



# JUNIPER对SDN的理解与实践

王卫

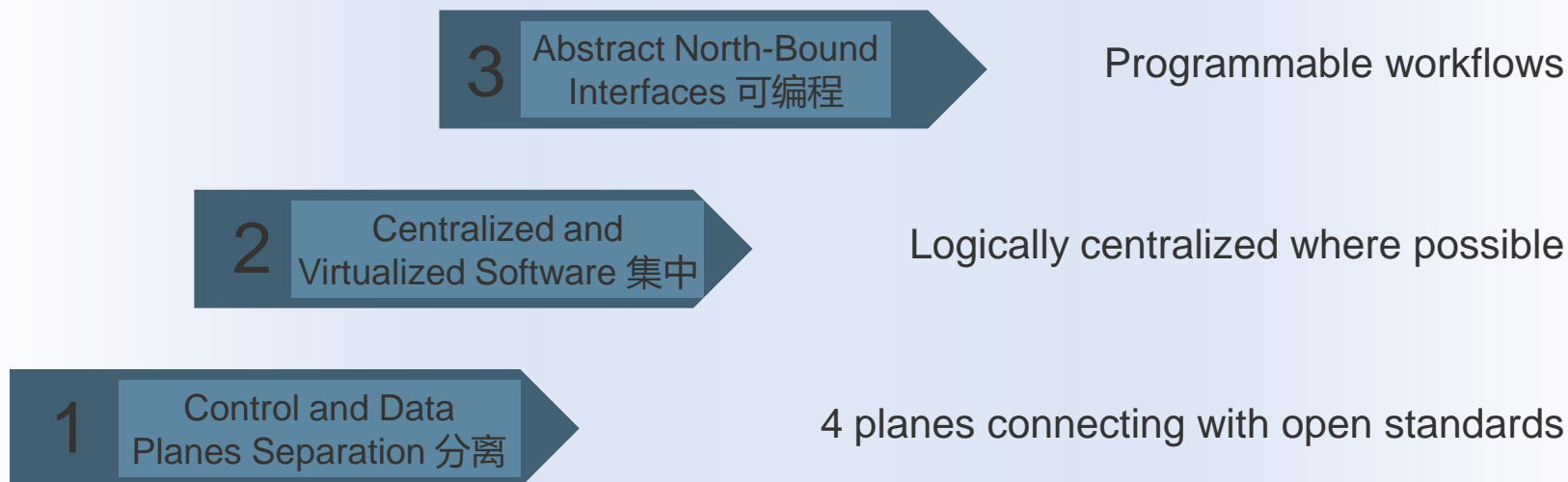
大中国区技术总监



# 瞻博认为 SDN是一种架构模式

SDN  $\neq$  APIs, Tools, Protocols or 

SDN's definition encompasses 3 elements (三个要素):



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# WE DO NEED SOME PROTOCOLS TO MAKE SDN COME TRUE 我们确实需要一些”协议”使SDN成为现实

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(an incomplete list)

OpenFlow

NETCONF

PCE

I2RS

ALTO

BGP-TE

BMP

VXLAN/NVGRE

.....

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# JUNIPER SDN/NFV PROGRAMS

## 瞻博的SDN和NFV项目

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### Contrail

- data center overlay
- edge services
- opencontrail
- easy to use northbound API

### Cloud/Virtual CPE

- tactic: simplify cpe
- strategy: service evolution

### Juniper Service Platform (JSP) also known as JunosV App Engine (JVAE)

- Software platform for hosting virtualized services and service chaining
- Hardware platforms: VSE, Router Blade, 3<sup>rd</sup>-party
- Juniper services: vSRX, DPI and more

### SDN protocols on routers and switches

- OpenFlow 1.3
- PCEP
- BGP-TE
- BMPv3
- VXLAN
- .....

# SDN USE IN WAN – CENTRALIZED TRAFFIC ENGINEERING

## Network Primitives

1. Understand real-time topology
2. Establish a path through the network(s)
3. Select what traffic may (not) use this path

## BORG (Network Control Center)

Routing

OF controller  
(optional)

Path Computation  
Element

### 1: IGP/BGP-TE

- One-way, One session per network
- Extract topology and reachability information (External reachability, internal links, internal nodes, traffic engineering reservation info)

BGP-TE  
IGP

OpenFlow/  
(optional)

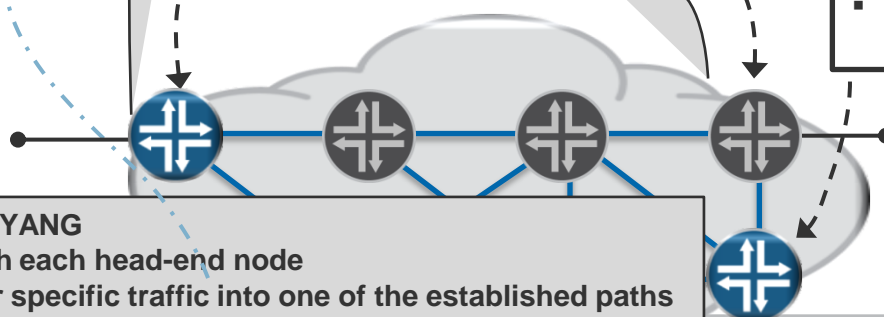
PCE-P

### 2: PCE-P

- Two-way, session with *each* head-end node
- Phase-1: Instruct router to modify existing RSVP LSP reservation (path to take, class, bandwidth,...)
- Phase-2: Instruct router to initiate/delete RSVP LSP reservation

