Compressed SRv6 Deployment and Operations White Paper

China Mobile   Bell Canada   Swisscom

Deutsche Telekom   Alibaba   MTN   Telefonica

IETF 123   Madrid

Why Operators need SRv6?

Native SDN

Optimized Routing and OPS

Simplified

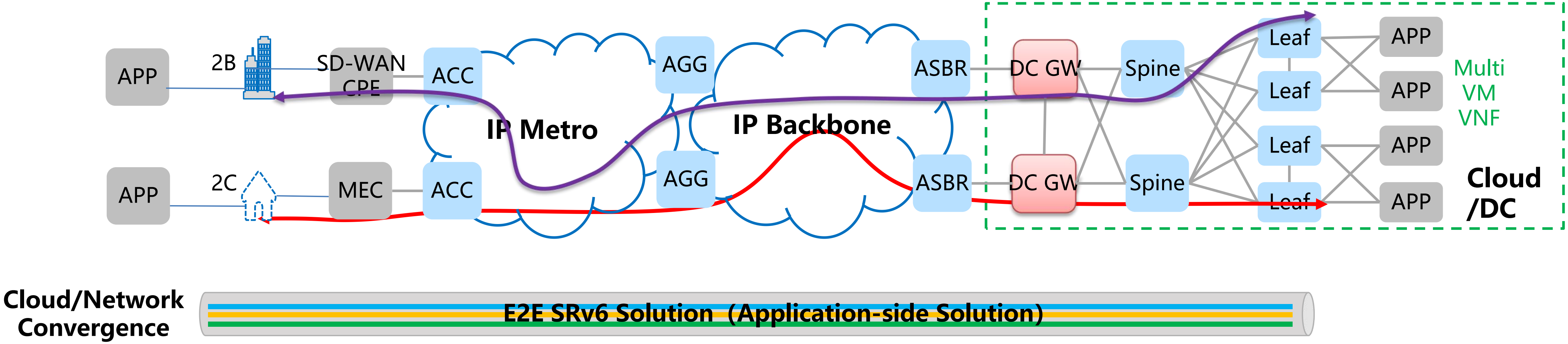
Protocols Reduced

Programmable

Routing/Service/ Application

Evolvable

Smoothly based on IPv6

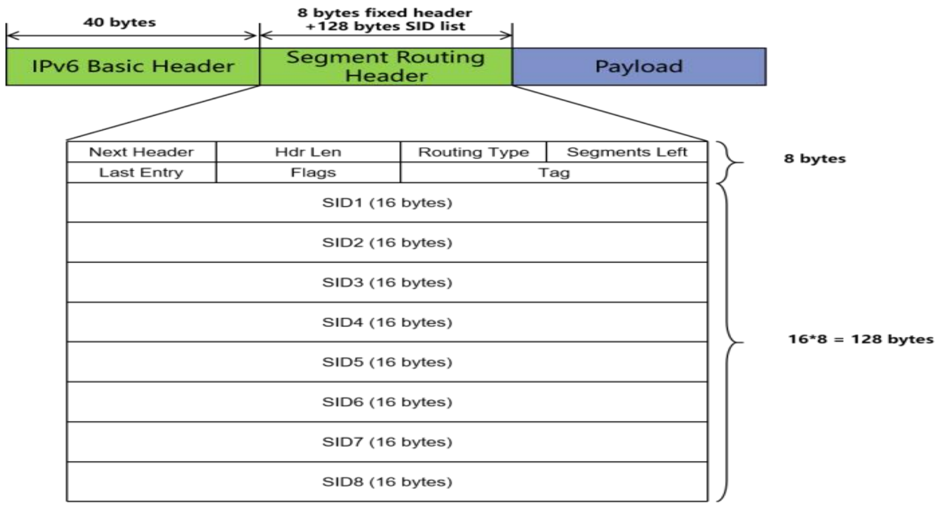


SRv6 is simple and powerful, is considered as a next-generation IP protocol

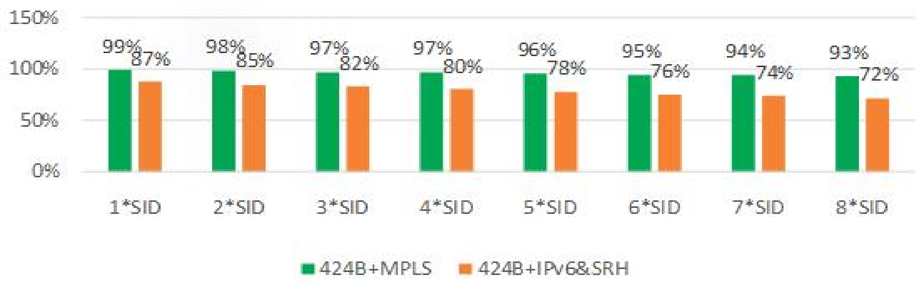
Why Does SRv6 Require Header Compression

- SRH Overhead Problem
  - Low transmission efficiency for Excessively long SRv6 packet header
  - complex implementation for current chipset with insufficient label stack depth
  - High migration costs for existing network devices

- Compressed SRv6 Benefits
  - Efficient Carrige: reducing transmission cost
  - High Scalability: supporting more SIDs in large-scale networks
