Segment Routing at IETF102

そして今後のネットワークアーキテクチャへの一考察

31 August 2018

Miya Kohno, Distinguished Systems Engineer, Cisco Systems

Agenda

- *Segment Routingが取り上げられたWG*

- IETF102におけるハイライト
  - Flex Algo for Network Slicing
  - SRv6 と NSH
  - SRv6 と hICN

- 今後のネットワークアーキテクチャへの一考察
  - Simplification
  - Overlay/Underlay – Separation or Integration?

Segment Routingが取り上げられたWG in IETF102 (1/3)

WG	Discussion Items
SPRING (Source Packet Routing in Networking)	Segment Routing 関連技術全般 ・ YANG model ・ SR Policy (Traffic Engineering) ・ NSH/SR Integration ・ Service Programming (Service Chaining) ・ SRv6 Network Programming ・ Node Protection for SR-TE path ・ Ping for Flex Algorithm prefix ・ SR for SD-WAN ・ OAM ・ Traffic Accounting ・ Performance Measurement
6man (IPv6 Maintenance)	・ SRv6 SR Header ・ SRv6 OAM

Segment Routingが取り上げられたWG in IETF102 (2/3)

WG	Discussion Items
LSR (Link State Routing)	• IS-IS extension for SRv6 • SR Flex Algorithm • IGP extension for SR based enhanced VPN
DMM (Distributed Mobility Management)	• SRv6 for mobile user plane • SRv6 as Data Plane for mobile packet core • SRv6 for mobile user plane – PoC report
IDR (Inter Domain Routing)	• SR Policies for Path Segment and Bi-directional Path • SR Policies for Path Segment and Bi-directional Path for BGP-LS
PIM (Protocol Independent Multicast)	• A Framework for Computed Multicast applied to SR-MPLS
BIER (Bit Indexed Explicit Replication)	• MVPN using Segment Routing and BIER

Segment Routingが取り上げられたWG in IETF102 (3/3)

WG	Discussion Items
MPLS (Multi Protocol Label Switching)	• Ping for Flex Algorithm prefix
LISP (Locator ID Separation Protocol)	• LISP Control Plane for SRv6
RTGWG (Routing Working Group)	• SRv6 Constrain Analysis
SFC (Service Function Chaining)	• SR for Service Programming • NSH/SR Integration

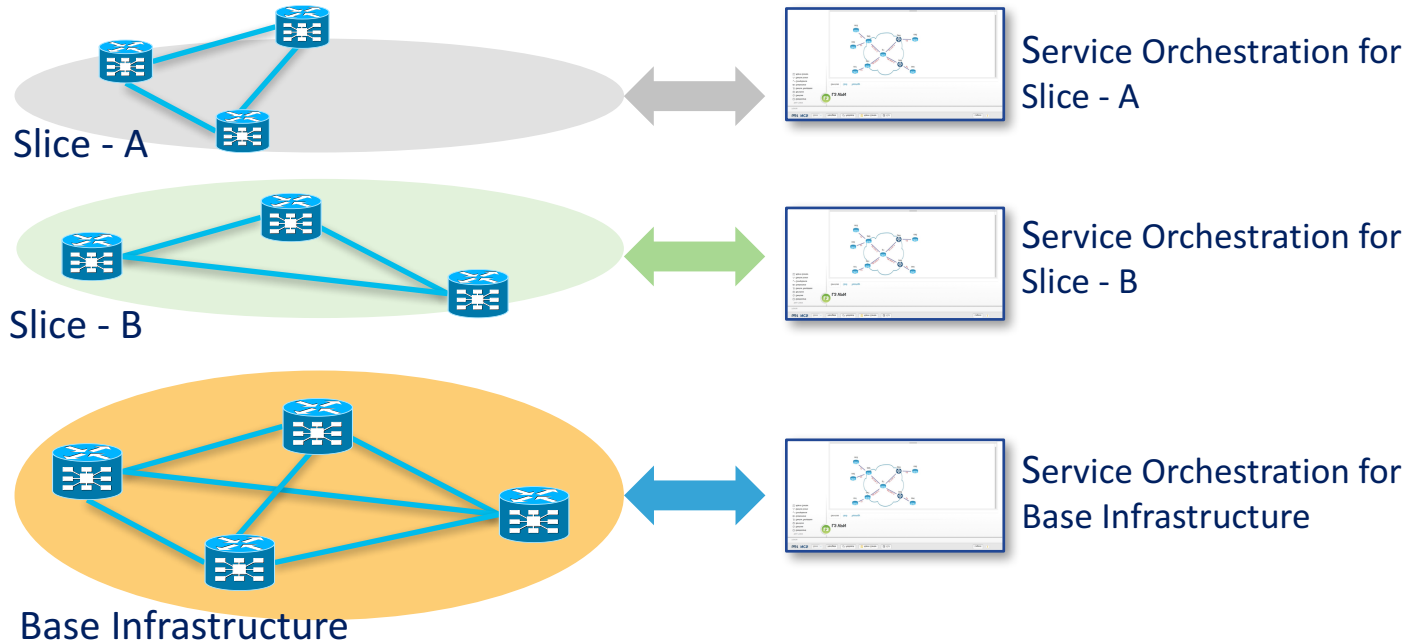11 WGs, 28 items !!!

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- Segment Routingが取り上げられたWG

- *IETF102におけるハイライト*

  - *Flex Algo for Network Slicing*

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Building blocks (SR centric) for enabling slices

- Segment Routing Policy
  - Flex-Algorithm based SR Policy
  - On demand SR Policy
  - Automatic Steering
  - Inter-domain considerations

