SRv6 Journey and experience

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Rakuten

Agenda

- SRv6 Design
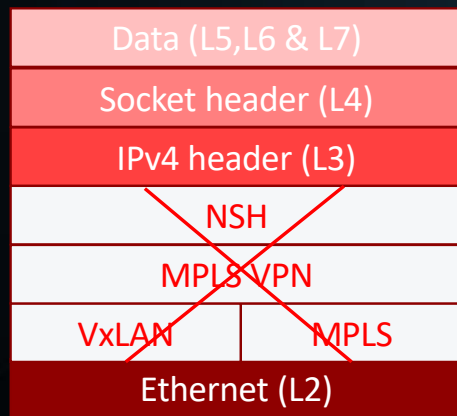- IGP design and Scale
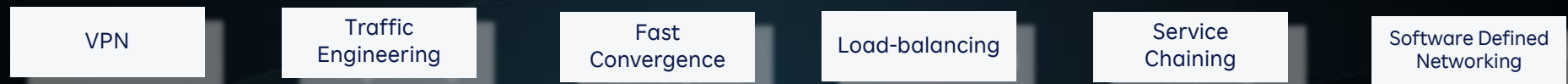- Challenges with Prefix summarization
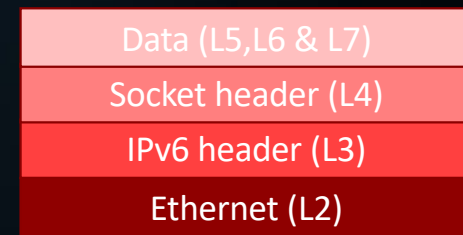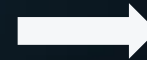- SRv6 migration strategy
- Deployment Outcomes
- Summary & Conclusion

Path to Simplicity

Achieve more with less

VPN	Traffic Engineering	Fast Convergence	Load-balancing	Service Chaining	Software Defined Networking

| Data (L5,L6 & L7) |
| Socket header (L4) |
| IPv4 header (L3) |
| ~~NSH~~ |
| ~~MPLS VPN~~ |
| ~~VxLAN~~ \ ~~MPLS~~ |
| Ethernet (L2) |

Simplicity
(back to OSI model)

→

| Data (L5,L6 & L7) |
| Socket header (L4) |
| IPv6 header (L3) |
| Ethernet (L2) |

SRv6 Design

Addressing schema - SID allocation

➤ ULA addressing, assignment /40 to each prefecture (IGP domain) that allows possibility of summarization at ABR level.

➤ uSID block in /32, uSID ID in 16-bits (F3216), uSID Node Locator in /48

➤ Loopbacks and Locator blocks are synchronized.

uSID: FC00:10/24

SIDSpace:BlockID:MDomainIDNodeID
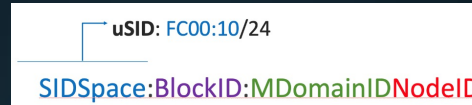
Protocols in use:

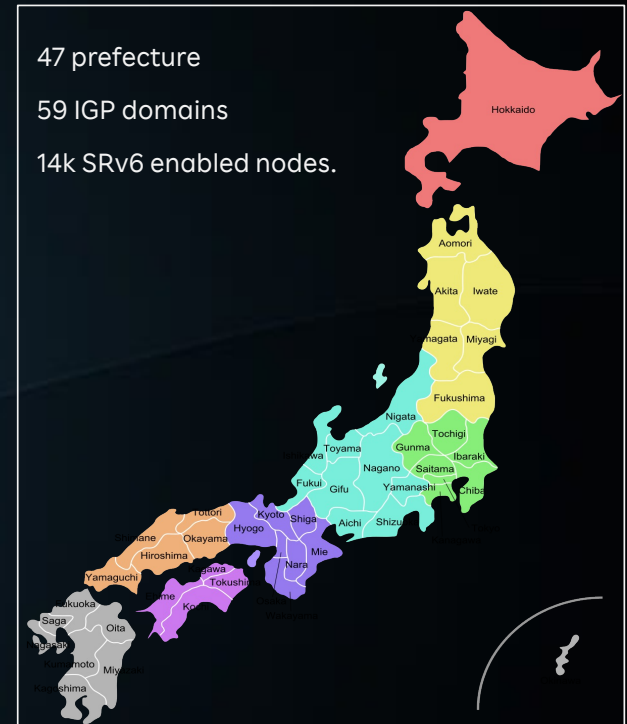➤ ISIS, BGP (vpnv4, vpnv6, rt-filter, evpn bgp-ls), BFD, VRRP, LACP.

