⇔ Extending the fabric to the host ⇔ 4 Design Options

Router-in-Container (Fabric to Host Option #1)

- SRv6 uSID ⇔ Full Control plane & Data plane support in a docker container
- XRD, SONiC, Nokia, Juniper cRPD ..

eBPF / Cilium (Fabric to Host Option #2)

- eBPF ⇔ SRv6 uSID support (Data Plane)
- Cilium ⇔ SRv6 uSID support (Control Plane & Data Plane)
- GO BGP (Control Plane)

FD.io / VPP – Calico (Fabric to Host Option #3)

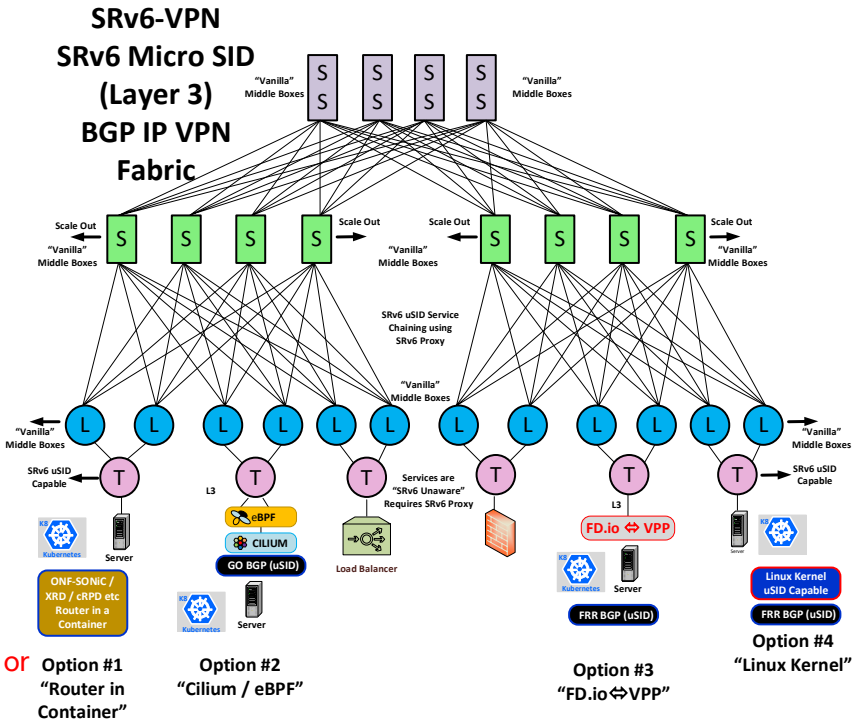
- VPP – Vector Packet Processing (Data Plane)
- Calico / VPP integration (Data Plane)
- FRR BGP (Control Plane)

Linux Kernel (Fabric to Host Option #4)

- Native SRv6 uSID support 6.11 (Data Plane)
- FRR BGP (Control Plane)

There maybe a combination of options as well such as XRD can be used for control plane for any option and for control plane FRR BGP or GO BGP can be used for any option

SRv6 uSID Design Options1-11
(4) DC Fabric ⇔ Host fabric connectivity options



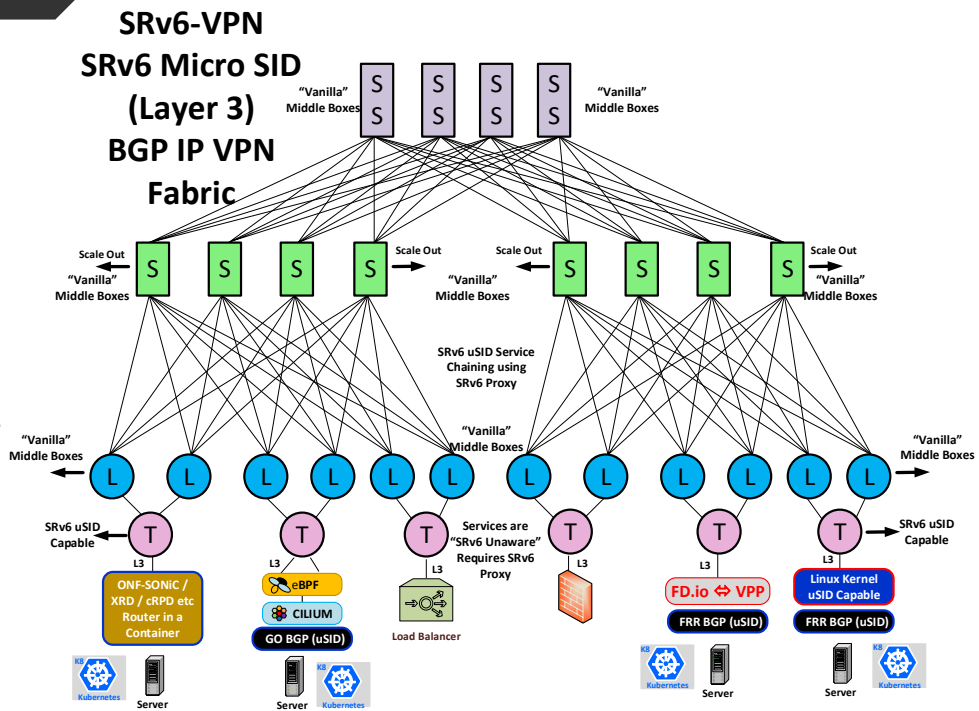
Design Option #1 L3 Centric Model (VPN)

Option 1 | Option 2 | Option 3 | Option 4

Option-1 Layer 3 – SRv6-VPN uSID
RFC 9252 BGP Service Overlay

SRv6 uSID Layer 3 Centric Model (VPN):

- **SRv6-VPN Overlay**
- **Endpoint behaviors End.DT4, End.DT6, End.DT46, End.DX4, End.DX6**
- **RFC 9252 SRv6 BGP Overlay Services**
  - SRv6 Service SID encoded entirely into BGP prefix SID (SRv6 L3 Service TLV) or with optional update packing transposition scheme common part encoded into BGP prefix SID and variable part encoded into VPN NRLI
- **Flattened Data plane with SRv6-VPN Label encoded into the Function field of SRv6 SID**
- **4 host endpoint attachments styles available**



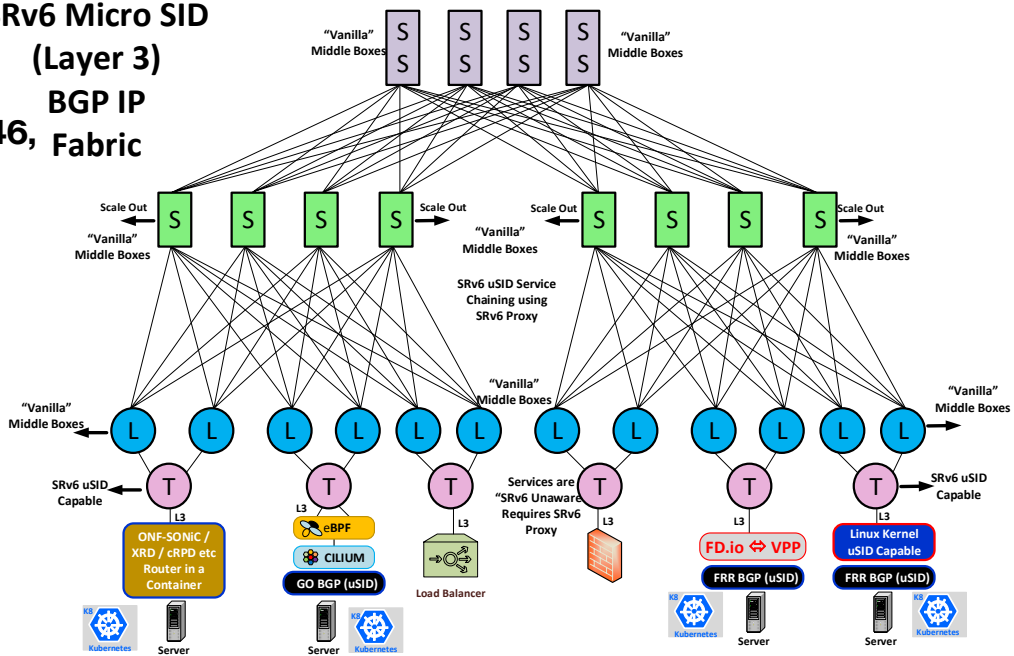
Design Option #2 L3 Centric Model (Global)

Option 1 | Option 2 | Option 3 | Option 4

SRv6 uSID Layer 3 Centric Model (Global):

- SRv6-Global Overlay
- Endpoint behaviors End.DT4, End.DT6, End.DT46, End.DX4, End.DX6
- RFC 9252 SRv6 BGP Overlay Services
  - SRv6 Service SID encoded into BGP prefix SID (SRv6 L3 Service TLV)
- Flattened Data plane with SRv6-Global Label encoded into the Function field of SRv6 SID
- 4 host endpoint attachments styles available

Option-2 Layer 3 – SRv6-Global uSID
RFC 9252 BGP Overlay Global Table Routing



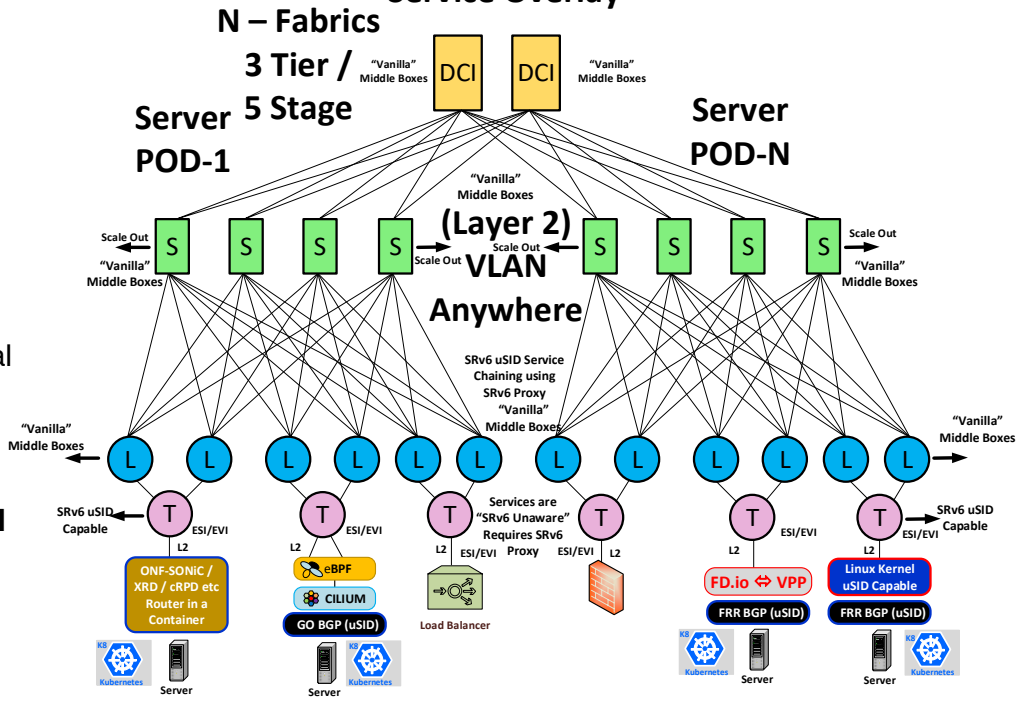
Design Option #3 L2 Centric Model (EVPN/MPLS)

Option 1 | Option 2 | Option 3 | Option 4

Option-3 Layer 2 – SRv6 uSID MPLS / EVPN RFC 7432
RFC 9252 BGP EVPN
Service Overlay

SRv6 uSID Layer 2 Centric Model (EVPN/MPLS Style):

- **SRv6-EVPN Overlay**
- **Endpoint behaviors End.DX2, End.DX2V, End.DT2U, End.DT2M**
- **RFC 9252 SRv6 BGP Overlay Services**
  - SRv6 Service SID encoded entirely into BGP prefix SID (SRv6 L2 Service TLV) or with optional update packing transposition scheme common part encoded into BGP prefix SID and variable part encoded into VPN NRLI
- **Flattened Data plane with SRv6-EVPN Label encoded into the Function field of SRv6 SID**
- **4 host endpoint attachments styles available**