- TI-LFA and microloop avoidance

- SR VPN

- Stateless Service Programming

- Operations, Administration, and Maintenance

- QoS

- Orchestration at the Controller

https://tools.ietf.org/html/draft-ali-spring-network-slicing-building-blocks-00

Automation/Orchestration for enabling slices

Slice - A

Slice - B

Base Infrastructure

Service Orchestration for Slice - A

Service Orchestration for Slice - B

Service Orchestration for Base Infrastructure

Flex-Algo mechanisms

- Each node MUST advertise Flex-Algo(s) that it participates in

  Nodes 0 and 9 participate to Algo 0 and 128 and 129

  Nodes 1/2/3/4 participate to Algo 0 and 128

  Nodes 5/6/7/8 participate to Algo 0 and 129

- Each node may advertise a prefix per algo

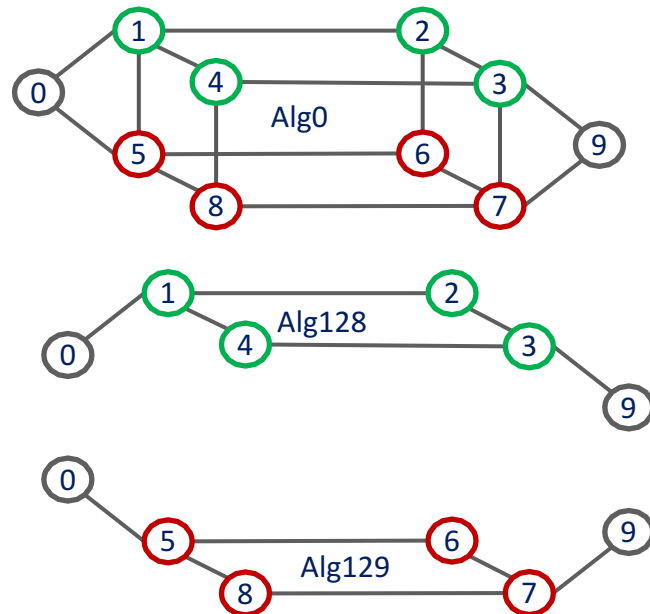 Node 2 advertises

  Prefix SID 16002 for ALGO 0

  Prefix SID 16802 for ALGO 128

- Node N computes Flex-Algo K if it is enabled for K

  Node prunes any links excluded by algo K
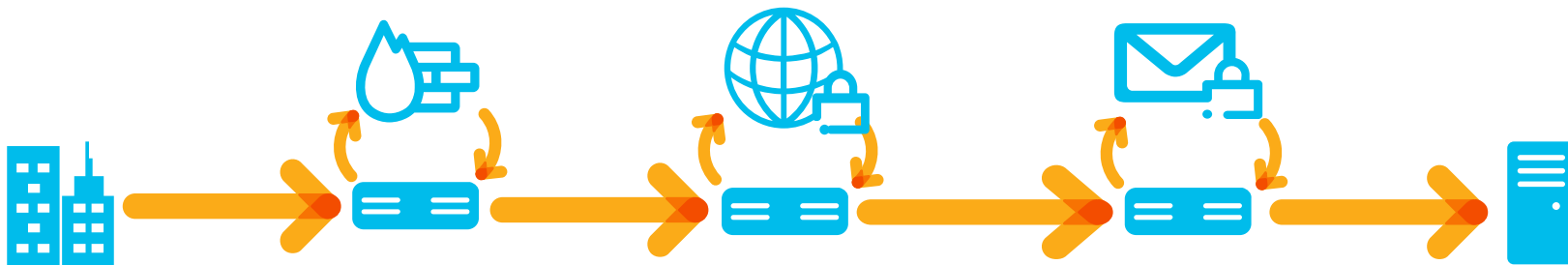
  Computes shortest path

- Installs prefixes into forwarding tables

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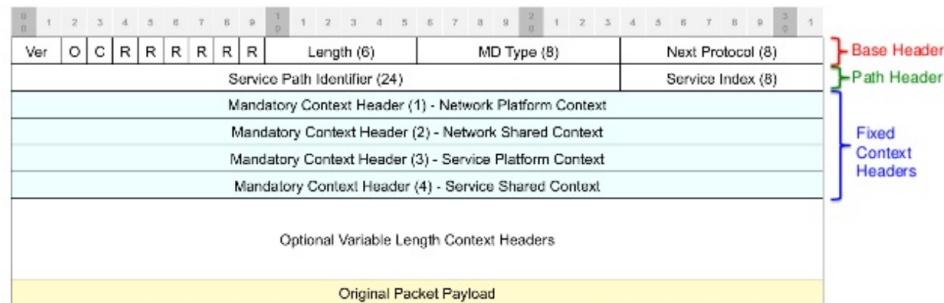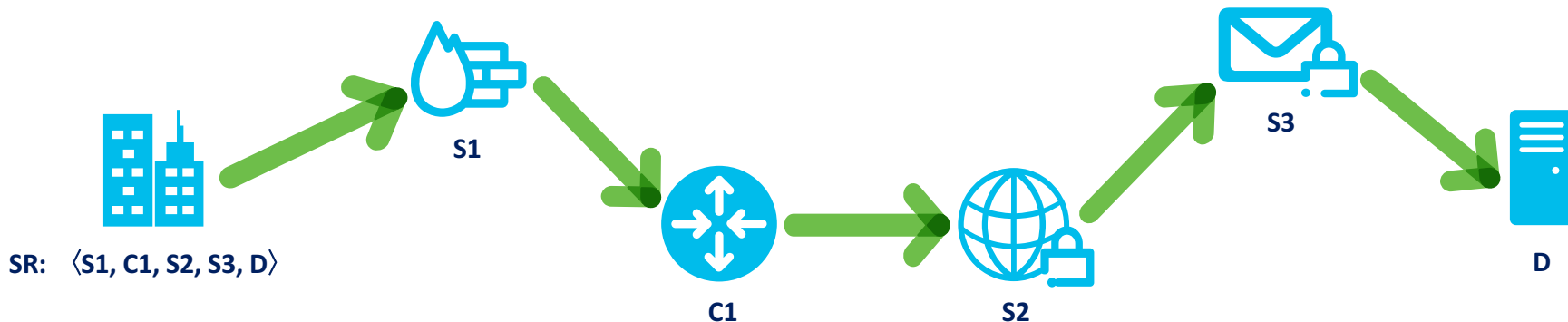
Service Chaining with NSH

Network Service Header

Pros:
- アンダーレイは問わない

Cons
- 各Service Chain参加ノードにおいて
  ステート保持の必要

									Length (6)	MD Type (8)	Next Protocol (8)	Base Header
Ver	O	C	R	R	R	R	R				
Service Path Identifier (24)											Service Index (8)	Path Header
Mandatory Context Header (1) - Network Platform Context												Fixed Context Headers
Mandatory Context Header (2) - Network Shared Context												
Mandatory Context Header (3) - Service Platform Context												
Mandatory Context Header (4) - Service Shared Context												
Optional Variable Length Context Headers												
Original Packet Payload												

Service Chaining with SRv6 (SRv6 Service Programming)