Levers for fast convergence:
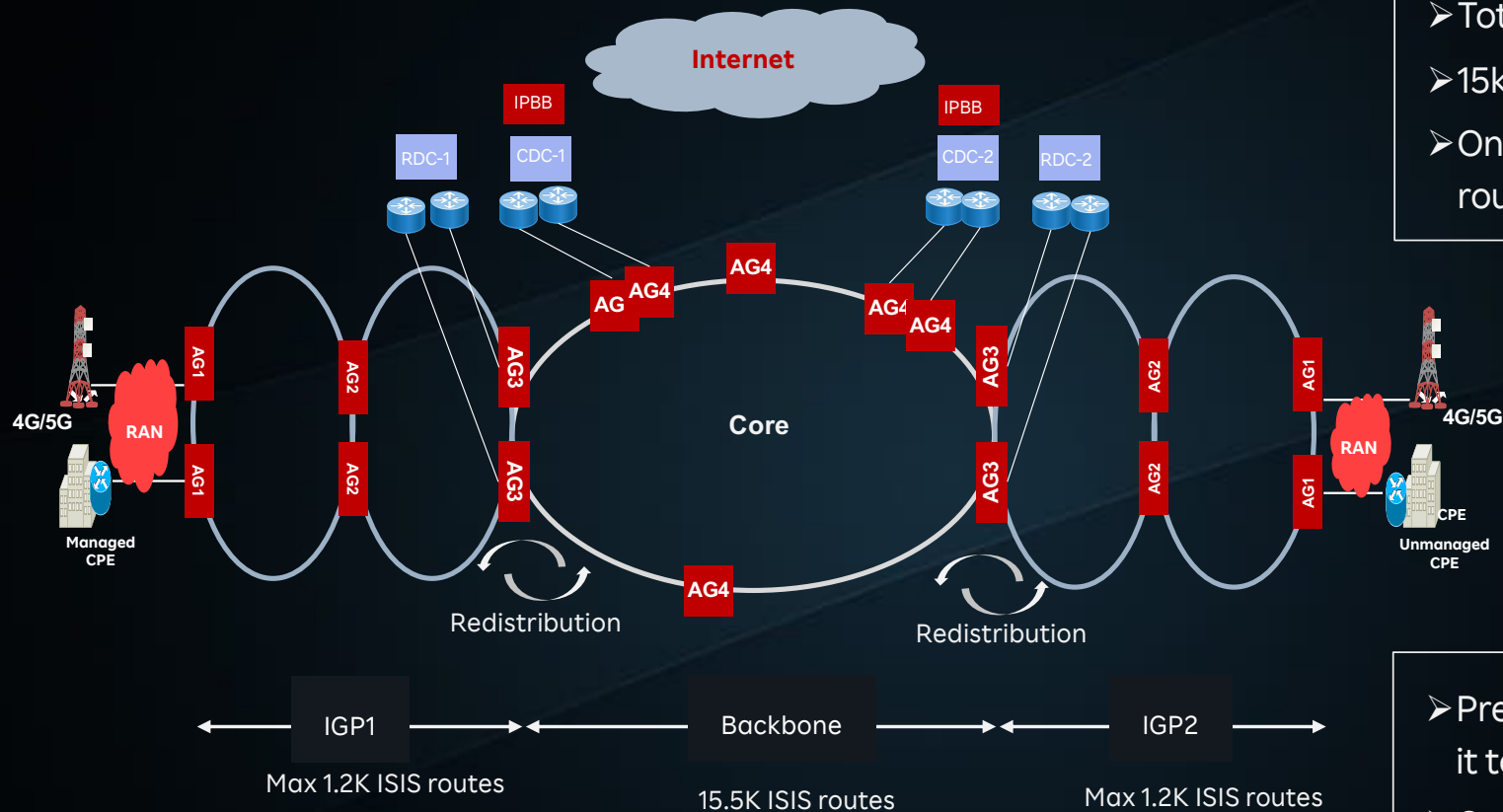
➤ BFD, TI-LFA, BGP-PIC

SRv6 Services

➤ L3VPN, EVPN based L2VPN (Mobility (4G,5G), Internet, Enterprise (B2B))

➤ Low-latency path using Flex-Algo

➤ Bandwidth Optimization using Demand-Matrix

Map of Japan

47 prefecture

59 IGP domains

14k SRv6 enabled nodes.