  - Smooth Evotlution: compatilbe with exisiting features and devices



SRv6 header overhead when 8 SRv6 SIDs are used



Transmission efficiency comparison
between MPLS and SRv6 when the payload is 424 bytes

SRv6 Compression C-SID Standardization Publication

- The IETF RFC 9800 was released at the end of June
- C-SID RFC defines flavors for the SR endpoint behaviors, which enable a compressed SRv6 Segment-List encoding in the Segment Routing Header (SRH).
  - Replace-C-SID Flavor a.k.a G-SRv6
  - Next-C-SID Flavor a.k.a uSID
- All the flavors are defined under the SRv6 network programming architecture RFC8986
- Mainstream vendors in the industry have successfully completed C-SID interoperability testing

Stream: Internet Engineering Task Force (IETF)
RFC: 9800
Updates: 8754
Category: Standards Track
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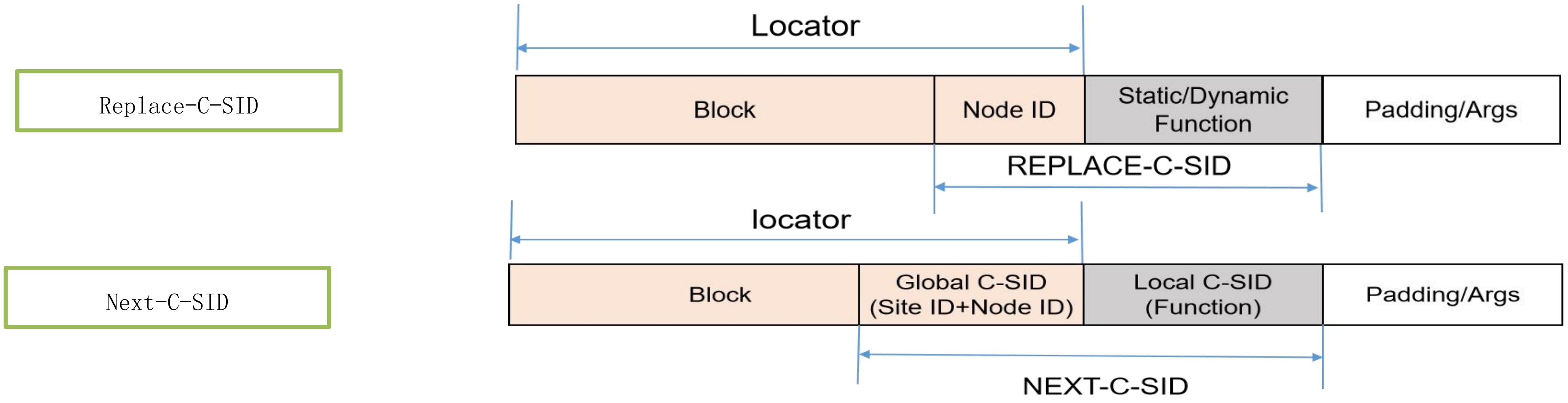
RFC 9800
Compressed SRv6 Segment List Encoding

