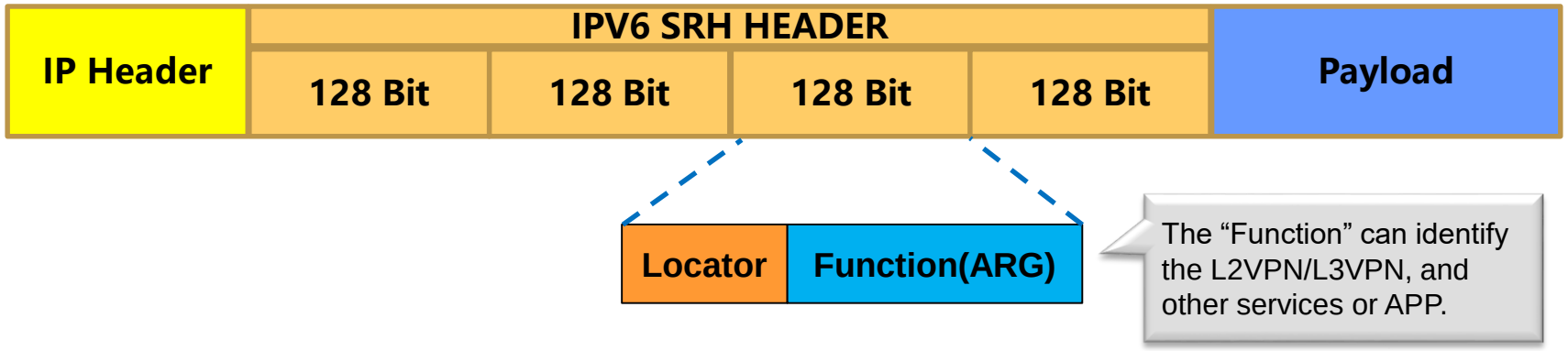
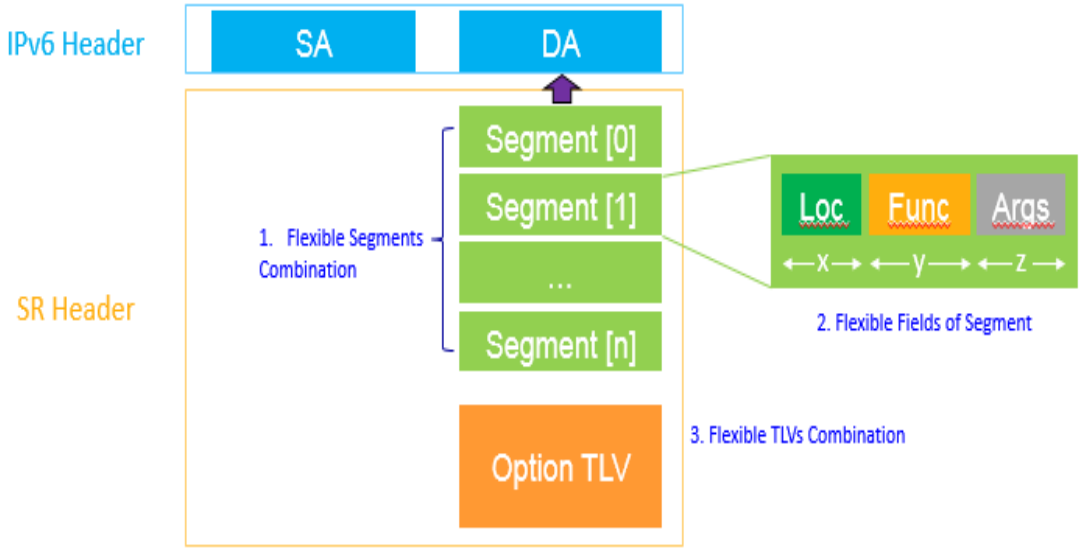
IPv6+ Introduction and Innovation

