Flow/Path Programmability

アプリケーションの要請に応える転送プレーンをプログラムする

29 Oct. 2013

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Agenda

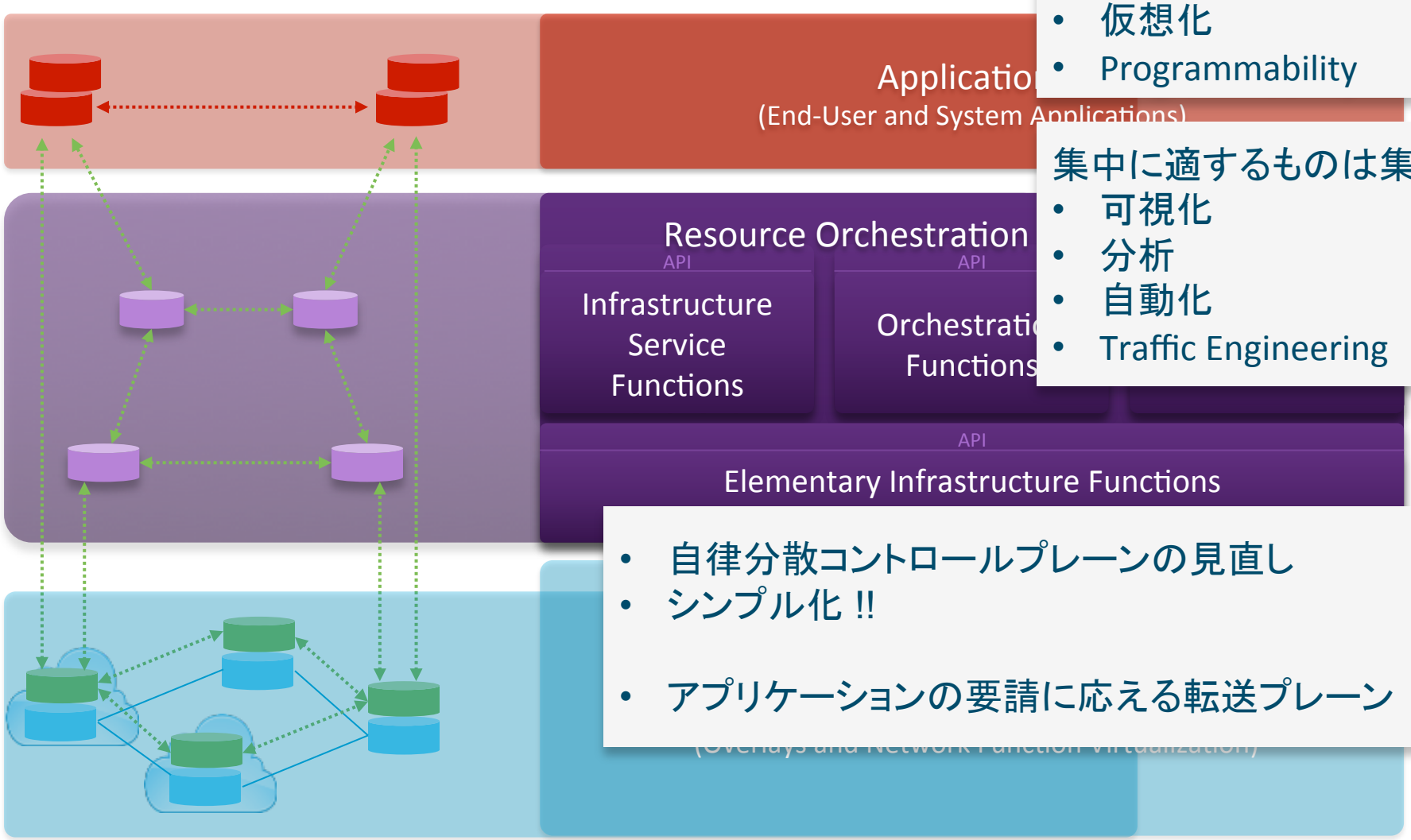
- *Introduction*
- Flow/Path Programmabilityを実現する技術例

  Segment Routing

  Service Chaining

  Policy-aware forwarding
- “Orchestrative” Architectureに向けて

背景 – ここ数年のSDN議論



- 抽象化
- 仮想化
- Programmability

集中に適するものは集中

- 可視化
- 分析
- 自動化
- Traffic Engineering

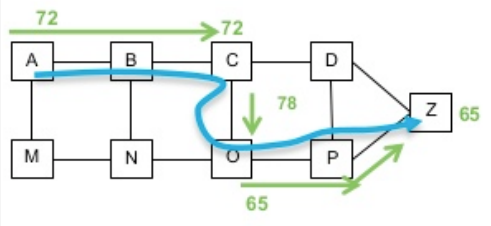
- 自律分散コントロールプレーンの見直し
- シンプル化 !!

- アプリケーションの要請に応える転送プレーン

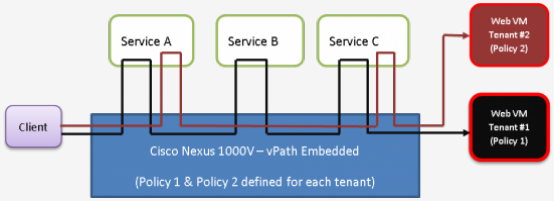
Applicationの要請に応える転送プレーン

- できるだけシンプルに
- 必要な価値を提供する

Segment Routing

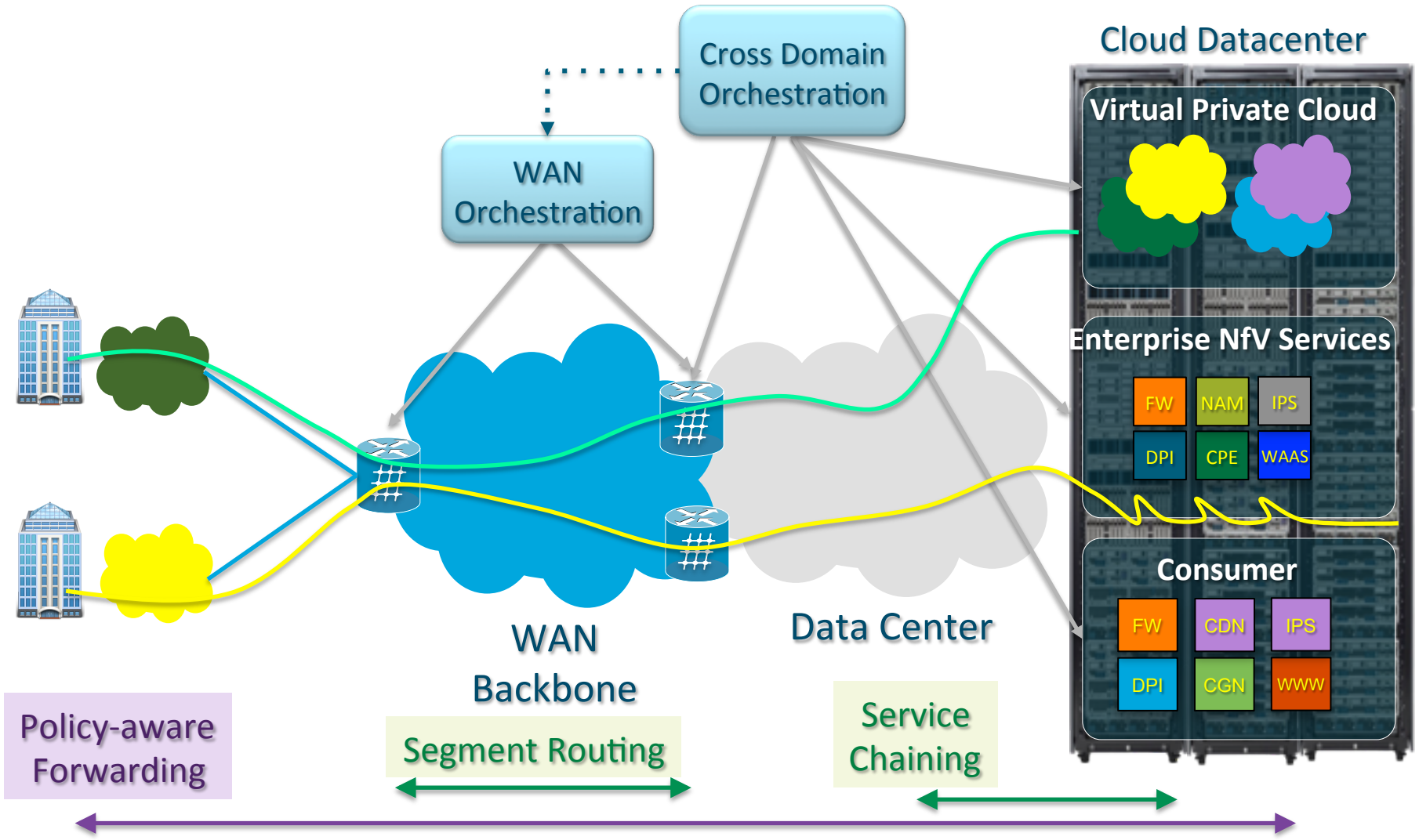


Network Service Chaining



Policy-aware forwarding

“Orchestrative” Architecture



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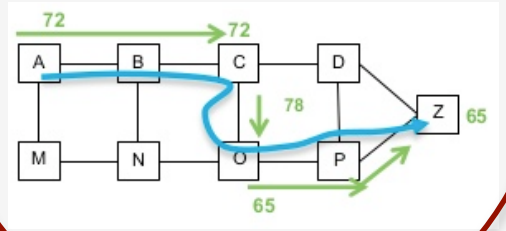
- Introduction
- *Flow/Path Programmabilityを実現する方式例*
  - Segment Routing
  - Service Chaining
  - Policy-aware forwarding
- “Orchestrative” Architectureに向けて

Applicationの要請に応える転送プレーン

Segment Routing



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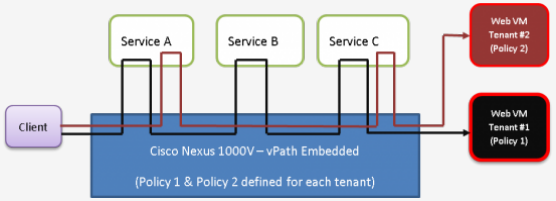
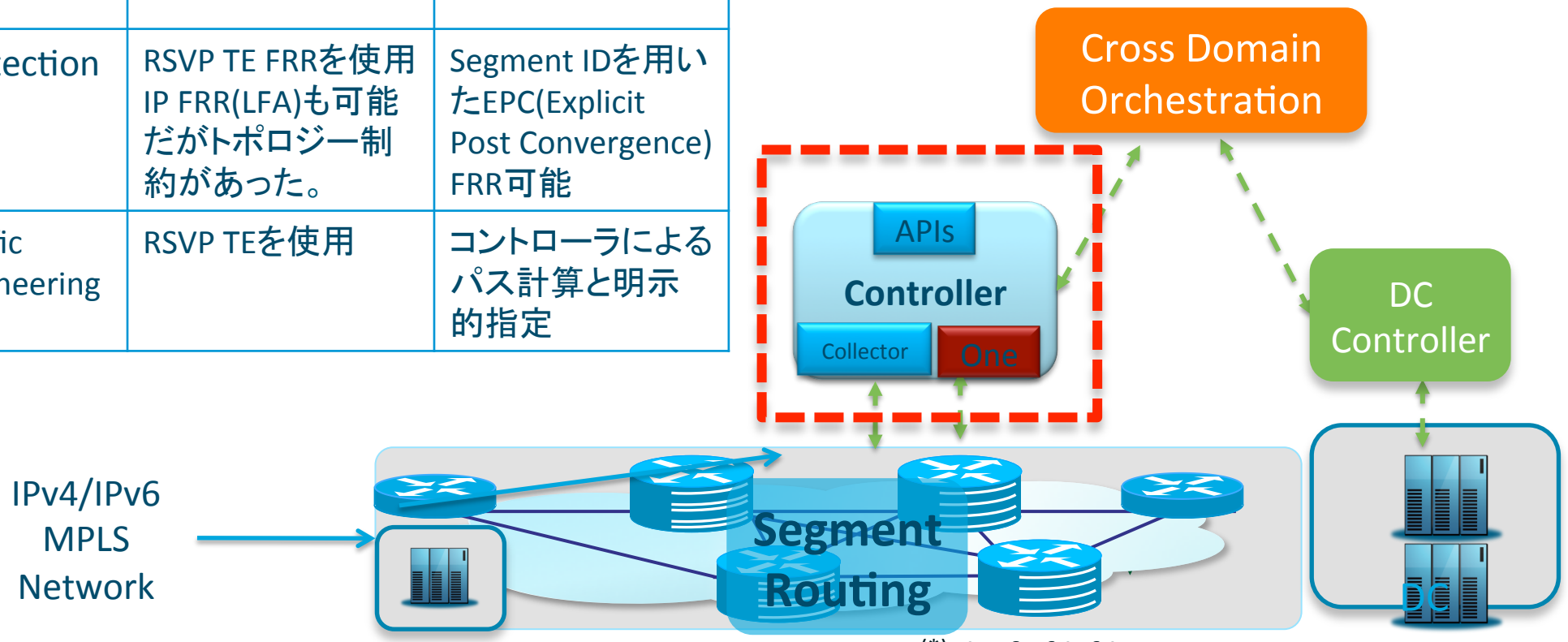