Abstract

Segment Routing over IPv6 (SRv6) is the instantiation of Segment Routing (SR) on the IPv6 data plane. This document specifies new flavors for the SRv6 endpoint behaviors defined in RFC 8986, which enable the compression of an SRv6 segment list. Such compression significantly reduces the size of the SRv6 encapsulation

SRv6 Compression Depolyment -1 : SID Assignment



Block Assignment

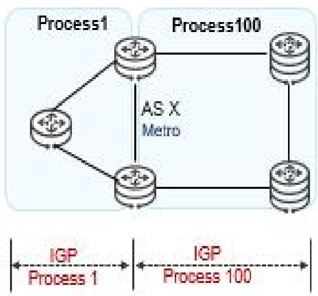
- Allocate separate prefix for SRv6 SID in IPv6 address space, due to the high aggregation of SIDs
- Structure the address space by AS number in support of Inter-Domain SRv6 networks
- Boundary devices have simple ACL policy configuration to prevent SID information leakage
- Flex-Algo can be encoded in the C-SID block

C-SID Assignment

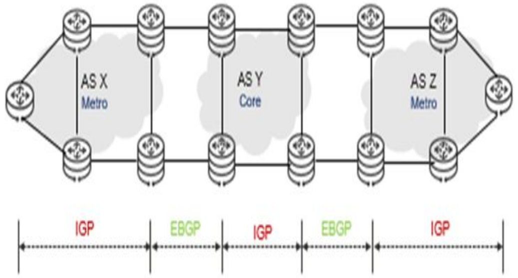
- Consistency between compressed/uncompressed SIDs saves space but may limit uncompressed SID length
- Allocate Hierarchical network ID like Site ID in Node ID field based on administrative regions like cities, counties etc.
- Assign specific Node IDs in every administrative region
- GIB and LIB share the same SID field for Next-C-SID

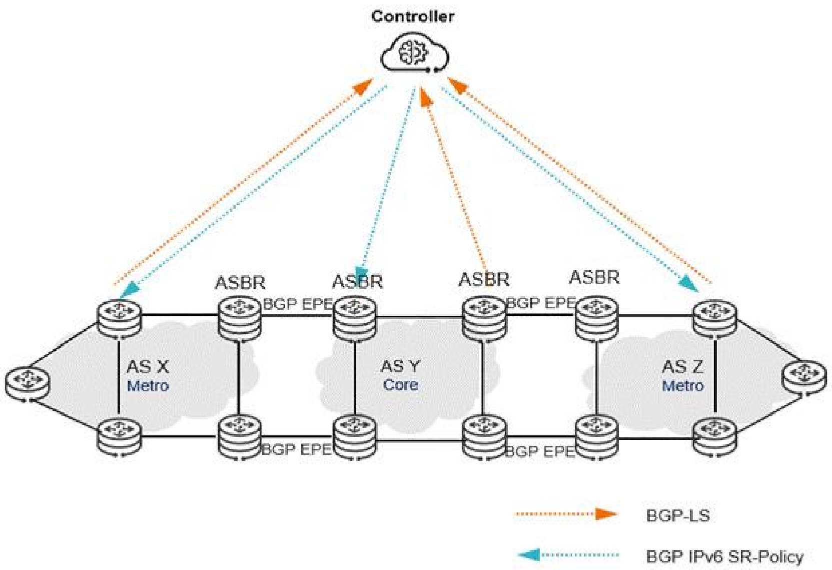
SRv6 Compression Deployment -2 : Inter-AS