Principle of SRv6 Network Programming

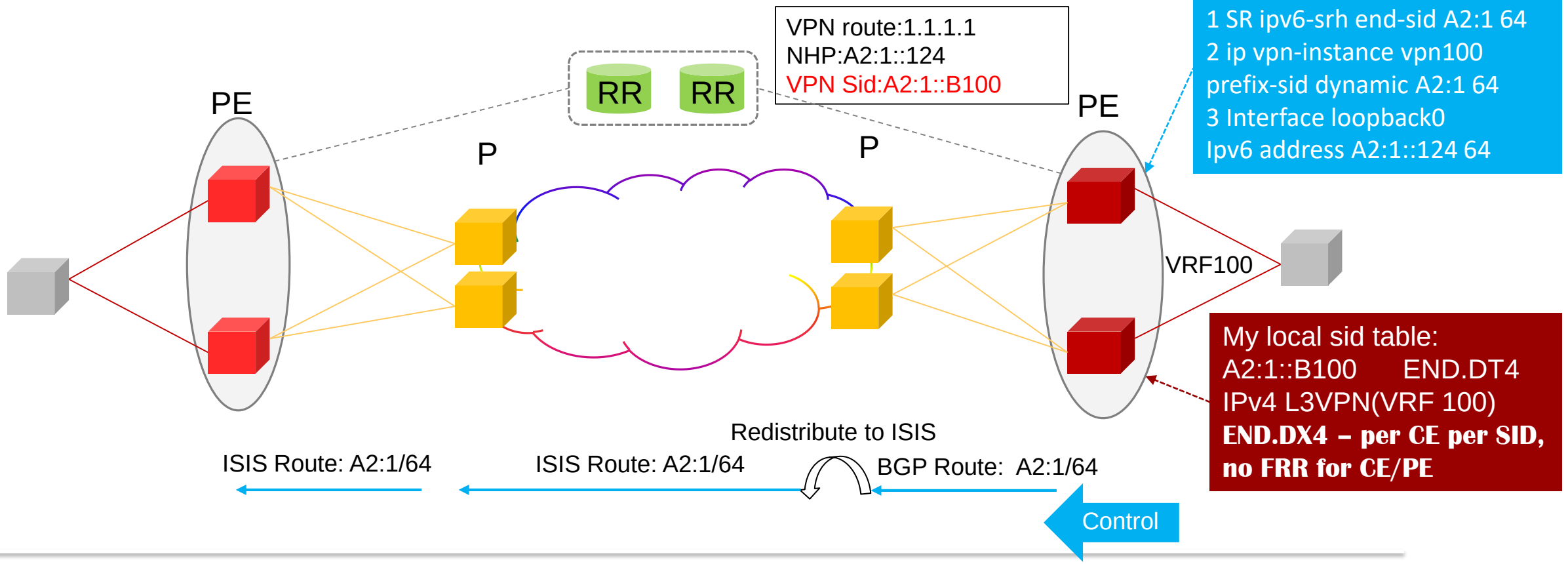


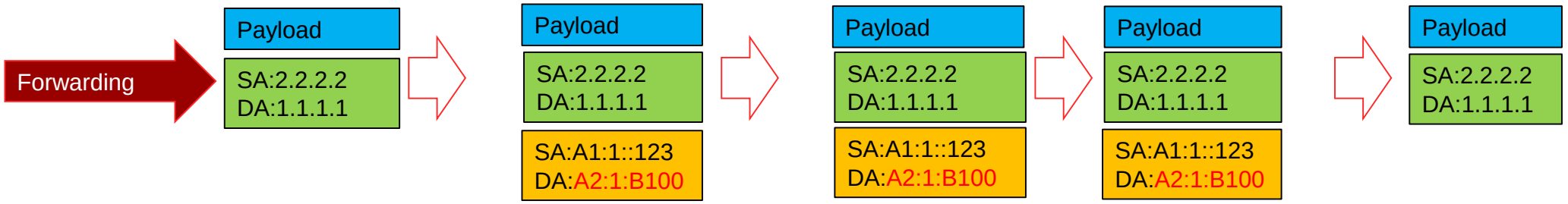
Version	Traffic Class	Flow Label	
Pload Length		Next=43	Hop Linmit
Source Address			
Destination Address			
Next Header	Hdr Ext Len	Routing Type	Segments Left
Last Entry	Flags	Tag	
Segment List[0]			
Segment List[1]			
Segment List[2]			
Paylod			