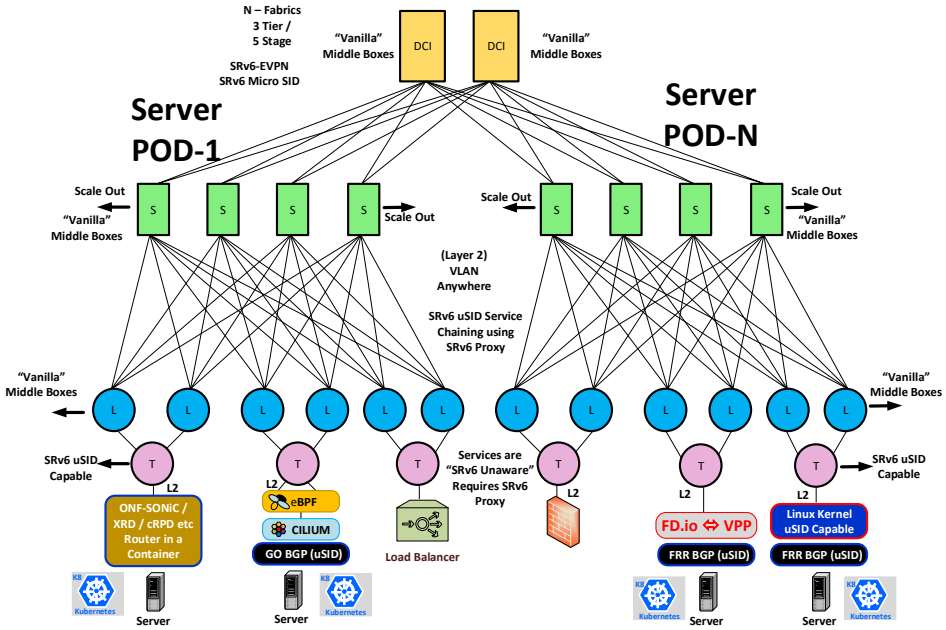
Design Option #4 L2 Centric Model (EVPN/NVO)

Option 1 | Option 2 | Option 3 | **Option 4**

Option-4 Layer 2 – SRv6 uSID NVO VXLAN EVPN RFC 8365
RFC 9252 BGP Service Overlay
EVPN (NVO3 Overlay)

SRv6 uSID Layer 2 Centric Model (EVPN/NVO Style):

- **SRv6-EVPN Overlay**
- **Endpoint behaviors End.DX2, End.DX2V, End.DT2U, End.DT2M**
- **RFC 9252 SRv6 BGP Overlay Services**
  - SRv6 Service SID encoded entirely into BGP prefix SID (SRv6 L2 Service TLV) or with optional update packing transposition scheme common part encoded into BGP prefix SID and variable part encoded into VPN NRLI
- **Flattened Data plane with SRv6-EVPN Label encoded into the Function field of SRv6 SID**
- **4 host endpoint attachments styles available**



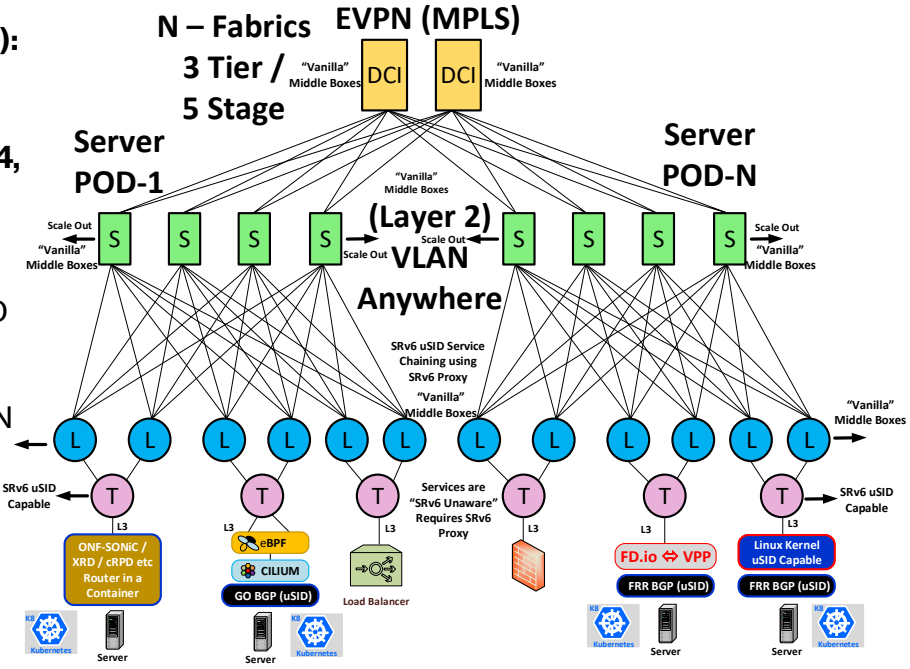
Design Option #5 L2 / L3 Mix model (VPN/EVPN MPLS)

Option 5 | Option 6 | Option 7 | Option 8

Option-5 Layer 2 – SRv6 uSID MPLS / EVPN RFC 7432 & Layer 3 SRv6-VPN BGP Overlay RFC 9252 BGP Service Overlay

SRv6 uSID Layer 2 / Layer 3 Centric Model (VPN/ EVPN MPLS):

- **SRv6-EVPN/VPN Overlay**
- **Endpoint behaviors End.DT4, End.DT6, End.DT46, End.DX4, End.DX6, End.DX2, End.DX2V, End.DT2U, End.DT2M**
- **RFC 9252 SRv6 BGP Overlay Services**
  - SRv6 Service SID encoded entirely into BGP prefix SID (SRv6 L2/L3 Service TLV) or with optional update packing transposition scheme common part encoded into BGP prefix SID and variable part encoded into VPN NRLI
- **Flattened Data plane with SRv6-VPN, SRv6-EVPN Label encoded into the Function field of SRv6 SID**
- **4 host endpoint attachments styles available**



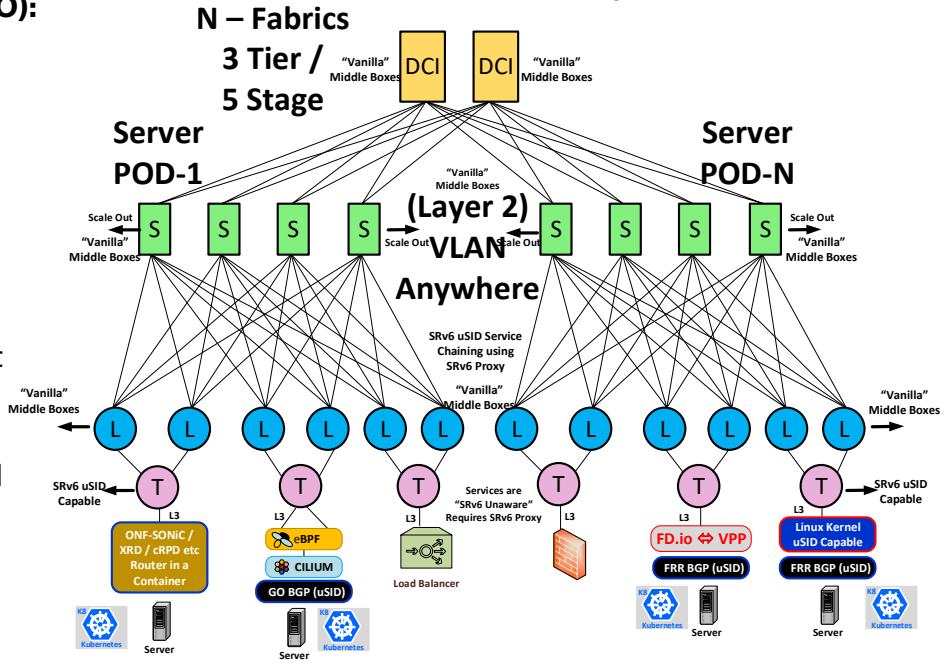
Design Option #6 L2/L3 Mix Model (VPN/EVPN NVO)

Option 5 | Option 6 | Option 7 | Option 8

Option-6 Layer 2 – SRv6 uSID NVO VXLAN EVPN RFC 8365 & Layer 3 SRv6-VPN BGP Overlay RFC 9252 BGP Service Overlay EVPN (NVO3 Overlay)

SRv6 uSID Layer 2 / Layer 3 Centric Model (VPN/EVPN NVO):

- **SRv6-EVPN/VPN Overlay**
- **Endpoint behaviors End.DT4, End.DT6, End.DT46, End.DX4, End.DX6, End.DX2, End.DX2V, End.DT2U, End.DT2M**
- **RFC 9252 SRv6 BGP Overlay Services**
  - SRv6 Service SID encoded entirely into BGP prefix SID (SRv6 L2/L3 Service TLV) or with optional update packing transposition scheme common part encoded into BGP prefix SID and variable part encoded into VPN NRLI
- **Flattened Data plane with SRv6-VPN, SRv6-EVPN Label encoded into the Function field of SRv6 SID**
- **4 host endpoint attachments styles available**



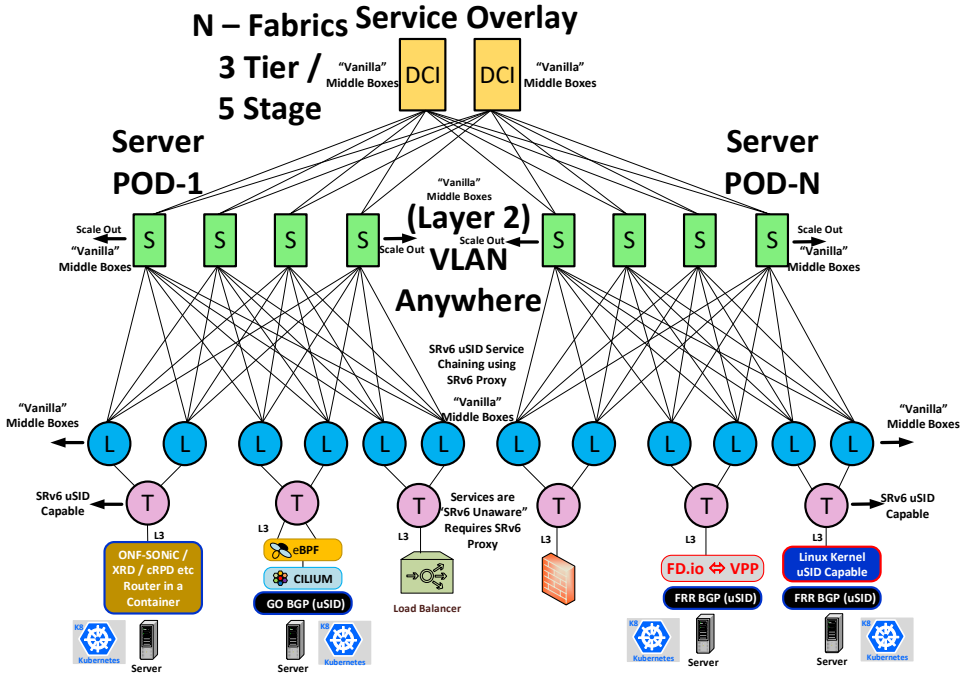
Design Option #7 L2/L3 Mix Model (Global/EVPN MPLS)

Option 5 | Option 6 | Option 7 | Option 8

Option-7 Layer 2 – SRv6 uSID MPLS / EVPN RFC 7432 & Layer 3 SRv6-Global BGP Overlay RFC 9252 BGP Global

SRv6 uSID Layer 2 / Layer 3 Centric Model (Global/EVPN MPLS):

- **SRv6-EVPN/Global Overlay**
- **Endpoint behaviors End.DT4, End.DT6, End.DT46, End.DX4, End.DX6, End.DX2, End.DX2V, End.DT2U, End.DT2M**
- **RFC 9252 SRv6 BGP Overlay Services**
  - SRv6 Service SID encoded entirely into BGP prefix SID (SRv6 L2/L3 Service TLV)
- **Flattened Data plane with SRv6-VPN, SRv6-EVPN Label encoded into the Function field of SRv6 SID**
- **4 host endpoint attachments styles available**