IGP design and scale

- Total 15k SRv6 nodes
- 15k locators in core
- One Flex-algo will add another 15k routes in the core

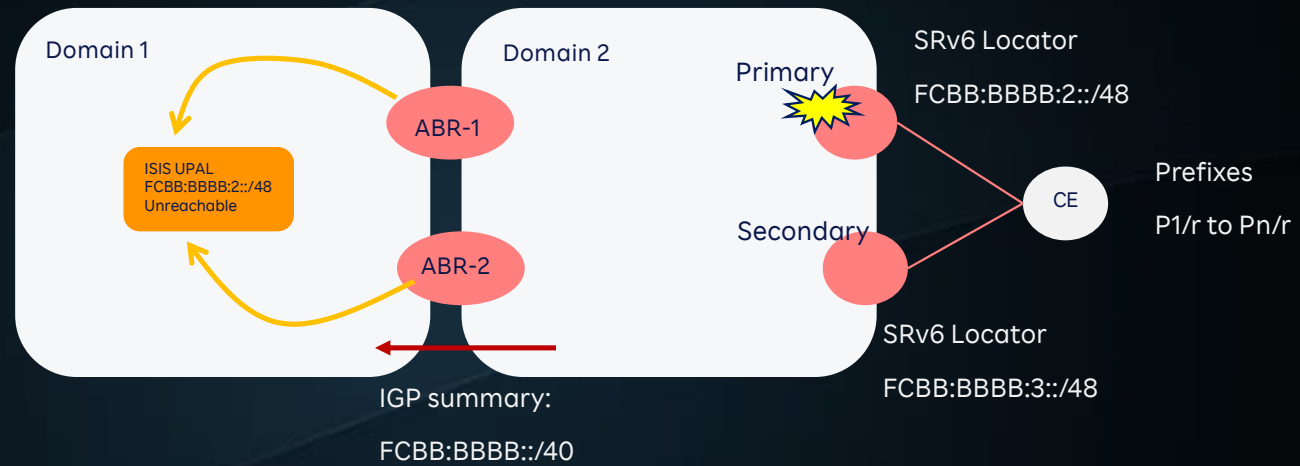- Prefix summarization will reduce it to <500
- One Flex-algo will add around 200 prefixes in the core.

Internet

IPBB   IPBB

RDC-1   CDC-1   CDC-2   RDC-2

AG4
AG AG4   AG4
AG4   AG4
AG3   AG3   AG2   AG1
4G/5G   RAN   AG1   AG2   AG3   Core   AG3   AG2   AG1   RAN   4G/5G
Managed CPE   AG1   AG2   AG3   CPE   Unmanaged CPE
AG4
Redistribution   Redistribution