Three Layers of Programming Spaces

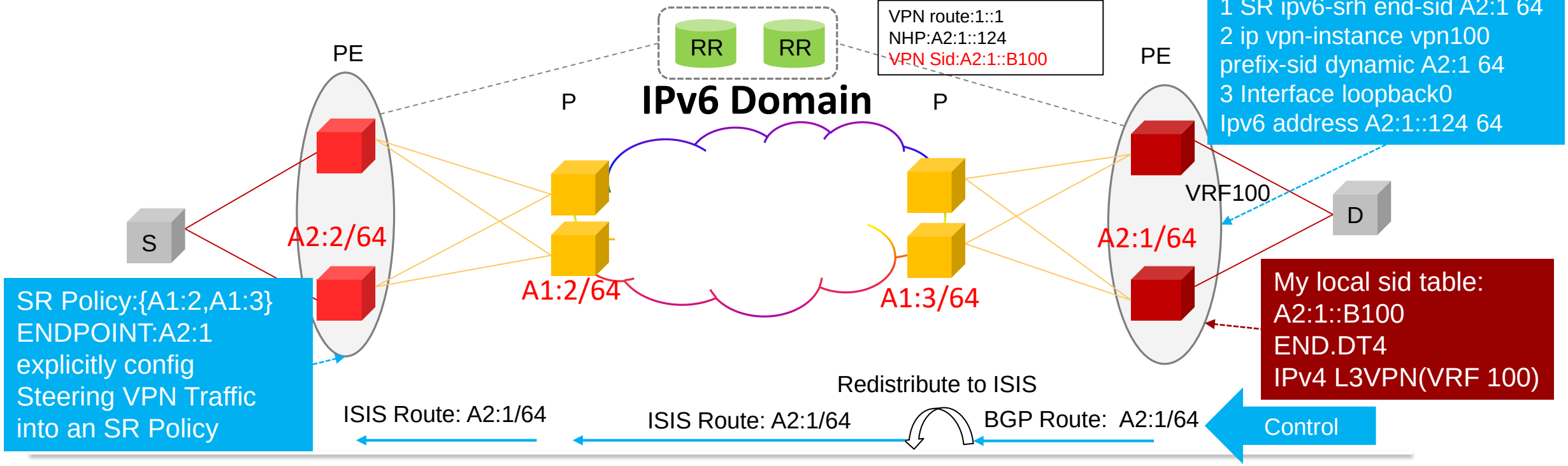


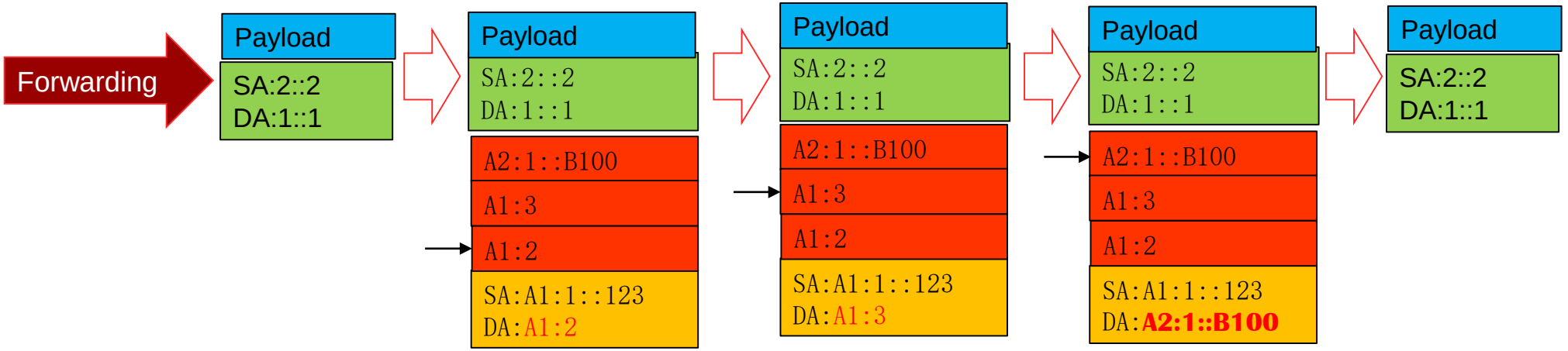
L3VPN Over BE Tunnel for SRv6



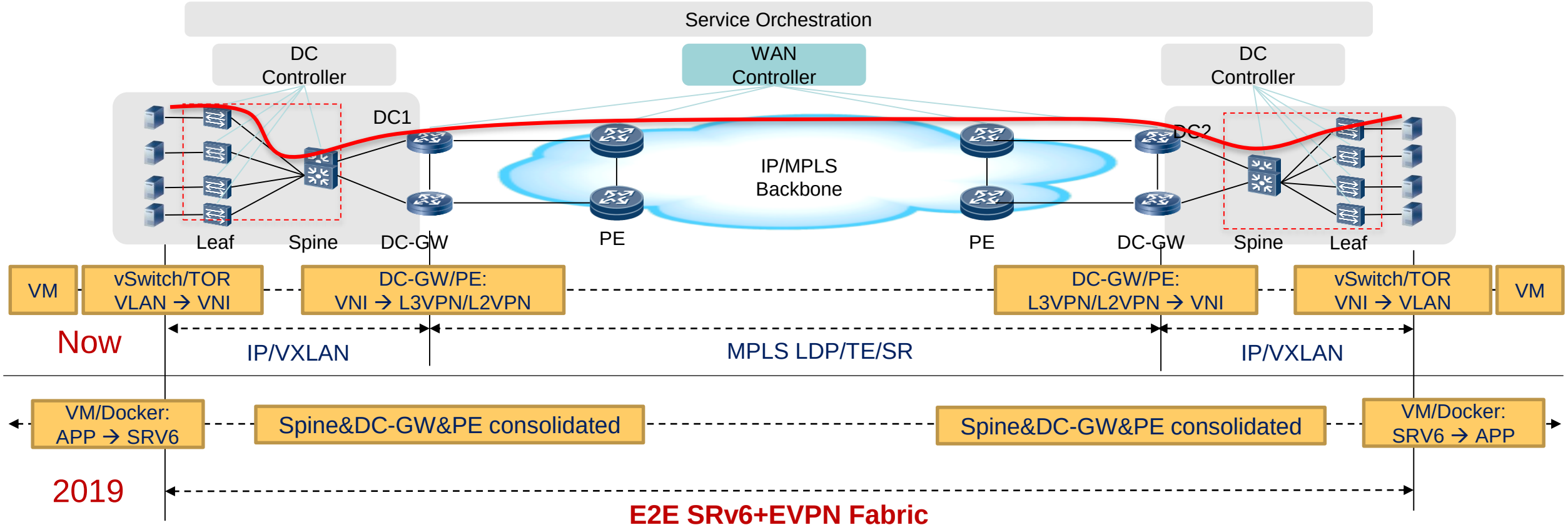


L3VPN Over TE Tunnel for SRv6



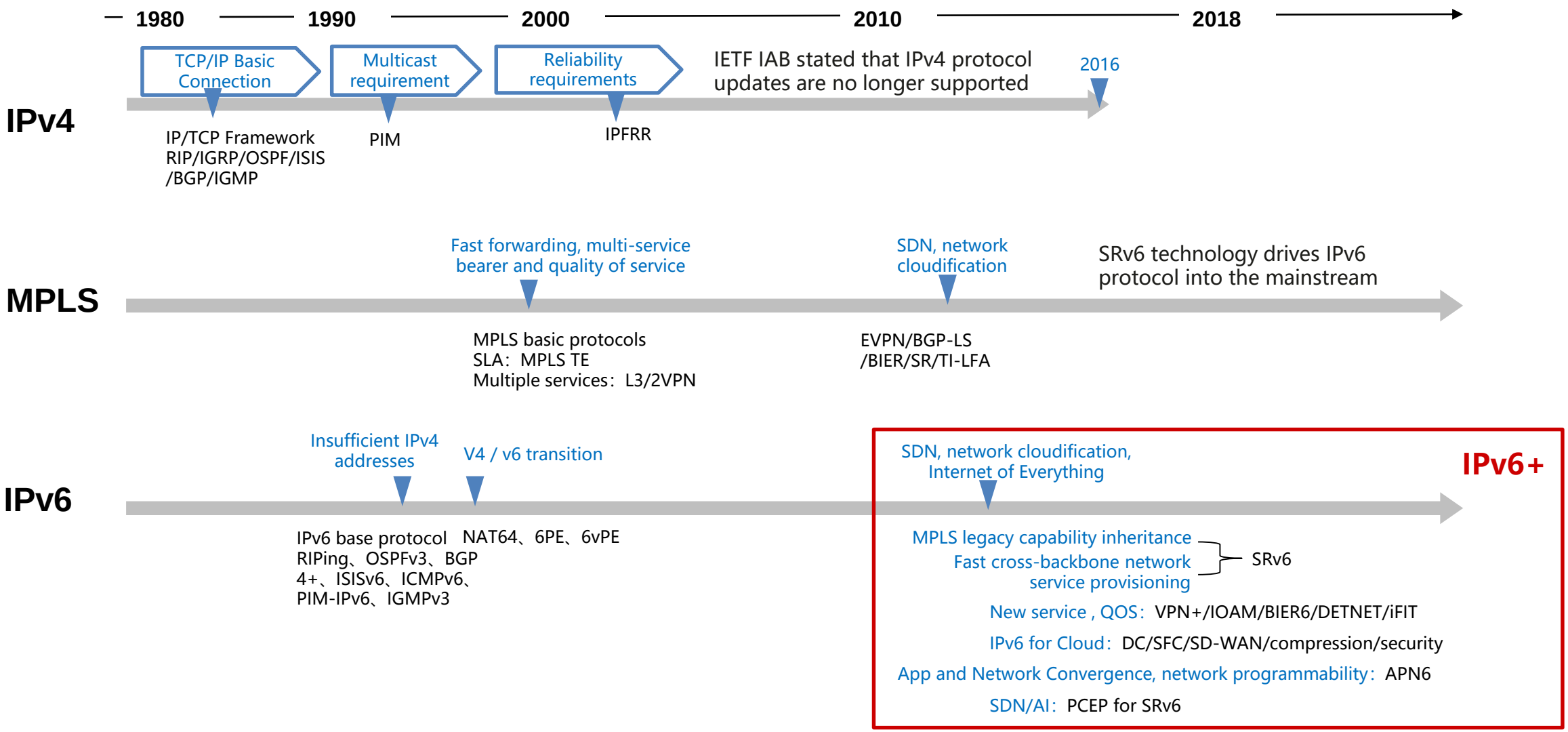


SRv6 Evolution: End-to-end Network Unified Forwarding Process



- **Simplicity: Work based on IPv6 reachability, no extra signaling.**
- **Industry Acceptance: MPLS in DC is not well accepted. SRv6 is based on IP reachability as VXLAN.**
- **E2E: Unified process to converge different IP network domain. TE and SFC can be deployed incrementally and easily.**
- **Extensibility: Possibility to be extended from network devices to application devices which support IPv6.**