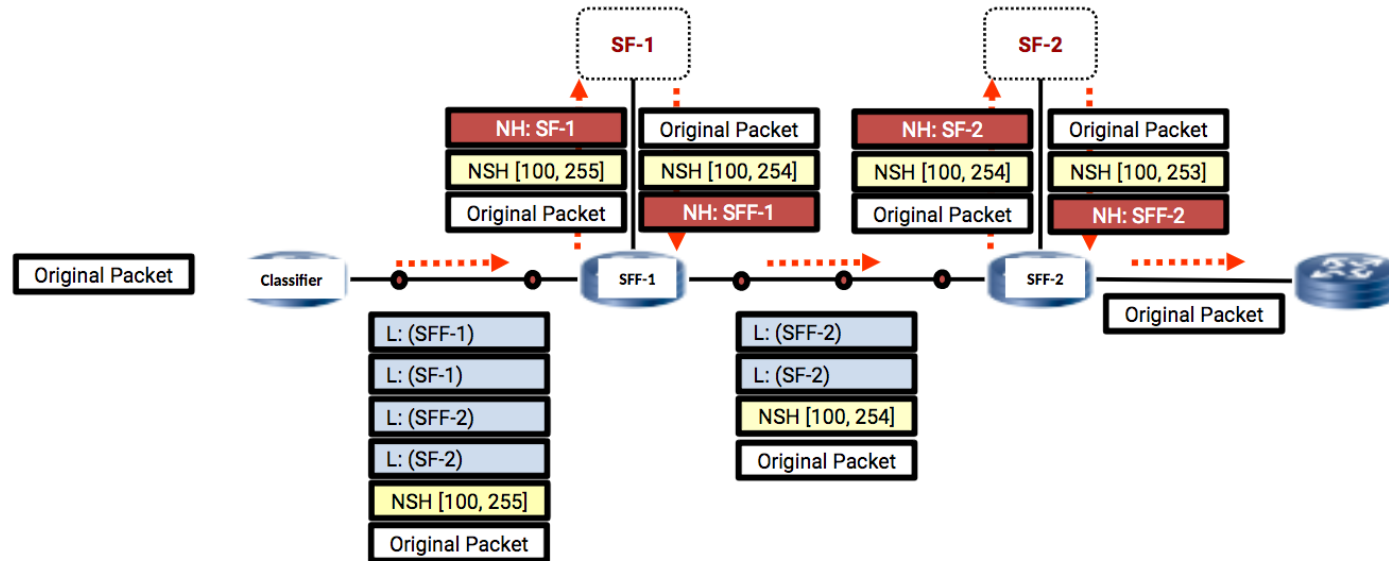**SR:** ⟨**S1, C1, S2, S3, D**⟩

S1

C1

S2

S3

D

Pros:
- サービスはSegmentとして表現される
  - → Flexible, Stateless, Scalable

Cons:
- SRv6が必要

SR and NSH integration?!

SR-based SFC with Integrated NSH Service Plane

slides-102-sfc-nsh-and-segment-routing-integration-for-service-function-chaining-sfc-01

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ICN communication principles

- Packets say 'what' not 'where' (no addresses)

- Pull-based model controlled by consumer

- No connections

- Dynamic in-network forwarding decisions

- in-network storage

Returned data is cached in routers

Subsequent requests can be served from cache
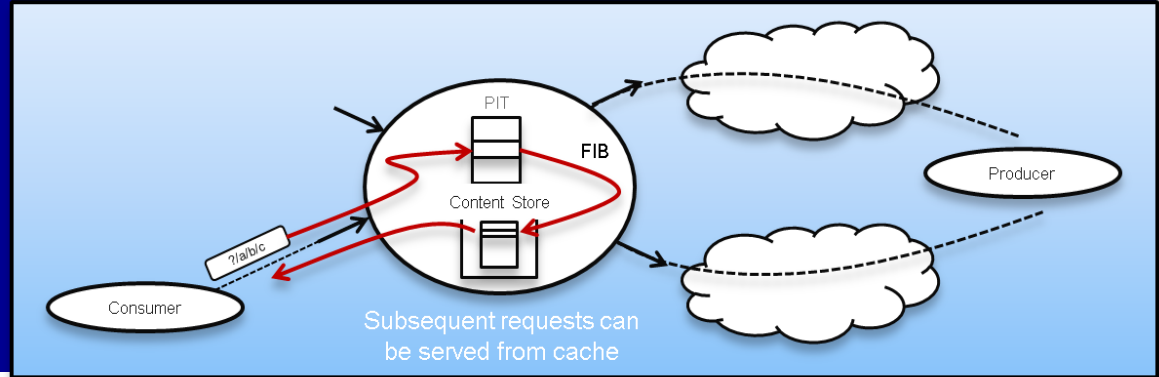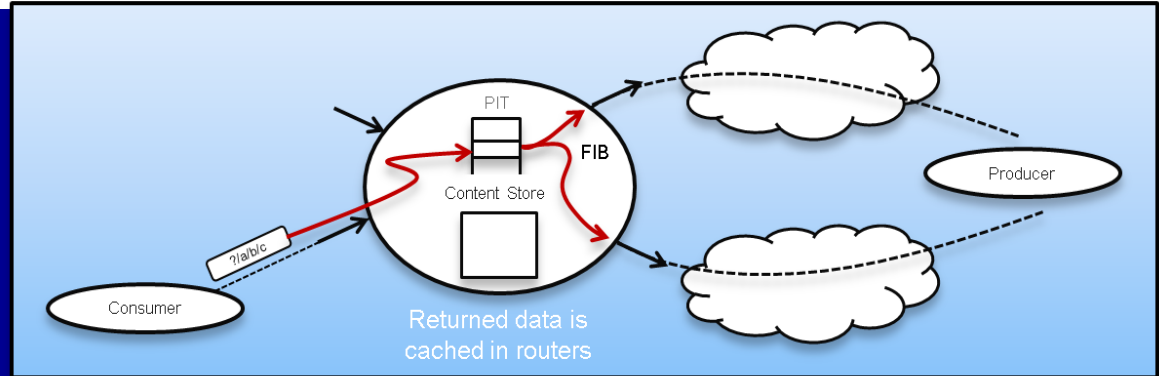
hICN (hybrid ICN) とは

Communication principles	IP	hICN	ICN
Names	Location-dependent Identifiers in IP addr	Location-independent Identifiers in IP addr	Location-independent Identifiers in new pkt format
Request routing	L4-L7 end to end	L3 hop-by-hop	L3 hop-by-hop
Transport	Connection-based Sender-driven	Connection-less Receiver-driven	Connection-less Receiver-driven
Mobility	Anchor-based	Anchor-less	Anchor-less
Security	Connection/Tunnel-based	Object-based	Object-based
Caching	Application-layer proactive caching	In-path reactive and proactive caching	In-path reactive and proactive caching

hICN - IETF drafts!