Policy-aware forwarding

Segment Routing おさらい

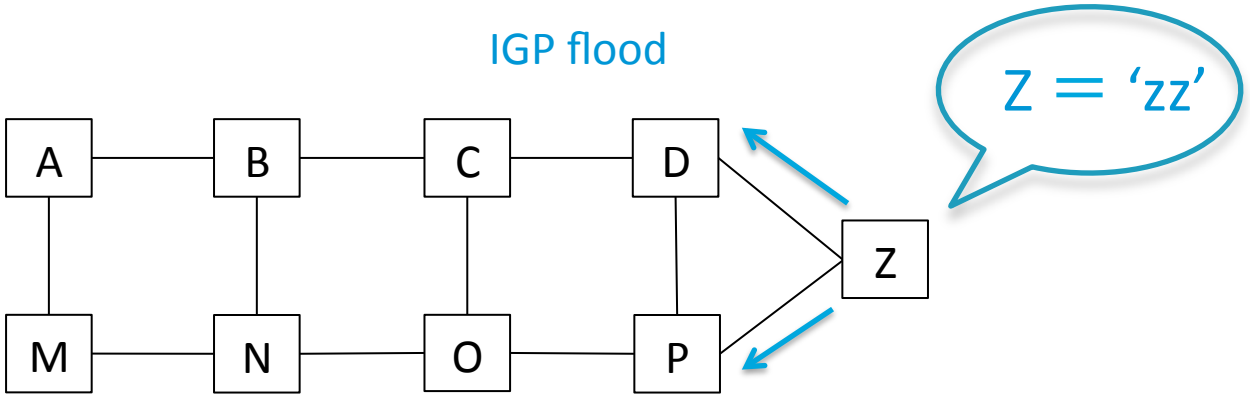
	MPLS	Segment Routing
転送ヘッダ	LDPやRSVPによりLabelを配布	IGPによりSegment IDを配布
Protection	RSVP TE FRRを使用IP FRR(LFA)も可能だがトポロジー制約があった。	Segment IDを用いたEPC(Explicit Post Convergence) FRR可能
Traffic Engineering	RSVP TEを使用	コントローラによるパス計算と明示的指定

- RSVP，LDPは不要
- ネットワーク内のステートが大幅に減少
- ApplicationやOrchestrationと容易に連携



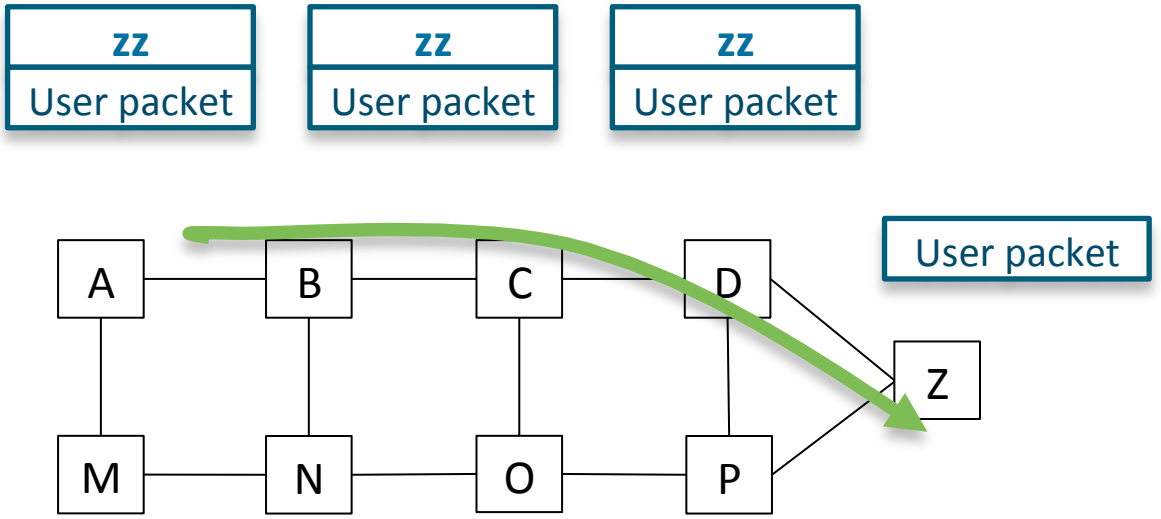
(*) draft-filsfils-rtgwg-segment-routing-00

Segment Routing – 基本動作



- 各ノードは自分のSegment IDを、IGPにより広報する
  - OSPFの場合、opaque LSAを使用 (draft-psenak-ospf-segment-routing-extensions)
  - 2種類のSegment ID
    - Node Segment ID (Node-SID) : ノードへのbest pathを表す
    - Adjacency Segment ID (Ajd-SID) : インタフェースへのone hop path