SRv6 pushes the next generation Internet to the IPv6+ Era



IPv6+ Research and Standard Planning Recommendations

IPv6+ 1.0： SRv6 basic features

- SRv6 VPN
- SRv6 TE
- SRv6 FRR

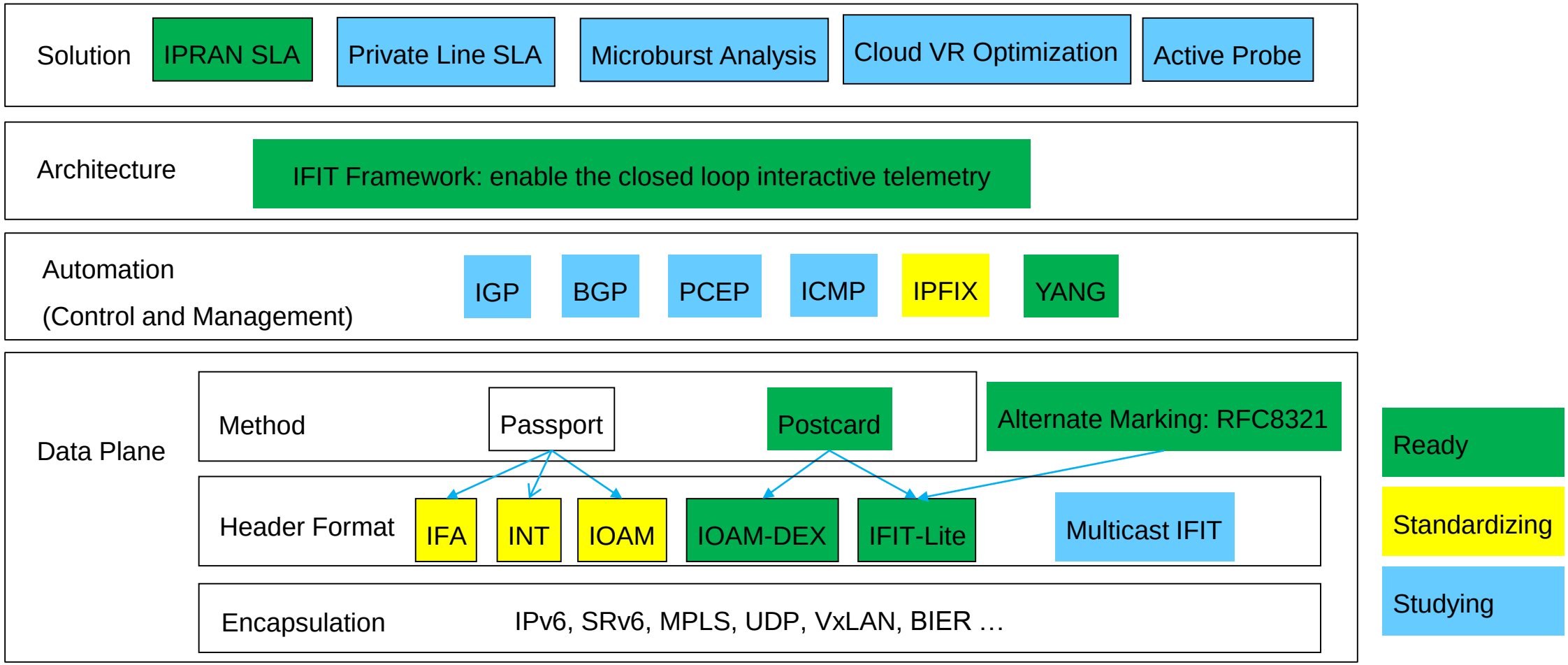
IPv6+ 2.0 ： 5G/cloud based application

- VPN+
- IFIT
- SFC
- Detnet
- BIER6
- SD-WAN

IPv6+ 3.0： APN6 – App-aware network architecture

- Forwarding plane： App information conveying via IPv6 extension header
- Protocol control plane： exchange information through protocol

IFIT (Insitu Flow Information Telemetry) Research Plan



IFIT Drafts and Award

Area	Topic	Drafts
Framework	In-situ Flow Information Telemetry Framework	draft-song-ifit-framework
Basic Encapsulation	Data Fields for In-situ OAM	draft-ietf-ippm-ioam-data
	Export User Flow Telemetry Data by Postcard Packets	draft-song-ippm-postcard-based-telemetry
	In-situ OAM Direct Exporting	draft-ietf-ippm-ioam-direct-export
	Enhanced Alternate Marking Method	draft-zhou-ippm-enhanced-alternate-marking
Encapsulation Types	IPv6 Encapsulation for SFC and IFIT	draft-li-6man-ipv6-sfc-ifit
	IPv6 Application of the Alternate Marking	draft-fz-6man-ipv6-alt-mark
	In-situ OAM Processing in Tunnels	draft-song-ippm-ioam-tunnel-mode
YANG Models	A YANG Data Model for In-Situ OAM	draft-zhou-ippm-ioam-yang

IFIT Data Plane has progressed fast and WG adopted

IFIT got awarded at Interop 2019

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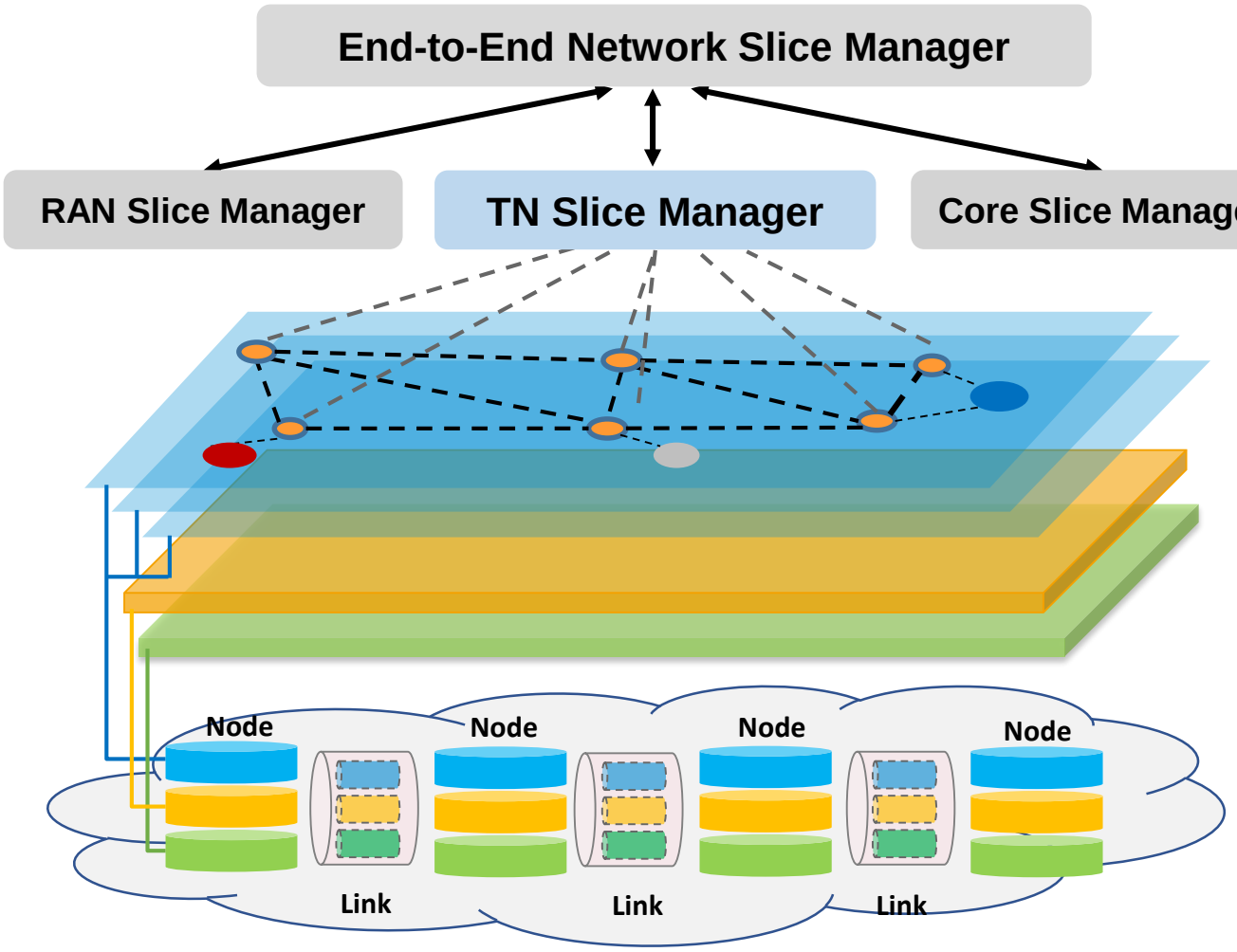
VPN+ Architecture: Enables Transport Network Slicing