Versions: 00

```
Internet Area WG                                    L. Muscariello
Internet-Draft                                        G. Carofiglio
Intended status: Informational                              J. Auge
Expires: December 9, 2018                                M. Papalini
                                                   Cisco Systems Inc.
                                                       June 07, 2018
```

             Hybrid Information-Centric Networ
                  draft-muscariello-intarea-hicn-

Abstract

   This documents describes the hybrid information
   (hICN) architecture for IPv6. The specificatio
   implement information-networking functionalitie
   objective is to use IPv6 without creating overl
   format as an additional encapsulation. The int
   design is to introduce some IPv6 routers in the
   additional packet processing operations to impl
   Moreover, the current design is tightly integra
   easy interconnection to IPv6 networks with the
   objective to exploit existing IPv6 protocols as
   they are, or extend them where needed.

Versions: 00

```
DMM Working Group                                           J. Auge
Internet-Draft                                        G. Carofiglio
Intended status: Informational                     L. Muscariello
Expires: December 22, 2018                               M. Papalini
                                                   Cisco Systems Inc.
                                                       June 20, 2018
```

                  Anchorless mobility through hICN
                   draft-auge-dmm-hicn-mobility-00

Abstract

   This document presents how mobility management is handled in Hybrid-
   ICN [I-D.muscariello-intarea-hicn]. The objective of the document is
   to present how end-points mobility is managed in two main cases: the
   end-point sends data (data producer) or the end-point receive data
   (data consumer). These two cases are taken into account entirely to
   provide anchorless mobility management in hICN.

Mobility Architectures

Locator-based

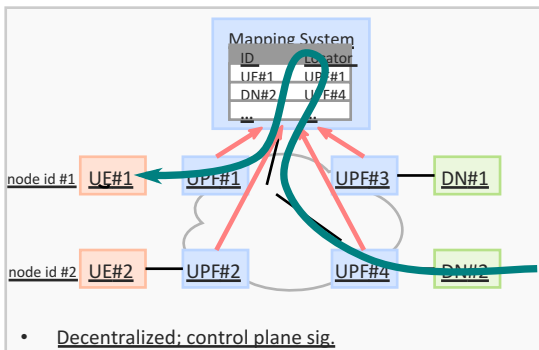- Decentralized; control plane sig.
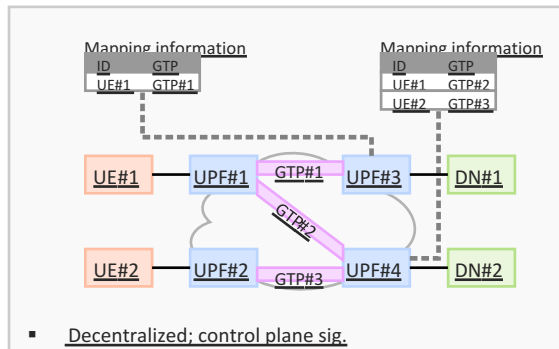
- **GTP-U**
- **SRv6**

- Locators used as identifiers: semantic overloading that complexifies mobility (anchors/tunnels)

- Lack of flexibility, complex management of synch, does not allow dynamic offload at edge
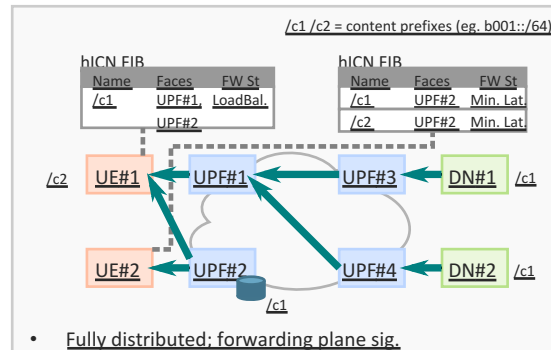
ID/Loc separation

- Decentralized; control plane sig.

- **LISP** (ILSR/ILNP)
- **ILA**
- **SRv6**

- Mapping system where to keep updated / verify Loc/ID binding

- Challenges : scalability, latency for the verification, issues in caching and synchronization of a distributed mapping system

ID-based

- Fully distributed; forwarding plane sig.

- *(draft-vonhugo-5gandip-ip-issues-03)*
- **ICN**
- **hICN**

- no anchors (neither in UP nor in CP)
- No operation for static/mobile cons.
- latency-optimized user plane updates
- access-agnostic approach
- seamless integration of hetnet

IETF102資料より

Complimentary Roles: hICN & SRv6

Control

Other Control Planes ..

VTS, BGP, IGP, XTC, GTP-C, SBA

Hybrid ICN

Anchorless Endpoint Mobility   Anchorless Application
Content Security   Asynchronous Control Plane
Multi-Homing   Stateless L4 Transport
Asynchronous "Multicast"   Leverage Native FIB

Path State

SRv6 (Source Routing, Segmentation)