IGP1	Backbone	IGP2
Max 1.2K ISIS routes	15.5K ISIS routes	Max 1.2K ISIS routes

Network physically connected in a ring-based architecture and logically divided in to 57 IGP domains, all connected to backbone IGP domain.
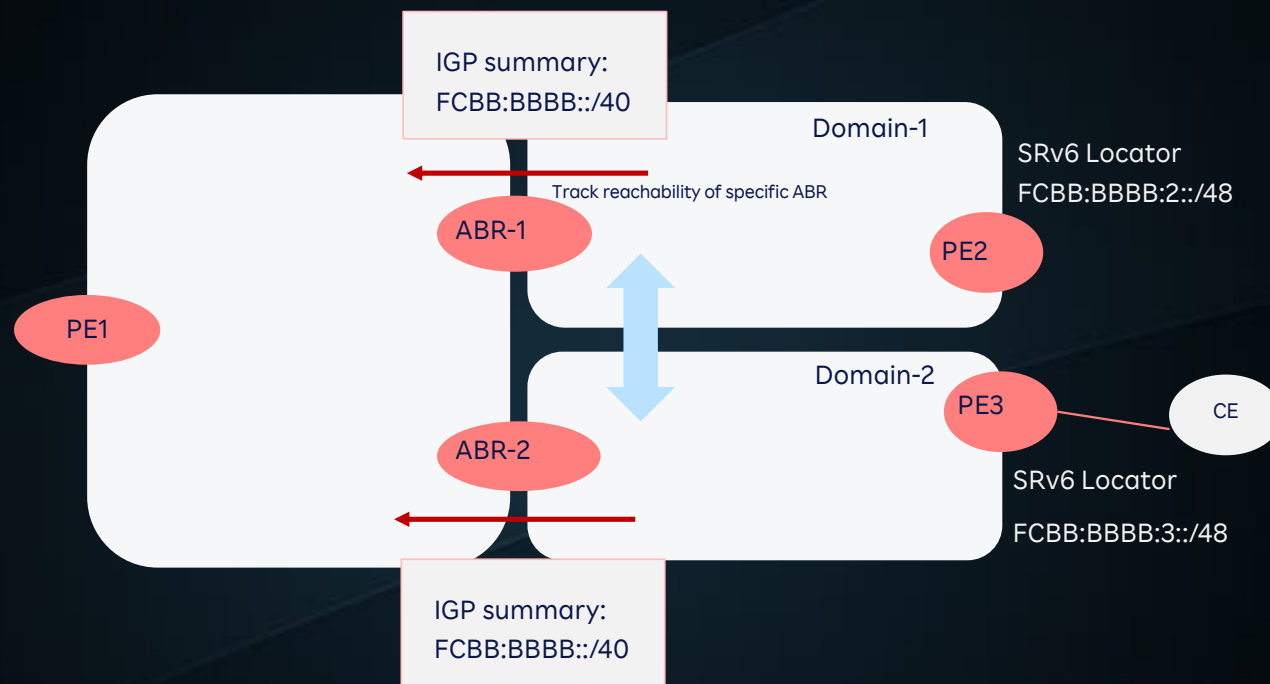
Unreachability Prefix Announcement

VRF-A FIB on PE1

P1/r,…Pn/r

  primary via PE2

     resolved via FCBB:BBBB::/40

Backup via PE3

     resolved via FCBB:BBBB::/40

Domain 1

ABR-1

ISIS UPAL
FCBB:BBBB:2::/48
Unreachable

ABR-2

Domain 2

Primary

Secondary

SRv6 Locator

FCBB:BBBB:2::/48

CE

Prefixes

P1/r to Pn/r

SRv6 Locator

FCBB:BBBB:3::/48

IGP summary:

FCBB:BBBB::/40

➢ ABR generates a UPA when it detects local unreachability of PE2 and PE2 is part of summarization