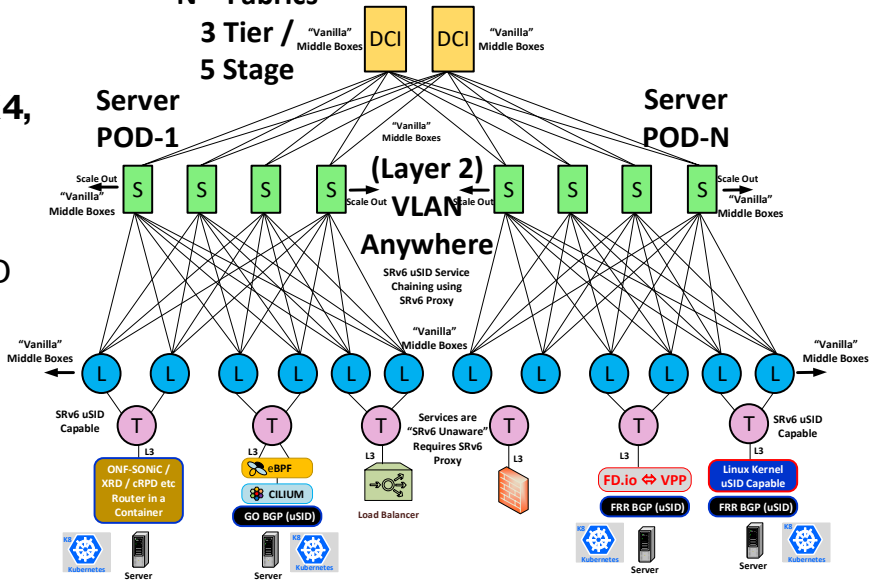
Design Option #8 L2/L3 Mix Model (Global/EVPN NVO)

Option 5 | Option 6 | Option 7 | Option 8

Option-8 Layer 2 – SRv6 uSID NVO VXLAN EVPN RFC 8365 & Layer 3 SRv6-Global BGP Overlay RFC 9252 BGP Service Overlay EVPN (NVO3 Overlay)

SRv6 uSID Layer 2 / Layer 3 Centric Model (Global/EVPN NVO):

- **SRv6-EVPN/Global Overlay**
- **Endpoint behaviors End.DT4, End.DT6, End.DT46, End.DX4, End.DX6, End.DX2, End.DX2V, End.DT2U, End.DT2M**
- **RFC 9252 SRv6 BGP Overlay Services**
  - SRv6 Service SID encoded entirely into BGP prefix SID (SRv6 L2/L3 Service TLV)
- **Flattened Data plane with SRv6-VPN, SRv6-EVPN Label encoded into the Function field of SRv6 SID**
- **4 host endpoint attachments styles available**



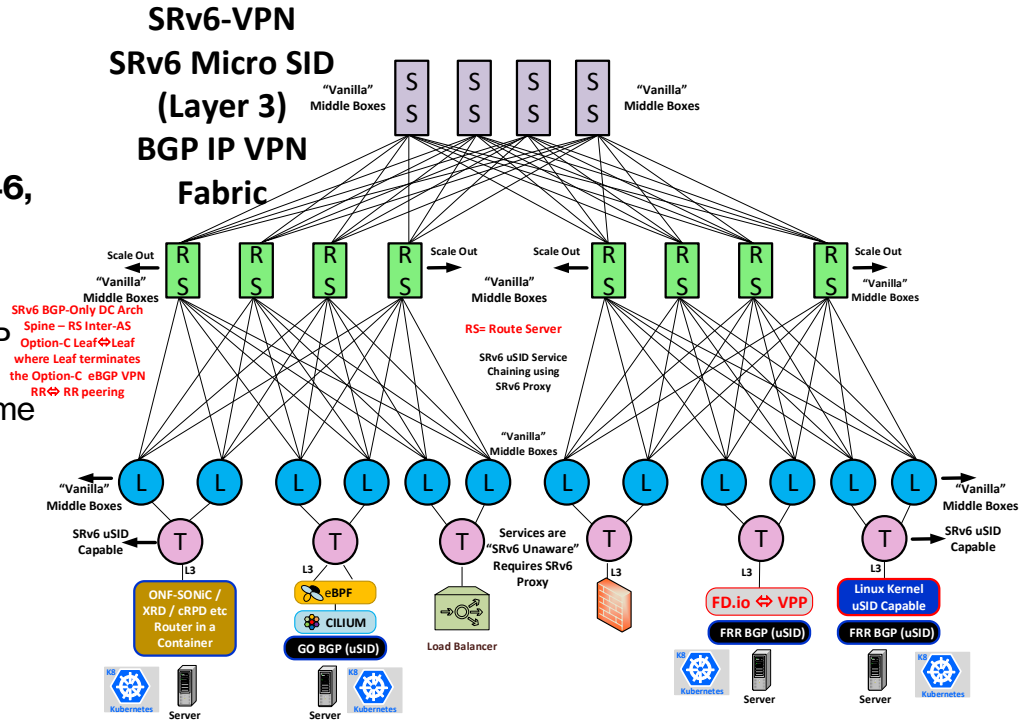
Design Option #9 BGP Only DC (VPN)

Option 9 | Option 10 | Option 11

BGP Only DC RFC 7938 (VPN):

- **SRv6-VPN Overlay**
- **Endpoint behaviors End.DT4, End.DT6, End.DT46, End.DX4, End.DX6**
- **RFC 9252 SRv6 BGP Overlay Services**
  - SRv6 Service SID encoded entirely into BGP prefix SID (SRv6 L3 Service TLV) or with optional update packing transposition scheme common part encoded into BGP prefix SID and variable part encoded into VPN NRLI
- **Flattened Data plane with SRv6-VPN Label encoded into the Function field of SRv6 SID**
- **4 host endpoint attachments styles available**

Option-9 Layer 3 – SRv6-VPN uSID
RFC 9252 BGP Service Overlay
w/ RFC 7938 BGP Only DC



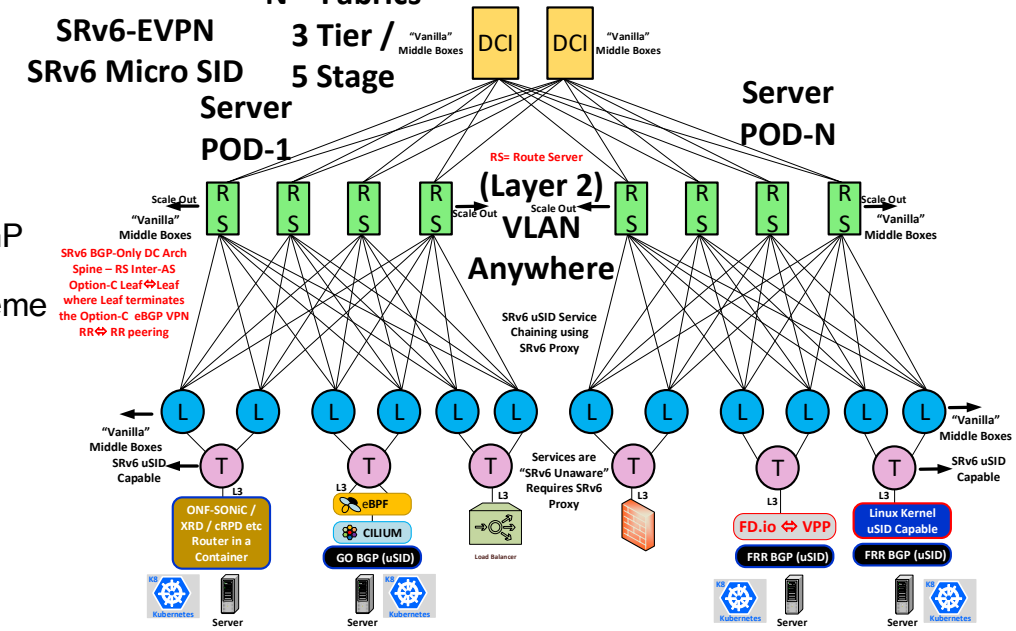
Design Option #10 BGP Only DC (EVPN)

Option 9 | Option 10 | Option 11

BGP Only DC RFC 7938 (NVO Style):

- **SRv6-EVPN Overlay**
- **Endpoint behaviors End.DX2, End.DX2V, End.DT2U, End.DT2M**
- **RFC 9252 SRv6 BGP Overlay Services**
  - SRv6 Service SID encoded entirely into BGP prefix SID (SRv6 L2 Service TLV) or with optional update packing transposition scheme common part encoded into BGP prefix SID and variable part encoded into VPN NRLI
- **Flattened Data plane with SRv6-EVPN Label encoded into the Function field of SRv6 SID**
- **4 host endpoint attachments styles available**

Option-10 Layer 2 – SRv6 uSID NVO VXLAN EVPN RFC 8365
RFC 9252 BGP Service Overlay
EVPN (NVO3 Overlay)
w/ RFC 7938 BGP Only DC



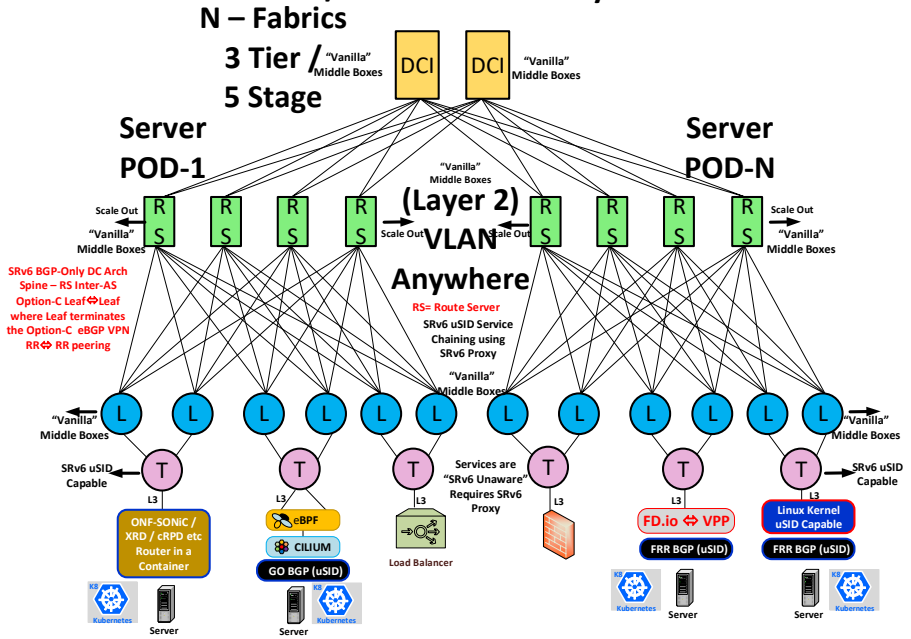
Design Option #11 BGP Only DC VPN/EVPN NVO

Option 9 | Option 10 | Option 11

BGP Only DC RFC 7938 (VPN/EVPN NVO):

- **SRv6-EVPN/VPN Overlay**
- **Endpoint behaviors End.DT4, End.DT6, End.DT46, End.DX4, End.DX6, End.DX2, End.DX2V, End.DT2U, End.DT2M**
- **RFC 9252 SRv6 BGP Overlay Services**
  - SRv6 Service SID encoded entirely into BGP prefix SID (SRv6 L2/L3 Service TLV) or with optional update packing transposition scheme common part encoded into BGP prefix SID and variable part encoded into VPN NRLI
- **Flattened Data plane with SRv6-VPN, SRv6-EVPN Label encoded into the Function field of SRv6 SID**
- **4 host endpoint attachments styles available**

Option-11 Layer 2 – SRv6 uSID NVO VXLAN EVPN RFC 8365 & Layer 3 SRv6-VPN BGP Overlay RFC 9252 BGP Service Overlay EVPN (NVO3 Overlay) w/ RFC 7938 BGP Only DC



Traffic Engineering in the DC:

- **We need Traffic Engineering for certain flows within the Data Center!**
  - Selective steering of elephant flows in the DC to avoid “hot spots”
  - Selective steering of elephant flows that are creating the DC “hot spots”
  - Bandwidth upgrade transitional periods where links are not the same bandwidth and UCMP load balancing
  - Excluding Link & Nodes experiencing congestions hot-stops
  - Mission critical mice-flows that require low-latency & jitter tolerance

SRv6 uSID Use case permutations in the context of “TE” or “No TE”

Traffic Engineering is NOT a requirement:

- SRv6 uSID on the host-only use case: “What you get for Free with SRv6 uSID in the DC Space”
  - SRv6-EVPN RFC 9252 SRv6 BGP Overlay Services for L2 Centric model EVPN
  - SRv6-VPN RFC 9252 SRv6 BGP Overlay Services for L3 Centric model IP-VPN
  - All switches in the Data center can be 100% Vanilla IPv6 enabled, IPv6 Data plane only required
  - BGP control plane for L2 VPN EVPN & L3 VPN IP-VPN peering to DC Spine Route Reflector
  - BGP control plane for L2 VPN EVPN & L3 VPN IP-VPN peering to DC Spine Route Server (BGP Only DC)
  - Data Center fabric can be 100% blind to L2 VPN EVPN & L3 VPN IP-VPN overlay and can forward the packets
  - SRv6 uSID “flattened” data plane with the L2 VPN & L3 VPN labels are encoded into the FUNC field of SRv6 SID and advertised so the packets are forwarded by the Vanilla IPv6 data plane only switch fabric
  - No advanced features such as Traffic Engineering, TI-LFA, uloop avoidance etc are required

- This model can be the Data Center end state use case
- This model can also be an interim initial step to deploying SRv6 uSID throughout the Data Center.