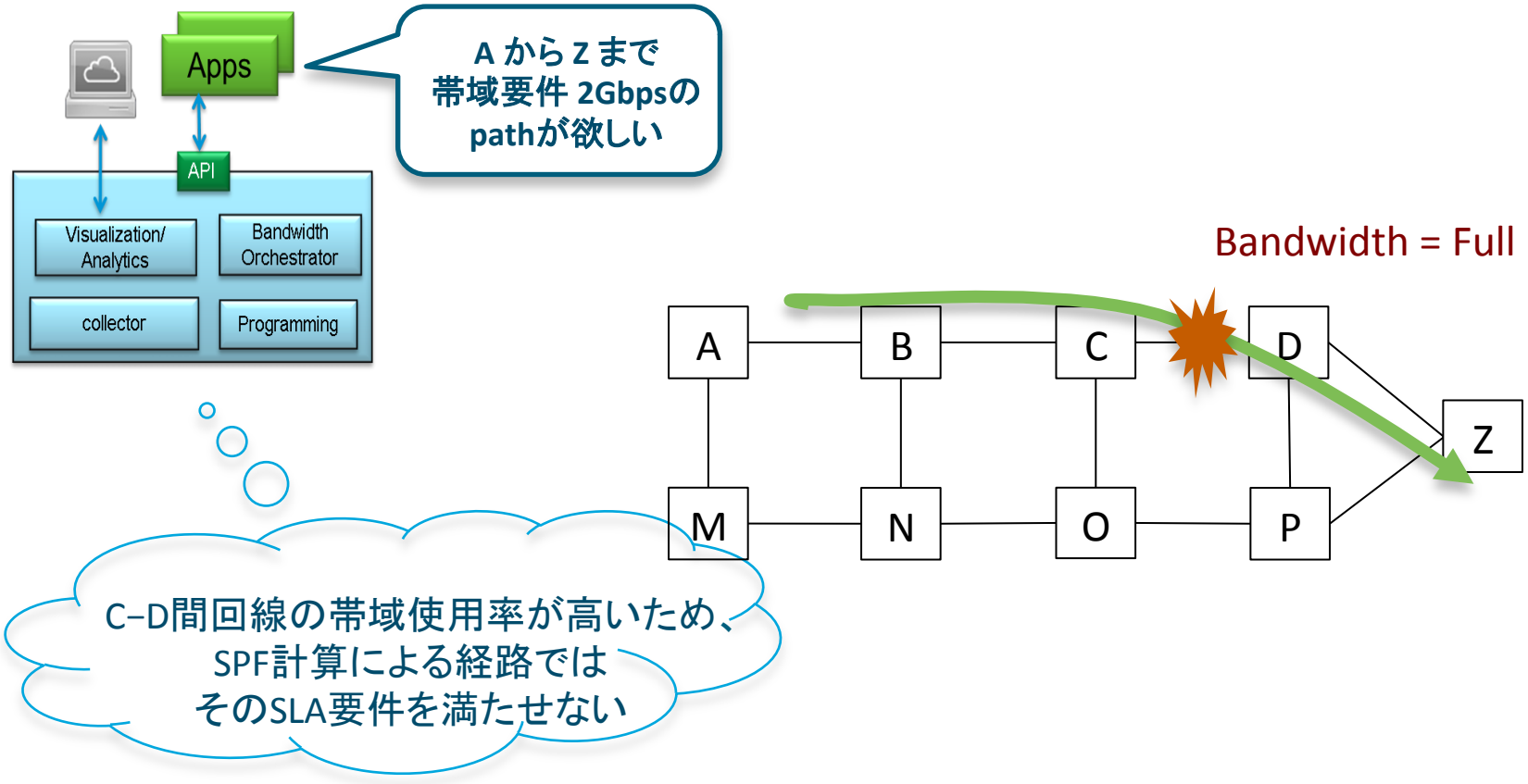
Segment Routing – 基本動作



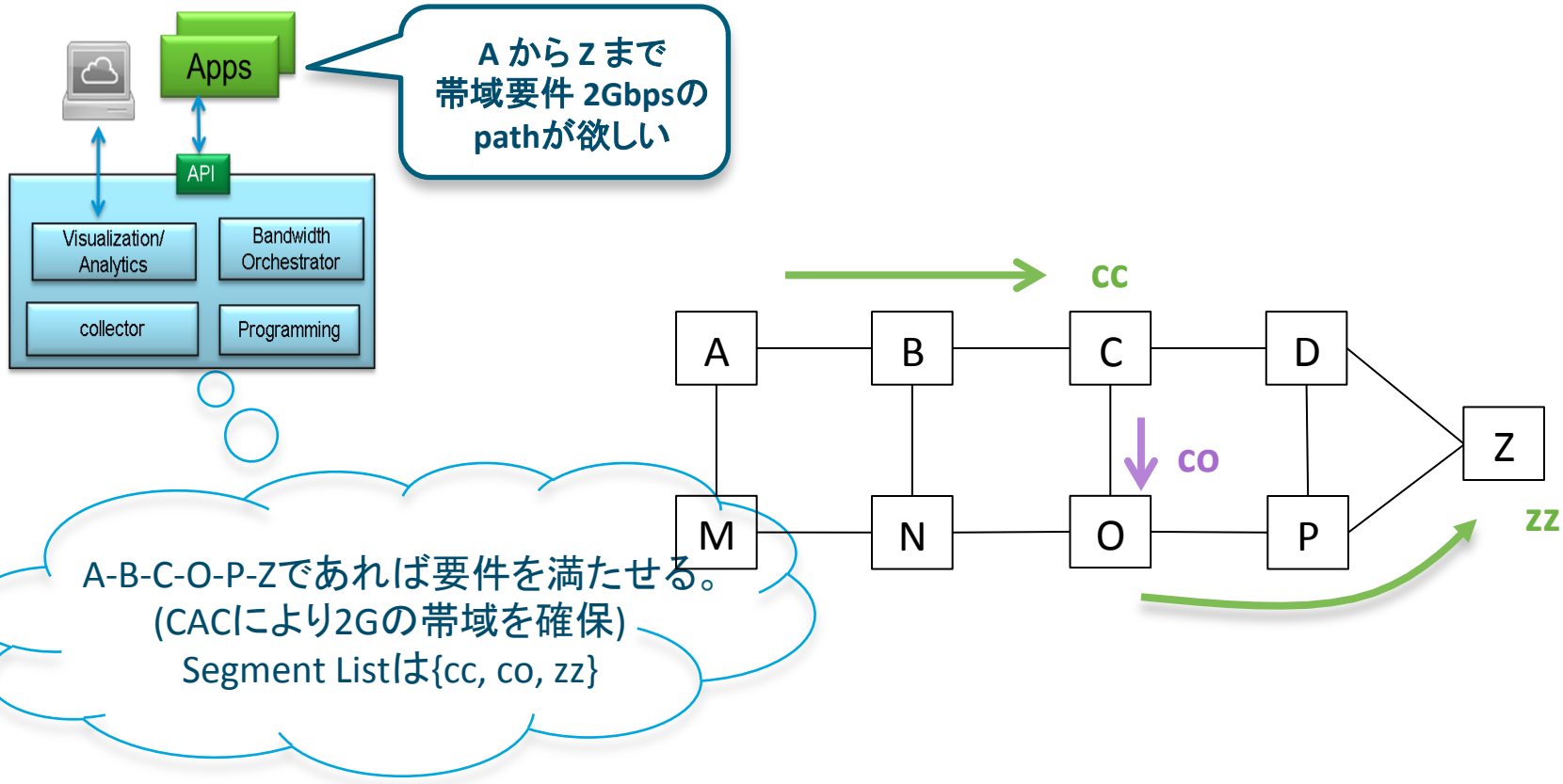
- ノードZを宛先とするパケットには、zzをつけて転送する

(Segment ID=global significant <-> c.f. MPLS Label = local significant)

Segment Routing – Controllerによる制御

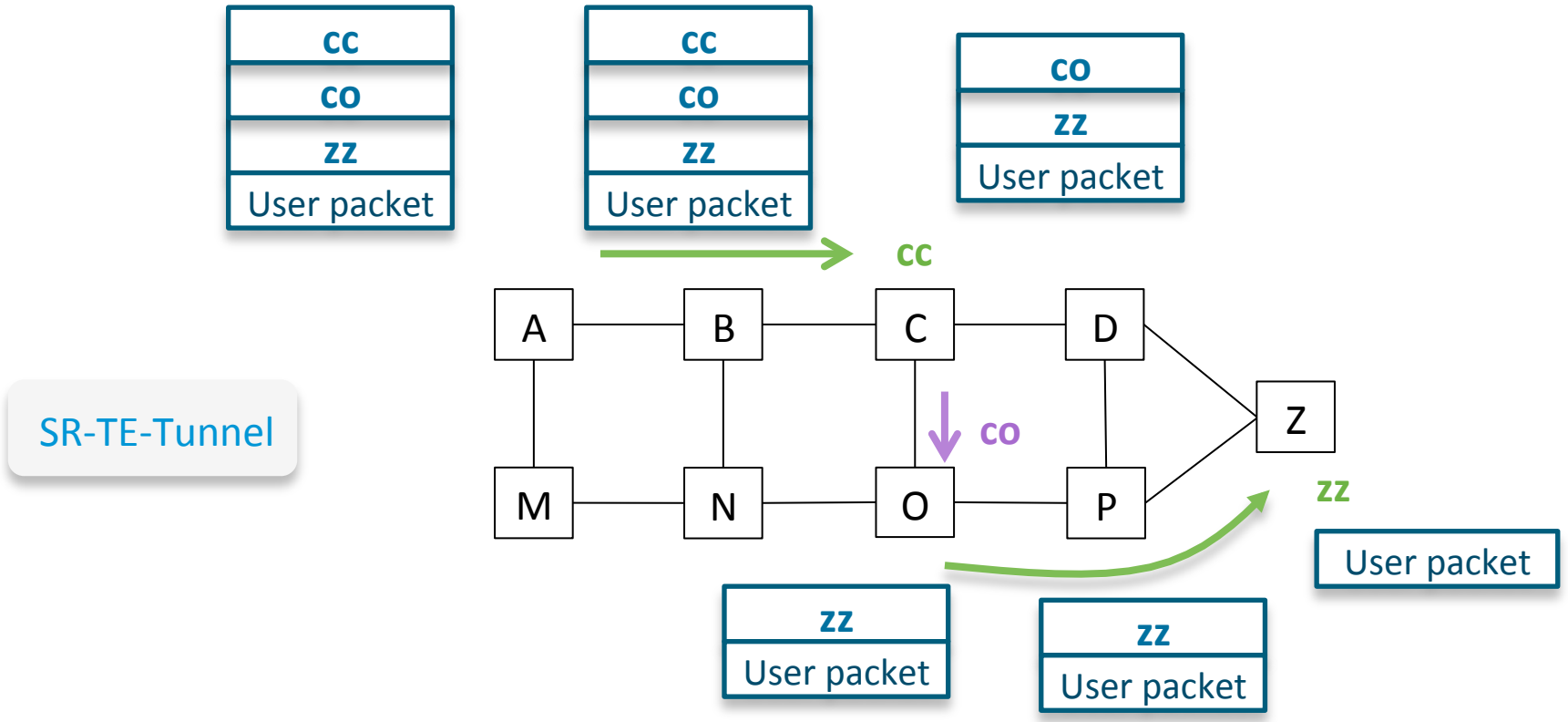


Segment Routing – Controllerによる制御



- Controller
  - そのSLA要件を満たすパスを発見する
  - NodeおよびAdjacency Segmentのリストをencodeする

Segment Routing - Source Routing

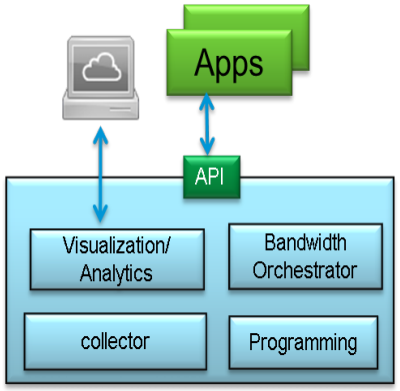


- SourceにてHeader Stackを生成し、パケットを送出する

  Pathは、Segment idのStackとして表現される。(転送ヘッダ == Label, IPv6 data planeも可)

- 中継ノードはヘッダーに応じてforwarding、RSVP stateを持つ必要がない

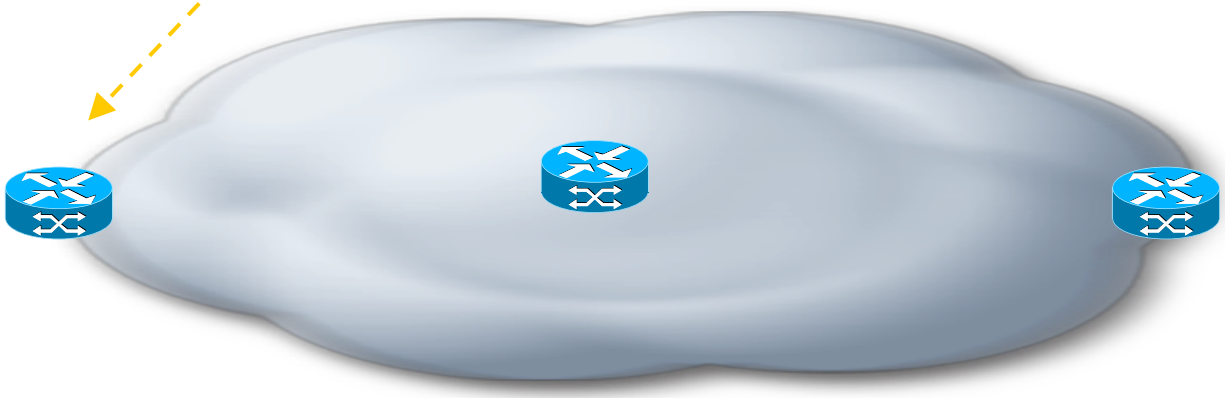
Controller : PCEP Capability Negotiation