### 3: OpenFlow or Netconf/YANG

- Two-way, session with each head-end node
- Instruct router to filter specific traffic into one of the established paths



# BORG: TRAFFIC ENGINEERING WITH A GLOBAL VIEW

## Global View of Network

- Rather than hop-by-hop
- Optimal view = optimal usage

## New routing algorithms

- Multiple constraints and rich data
- Leverage social networking and graph theory

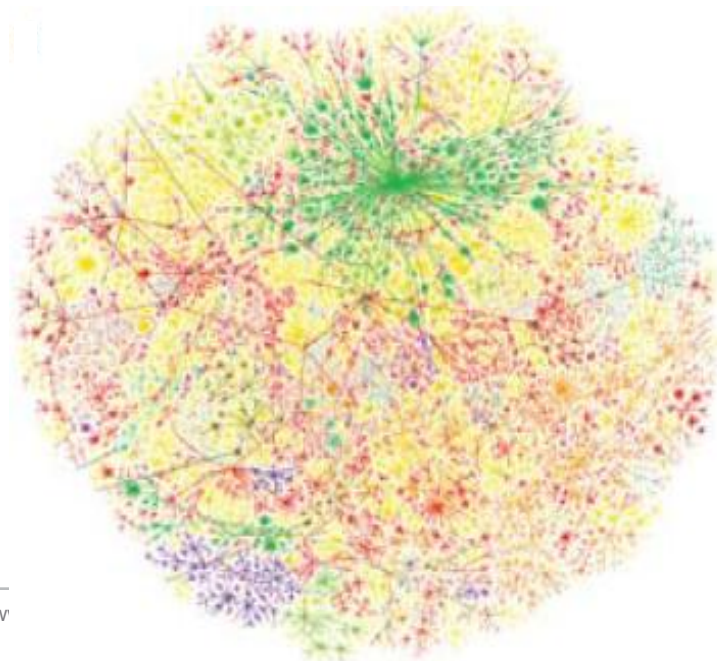
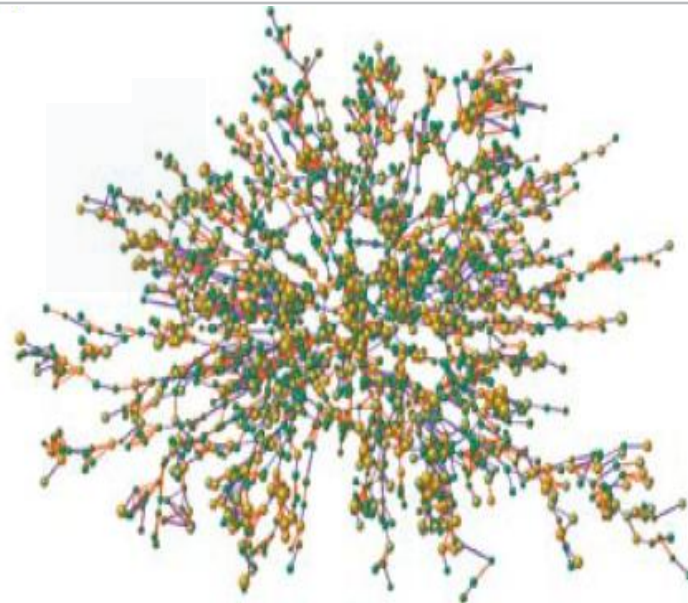
## Off-load Router Control Plane