➢ PE1 triggers BGP PIC upon reception of UPA related to PE2

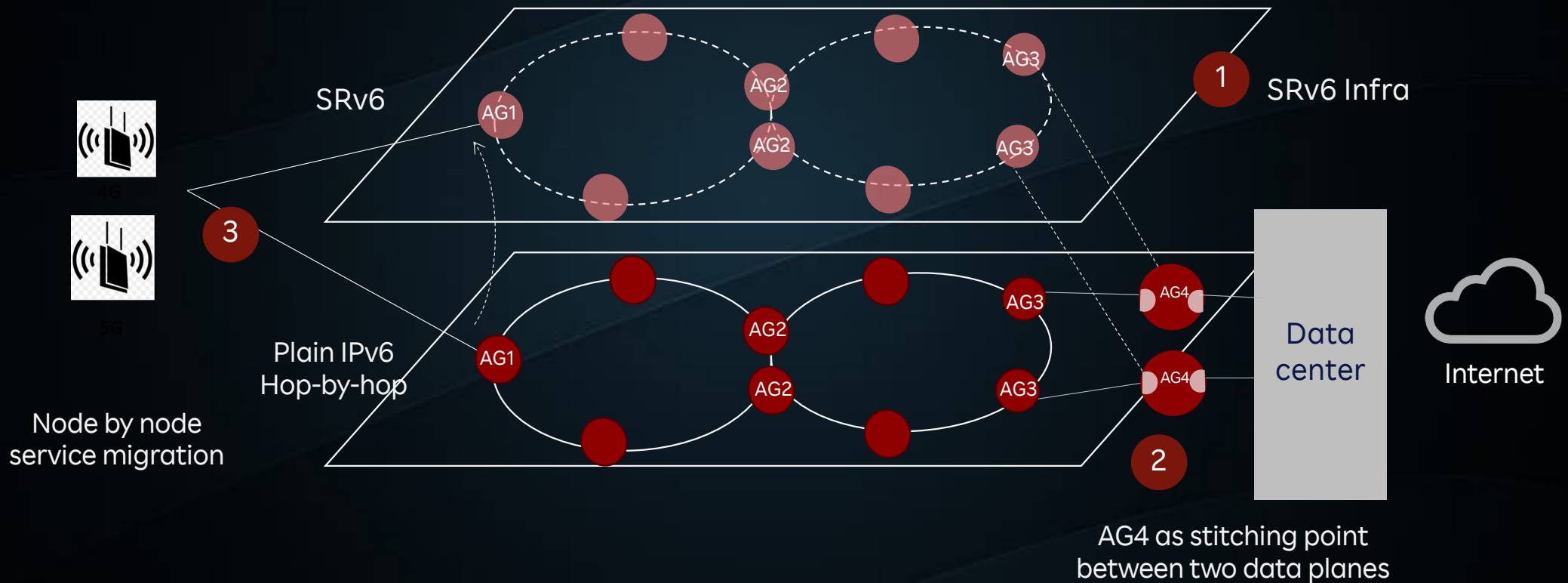➢ Successfully validated in Rakuten Lab

Area Partitioning Feature (AP-SRv6)

IGP summary:
FCBB:BBBB::/40

Domain-1

SRv6 Locator
FCBB:BBBB:2::/48

Track reachability of specific ABR

ABR-1

PE2

PE1

Domain-2

PE3

CE

SRv6 Locator
FCBB:BBBB:3::/48

ABR-2

IGP summary:
FCBB:BBBB::/40

➢ ABR, on detection, stops advertising the summary prefix

➢ Specific prefixes of only one IGP domain will be leaked to Core, thus no exponential increase to total no. of routes.

➢ Revert to summary after partition removal

SRv6 Migration Strategy

Quite effective migration strategy with a common interface towards Data-Center

SRv6

SRv6 Infra

AG1
AG2
AG2
AG3
AG3

1

Plain IPv6
Hop-by-hop

AG1
AG2
AG2
AG3
AG3
AG4
AG4

2

4G

5G

3

Node by node
service migration

Data
center

Internet

AG4 as stitching point
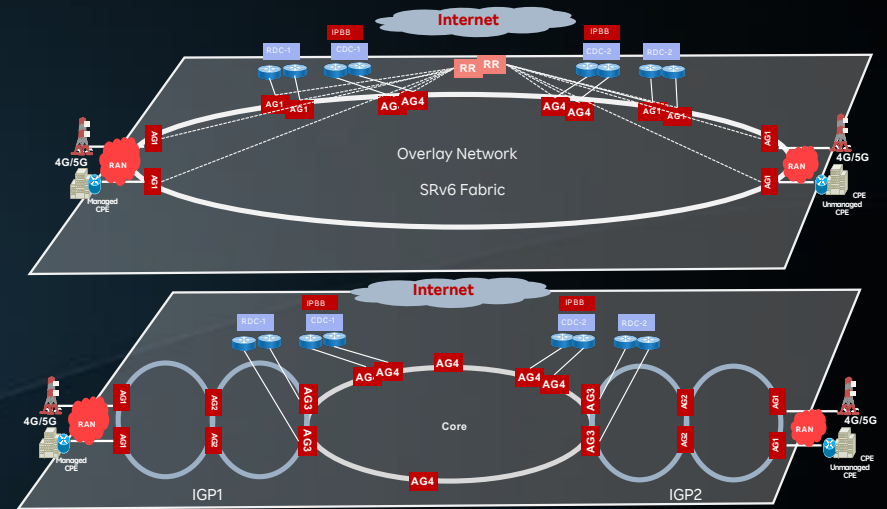between two data planes