inter IGP process



inter-AS

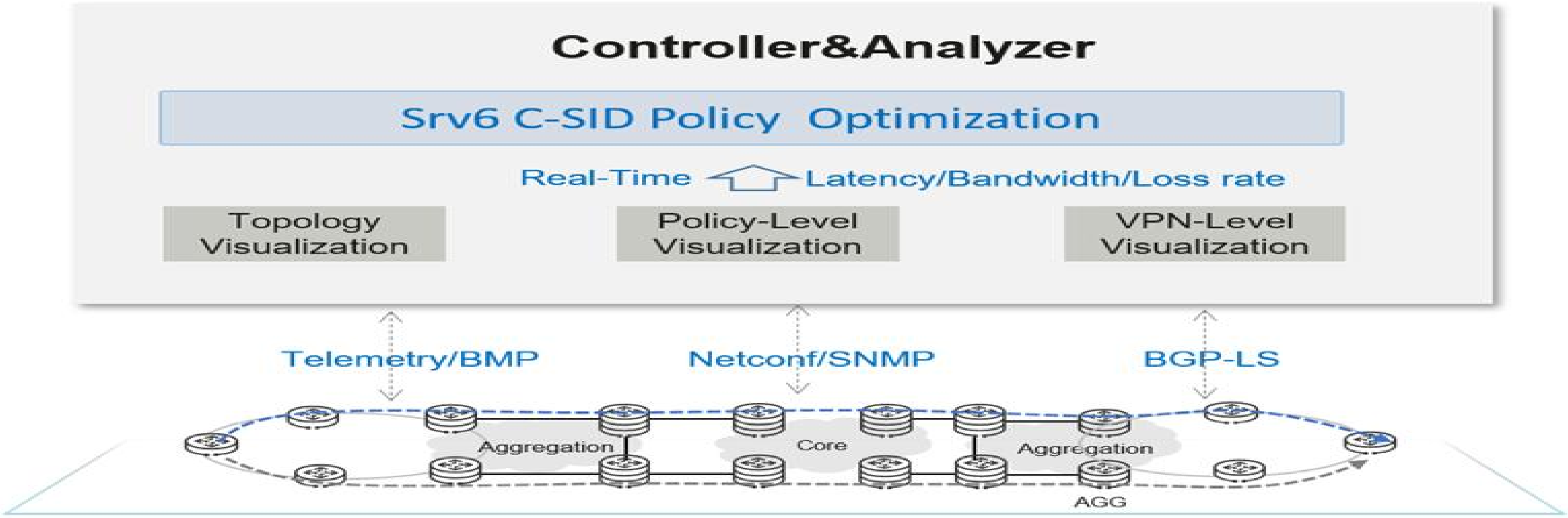




- intra-AS :
  - ✓ IGP advertise locator routes
  - ✓ topology, C-SIDs of nodes, C-SIDs of links
- inter-AS :
  - ✓ BGP advertise aggregated routes between ASs
  - ✓ EPE links and C-SIDs

- Single-layer controller mode for multiple ASs
- BGP LS sending intra-AS and inter-AS information to the controller
- BGP IPv6 SR-Policy delivering the C-SID list to th ingress
- Establish inter-AS E2E C-SID list with highest compression efficiency