## Route over non-IP network layers

- Optical, microwave, hetnet

## Integrate with non-IP applications

- Create an API for network



# JUNIPER WAN SDN STRATEGY



WAN SDN networks need to rely on an ecosystem of open interoperable standards



Juniper believes in open standards to enable innovation



Juniper actively driving open standards for the benefit of the Industry

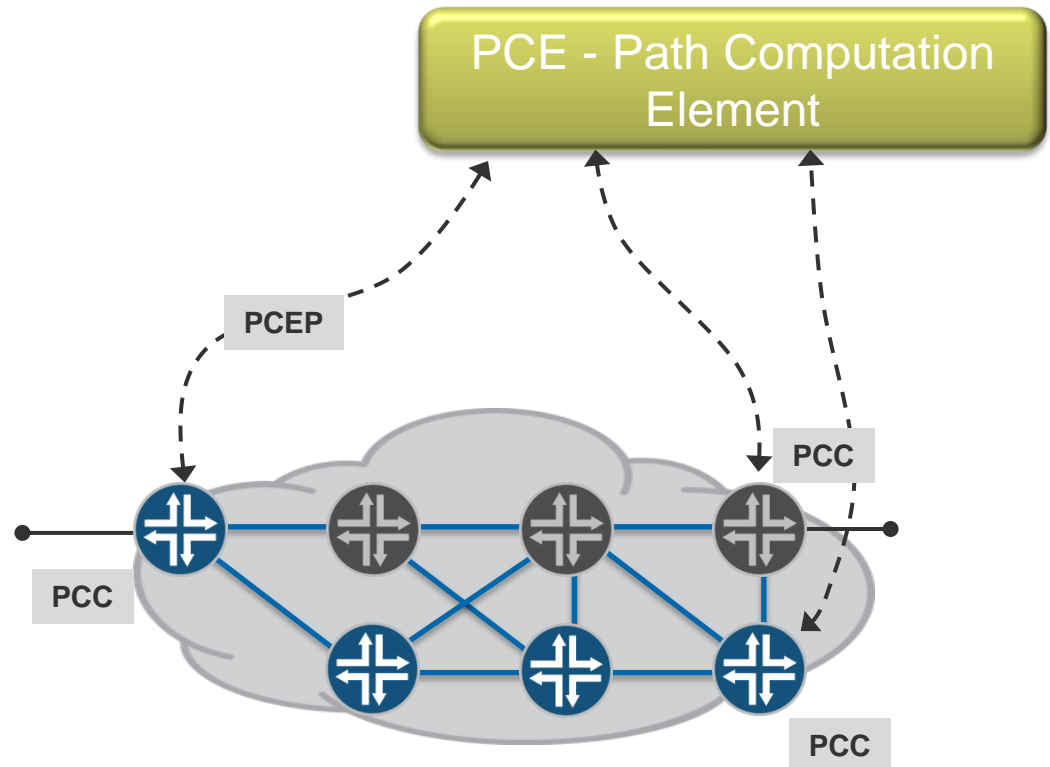
# PCE: A STANDARDS-BASED APPROACH

## What is it?

- Path computation element (PCE) – an entity that can calculate paths in the network. Can be a network node, a server, an application, etc.

## Components

- PCE – path computation element – computes the path
- PCC – path computation client – receives the path and applies it in the network. Paths are still signaled with RSVP-TE.
- PCEP – PCE protocol – for PCE/PCC communication
- Path signaling in the network – through RSVP





# WHY PCE IN THE CONTEXT OF SDN?

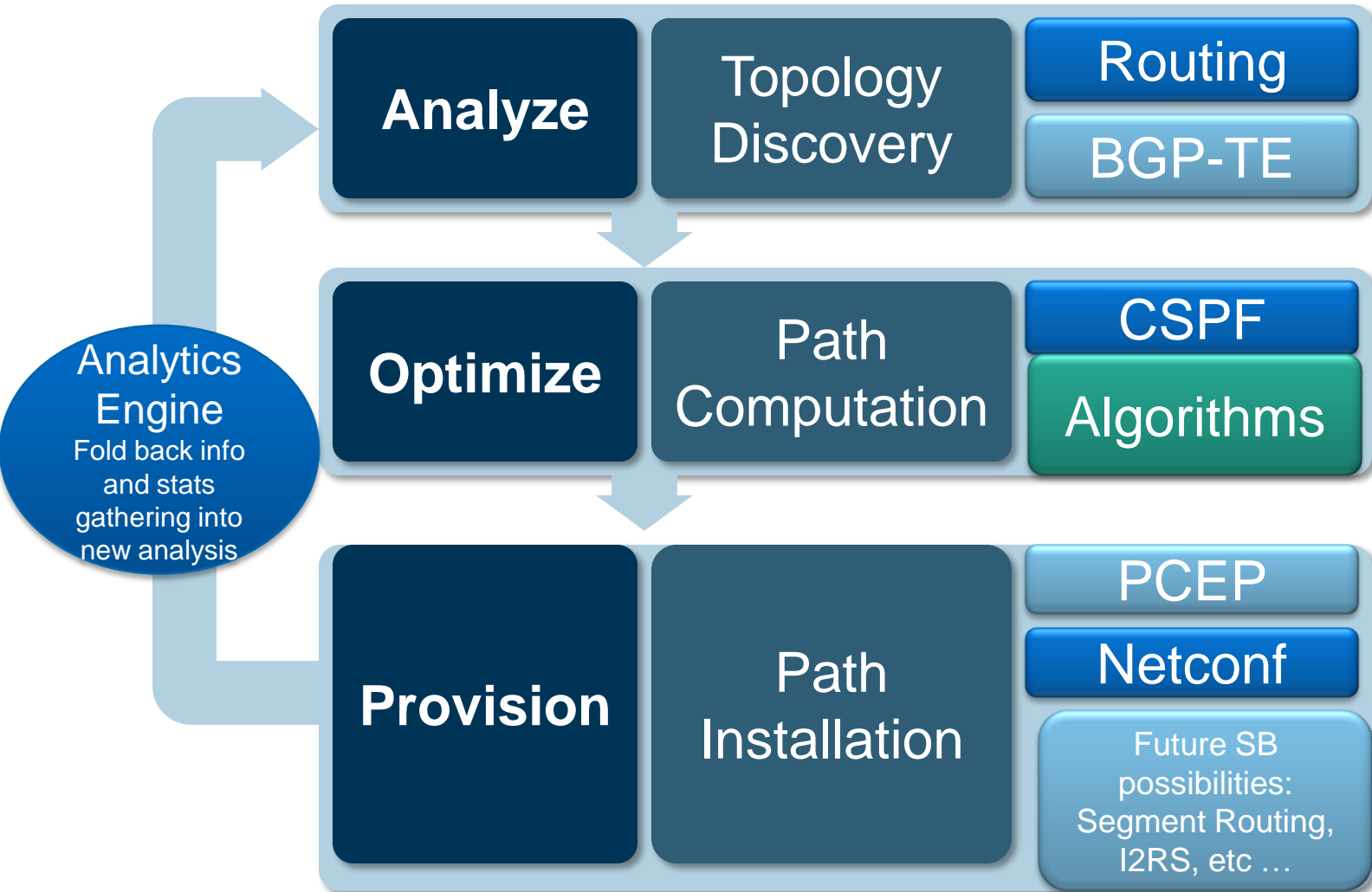
## SDN – centrally controlled network

- Centralized determination of traffic flows -> centralized TE. Central computation offers many benefits. Possible applications:
  - Steer traffic through optimal paths
  - Resize existing paths or create new paths on demand
  - Key component of the provision/analyze/optimize cycle of a software-driven network.
  - Enables applications such as bandwidth calendaring.