Rakuten IP Transport Transformation

SRv6 transforms Rakuten IP Transport network to world class converged 5G SDN-ready network
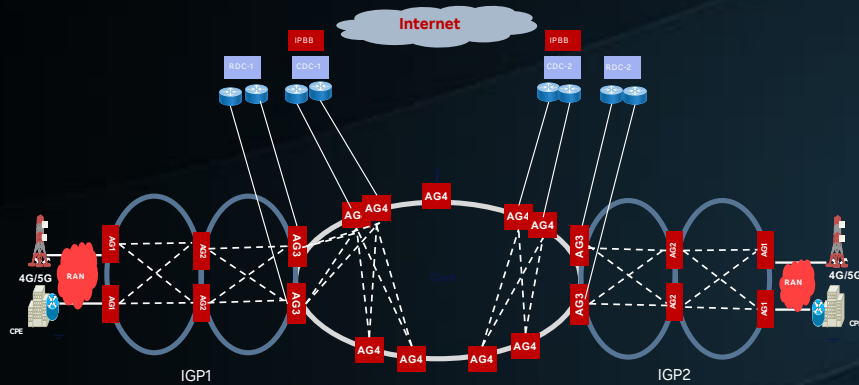
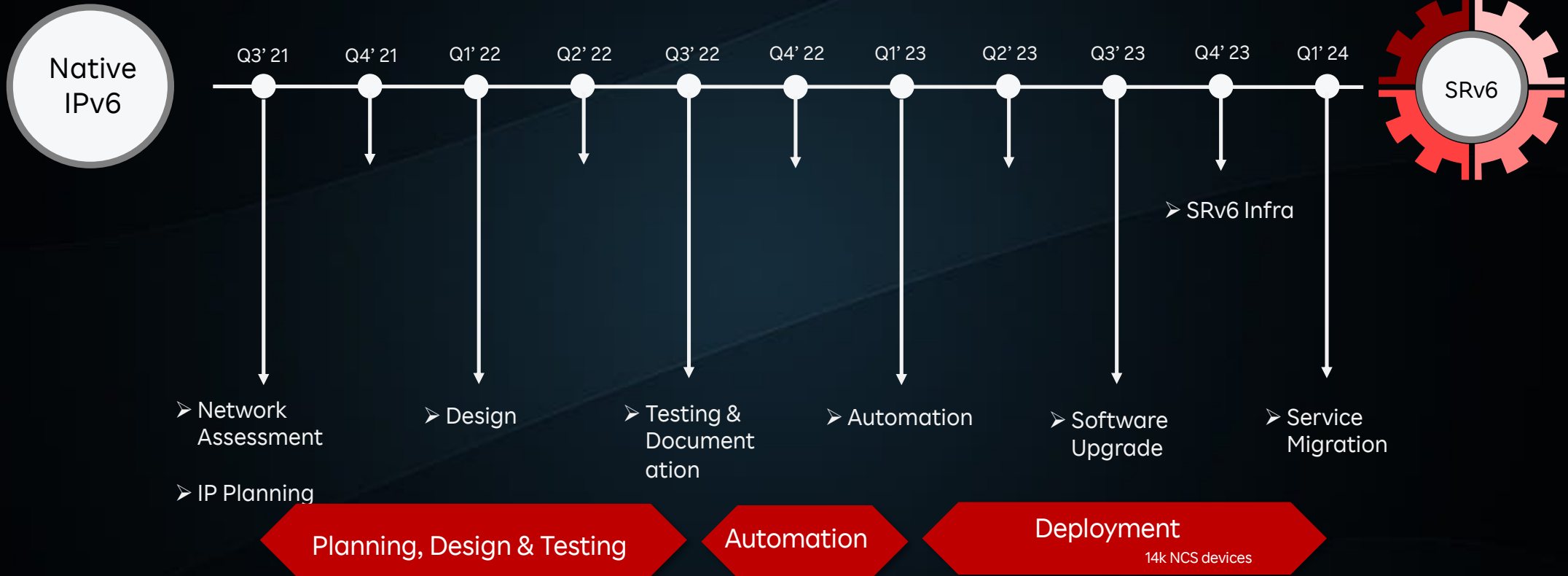Old NW - Hop-by-hop routing architecture

Current NW - Overlay-Underlay routing architecture using SRv6

> ➤ More and better services offering using existing infrastructure.
> ➤ Single SRv6 fabric, reduced provisioning touch-points, faster provisioning time, easy to automate, less human error.
> ➤ Reduced number of protocols, simple to troubleshoot and operate

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Rakuten SRv6 Journey in the last 3 years