SR Cap TLV in PCEP
Open message

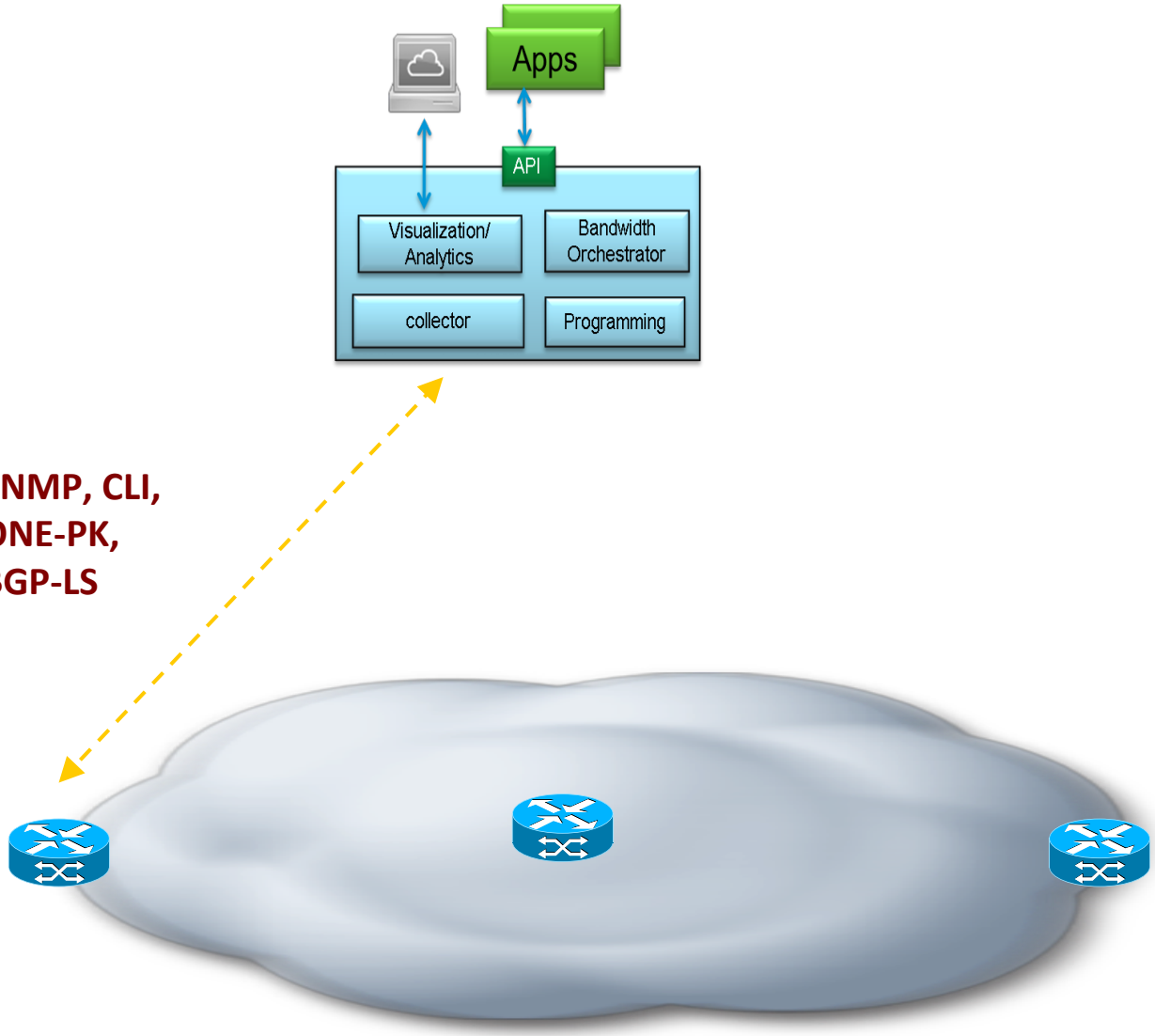
```
 0                   1                   2                   3
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|           Type= TBD           |            Length=4           |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                               Flags                           |R|I|S|U|
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Figure 1: STATEFUL-PCE-CAPABILITY TLV format



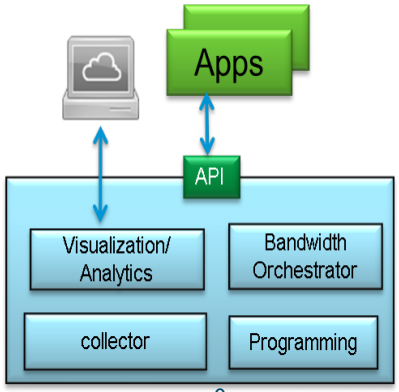
draft-sivabalan-pce-segment-routing

Controller : Topology Information Gathering



BGP-LS : draft-ietf-idr-ls-distribution

Controller : Stateful PCEP



PCCreate
PCRpt
PCUpdate

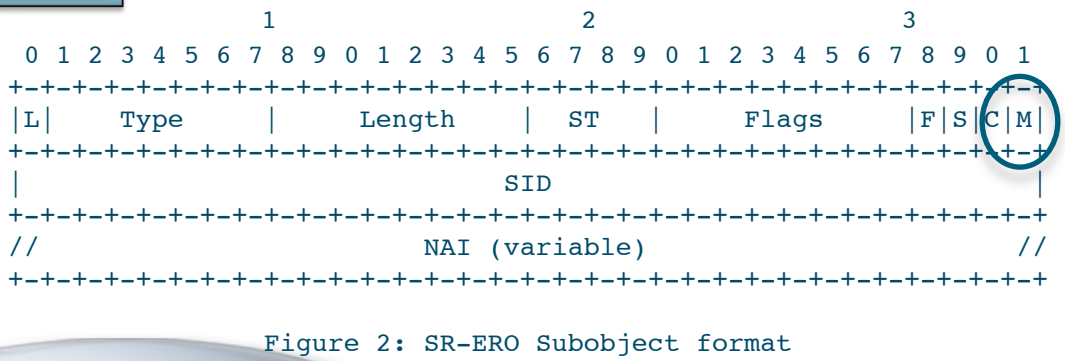


Figure 2: SR-ERO Subobject format

ST: Segment ID type
SID: Segment ID
NAI: Node or Adjacency Information (IPv4/v6)

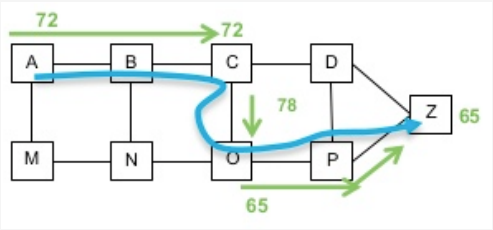
IETF drafts

- Architecture (draft-filsfils-rtgwg-segment-routing)
- Use-Case (draft-filsfils-rtgwg-segment-routing-use-cases)
- ISIS extension for SR (draft-previdi-isis-segment-routing-extensions)
- OSPF extension for SR (draft-psenak-ospf-segment-routing-extensions)
- FRR with SR (draft-francois-sr-frr)
- PCEP extension for SR (draft-sivabalan-pce-segment-routing)