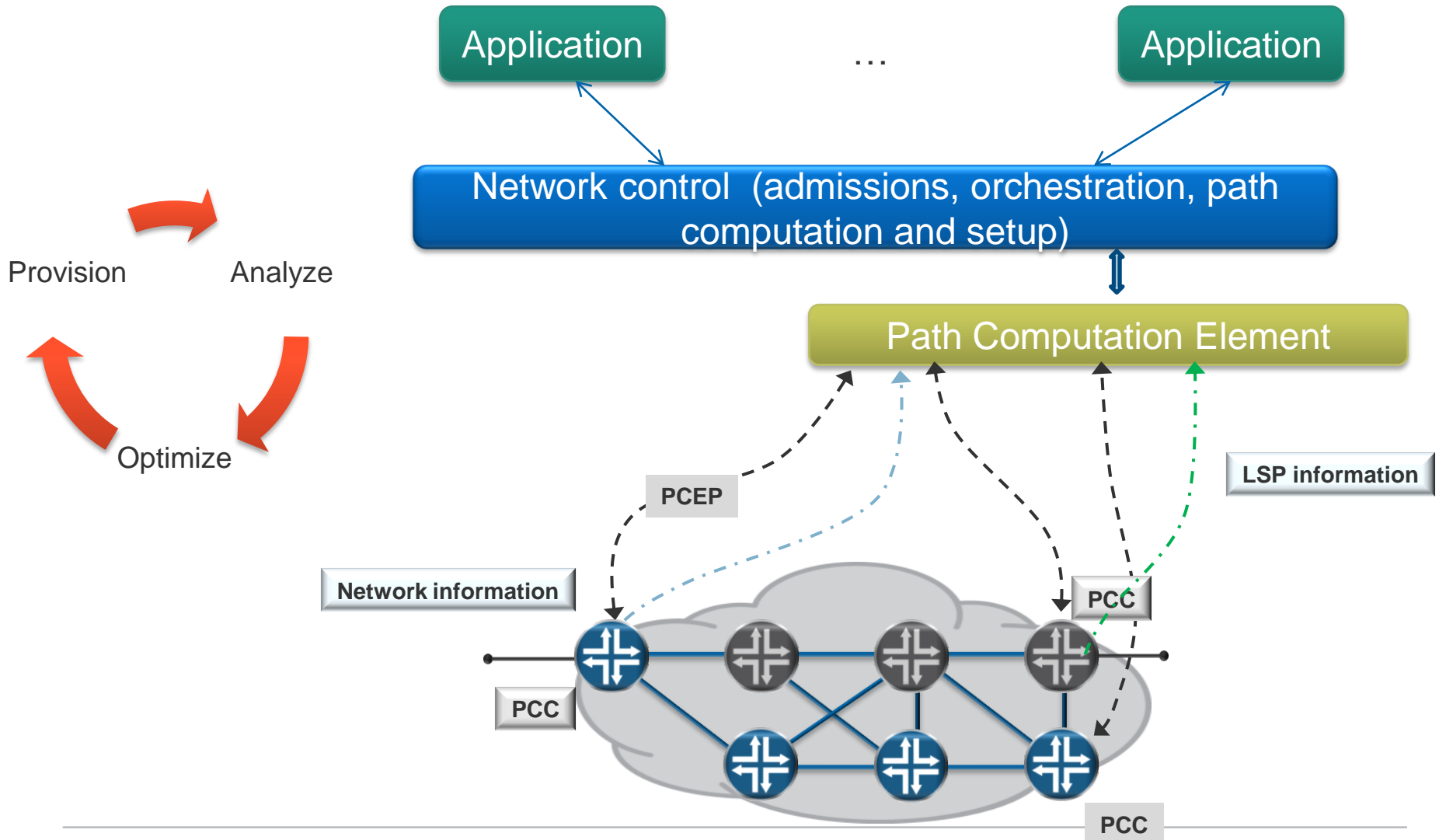
## PCE fits in well for an evolutionary approach to SDN

- PCE peacefully co-exists with existing network
- Operators can do tactical PCE
- Can continue to use the same protocols for signaling (RSVP-TE) and for mapping traffic to paths at the edges.
- Only needs a SW upgrade to enable the client functionality