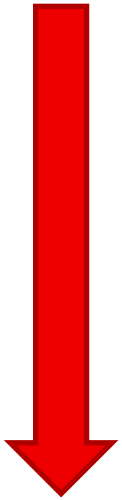
******Note that Both are valid use cases******

SRv6 uSID Use case permutations in the context of “TE” or “No TE”

Traffic Engineering is a requirement:

- E-W Compute host steering N-WAY ECMP ⇔ Fabric is 100% vanilla
  - TOR, Leaf, Spine, SS is Vanilla IPv6 Data plane
- E-W Compute host steering loose hops path ⇔ Steer to TOR with uA Adj-SID to Leaf
  - Leaf, Spine, SS are Vanilla IPv6 Data plane
- E-W Compute host steering loose hops path ⇔ Steer to leaf with uA Adj-SID to Spine
  - TOR, Spine, SS are Vanilla IPv6 Data plane
- E-W N-S Compute host steering loose hops path ⇔ Steer to leaf with uA Adj-SID to Spine
  - TOR, Spine are Vanilla IPv6 Data plane
- E-W Compute host steering N-Way ECMP steer around “Hot Spot”
  - Entire path is uSID capable ⇔ static SID list of uN nodes
- Entire DC Fabric SRv6 uSID capable ⇔ Requirement for all Carrier Grade features
  - All DC Fabric nodes are uSID capable

“Vanilla fabric”



“Full Carrier Grade Features”

All of the above can be TE use cases or interim steps for the DC to be 100% uSID capable

SRv6 uSID and steering with vanilla fabric using uA Adj-Sid

Entire DC fabric uSID capable

- All nodes require Carrier Grade features TI-LFA etc

E⇔ W Steering N-Way ECMP with entire DC fabric Vanilla

- uSID Carrier, 1st uSID is **uA Adj-SID** to TOR
- **TOR forwards as native IP**

E⇔W Steering Loose path (Next slides focus on this style)

- Host steers to Leaf with **uA Adj-SID** to Spine
- **TOR, Spine, SS are Vanilla**

E⇔W & N⇔S Steering Loose path (Next slides focus on this style)

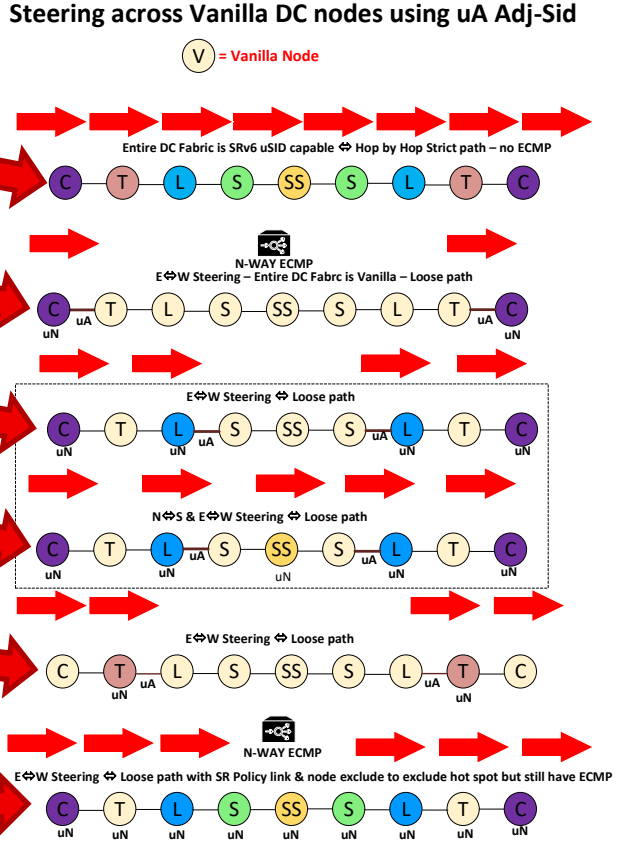
- Host steers to Leaf with **uA Adj-SID** to Spine
- SS is SRv6 capable for USD function for N⇔S flow
- **TOR, Spine are Vanilla**

E⇔W Steering Loose path

- Host steers to TOR with **uA Adj-SID** to Leaf
- **Leaf, Spine, SS are Vanilla**

E⇔W Steering N-Way ECMP – exclude hot spot

- Host steers entire path is uN – SR Policy enabled exclude hot spot
- **TOR, Spine, SS are Vanilla**



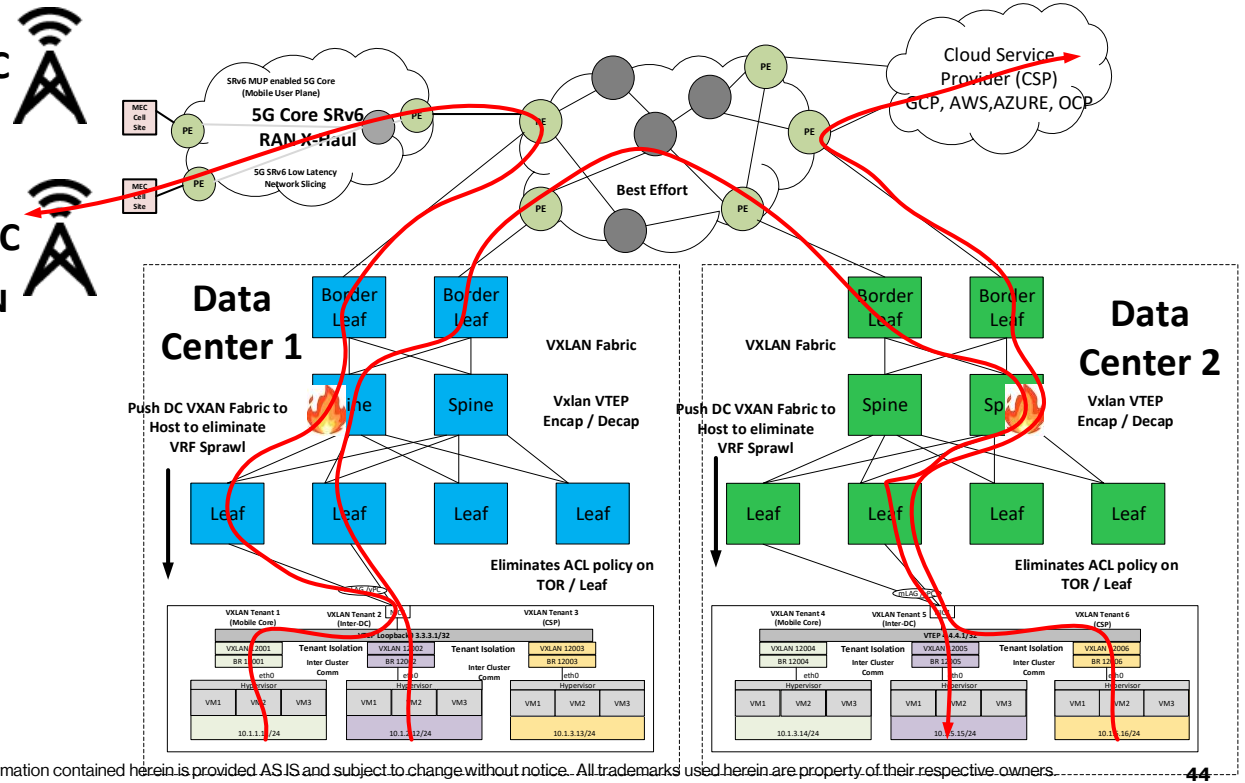
SRv6 uSID Telco Cloud meets Hyperscaler IT Cloud with Multi Cloud / Hybrid Cloud

VXLAN ⇔ VM Scenario

Telco Cloud meets Hyperscaler IT Cloud with " Multi Cloud / Hybrid Cloud"

Today's NVO VXLAN (VM Scenario)

- Historically Compute hosts have had many fiber runs to different VRFs ⇔ spaghetti mess
- Requirement to extend NVO VXLAN Fabric to the compute host
- Extending fabric to host eliminates ACL policy on TOR/Leaf
- VXLAN Fabric must be pushed down to the host to eliminate VRF sprawl on the compute host
- No Traffic Eng capability to steer around Data Center "Hot Spots"

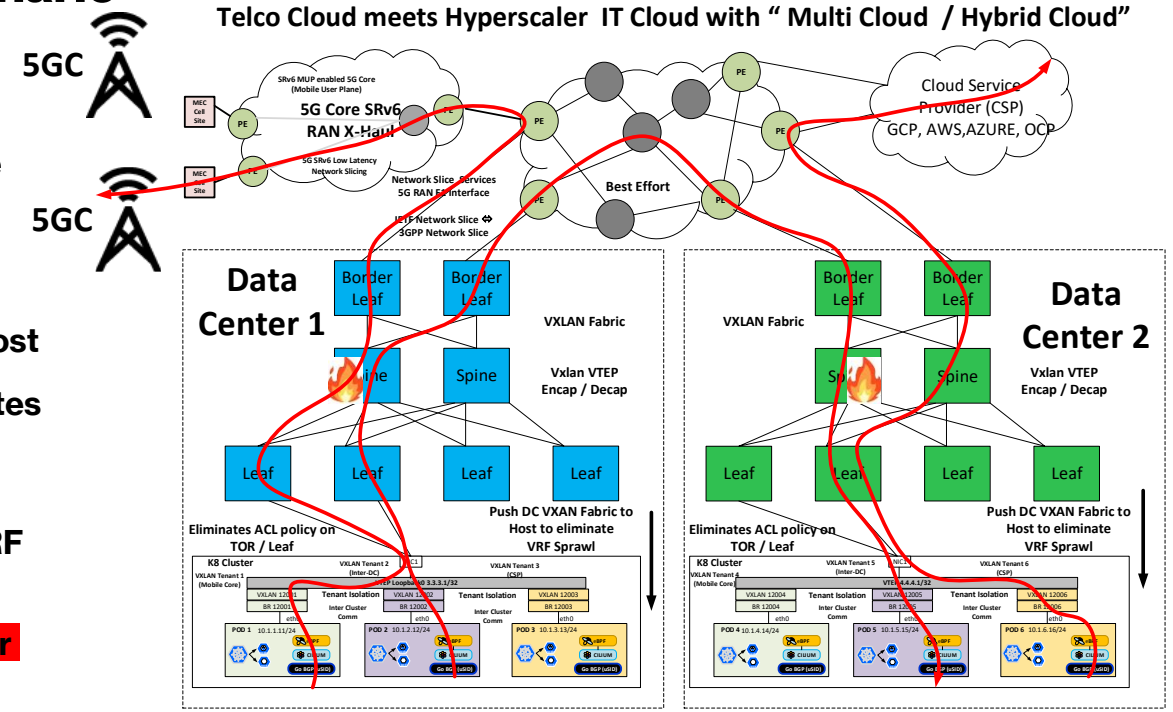


SRv6 uSID Telco Cloud meets Hyperscaler IT Cloud with Multi Cloud / Hybrid Cloud

VXLAN ⇔K8 Scenario

Today's NVO VXLAN (K8 Scenario)

- Historically Compute hosts have had many fiber runs to different VRFs ⇔ spaghetti mess
- Requirement to extend NVO VXLAN Fabric to the compute host
- Extending fabric to host eliminates ACL policy on TOR/Leaf
- VXLAN Fabric must be pushed down to the host to eliminate VRF sprawl on the compute host
- No Traffic Eng capability to steer around Data Center "Hot Spots"