Service Chaining   Segment Identification
Source Vectoring   Distributed Control

Multi-Path

Recovery

FRR

Caching

Forwarding

IPv6

Path Recovery   Host / VM / Container Identification
End-point Addressing   **Standards Based Support**
Topological Forwarding State   **Underlay Management**
Open Source Community   **Basic Services Support**
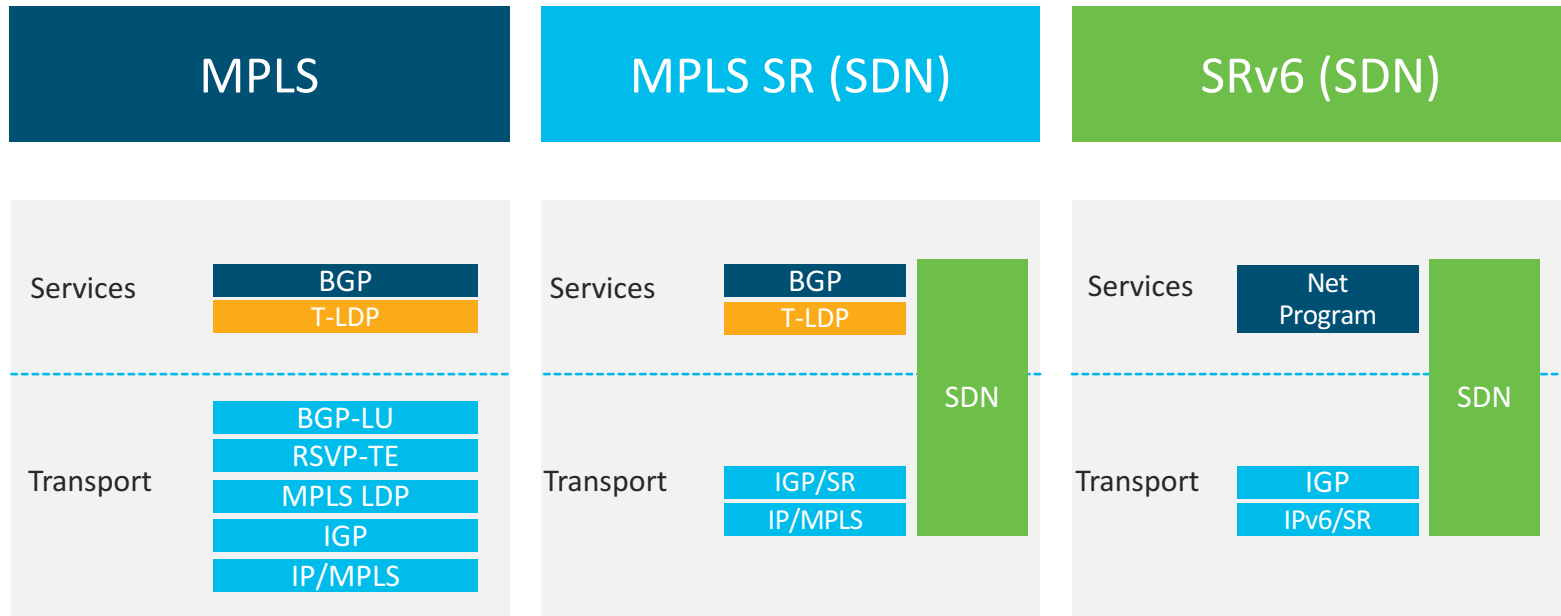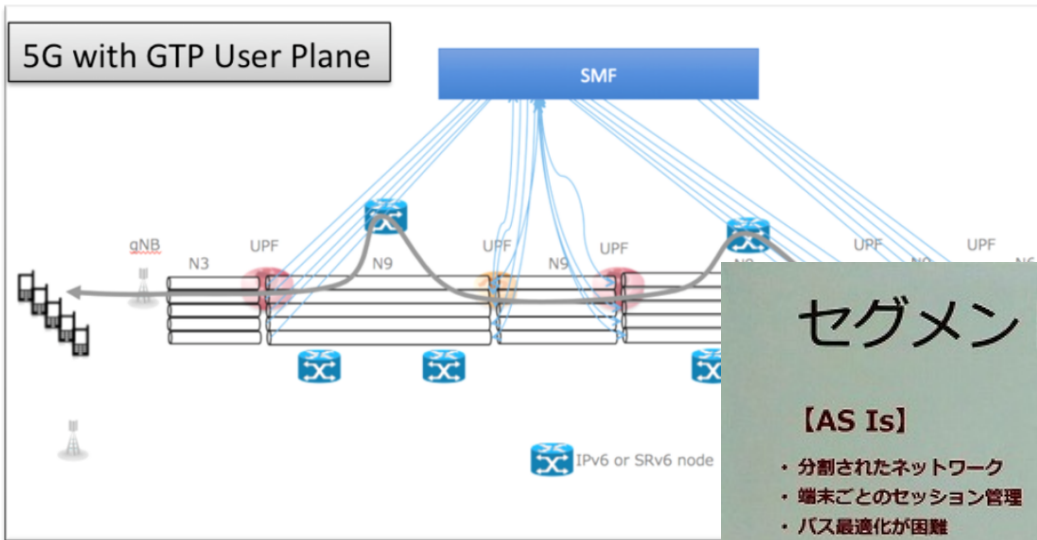
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  - *Simplification*
  - Overlay/Underlay – Separation or Integration?

Simplification – Protocol reduction

MPLS	MPLS SR (SDN)	SRv6 (SDN)

MPLS

Services
- BGP
- T-LDP

Transport
- BGP-LU
- RSVP-TE
- MPLS LDP
- IGP
- IP/MPLS

MPLS SR (SDN)

Services
- BGP
- T-LDP

SDN

Transport
- IGP/SR
- IP/MPLS

SRv6 (SDN)

Services
- Net Program

SDN

Transport
- IGP
- IPv6/SR

* SDN for Service Orchestration, Automation

Simplification – State reduction

http://www.itmedia.co.jp/mobile/articles/1805/24/news143.html

https://blog.apnic.net/2018/03/07/reducing-complexity-5g-networks-using-segment-routing-ipv6/
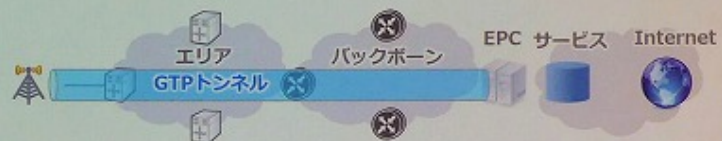
Simplification – Control plane/User plane separation

slides-102-rtgwg-sessb-draft-wadhwa-rtgwg-bng-cups-01

CUPS-BNG

CP VNF

Address Pool Mgmt	Management Client	DHCPv4/v6, PPPoE IPv6 RS/RA, L2TP LAC	RADIUS CLIENT	Gx	Gy	S11/N11