# JUNIPER NETWORK PROGRAMMABILITY



# PCE IN SDN: CONTROL-LOOP USE CASES



# BORG ENABLES NEW COMMERCIAL MODELS

## Data Center Interconnect (Enterprise, Carrier and CSP)

- Time of day or congestion-based service offerings

## Carrier's Carrier Service

- Transport Providers can offer premium service across the core

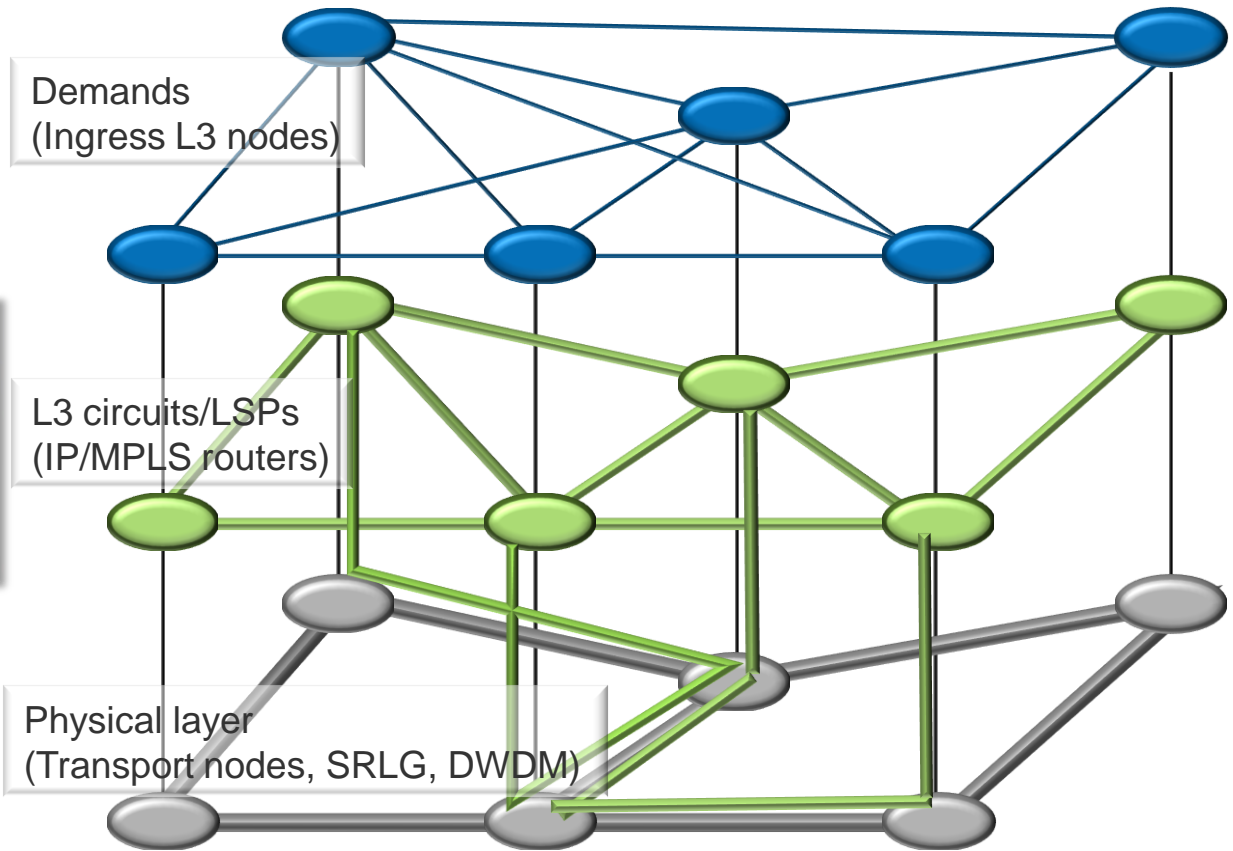
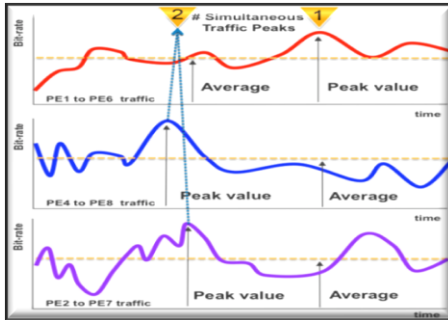
## Business Services

- May be combined with a portal for enhanced dynamic service

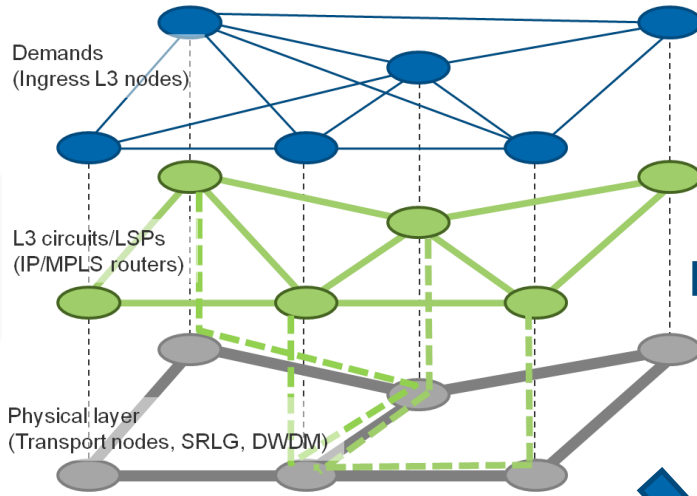
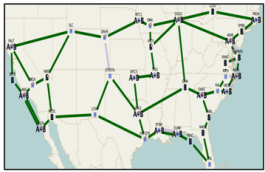
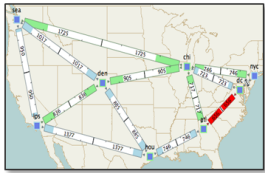
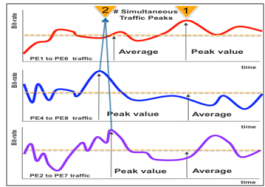
## Inter-carrier Routing Service and Peering

- Peering link selection
- Establish premium (high-bandwidth, low-latency, etc) routes across provider networks

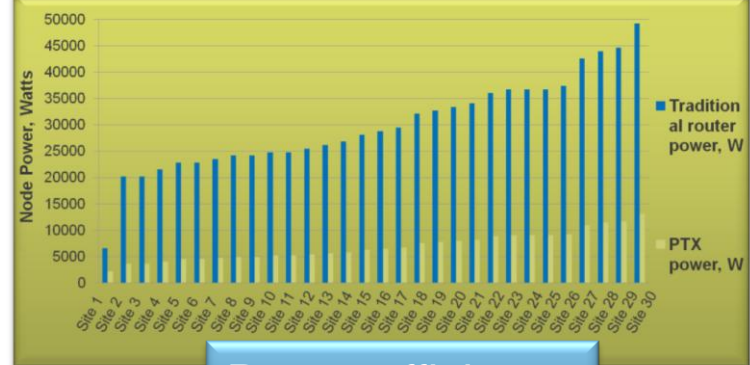
# PRIOR TO DYNAMIC PCE: STATIC MODELING OF LAYERS 1 THROUGH 3