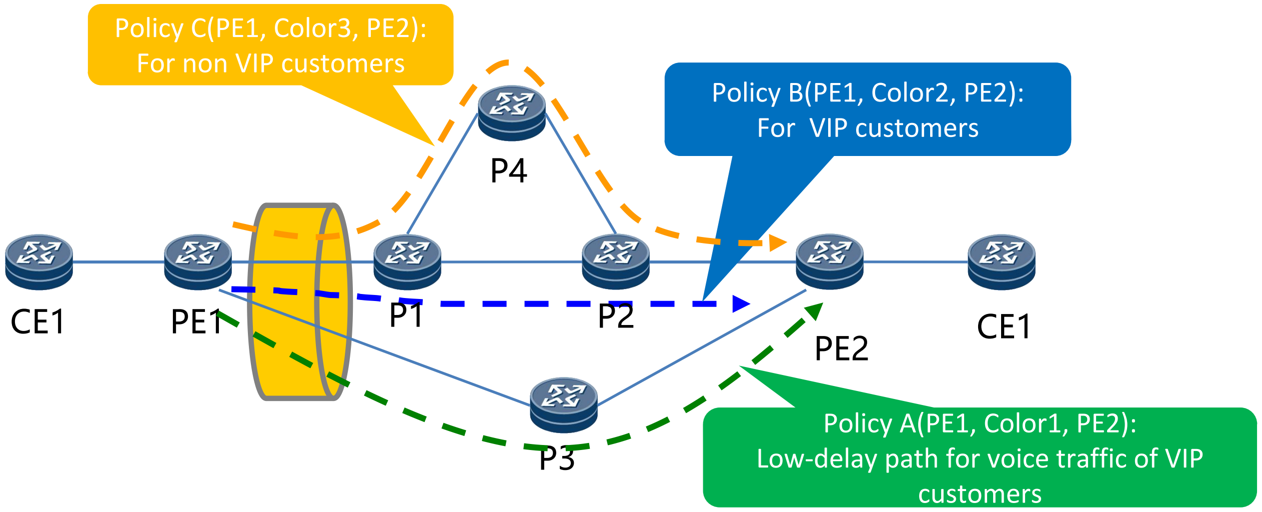
SRv6 Compression Deployment -3 : Visualization



Physical Topology Visualizaiton	C-SID Policy Visualizaiton	Service Visualizaiton
• LLDP and YANG-push reporting topology information • TWAMP/STAMP per-link latency measurement and BGP-LS reporting	• C-SID Policy level detection of latency, bandwidth and packet loss rates via IOAM/IFIT • Telemetry reporting for real-time C-SID Policy quality	• IOAM/IFIT/STAMP detection for service-level quality • YANG-push and IPFIX reporting real-time service layer quality

SRv6 Compression Deployment -4 : Traffic Steering

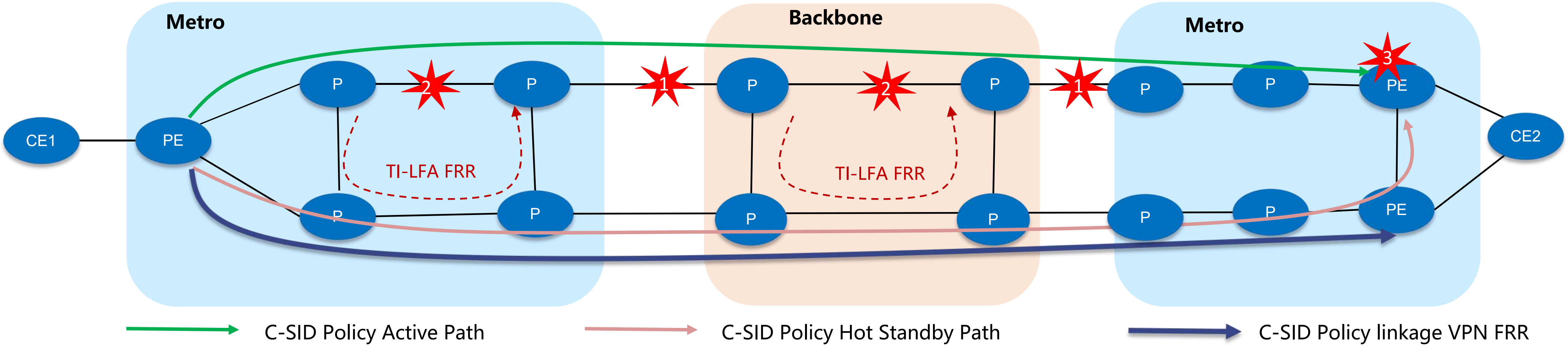
- Based on Destination Address
  - BSID-based : specify a corresponding C-SID policy
  - Color-based : Refer to the Color attribute
  - IGP Shortcut: alternative to traditional MPLS-TE
- Based on Traffic Characteristics
  - DSCP, 802.1Q, Service-Class
  - Match packet field information through BGP-FlowSpec
  - Match packet information through PBR



For Example： DSCP mapping to color:

- DSCP1 -> Color1
- DSCP2 -> Color2
- Other DSCPs -> Color3

SRv6 Compression Deployment -5 : Traffic Protection



Policy-Level Protection

- Hot-Standby both path use C-SID
- BFD detection bidirectional path consisitency

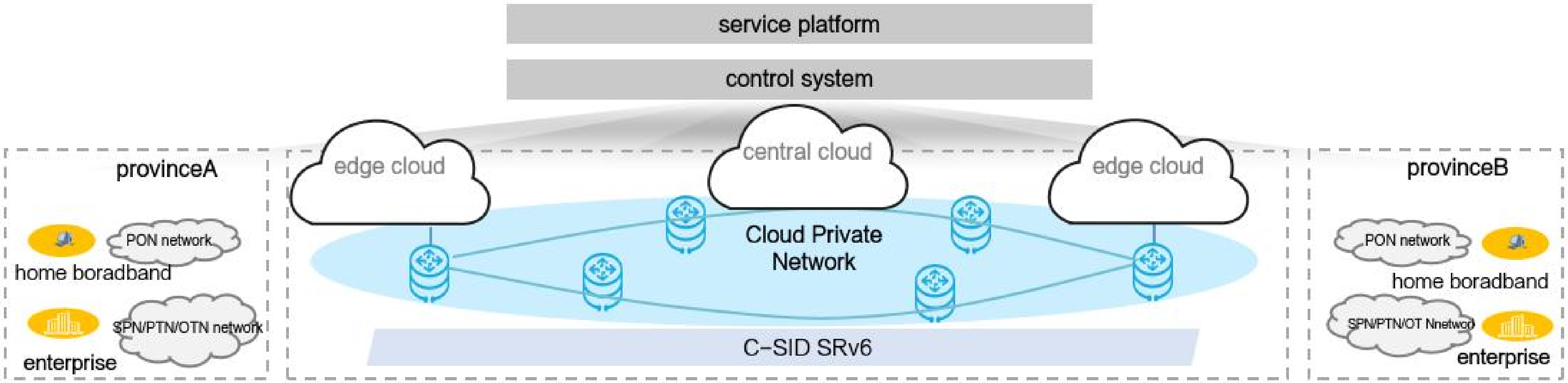
Local Protection

- TILFA repair list should use C-SID
- Local BFD detection time should be shorter than Hot-Standby path BFD

VPN-Level Protection

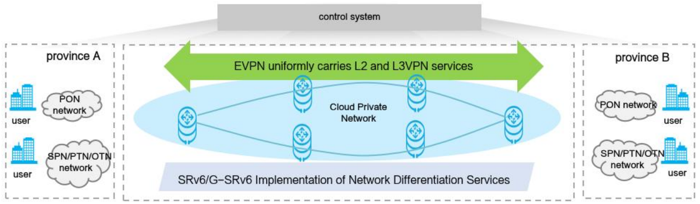
- Establishing primary and backup C-SID policy to both egress PEs
- Quick switch to backup egress PE by VPN FRR

SRv6 Compression Deployment Case -1 : China Mobile

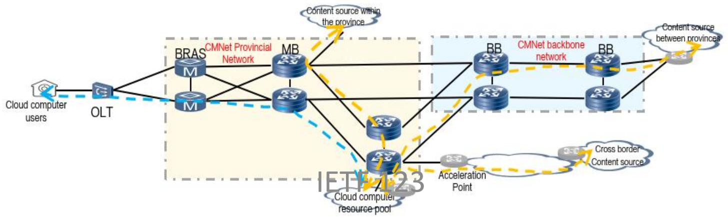


- China Mobile has deployed SRv6 C-SID in Cloud Private Network(CPN)， makes E2E service deployment simple
- Covering more than 700 devices in 31 provinces across the country, with a planned bandwidth of 47 Tbps
- Single AS and Single layer SDN Controller to distribute SRv6 C-SID Policy, day-level service opening and second-level bandwidth adjustment