Management Interface

In-band Signaling Channel

State Control Interface

AAA

PCRF

OCS

OSS/BSS

UP

Local CP
Routing, MPLS
IGMP, BFD

Forwarding,
Traffic Mgmt

UP

Local CP
Routing, MPLS
IGMP, BFD

Forwarding,
Traffic Mgmt

UP

Local CP
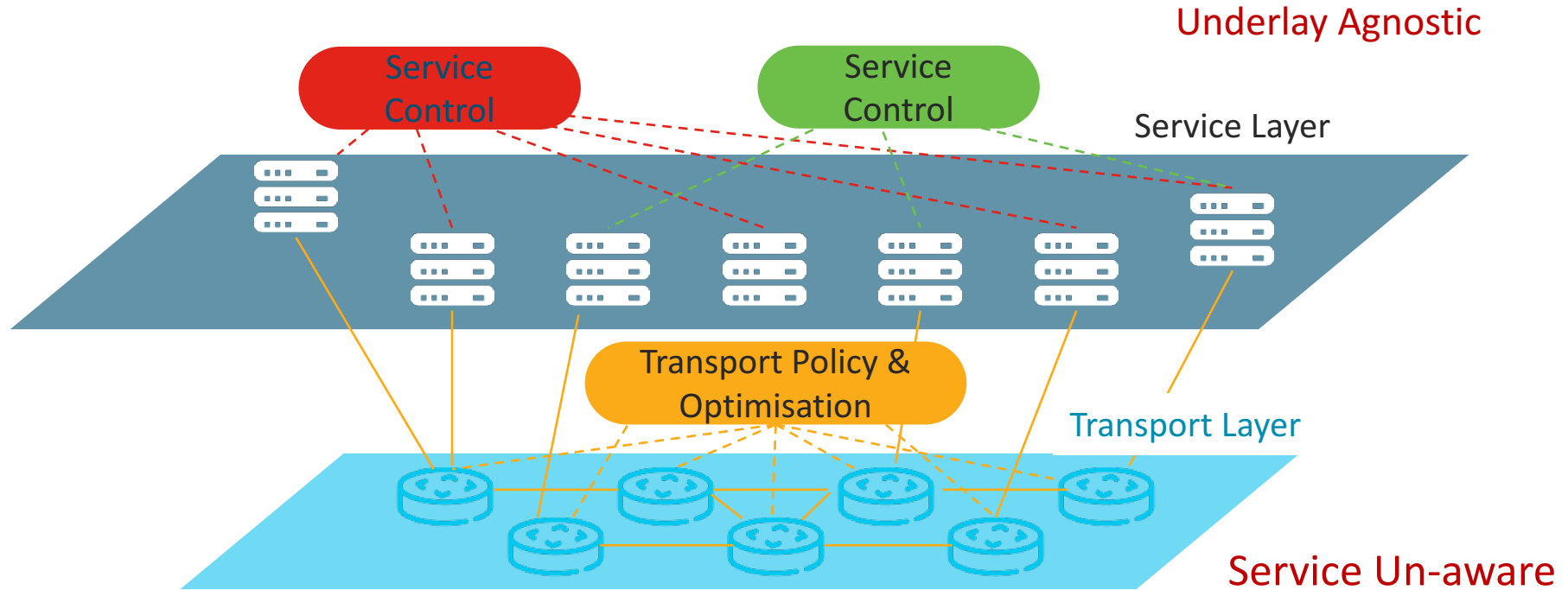Routing, MPLS
IGMP, BFD

Forwarding,
Traffic Mgmt

IETF102 RTGWG Montreal

4

Control Planeを分離し、User Planeをシンプル化、ステートレス化することによって
柔軟な構成とScale Outを実現

Simplification – Overlay/Underlay separation ?!

Underlay Agnostic

Service Control

Service Control

Service Layer

Transport Policy & Optimisation

Transport Layer

Service Un-aware

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現在のコミュニケーションモデル

- Mobility, Content, Load Balancing, Securityはネットワークアーキテクチャに組み込まれておらず、付加的に実装

    → Overlay/Tunnelの蔓延

- Security
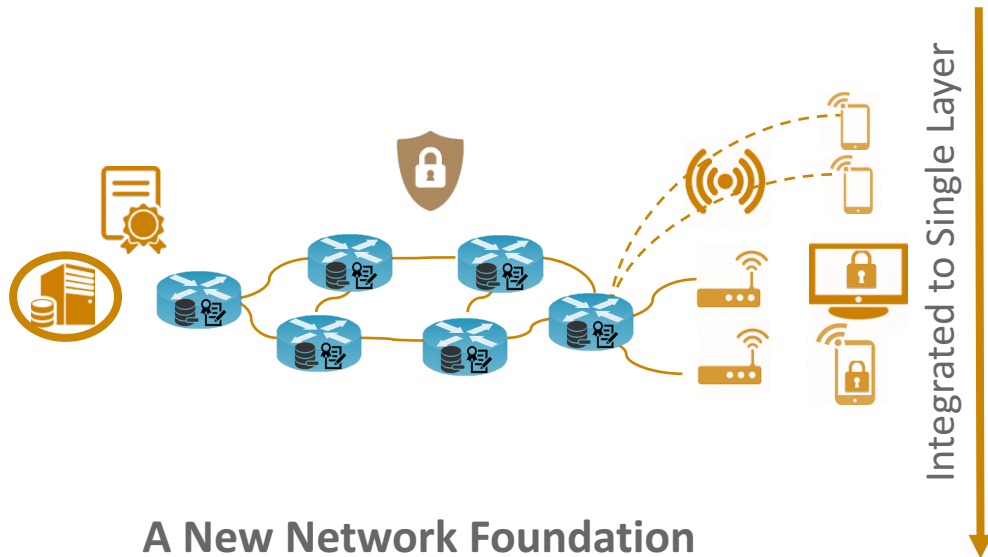- Load Balancing
- Content Distribution
- Mobility
- Network
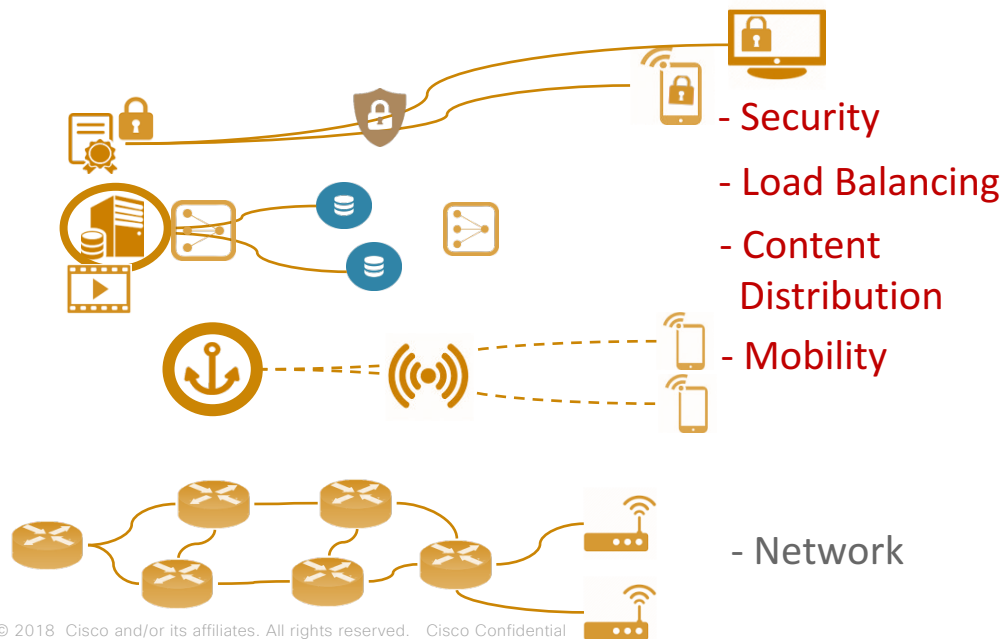
- **Security** – End 2 End crypto, Various/uncoordinated security