- Performance Engineered LSP using SR (draft-shakir-rtgwg-sr-performance-engineered-lsps)

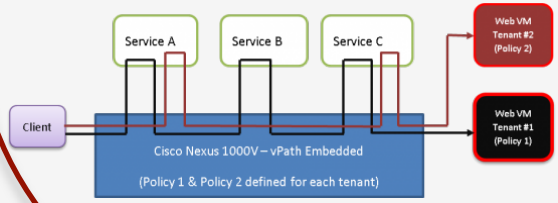
http://www.segment-routing.net/

Applicationの要請に応える転送プレーン

Segment Routing

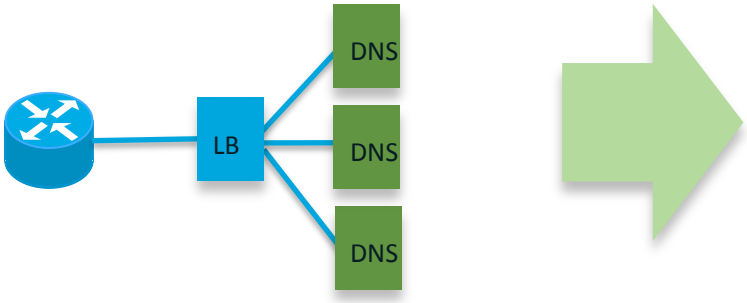


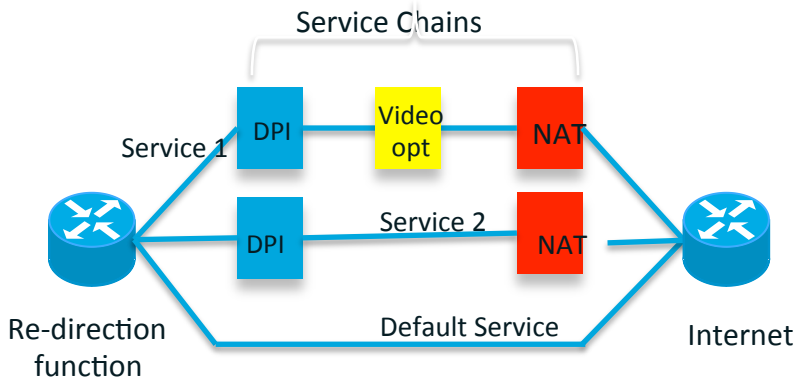
Network Service Chaining



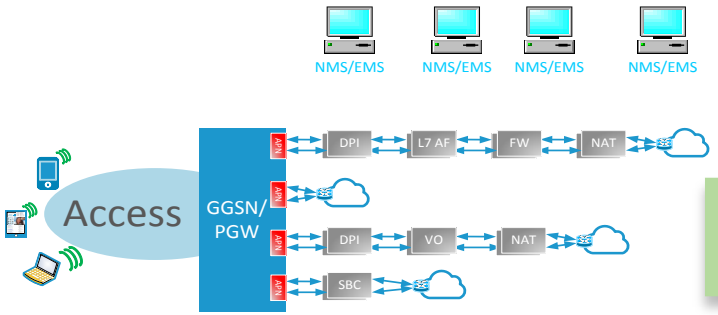
Policy-aware forwarding

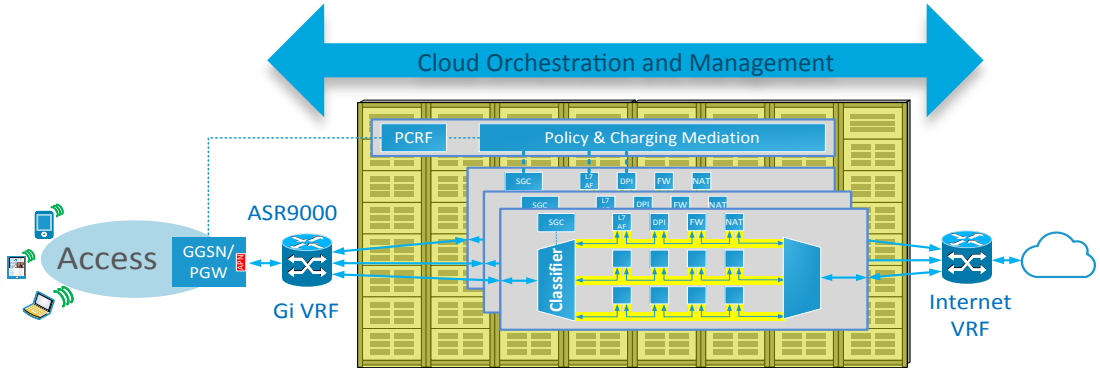
Problem Definition





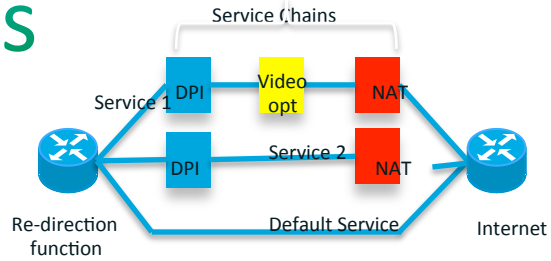
- Simple
- Complicated (per-subscriber, per-app)





- Physical, Static
- Virtual, Dynamic

Service Chain Data Plane Components



Traffic Classifier	• トラフィックの識別 • サービスパスの生成 • NSH(Network Service Header)の挿入
Service Functional Chain / Service Chain	• 選択されたトラフィックに対し、適用されるサービス機能の連なり
Service Path	• Service Chainに従ってデータを転送するための転送パス • 一連の”Service Hop”から構成される
Overlay	• Service Pathによって使用される論理ネットワーク(tunnel)

draft-quinn-sfc-arch-02

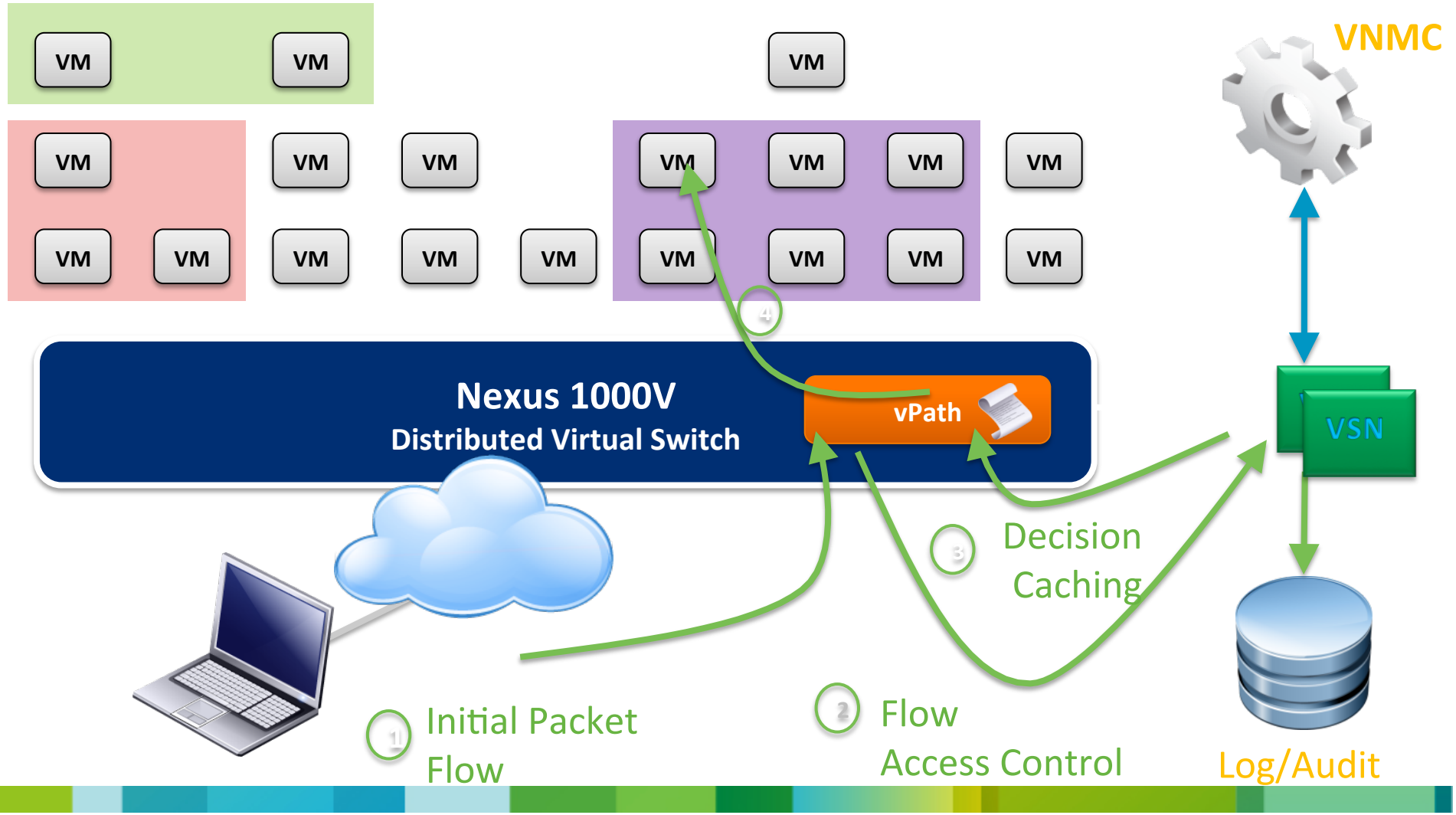
Service Path

	Service A	Service B	Service C	…	Destination
Group (1)	○	○	—		Internet
Group (2)	—	○	—		Internet
Group (3)	—	—	—		Private-i
Group (4)	○	—	○		Private-ii
…					

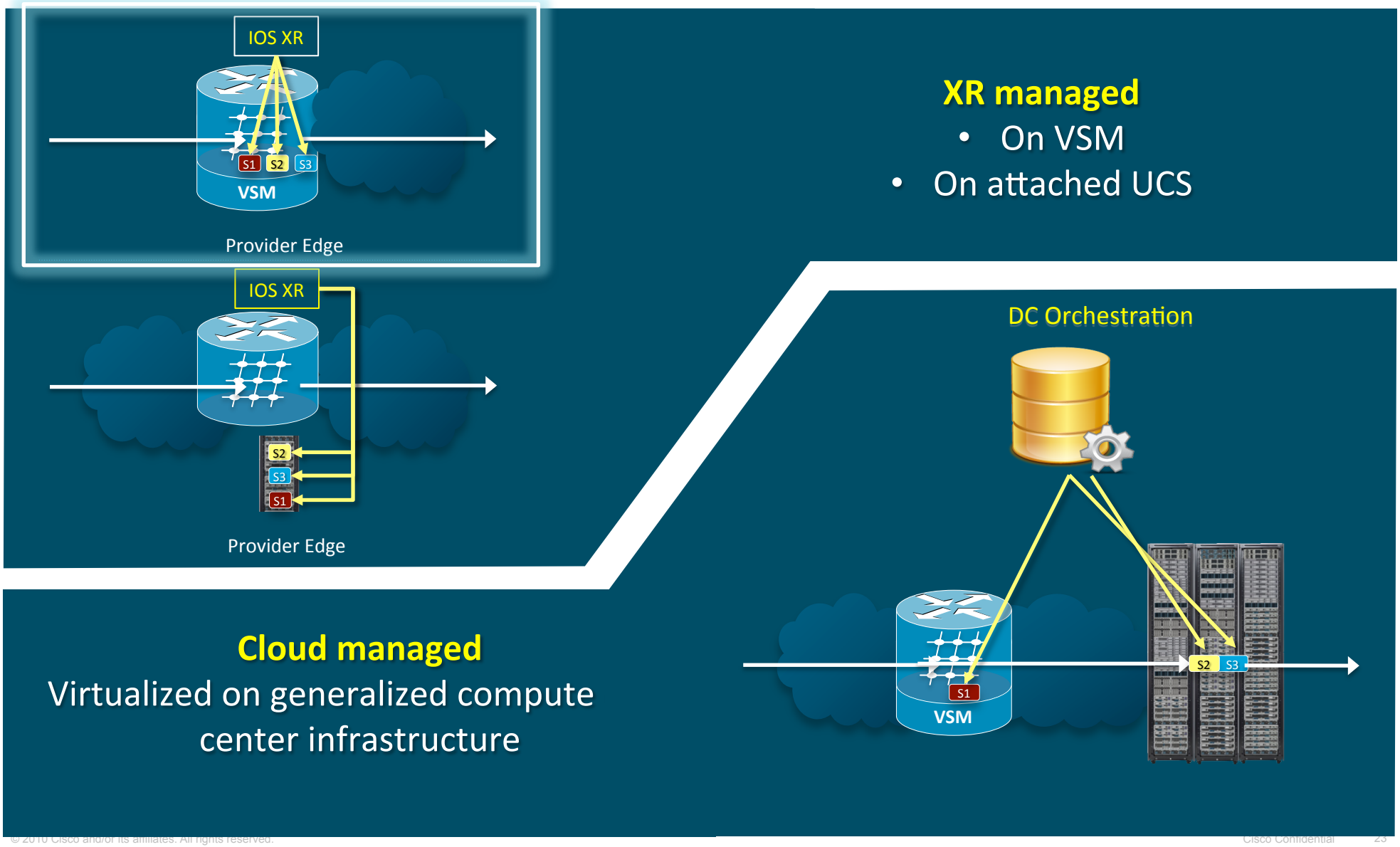
- 加入者（グループ）毎、アプリケーション毎、等によりClassificationを行う

  e.g.
  - あるユーザグループはParental Control(URL filtering)対象