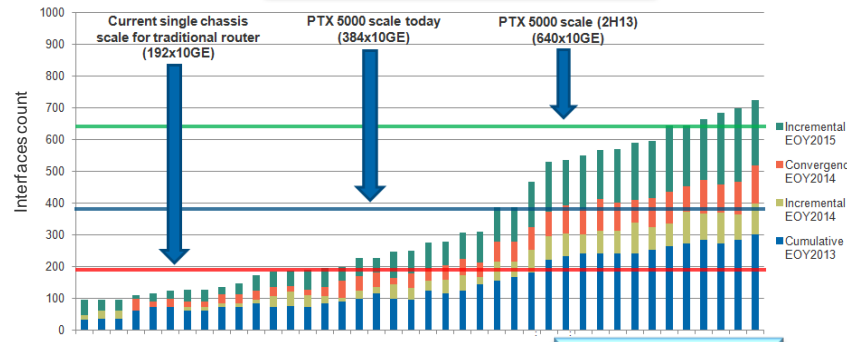
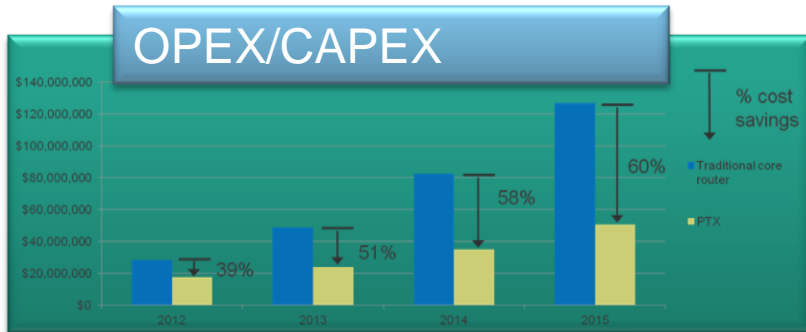
# ACTIVE STATEFUL PCE ENABLES: TRUE DYNAMIC MULTILAYER OPTIMIZATION



Quantifiable output gives true insight in cost, capacity and power efficiency scaling



Power efficiency



Capacity

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# CONTRAIL?