Native IPv6 -> SRv6 deployment on 14k NCS devices

Native IPv6

| Q3' 21 | Q4' 21 | Q1' 22 | Q2' 22 | Q3' 22 | Q4' 22 | Q1' 23 | Q2' 23 | Q3' 23 | Q4' 23 | Q1' 24 |

SRv6

➢ SRv6 Infra

➢ Network Assessment

➢ Design

➢ Testing & Document ation

➢ Automation

➢ Software Upgrade

➢ Service Migration

➢ IP Planning

Planning, Design & Testing

Automation

Deployment
14k NCS devices

Deployment Outcomes

98%
Reduction in ISIS LSP in Core

73%
Reduction in total ISIS routes in Core

96%
Reduction in number of BGP sessions on Core routers

55 to 2

90%
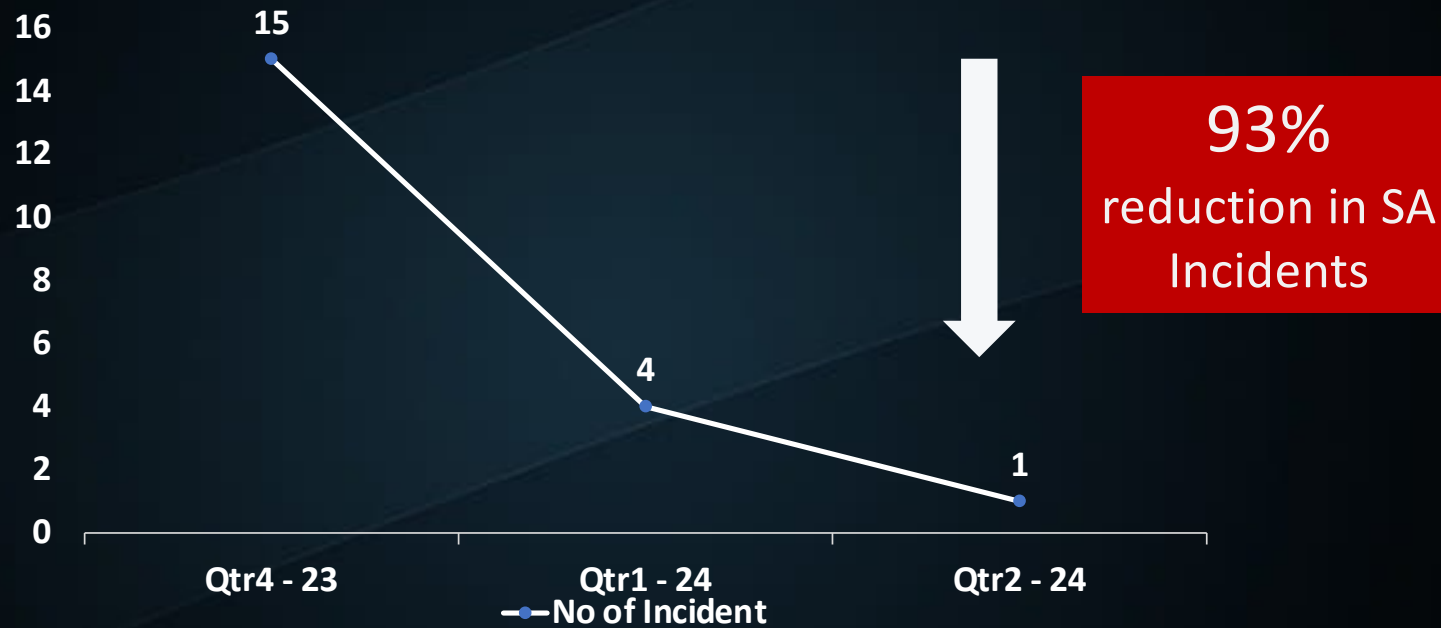Reduction in total routes to data centers

6500+ → 500

86%
Reduction in config touch-points

13-15 -> 2

90%
Improvement in convergence time

500ms to 50ms

SRv6 transforms Rakuten IP Transport network to world class converged 5G SDN-ready network

Summary & Conclusion

✓ SRv6 design brings network simplicity & efficiency to the Rakuten network.

✓ SRv6 uSID supports ultra scalability due to native IPv6 forwarding architecture and summarization capability.

✓ SRv6 design Improved network stability.

✓ Transport with comprehensive SLA .