  - HTTP (TCP port = 80) request はcacheを通す

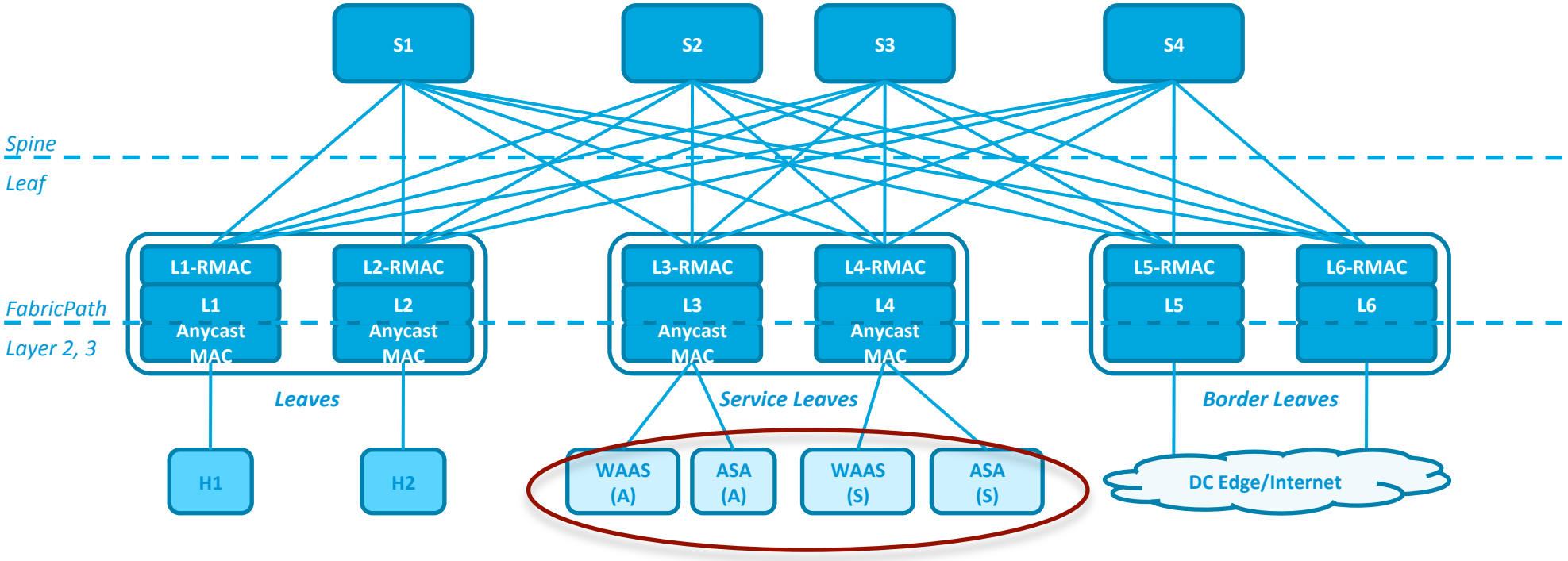
(1) 仮想スイッチ(N1Kv)によるService Chaining



(2) WAN Gateway (e.g. ASR9k)によるService Chaining

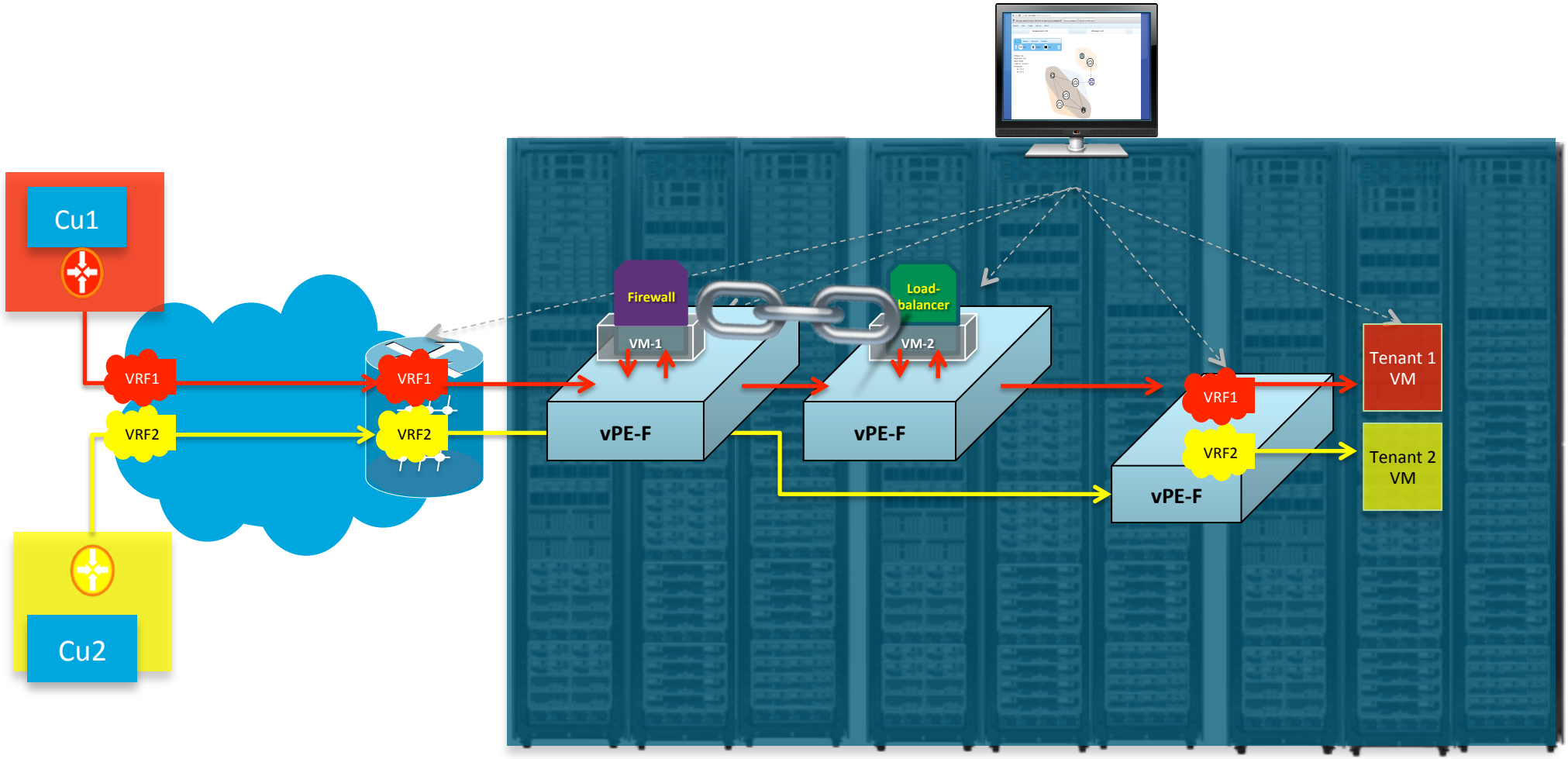


(3) Data Center FabricにおけるService Chaining

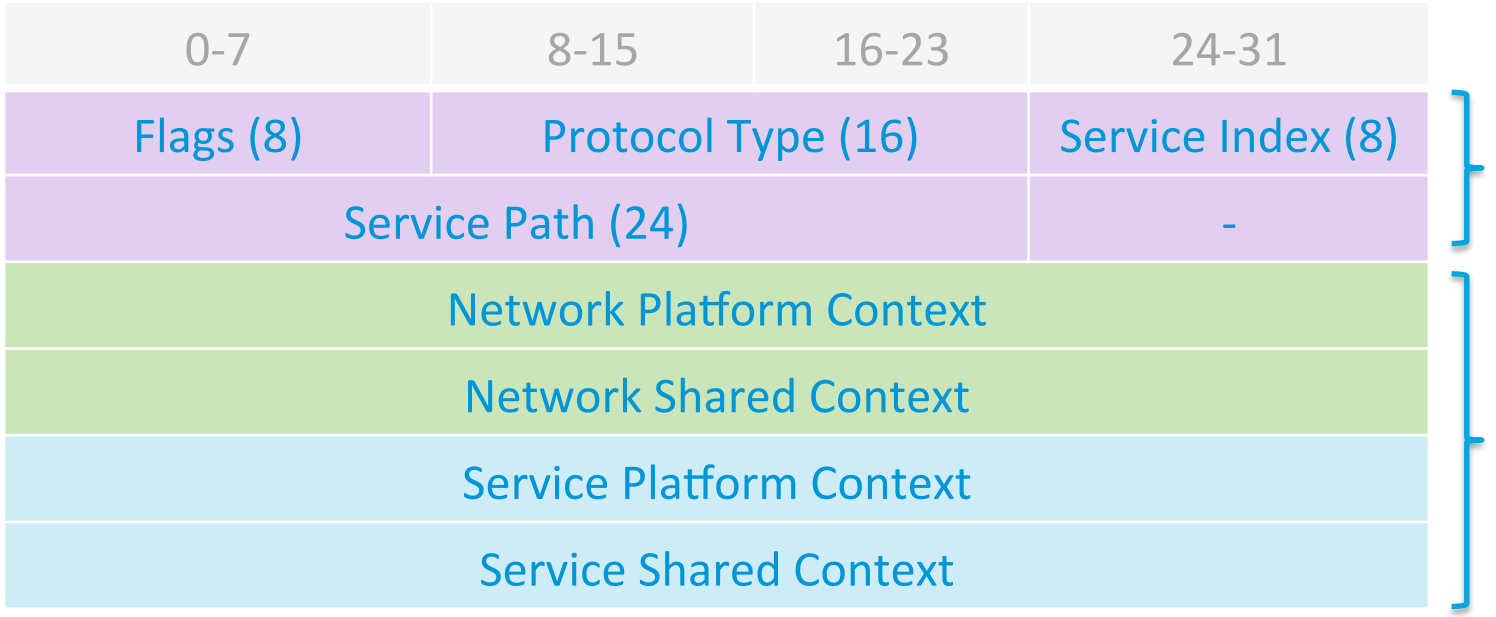


*Vinci phase 1 implementation

(4) VPC(Virtual Private Cloud)とService Chaining



Network Service Header



- Transport Independent
- Fixed Length (32 bit * 6)
- Meta data sharing for various purpose

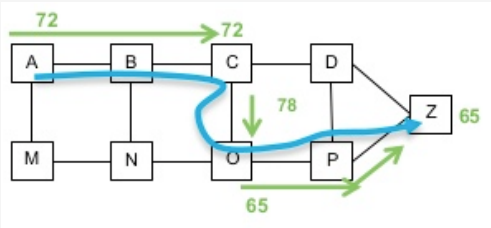
draft-quinn-nsh-01

IETF drafts

- Network Service Chaining Problem Statement, (draft-quinn-nsc-problem-statement-00)
- Architecture, (draft-quinn-sfc-arch-00)
- Framework, (draft-boucadair-sfc-framework-00)
- Common Metadata Header Format for IP/MPLS Networks, (draft-guichard-metadata-header-00)
- Carrying Metadata in MPLS Networks, (draft-guichard-mpls-metadata-00)
- Carrying Metadata in IP Networks, (draft-bryant-ip-metadata-00)
- Differentiated Network-Located Function Chaining Framework (draft-boucadair-network-function-chaining-02)
- Virtual Topologies for Service Chaining in BGP IP VPNs, (draft-rfernando-l3vpn-service-chaining-01)
- Generic Protocol Extension, (draft-quinn-vxlan-gpe-00 | draft-lewis-lisp-gpe-00)