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what

- about network virtualization

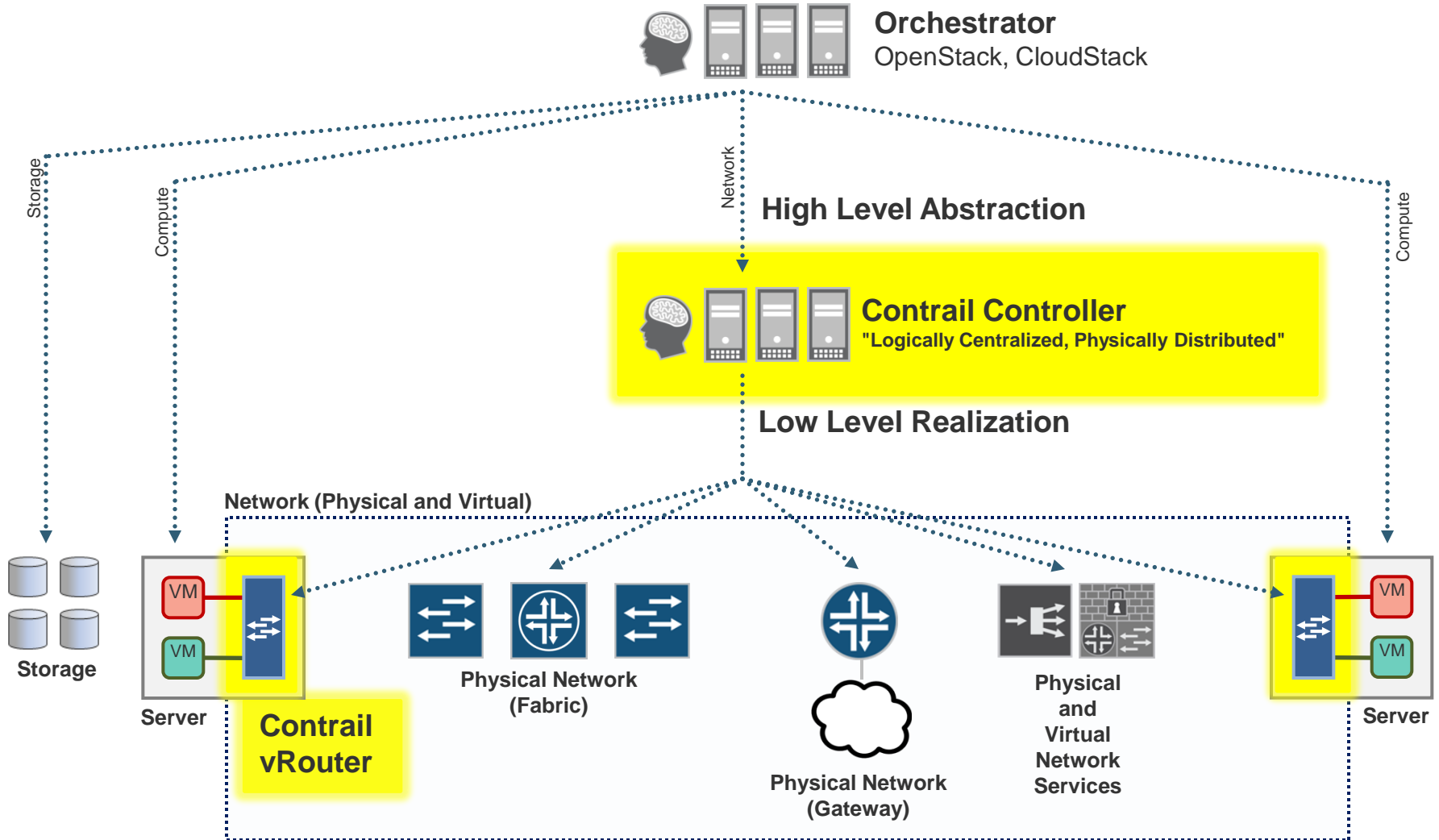
why

- VLAN?
- MC-LAG/virtual chassis?
- TRILL/FabricPath?
- openflow (in underlay)?
- it's about flexibility, scale, automation and programmability

how

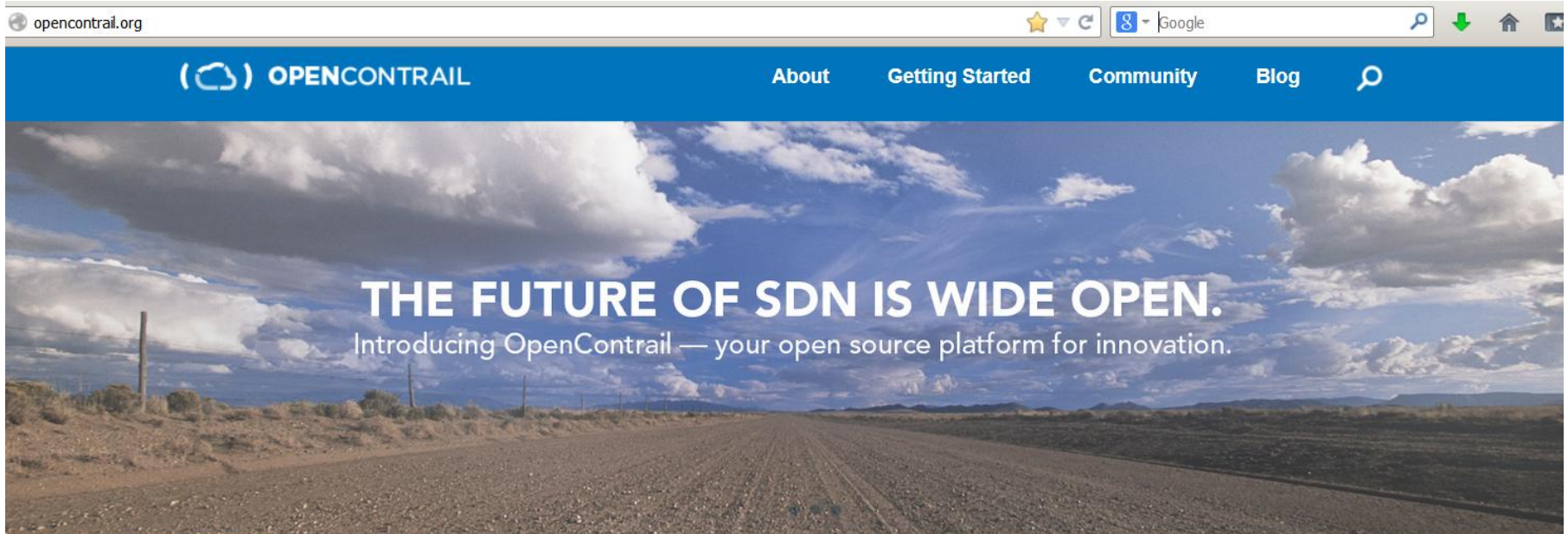
- an intelligent overlay architecture
- based on standard protocol
- integrated with mainstream cloud OS

# ROLE OF CONTRAIL IN A VIRTUALIZED ENVIRONMENT





# AND IT'S OPEN!



OpenContrail is an Apache 2.0-licensed project that is built using standards-based protocols and provides all the necessary components for network virtualization—SDN controller, virtual router, analytics engine, and published northbound APIs. Learn more about OpenContrail from the [slideshow](#) overview or the detailed [software architecture document](#).

[Upcoming events](#)

[From the blog](#)

[OpenContrail Video](#)

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# CLOUD/VIRTUAL CPE CONCEPTS

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“shifting **some** of the **functionalities** of a residential gateway to the operator's network, for **enabling** network based **features**. The aim is to **facilitate** the **deployment, maintenance** and **evolution** of both existing and new **capabilities without adding complexity to the RG and/or the home network.**”