Network Slice Management

- Dynamic/automatic network slice life-cycle management
- Creation, monitoring, adjustment, deletion
- Deploy services in network slices

YANG Models

Network Slice Instantiation

- Customize network slice topology and associated attributes
- Integration between overlay connectivity and underlay resource

SR/SRv6 Extensions

Network Resource Partitioning

- Physical Interface
- Flexible Ethernet (FlexE)
- Logical sub-interface
- Dedicated queues
- Time Sensitive Networking (TSN)

Underlay Innovations

https://tools.ietf.org/html/draft-ietf-teas-enhanced-vpn

VPN+ Drafts in IETF

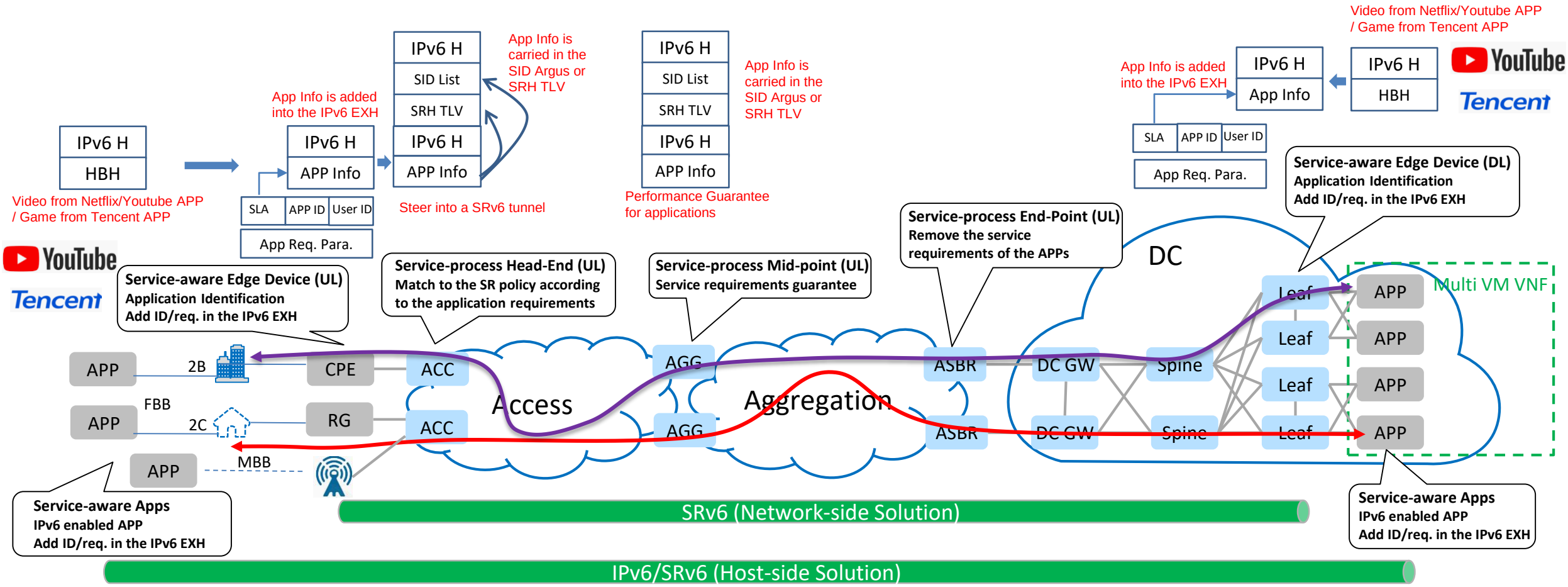
Area	Topic	Draft Name	Content
Framework	VPN+ Framework	draft-ietf-teas-enhanced-vpn	Describe the architecture of VPN+ and the candidate technologies in different layers. **Network slicing is one use case of VPN+.**
	VPN+ Scalability Considerations	draft-dong-teas-enhanced-vpn-vtn-scalability	Analyze the control plane and data plane scalability of VPN+ and possible optimizations
Data Plane	SR based VPN+	draft-dong-spring-sr-for-enhanced-vpn	Define SR data plane extensions for VPN+, resource semantics are added to SR SIDs.
	Carrying VTN ID in IPv6 Extension Headers	draft-dong-6man-enhanced-vpn-vtn-id	Define IPv6 data plane extensions for identifying the underlay of VPN+
Control Plane	IGP extensions for SR based VPN+	draft-dong-lsr-sr-enhanced-vpn	Define the IGP extensions for SR based VPN+
	BGP-LS Extensions for SR based VPN+	draft-dong-idr-bgpls-sr-enhanced-vpn	Define the BGP-LS extensions for SR based VPN+
	IGP Multi-topology based SR-VTN	draft-xie-lsr-isis-sr-vtn-mt	Define IGP-MT based mechanism with necessary extensions to provide SR based VTN
	BGP-LS for Multi-topology based SR-VTN	draft-xie-idr-bgpls-sr-vtn-mt	Define BGP-LS with MT support and necessary extensions to provide SR based VTN
	IGP Flex-Algo based SR-VTN	draft-zhu-lsr-isis-sr-vtn-flexalgo	Define IGP Flex-Algo based mechanism with necessary extensions to provide SR based VTN
	BGP-LS for Flex-Algo based SR-VTN	draft-zhu-idr-bgpls-sr-vtn-flexalgo	Define BGP-LS with Flex-Algo support and necessary extensions to provide SR based VTN