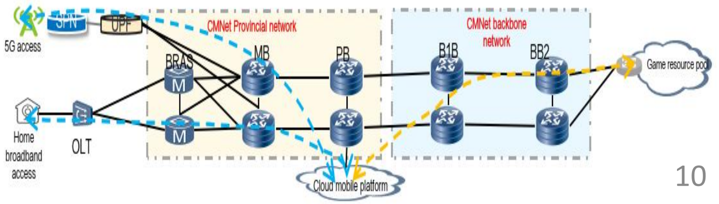
New VPN Dedicated Line



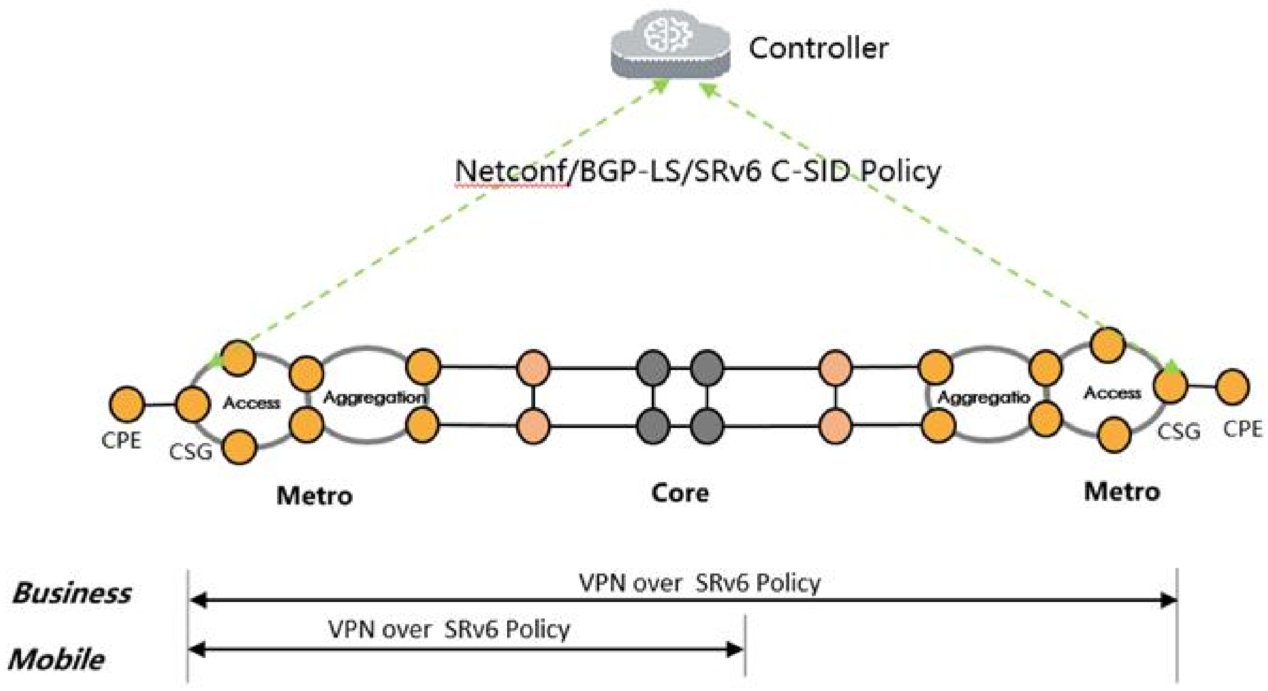
Cloud Computer Service



Cloud Mobile Phone



SRv6 Compression Deployment Case -2 : MTN



- IPRAN and backbone network
- End-to-end SRv6 C-SID Policy deployment
- L2/L3 EVPN for Mobile and Enterprise services
- TILFA + VPN FRR protection
- Over 20 nodes with 20 SIDs in the SID list

- In extreme 20-hop scenarios, when carrying 3G services with an average packet length of 300 bytes, the SRv6 C-SID technology can improve the carrying efficiency from 43.9% to 67.6%
- In extreme 20-hop scenarios, when carrying 4G services with an average packet length of 700 bytes, the carrying efficiency can be improved from 64.6% to 82.9%

White Paper Information

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access code: zcva

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