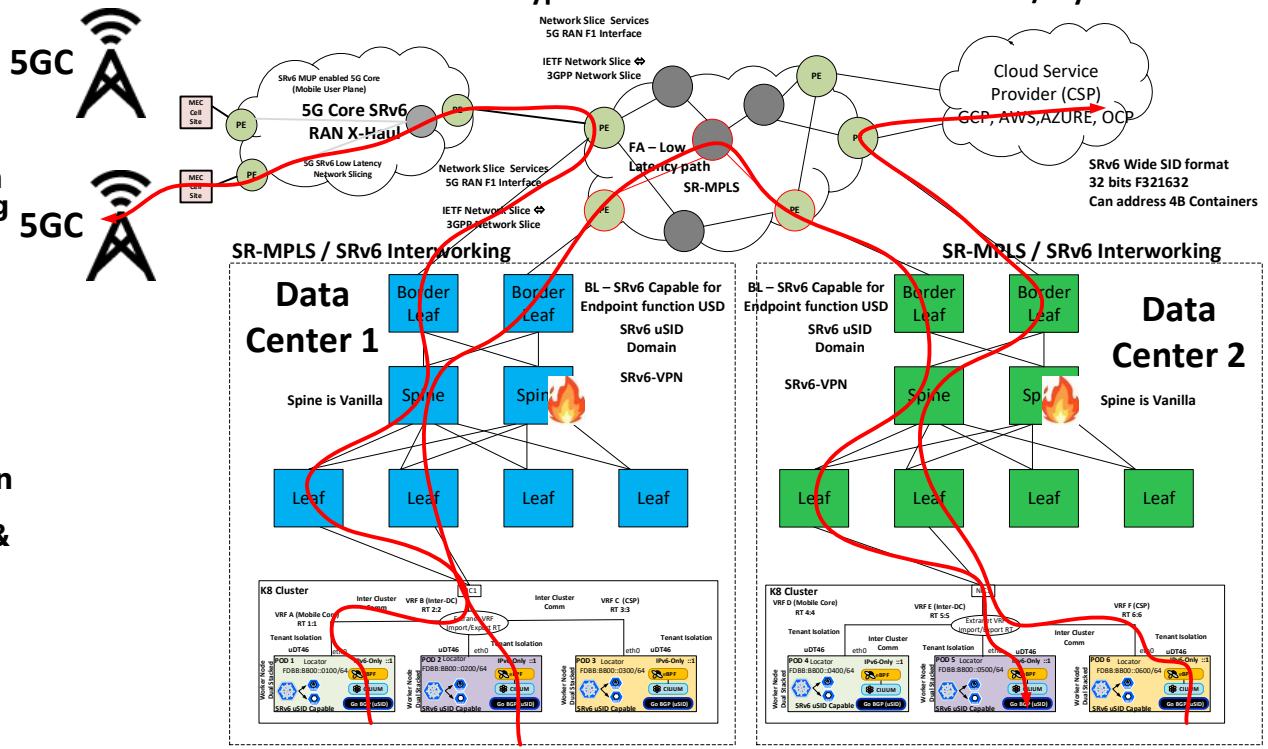
SRv6 uSID Telco Cloud meets Hyperscaler IT Cloud with Multi Cloud / Hybrid Cloud

MPLS / SR-MPLS ⇔ SRv6 uSID Interworking

SRv6 ⇔ SR-MPLS / MPLS "Interworking"

draft-agrawal-spring-srv6-mpls-interworking

- **E2E Traffic Eng Capability from SRv6 uSID Data Center steering around DC hotspots and taking low latency path across MPLS / SR-MPLS core to egress DC**
- **Data Center is SRv6 uSID and Core network is MPLS or SR-MPLS**
- **SRv6 uSID to MPLS / SR-MPLS Interworking at the inter-domain boundary using Service IW Gateway SRv6 to MPLS (6oM) & MPLS to SRv6 (Mo6)**



SRv6 uSID Telco Cloud meets Hyperscaler IT Cloud with Multi Cloud / Hybrid Cloud

Option 1 | Option 2 | Option 3 | Option 4

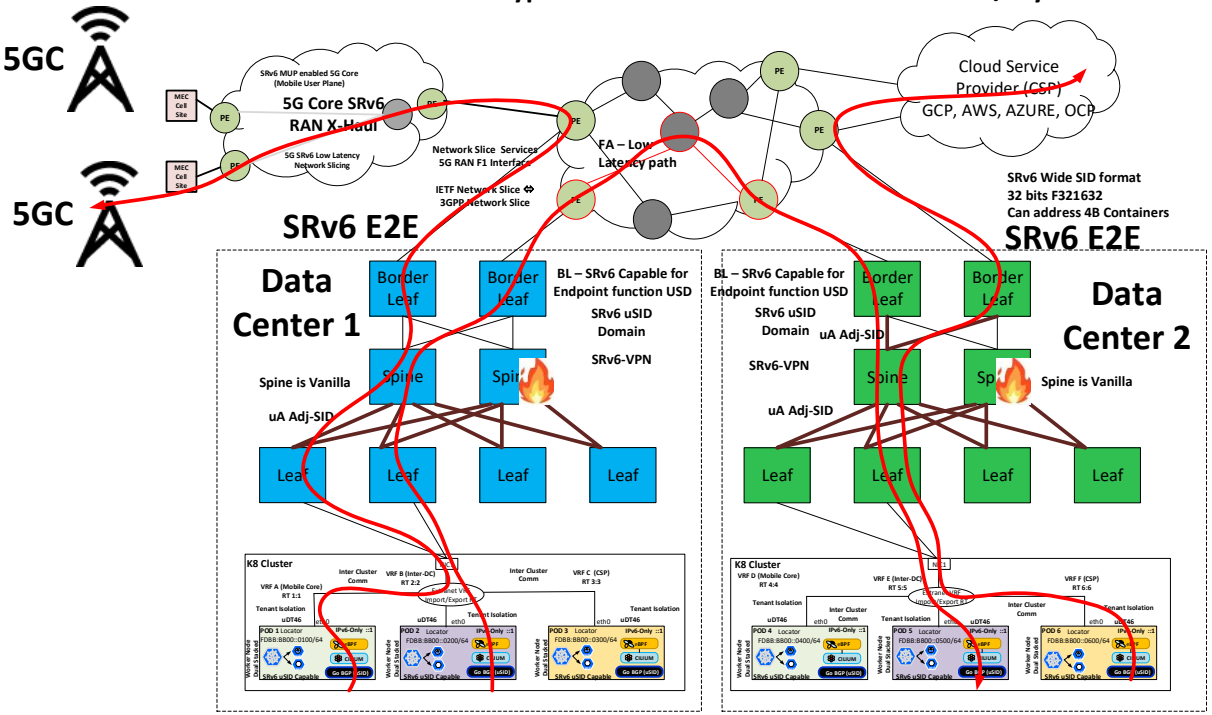
E2E SRv6 uSID:

SRv6 uSID steering using uA Adj-SID to steer around DC Hot Spot and taking low latency path across the Core Network

3 Common flows observed:

- **DC to 5G Mobile Core**
- **Inter-Data Center**
- **DC to CSP**

Host Endpoint = eBPF/Cilium



SRv6 uSID Telco Cloud meets Hyperscaler IT Cloud with Multi Cloud / Hybrid Cloud

Option 1 | Option 2 | Option 3 | Option 4

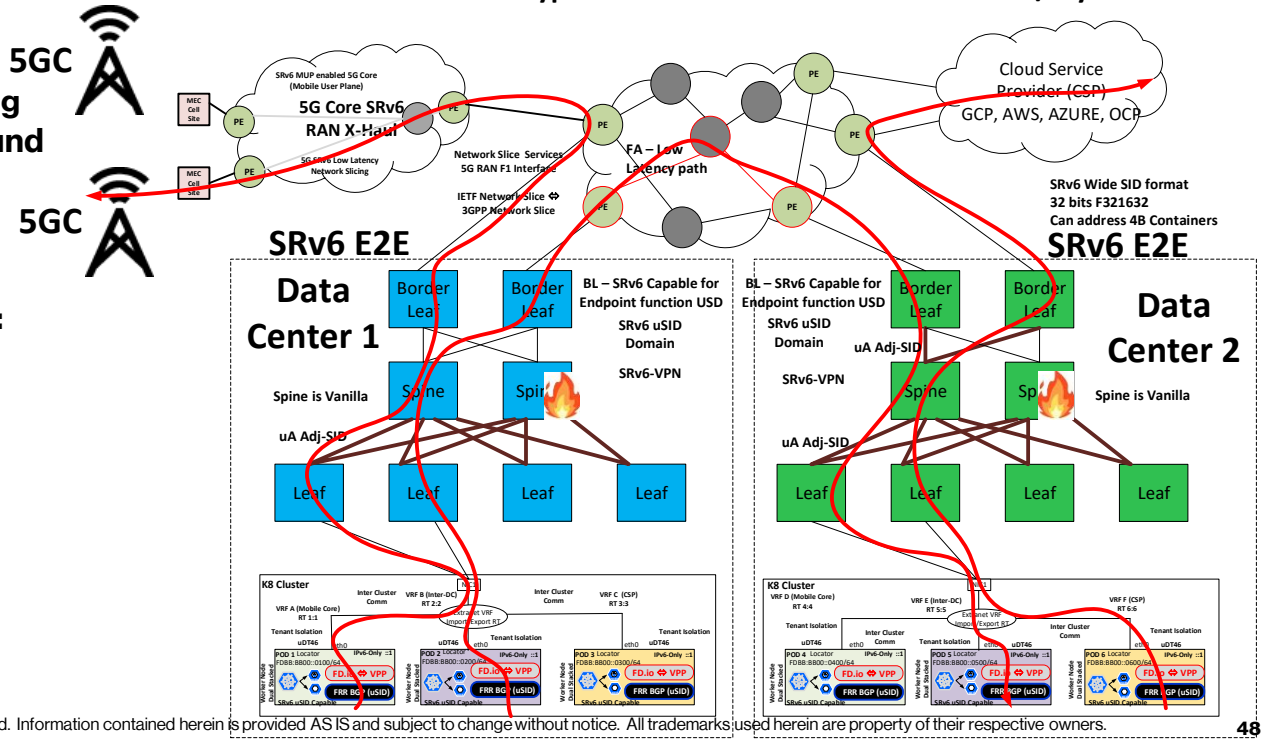
E2E SRv6 uSID:

SRv6 uSID steering using uA Adj-SID to steer around DC Hot Spot and taking low latency path across the Core Network

3 Common flows observed:

- DC to 5G Mobile Core
- Inter-Data Center
- DC to CSP

Host Endpoint = FD.io VPP



SRv6 uSID Telco Cloud meets Hyperscaler IT Cloud with Multi Cloud / Hybrid Cloud

Option 1 | Option 2 | **Option 3** | Option 4

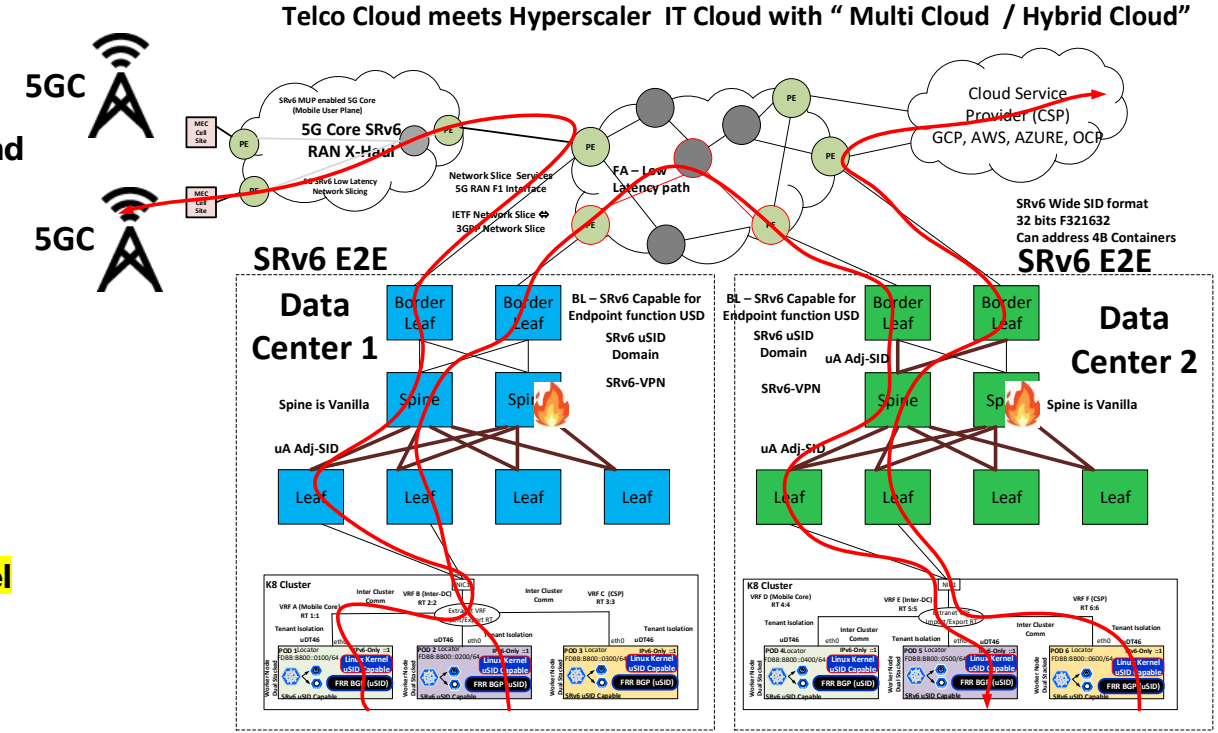
E2E SRv6 uSID:

SRv6 uSID steering using uA Adj-SID to steer around DC Hot Spot and taking low latency path across the Core Network

3 Common flows observed:

- **DC to 5G Mobile Core**
- **Inter-Data Center**
- **DC to CSP**

Host Endpoint = Linux Kernel



SRv6 uSID Telco Cloud meets Hyperscaler IT Cloud with Multi Cloud / Hybrid Cloud

Option 1 | Option 2 | Option 3 | **Option 4**

E2E SRv6 uSID:

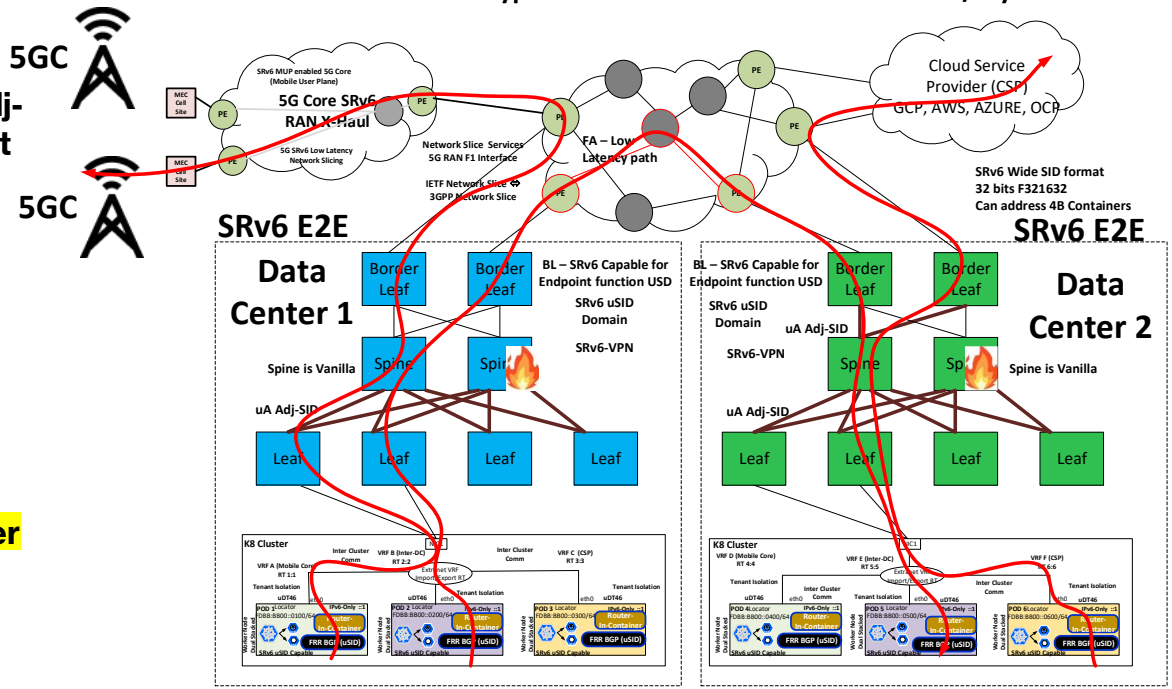
SRv6 uSID steering using uA Adj-SID to steer around DC Hot Spot and taking low latency path across the Core Network

3 Common flows observed:

- **DC to 5G Mobile Core**
- **Inter-Data Center**
- **DC to CSP**

Host Endpoint =Router-in-Container

Telco Cloud meets Hyperscaler IT Cloud with " Multi Cloud / Hybrid Cloud"



SRv6 uSID - Telco Cloud ⇔ CXP ⇔CSP Native SRv6 uSID w/ CSP Ingress tunnel

Option 1 | Option 2 | Option 3 | Option 4

E2E SRv6 uSID:

E2E SRv6 uSID with tunnel within CSP ⇔ SRv6 uSID tunneled to host ⇔ native SRv6 to host

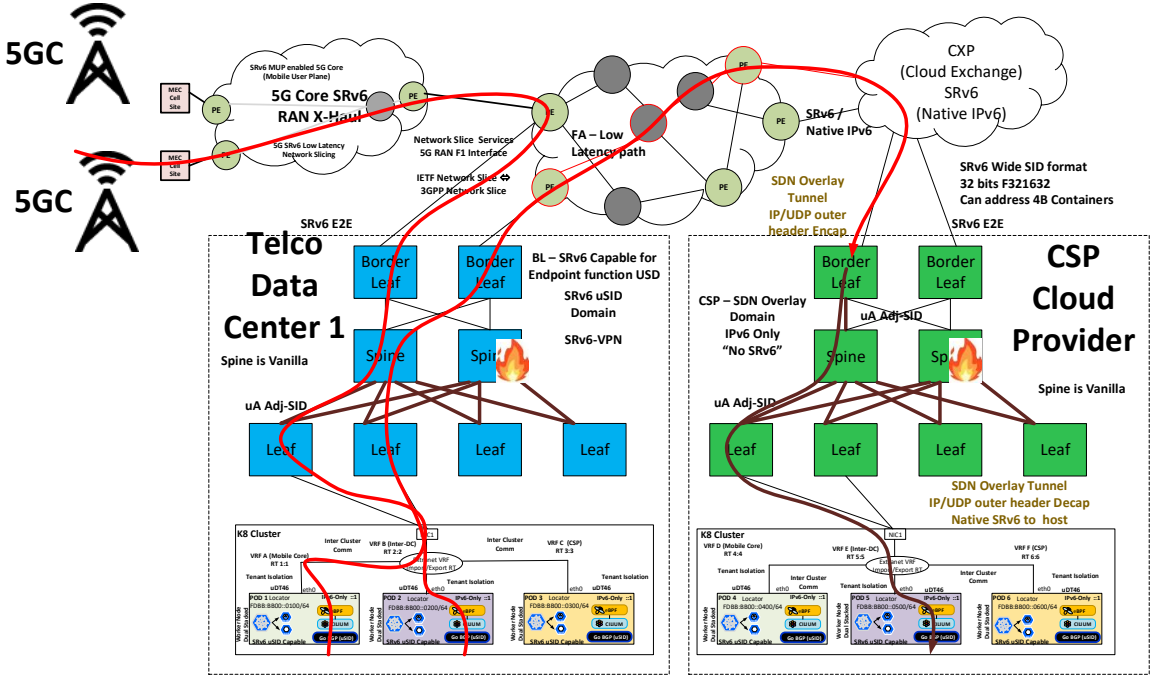
SRv6 uSID steering using uA Adj-SID to steer around DC Hot Spot and taking low latency path across the Core Network

2 Common flows observed:

- **DC to 5G Mobile Core**
- **DC to CSP Native SRv6 uSID with SRv6 Tunnel**

Host Endpoint = eBPF/Cilium

Telco Cloud meets Hyperscaler IT Cloud with " Multi Cloud / Hybrid Cloud"
"With Native SRv6 through CXP to CSP ingress SDN Overlay tunnel to VPC w/ eBPF/Cilium host



SRv6 uSID - Telco Cloud ⇔ CXP ⇔CSP Native SRv6 uSID w/ CSP Ingress tunnel

Option 1 | Option 2 | Option 3 | Option 4

Telco Cloud meets Hyperscaler IT Cloud with " Multi Cloud / Hybrid Cloud"
"With Native SRv6 through CXP to CSP ingress SDN Overlay tunnel to VPC w/ FD.IO/VPP Host

E2E SRv6 uSID:

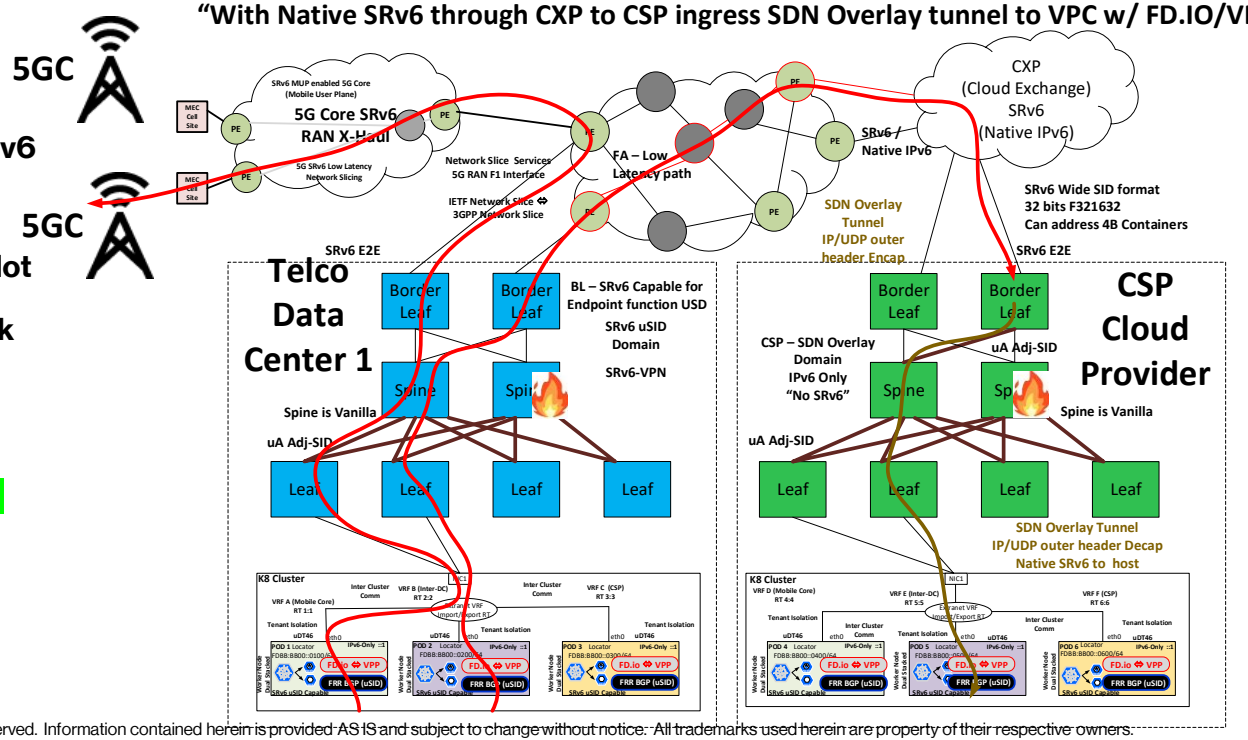
E2E SRv6 uSID with tunnel within CSP ⇔ SRv6 uSID tunneled to host ⇔ native SRv6 to host

SRv6 uSID steering using uA Adj-SID to steer around DC Hot Spot and taking low latency path across the Core Network

2 Common flows observed:

- **DC to 5G Mobile Core**
- **DC to CSP Native SRv6 uSID with SRv6 Tunnel**

Host Endpoint = FD.io VPP



SRv6 uSID - Telco Cloud ⇔ CXP ⇔CSP Native SRv6 uSID w/ CSP Ingress tunnel

Option 1 | Option 2 | Option 3 | Option 4

E2E SRv6 uSID:

E2E SRv6 uSID with tunnel within CSP ⇔ SRv6 uSID tunneled to host ⇔ native SRv6 to host