Challenges by the decoupled Applications and Network

- The challenges faced by Operators
  - Large but dumb pipeline, not able to obtain corresponding revenue increase
  - Not aware of the applications, only coarse-granularity SLA, resource waste and cost increase
- The problems caused by the current app-aware network services
  - ACL/PBR based on 5 tuples
    - Indirect application information which requires mapping and converting
    - Impacted forwarding performance
    - Bad scalability limited by the hardware resources
  - DPI (Deep Packet Inspection)
    - Challenges by network neutrality and security
    - Impacted forwarding performance
  - Application-awareness based on the orchestrator/controller
    - Long control and management loop, hard to have quick response
    - Multiple interfaces, hard to standardize, difficult to interwork

App-aware IPv6 Networking (APN6) Framework

- Make use of IPv6 extensions header to convey the service requirements along with the packet to the network
- To facilitate the service deployment and network resource adjustment to guarantee SLA for applications



https://tools.ietf.org/html/draft-li-6man-app-aware-ipv6-network-00 @IETF105

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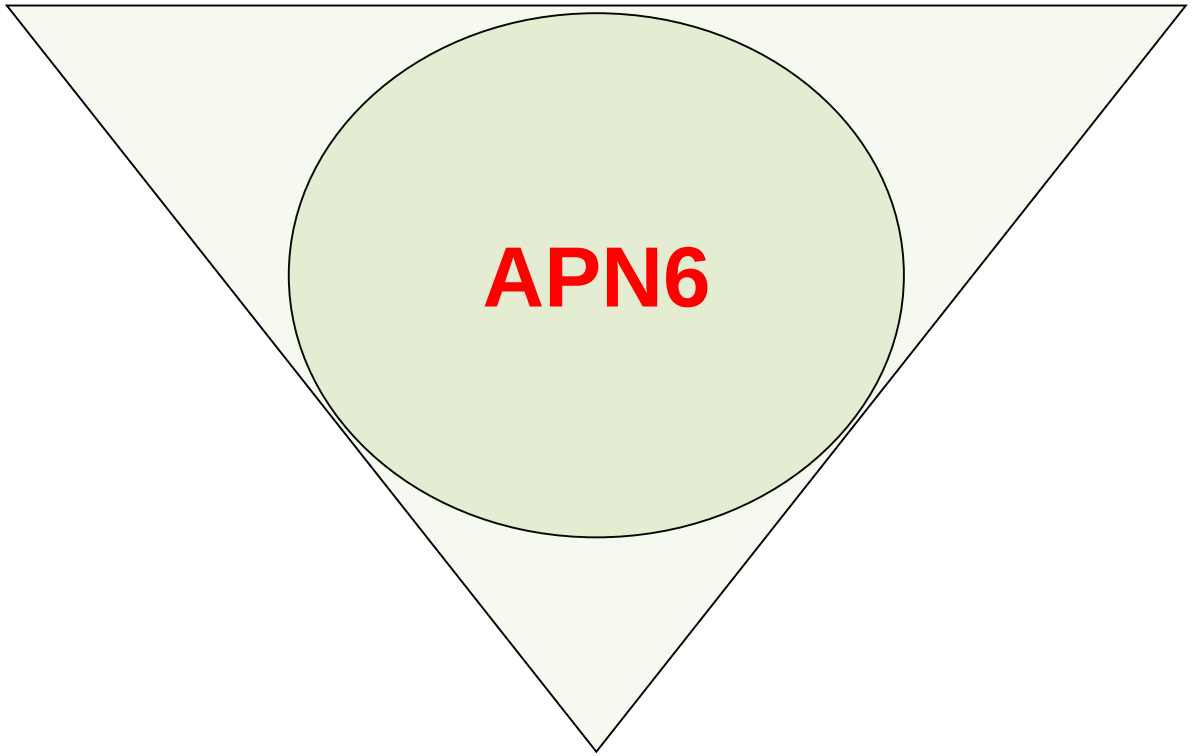
Three Elements of APN6

1. Open Application info carrying

- APP-ID
  - SLA Level
  - App ID
  - User ID
  - Flow ID
- APP Parameter Info
  - Bandwidth
  - Latency
  - Loss rate



2. Rich network services

- DiffServ
- H-QoS
- Network slicing
- DetNet
- SFC
- BIER6

3. Accurate Network Measurement

- Finer-granularity
  - per packet vs. per flow, per node vs. E2E, individual vs. statistics, etc.
- Comprehensive measurements
  - per packet with per flow, per node with E2E, individual with statistics, in-band with out-band, passive with active, etc.