Applicationの要請に応える転送プレーン

Segment Routing



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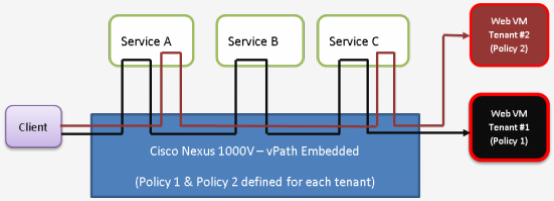
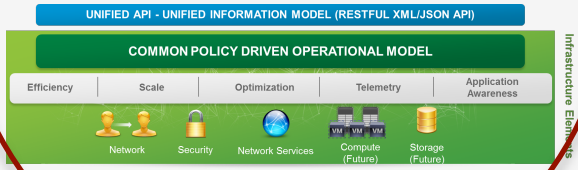
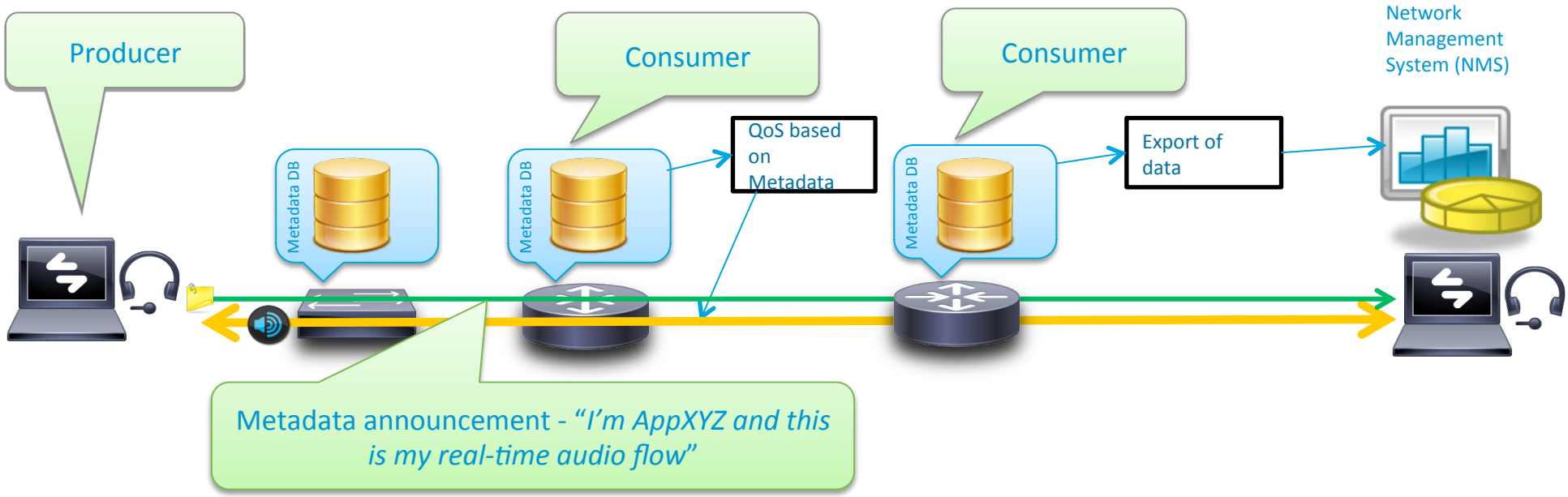


Policy-aware forwarding

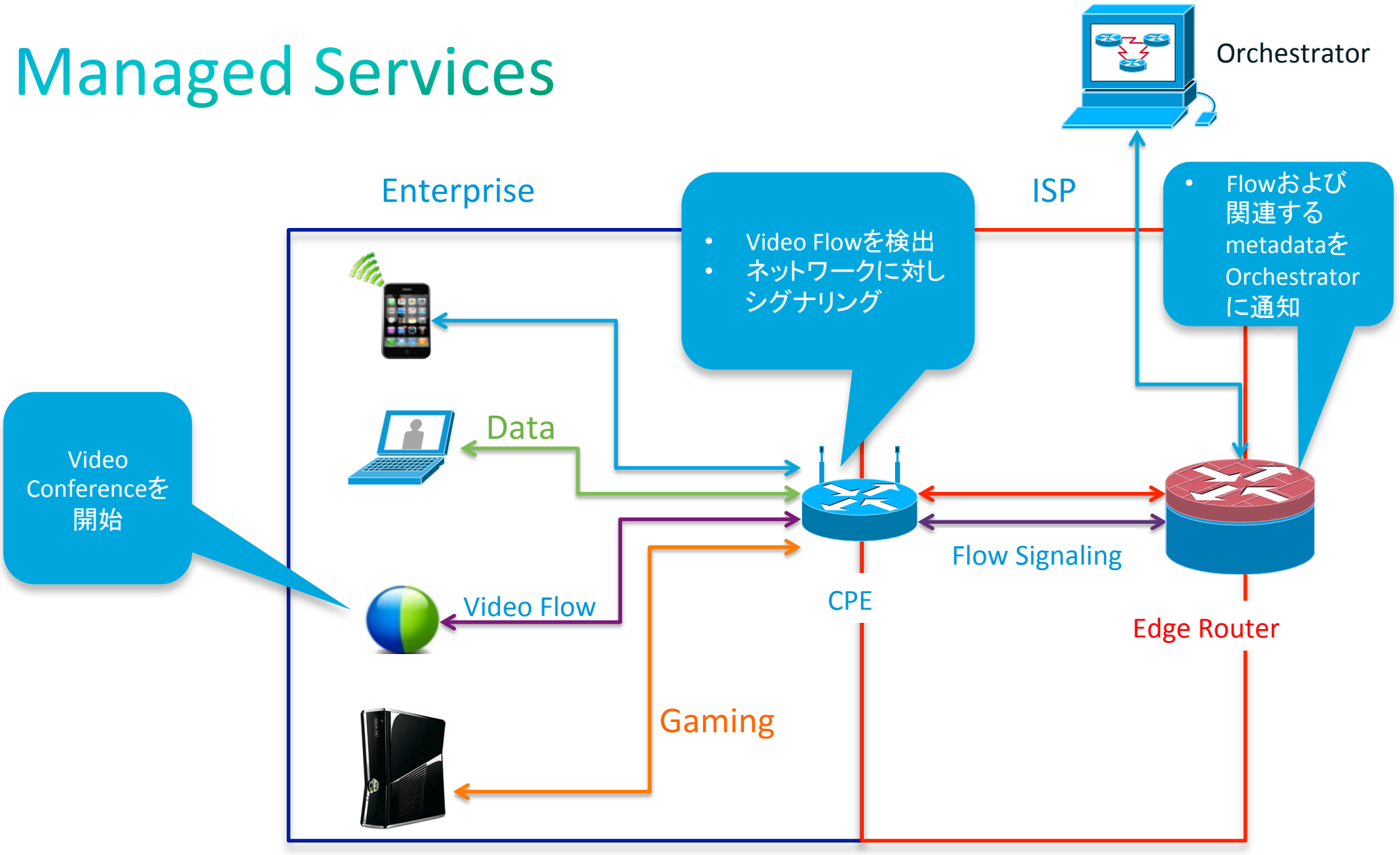


Flow Metadata を運ぶ
for QoS & Management

- Producer: flow metadataを生成する人
- Consumer: flow metadataを使う人
- Flow DataBase: flow attribute informationの維持・管理



Managed Services



IETF drafts

- draft-eckert-intarea-flow-metadata-framework :
  - framework to communicate information elements (a.k.a. metadata) in consistent manner between apps and network
  - better visibility of application flows
  - means to differentiated treatment of those flows

- draft-choukir-tsvwg-flow-metadata-encoding :
  - protocol independent encoding for flow metadata

- Information elements conveyed using various signaling protocols:
  - PCP (draft-wing-pcp-flowdata)
  - RSVP (draft-zamfir-tsvwg-flow-metadata-rsvp)
  - STUN (draft-martinsen-mmusic-malice)
  - Others …

Agenda

- Introduction
- Flow/Path Programmabilityを実現する方式例

  Segment Routing

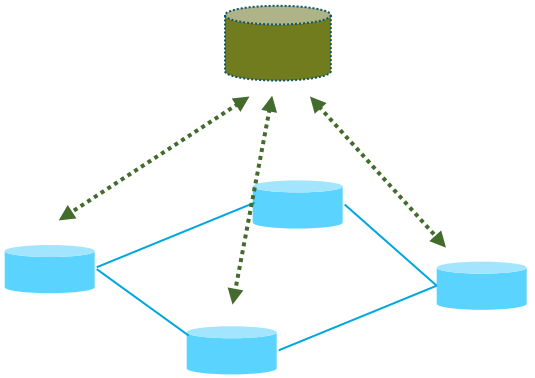
  Service Chaining

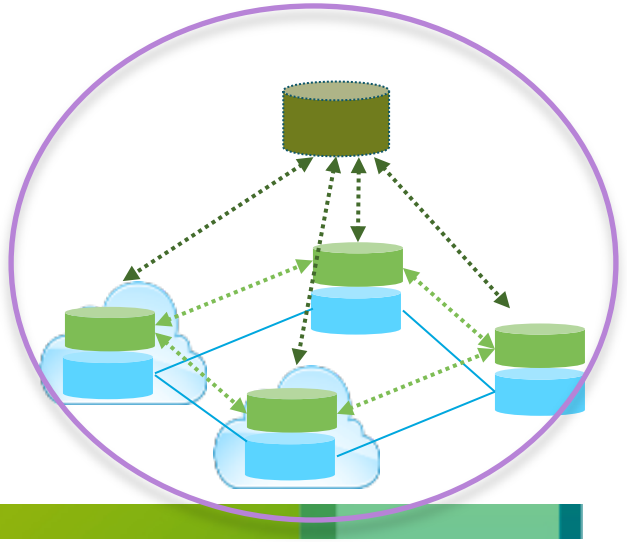
  Policy-aware forwarding
- *“Orchestrative” Architectureに向けて*