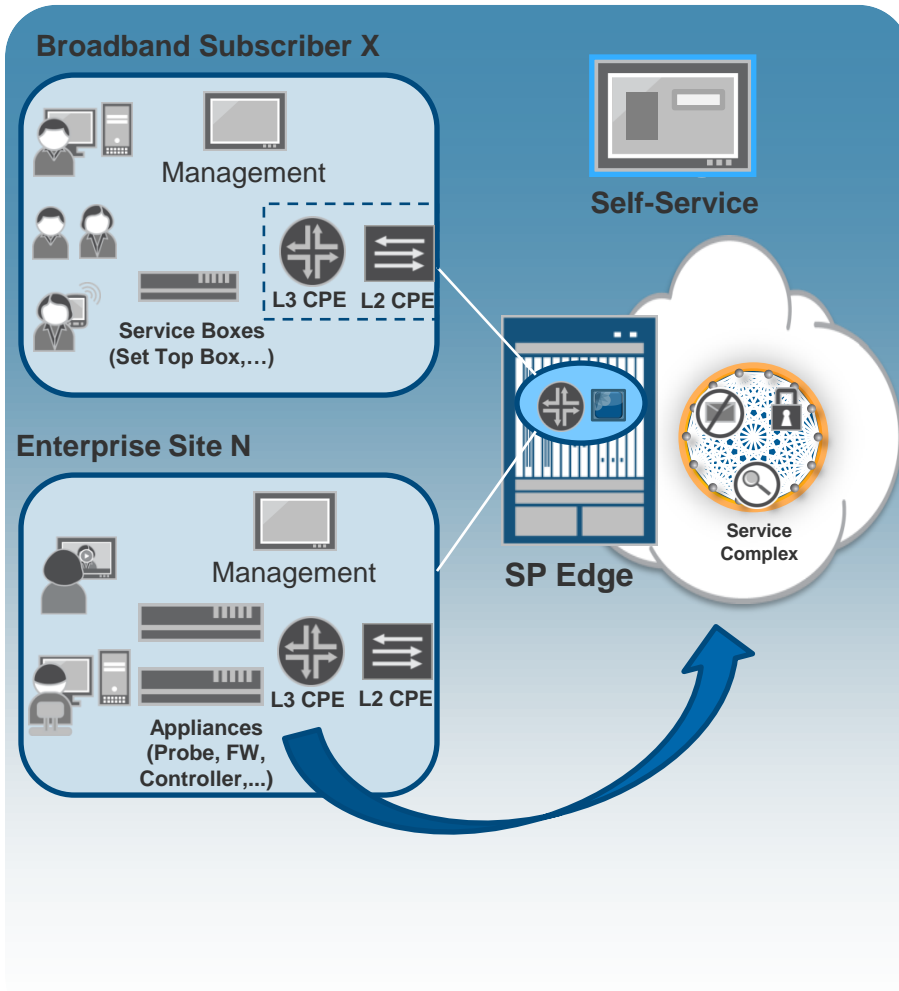
本质上, vCPE是: managed service+virtualization

- dynamic service creation and chaining是managed service的高级形式

它也和SDN, NFV思想高度一致

# CLOUD CPE VISION

## ALIGNING CPE MODEL AND SERVICE INNOVATION



### Physical CPE

Service creation  
on-site

New Service =  
New Box

Static Services

NAT hides devices

Localized  
Management

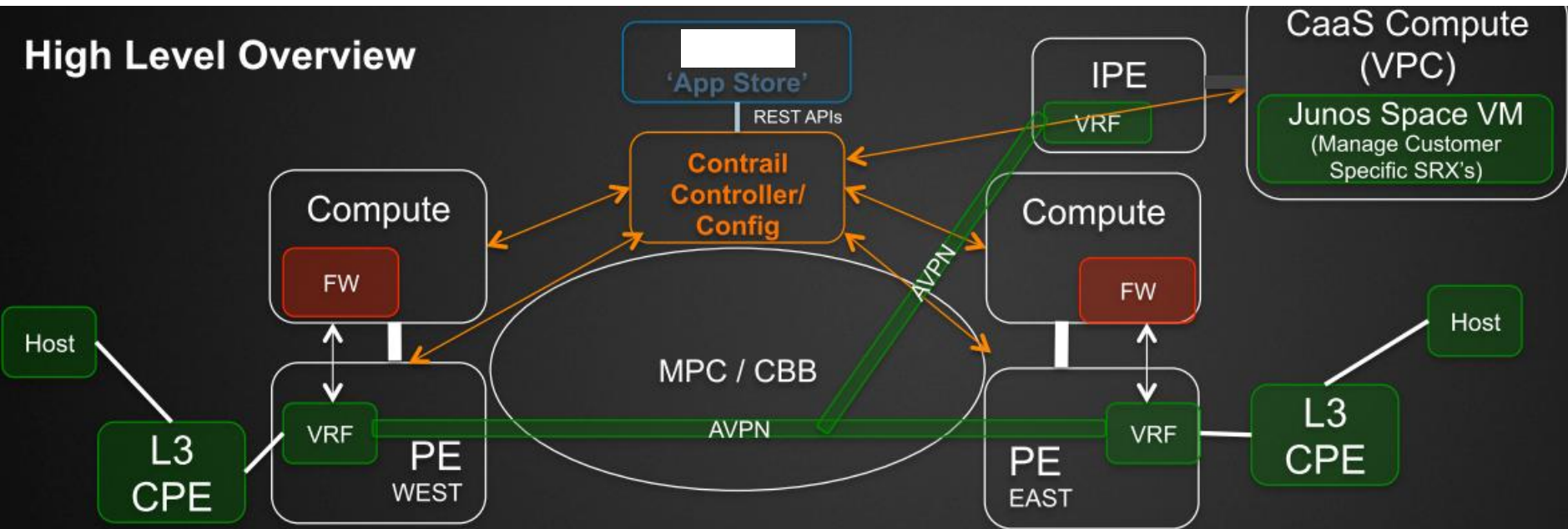
Monolithic Charging

Dedicated

Distributed

# CONTRAIL FOR DYNAMIC SERVICE INSTANTIATION AND CHAINING

## High Level Overview





everywhere