APN6 value obtained wide industry consensus

APN6 Side Meeting @ IETF105

- Thursday Morning @Notre Dame
- Attendee: 50+

Agenda

1. **Admin** (Chairs) [5 : 5/75]
2. **Problem Statement and Requirements** (Zhenbin Li) [10 : 15/75]
3. **Application-aware Information Conveying**
   a) Framework of App-aware IPv6 Networking (Shuping Peng) [10 : 25/75]
   b) Firewall and Service Tickets (Tom Herbert) [10 : 35/75]
   c) SRH Metadata for Simplified Firewall (Jim Guichard) [5 : 40/75]
4. **App-aware Services**
   a) IPv6-based DetNet (Yongqing Zhu) [5 : 45/75]
   b) SRv6 Path Segment (Fengwei Qin) [5 : 50/75]
   c) IPv6-based IFIT (In-situ Flow Information Telemetry) (Haoyu Song) [5 : 55/75]
5. **Shaping Our Discussion** (Chairs and Room) [15 : 70/75]
6. **Wrap Up** (Chairs) [5 : 75/75]

Next Step:

- Setup Mailing list to continue discussions
- https://github.com/shupingpeng/IETF105-Side-Meeting-APN6

Chinese Gov.	CAICT 中国信通院
Operators	Bell, Deutsche Telekom, SoftBank, KDDI, 中国移动 China Mobile, 中国电信 China Telecom
Vendors	Cisco, Nokia, vmware
Academia	The University of Auckland, 清華大學 Tsinghua University
OTT	Google, Tencent 腾讯
Verticals	Toyota, CERNET

Area	Topic	Draft	Vendors	Operators & Verticals
APN6	Problem statement and use cases	draft-li-apn6-problem-statement-usecases	HUAWEI	Bell, 中国电信 China Telecom, 中国移动 China Mobile, China unicom 中国联通, Toyota
	Application-aware IPv6 Networking	draft-li-apn6-app-aware-ipv6-network		

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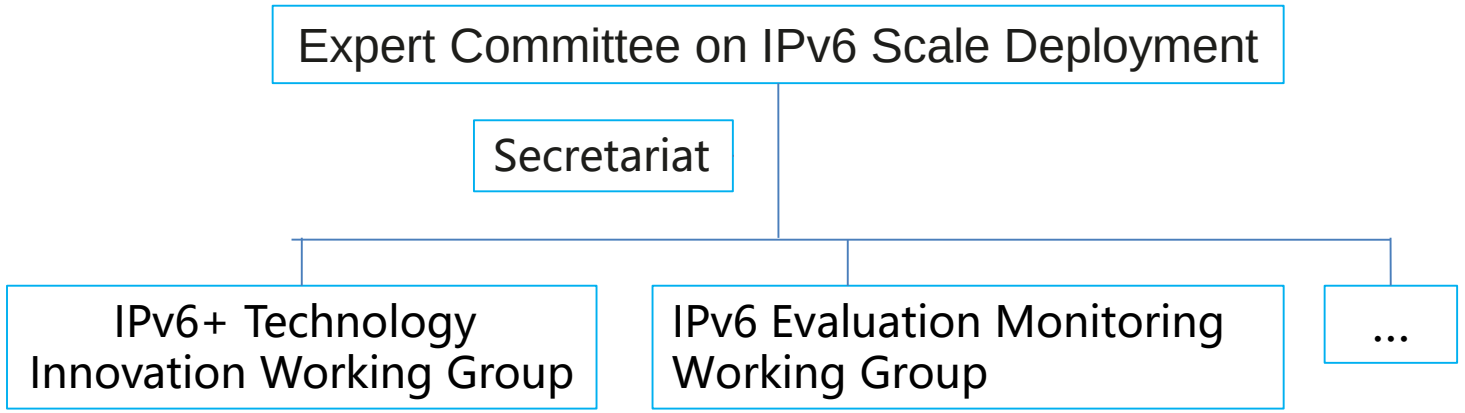
Chinese IPv6+ Technology Innovation Working Group



Technology Innovation WG Goals:

Relying on the achievements of IPv6 large-scale deployment in China, **strengthen the architectural innovation** based on IPv6 next-generation Internet technology, **integrate the IPv6 related technology ECO-system**.

The direction is to actively carry out **new IPv6+ network technologies**, test verification and demonstration of **new applications**, continuously improve the **IPv6 technical standard** system, and significantly improve **China's international competitiveness in the IPv6 field**.

ipv6 行动计划

Industry-University-Research-Application, Multi-dimensional Integration

CAICT 中国信息通信研究院 China Academy of Information and Communications Technology
HUAWEI
清華大學
CBN
中国电信 CHINA TELECOM
中国移动 China Mobile
China unicom 中国联通
Alibaba Group
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Thank you