- **Session Load Balancing**

- **Storage** – Pre-Positioned Cache/Storage

- **Mobility** – Sub-Optimal / Anchor based, inconsistent with heterogeneous access

ICNモデル
Information Awareなネットワーク, Not Where -> WHAT

- Mobility, Content, Load Balancing, Security
- → ネットワークアーキテクチャへの基本的な組み込み

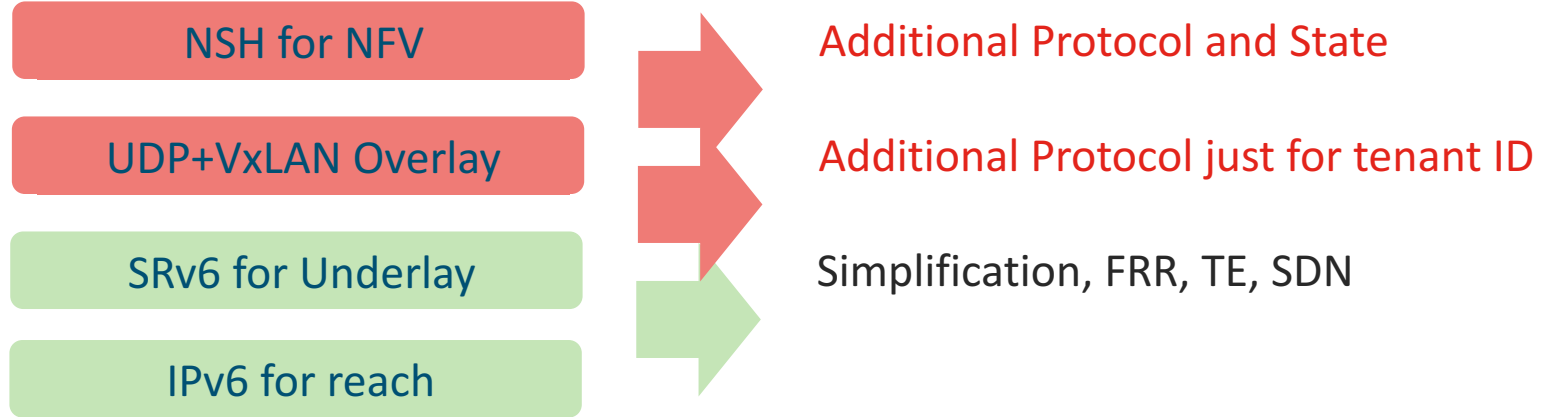**A New Network Foundation**

Integrated to Single Layer

- **Security** – Object Based Security,

- **Intelligent Load Balancing** - per app and at every hop

- **Storage** – Dynamic Store/caching of Objects in the forwarding fabric

- **Mobility** – Optimal, No Anchors

- **Networking on Named Data**
  Enable rapid loss recovery, optimal congestion control, consistent Unicast/Multicast, per apps/name forwarding strategy

SRv6 for underlay

SRv6 for Underlay

IPv6 for reach

→ Simplification, FRR, TE, SDN

SRv6 - Opportunity for further simplification

NSH for NFV	→	Additional Protocol and State
UDP+VxLAN Overlay	→	Additional Protocol just for tenant ID
SRv6 for Underlay	→	Simplification, FRR, TE, SDN
IPv6 for reach		

- Multiplicity of protocols and states hinder network economics

Overlay/Underlay -- Separated or Integrated?

Separated ← ← ← ← ← ← → → → → → → Integrated

Separated

- VXLAN
- NSH
- SD-WAN
- GTP tunnel
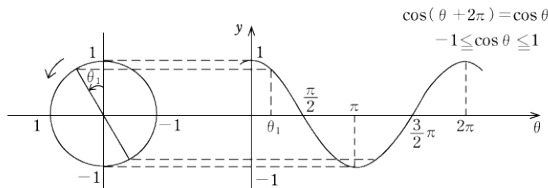
...

Integrated

- SRv6 Net Programming
- SRv6 Service Programming
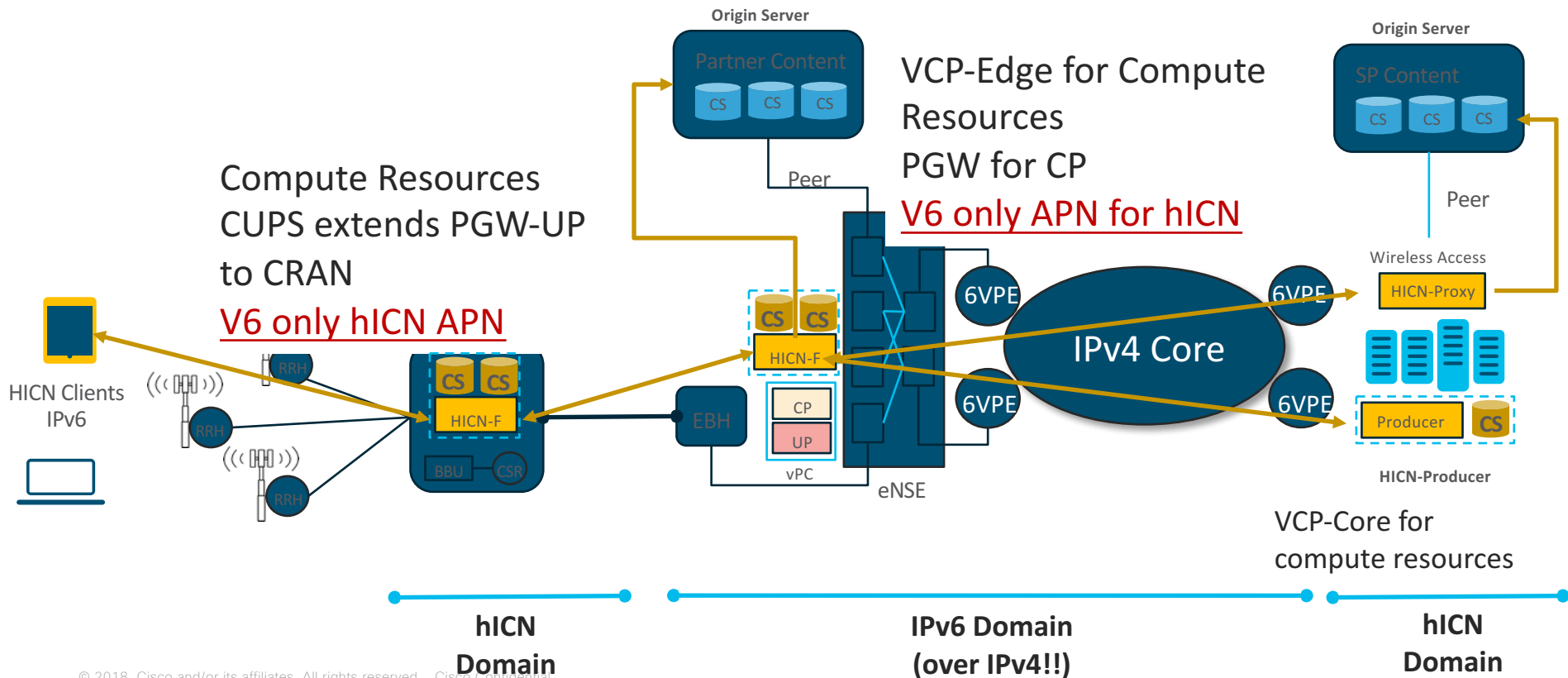- SD-WAN + SR integration
  - SRv6 Mobility
  - (h)ICN
- SLA aware Network Slicing