Orchestrationと自律分散

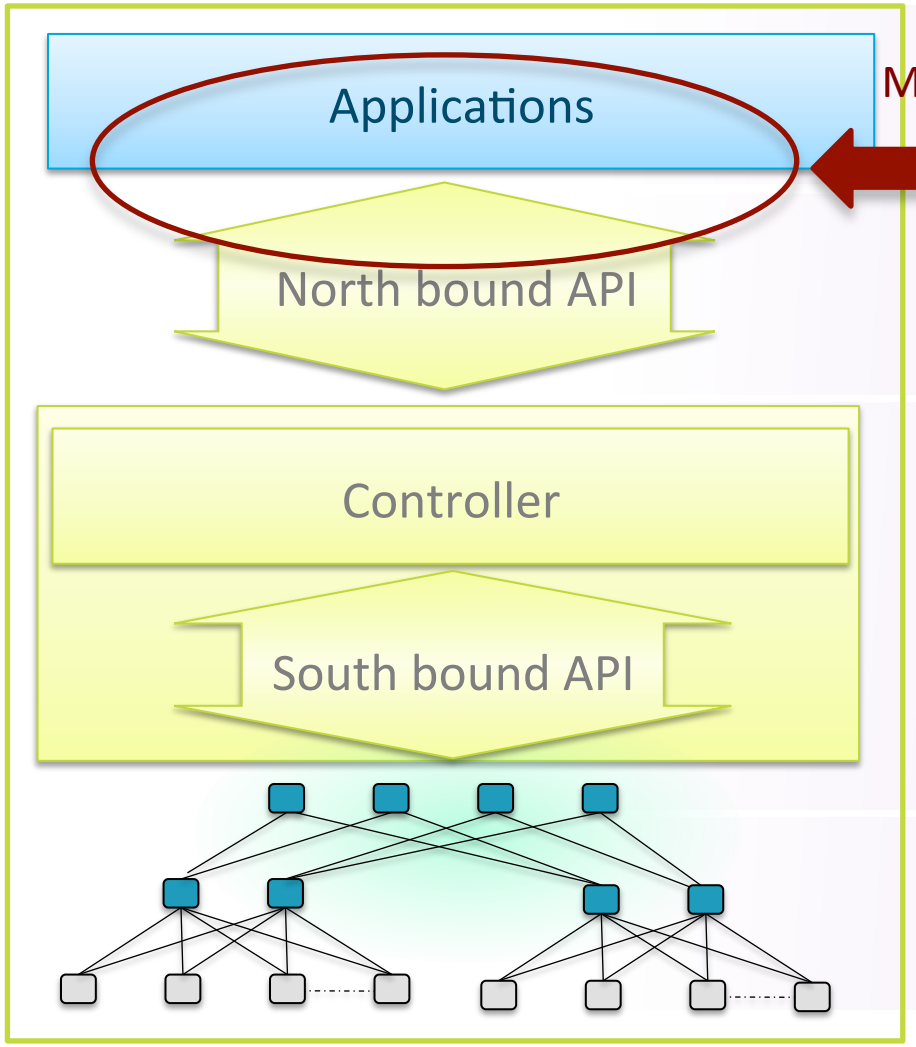
ControllerとOrchestrationを厳密に区別すると…

- Orchestrationの場合は、自律分散性との共存が前提
  - → 集中型intelligenceが適する物は集中で
    - 可視化、分析、
    - 自動化、Traffic Engineering
  - → 自律分散コントロールプレーンは残す
    - 障害検知、保護
    - Self Healing, Auto Discovery, LAG..
    - スケール性、頑強性





重要なのは、いかにアプリケーションの要請に応えるか



More Important

Orchestration, Application

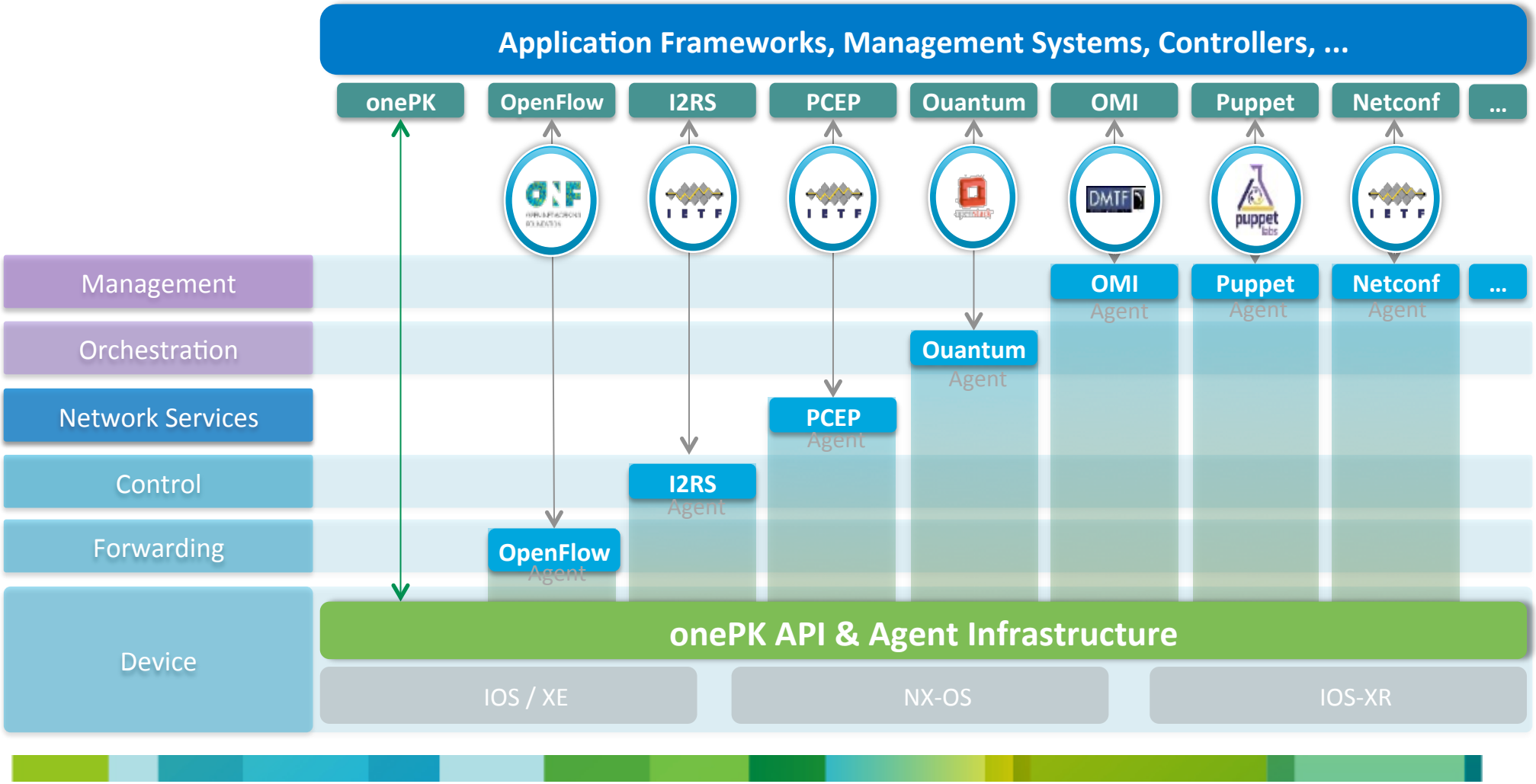
Northbound Interfaces

Advanced and Core Functions

Southbound interfaces

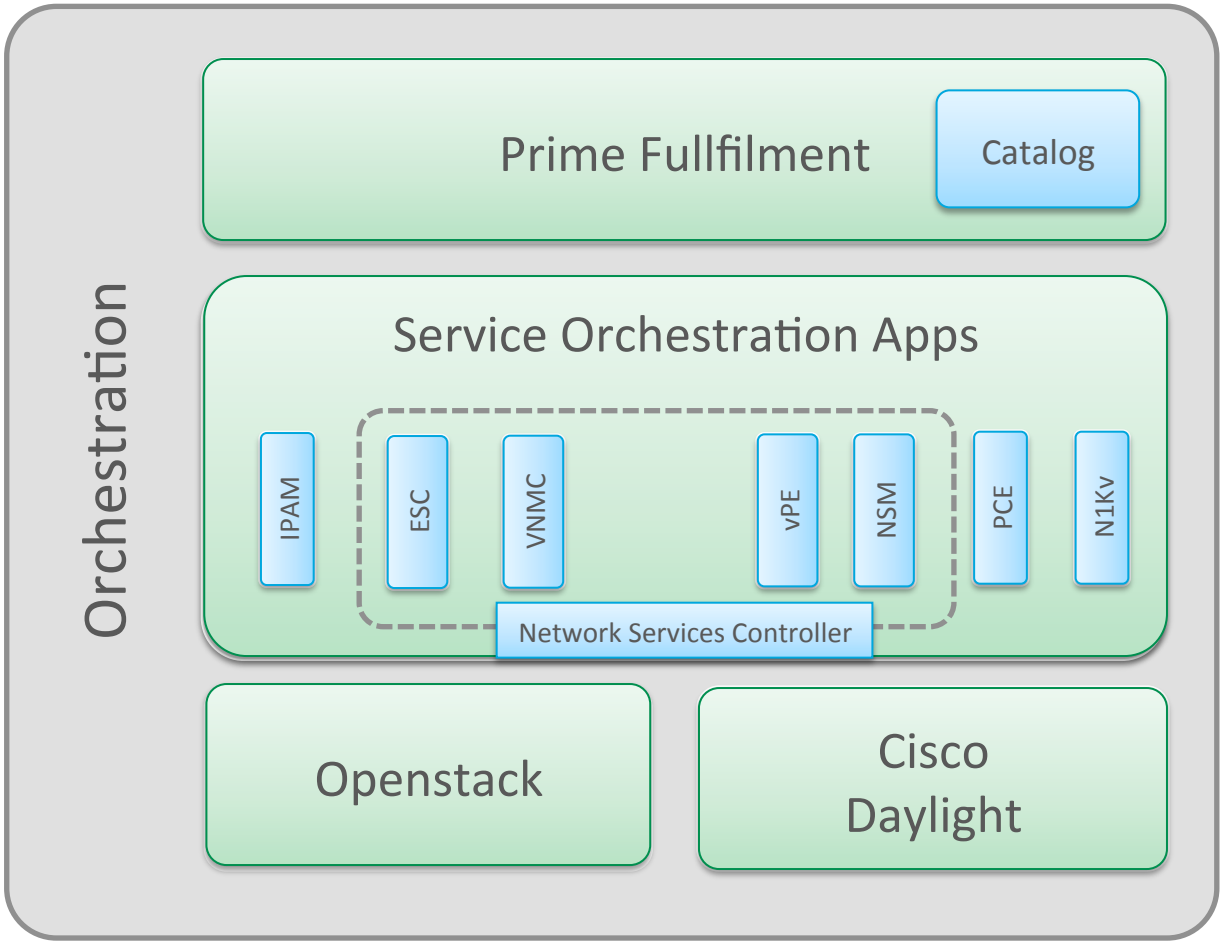
Network Infrastructure

South bound Protocolは適材適所で！



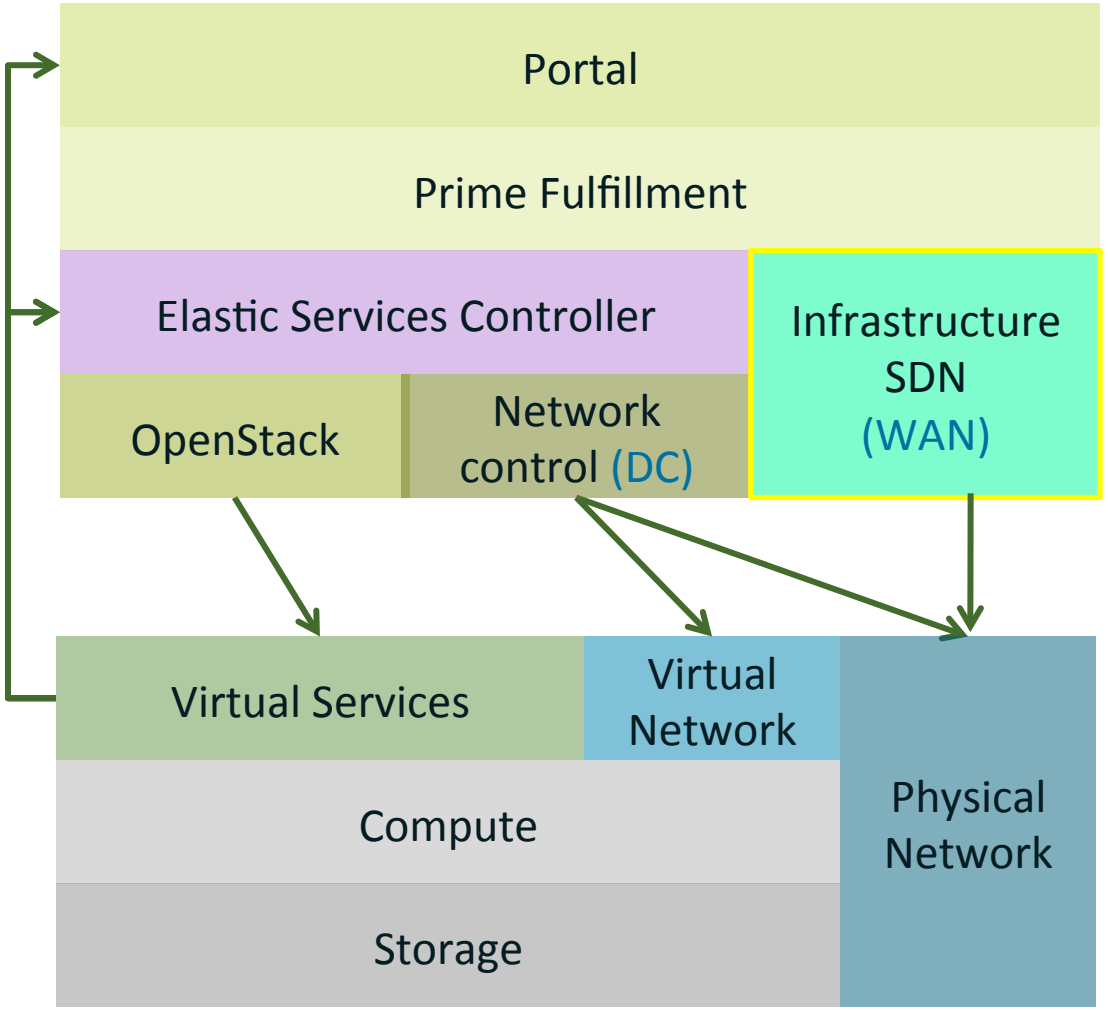
Orchestrationに求められること – Modularity, Openness

"Cisco Cloudshaper"



animated

SP Cross Domain Orchestration



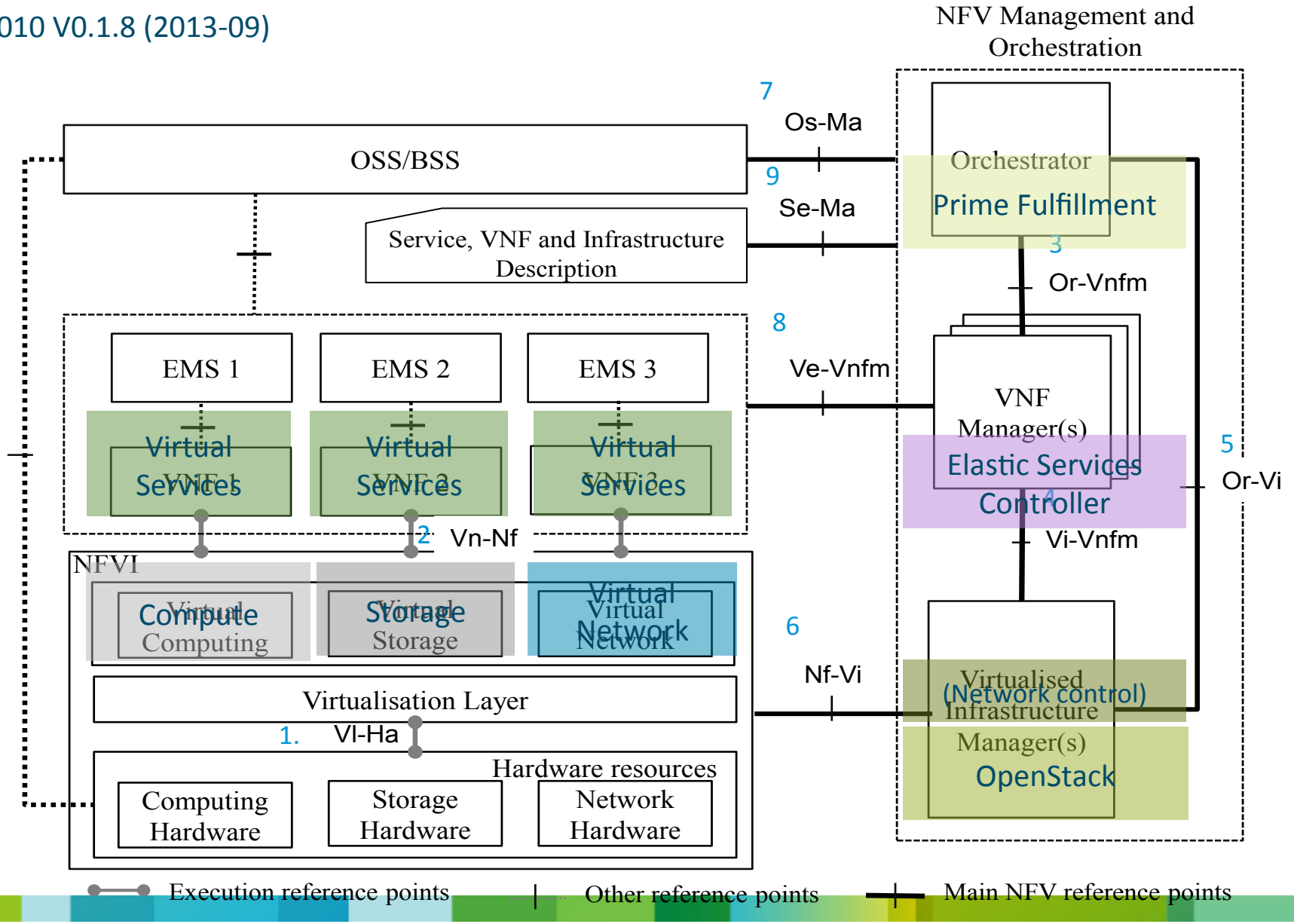
- Virtualized Service Workflow
- Application Workflow
- Design and Operation

- Orchestration & Monitoring
- Programmability

- Computing & Networking Resources
- HW & SW

NFV end-to-end reference architecture

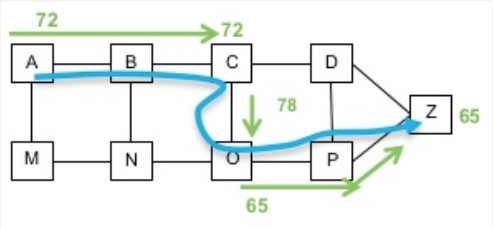
NFV-0010 V0.1.8 (2013-09)



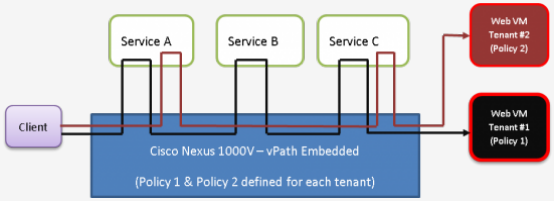
Applicationの要請に応える転送プレーン

- できるだけシンプルに
- 必要な価値を提供する (最適パス、metadata…)

Segment Routing



Network Service Chaining



Policy-aware forwarding

Overlayも重要！、Underlayも重要!!

Thank you !