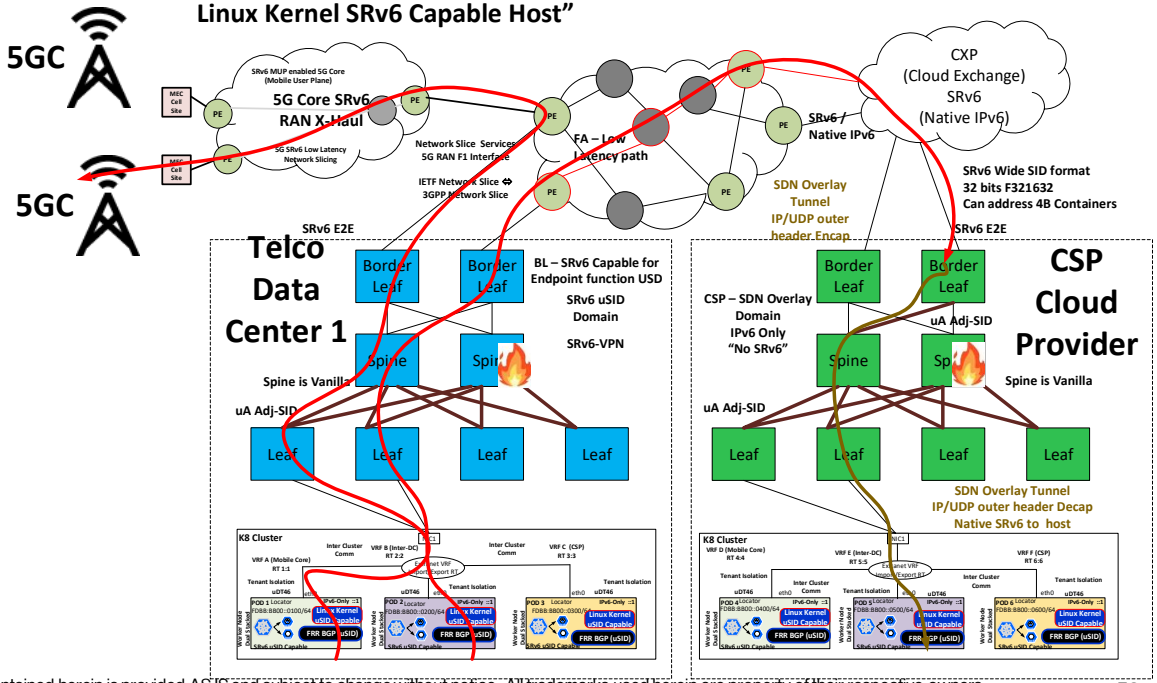
SRv6 uSID steering using uA Adj-SID to steer around DC Hot Spot and taking low latency path across the Core Network

2 Common flows observed:

- DC to 5G Mobile Core
- DC to CSP Native SRv6 uSID with SRv6 Tunnel

Host Endpoint = Linux Kernel

Telco Cloud meets Hyperscaler IT Cloud with " Multi Cloud / Hybrid Cloud"
"With Native SRv6 through CXP to CSP ingress SDN Overlay tunnel to VPC w/ Linux Kernel SRv6 Capable Host"



SRv6 uSID - Telco Cloud ⇔ CXP ⇔CSP Native SRv6 uSID w/ CSP Ingress tunnel

Option 1 | Option 2 | Option 3 | **Option 4**

E2E SRv6 uSID:

E2E SRv6 uSID with tunnel within CSP ⇔ SRv6 uSID tunneled to host ⇔ native SRv6 to host

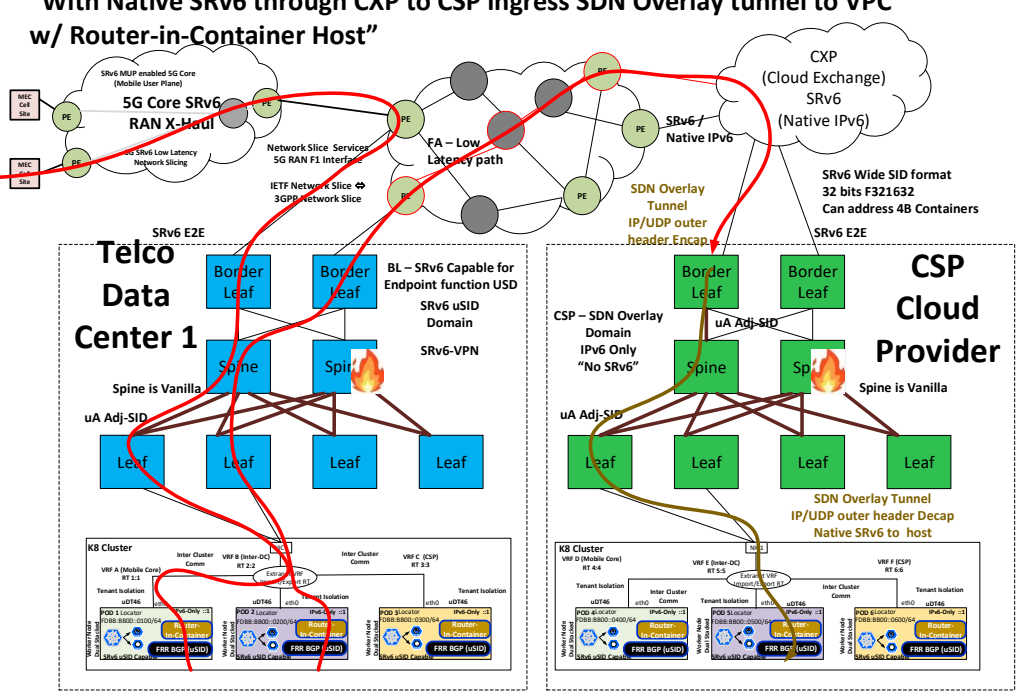
SRv6 uSID steering using uA Adj-SID to steer around DC Hot Spot and taking low latency path across the Core Network

2 Common flows observed:

- **DC to 5G Mobile Core**
- **DC to CSP Native SRv6 uSID with SRv6 Tunnel**

Host Endpoint = Router-in-Container

Telco Cloud meets Hyperscaler IT Cloud with " Multi Cloud / Hybrid Cloud"
"With Native SRv6 through CXP to CSP ingress SDN Overlay tunnel to VPC w/ Router-in-Container Host"



SRv6 uSID - Telco Cloud ⇔ CXP ⇔CSP Native SRv6 uSID ⇔ E2E SRv6 uSID

Option 1 | Option 2 | Option 3 | Option 4

E2E SRv6 uSID:

E2E SRv6 uSID 5G Telco Cloud to CSP

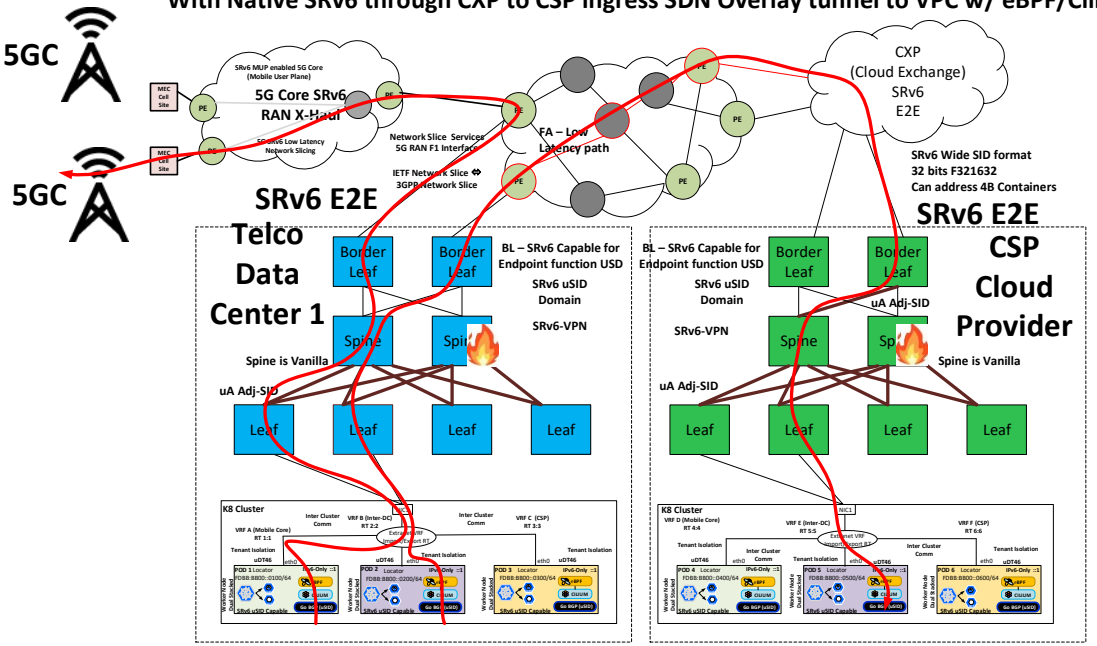
SRv6 uSID steering using uA Adj-SID to steer around DC Hot Spot and taking low latency path across the Core Network to CSP

2 Common flows observed:

- DC to 5G Mobile Core
- DC to CSP with Native SRv6 uSID E2E

Host Endpoint = eBPF/Cilium

Telco Cloud meets Hyperscaler IT Cloud with " Multi Cloud / Hybrid Cloud"
"With Native SRv6 through CXP to CSP ingress SDN Overlay tunnel to VPC w/ eBPF/Cilium Host"



SRv6 uSID - Telco Cloud ⇔ CXP ⇔CSP Native SRv6 uSID ⇔ E2E SRv6 uSID

Option 1 | Option 2 | Option 3 | Option 4

E2E SRv6 uSID:

E2E SRv6 uSID 5G Telco Cloud to CSP

SRv6 uSID steering using uA Adj-SID to steer around DC Hot Spot and taking low latency path across the Core Network to CSP

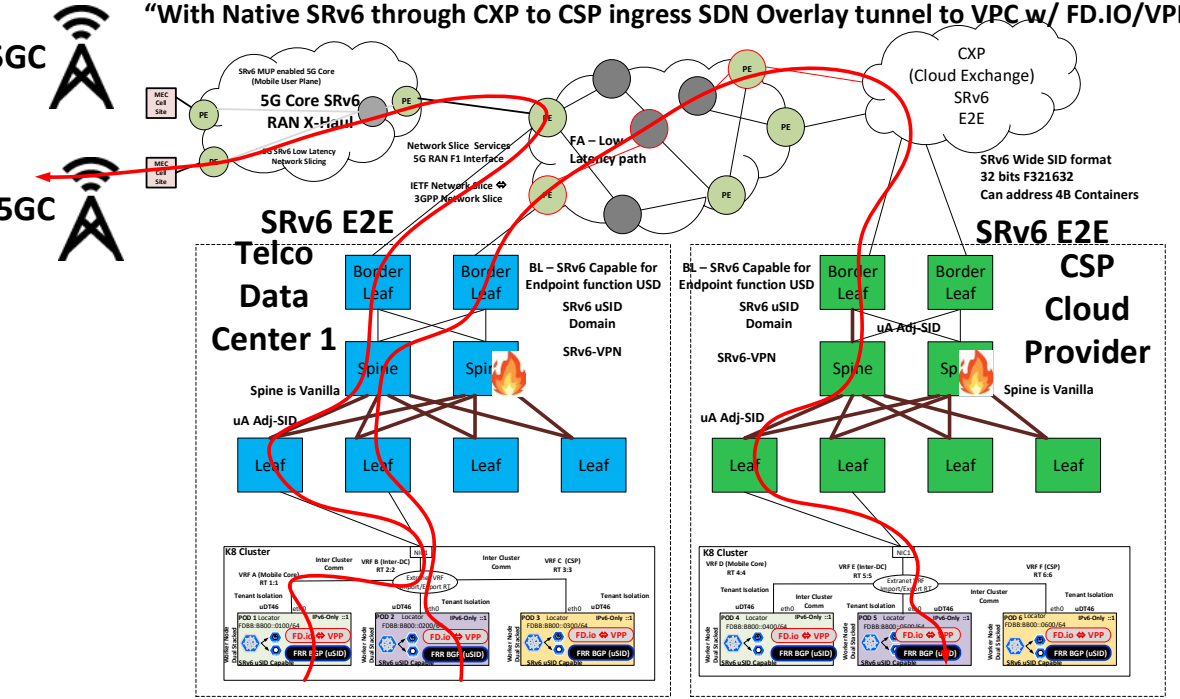
2 Common flows observed:

- DC to 5G Mobile Core
- DC to CSP with Native SRv6 uSID E2E

Host Endpoint = FD.io VPP

Telco Cloud meets Hyperscaler IT Cloud with " Multi Cloud / Hybrid Cloud"