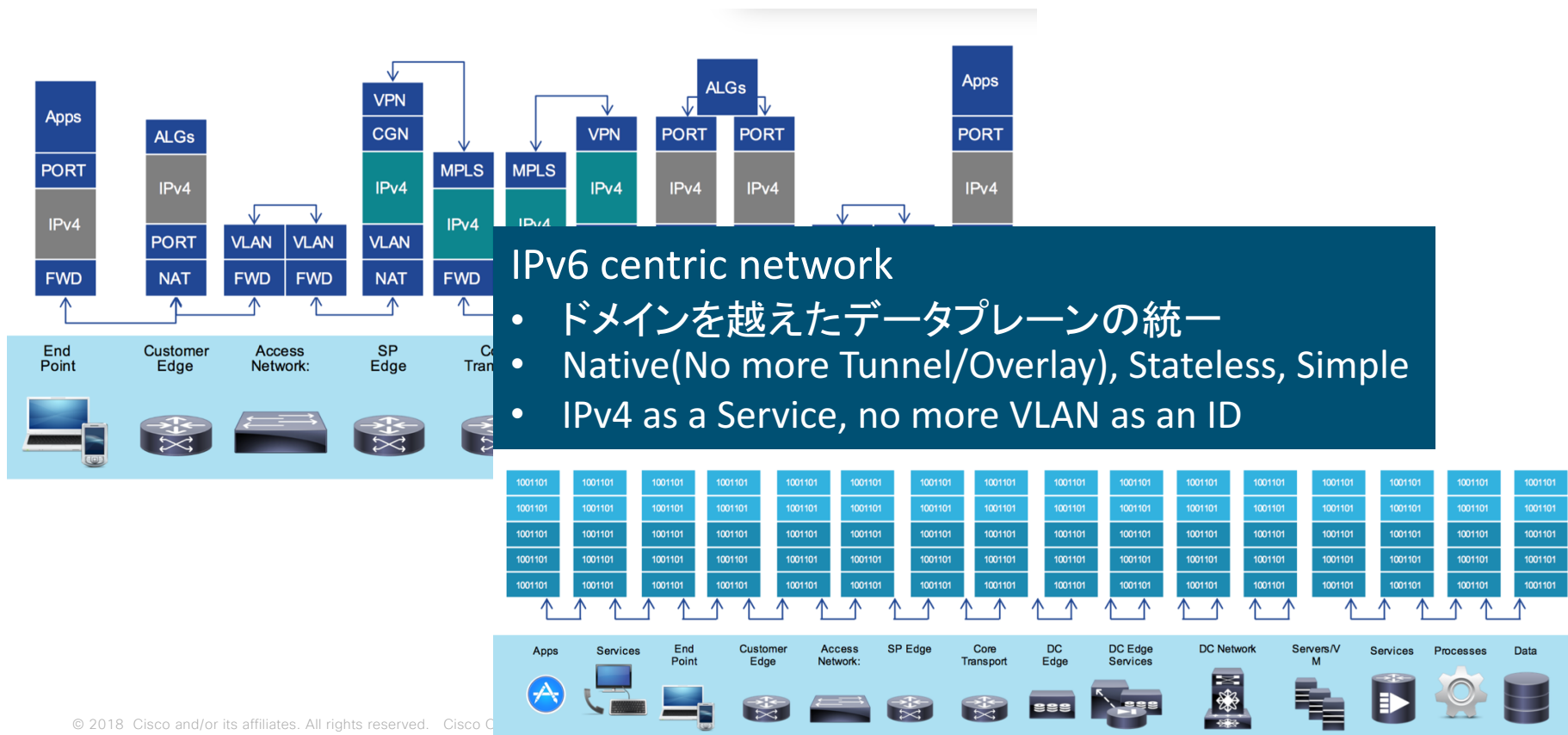Integrated Modelへの批判：
- Underlay InfraがIPv6に限られてしまう！

hICN Insertions Points（例）

Origin Server

Partner Content

CS CS CS

Origin Server

SP Content

CS CS CS

VCP-Edge for Compute
Resources
PGW for CP
V6 only APN for hICN

Compute Resources
CUPS extends PGW-UP
to CRAN
V6 only hICN APN

Peer

Peer

Wireless Access

HICN-Proxy

6VPE

6VPE

IPv4 Core

6VPE

6VPE

HICN Clients
IPv6

RRH

RRH

RRH

CS CS

HICN-F

BBU   CSR

EBH

CS CS

HICN-F

CP

UP

vPC

eNSE

Producer   CS

HICN-Producer

VCP-Core for
compute resources

**hICN
Domain**

**IPv6 Domain
(over IPv4!!)**

**hICN
Domain**

IPv6 centric networkへ

IPv6 centric network
- ドメインを越えたデータプレーンの統一
- Native(No more Tunnel/Overlay), Stateless, Simple
- IPv4 as a Service, no more VLAN as an ID

まとめ

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