"With Native SRv6 through CXP to CSP ingress SDN Overlay tunnel to VPC w/ FD.IO/VPP Host



SRv6 uSID - Telco Cloud ⇔ CXP ⇔CSP Native SRv6 uSID ⇔ E2E SRv6 uSID

Option 1 | Option 2 | Option 3 | Option 4

E2E SRv6 uSID:

E2E SRv6 uSID 5G Telco Cloud to CSP

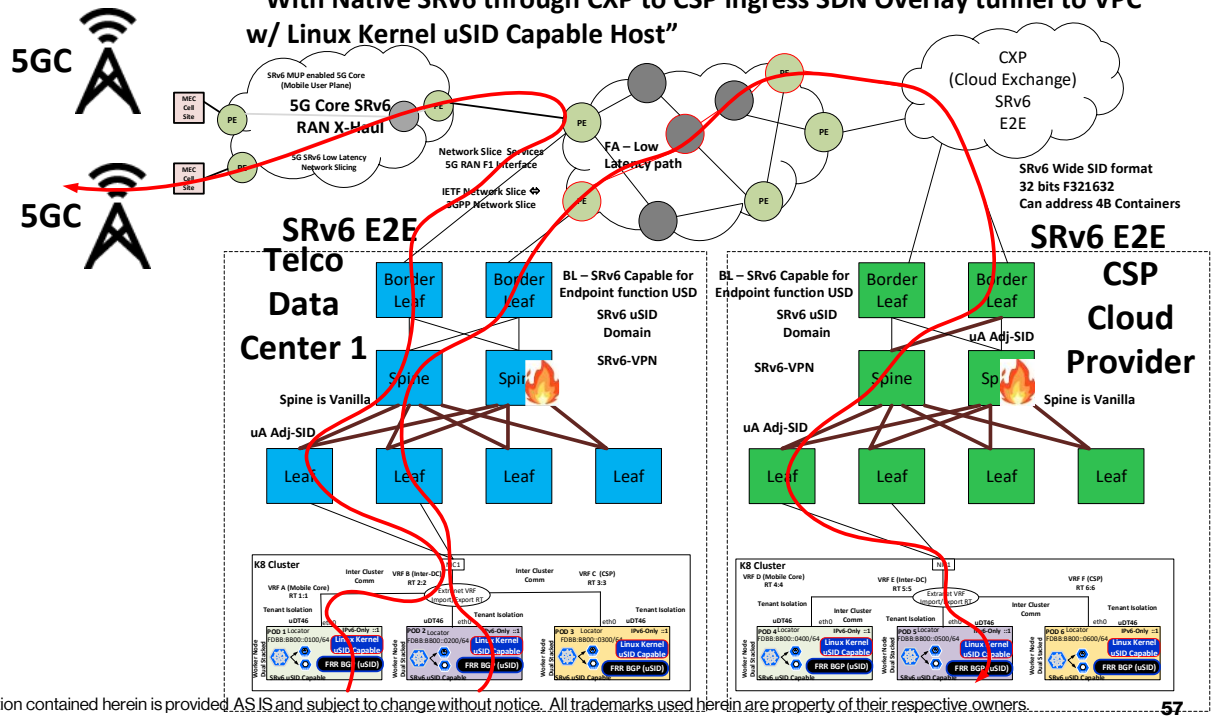
SRv6 uSID steering using uA Adj-SID to steer around DC Hot Spot and taking low latency path across the Core Network to CSP

2 Common flows observed:

- **DC to 5G Mobile Core**
- **DC to CSP with Native SRv6 uSID E2E**

Host Endpoint = Linux Kernel

Telco Cloud meets Hyperscaler IT Cloud with " Multi Cloud / Hybrid Cloud"
"With Native SRv6 through CXP to CSP ingress SDN Overlay tunnel to VPC w/ Linux Kernel uSID Capable Host"



SRv6 uSID - Telco Cloud ⇔ CXP ⇔CSP Native SRv6 uSID ⇔ E2E SRv6 uSID

Option 1 | Option 2 | Option 3 | **Option 4**

E2E SRv6 uSID:

E2E SRv6 uSID 5G Telco Cloud to CSP

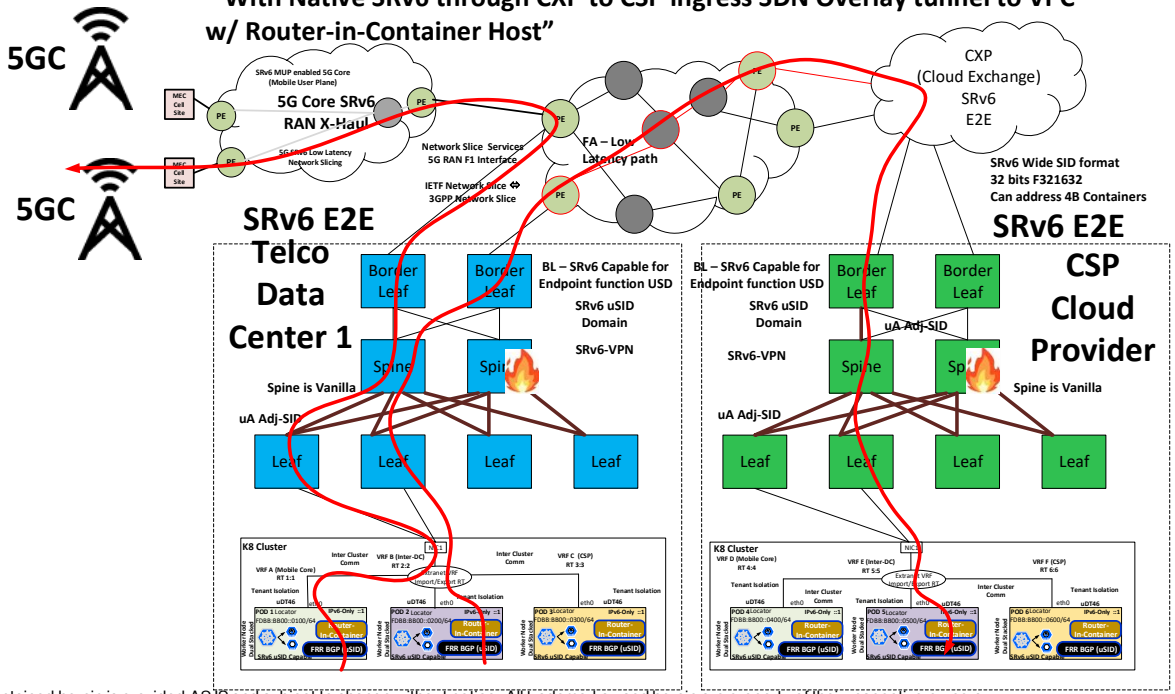
SRv6 uSID steering using uA Adj-SID to steer around DC Hot Spot and taking low latency path across the Core Network to CSP

2 Common flows observed:

- **DC to 5G Mobile Core**
- **DC to CSP with Native SRv6 uSID E2E**

Host Endpoint = Router-in-Container

Telco Cloud meets Hyperscaler IT Cloud with " Multi Cloud / Hybrid Cloud"
"With Native SRv6 through CXP to CSP ingress SDN Overlay tunnel to VPC w/ Router-in-Container Host"



Vendor, Merchant & SONiC maturity

- **SONiC support**
  - Rich support in SAI/SONiC/FRR stack
- **Merchant SRv6 uSID**
  - Broadcom Jericho/Jericho2
  - Broadcom Trident4
  - Broadcom Tomahawk5
  - Cisco Silicon One

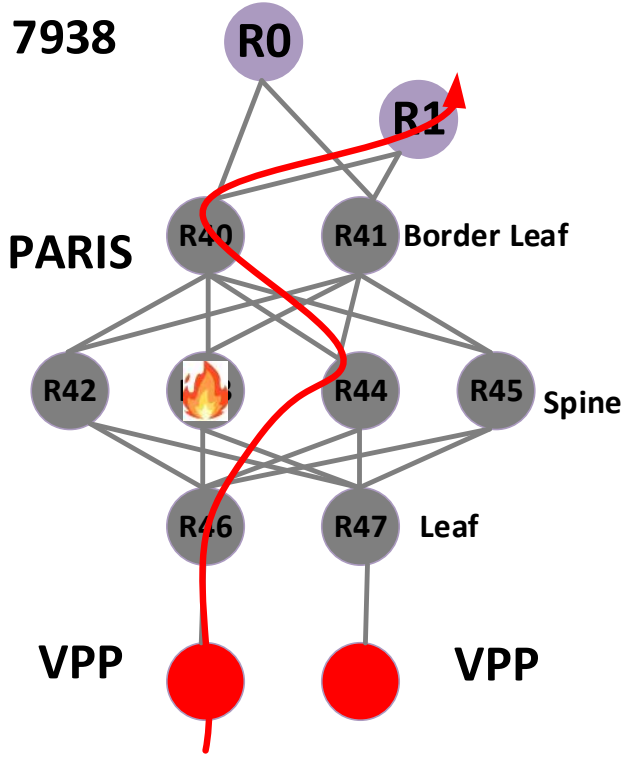
Demo time!

- **Use-case 1: SRv6 uSID DC fabric**
  - Host-to-Host
  - Policy programmed from Linux Kernel & VPP host
- **Use-case 2: Inter-DC**
  - Host-to-Host across the metro
  - Metro with several planes, and FlexAlgo
- **Full demo available in here: https://youtu.be/w7R53ni8ATk**

Use-Case 1: SRv6 uSID Intra-DC steering

DC-2 BGP Only DC RFC 7938
Node number = ASN

SR Algo 0 (All links)
SR Algo 0 -Latency)
SR Algo 0-Latency



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
```

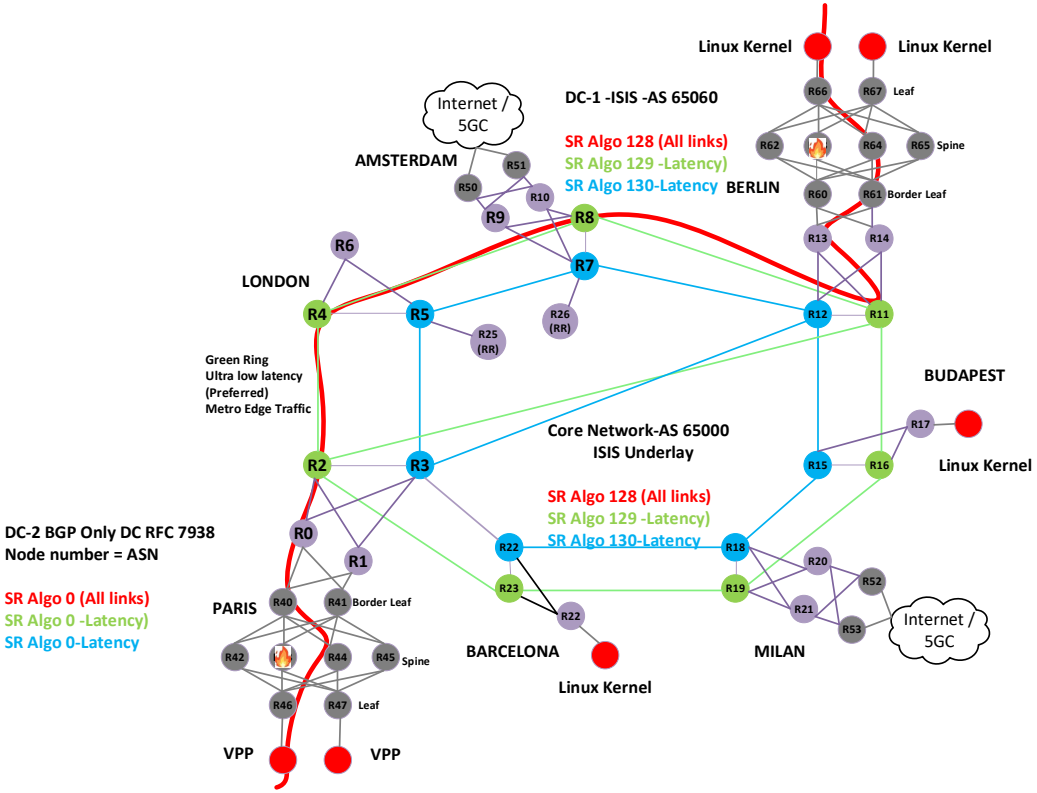
IPv4 payload packet capture xrd61-xrd64

```
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 Drawing



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