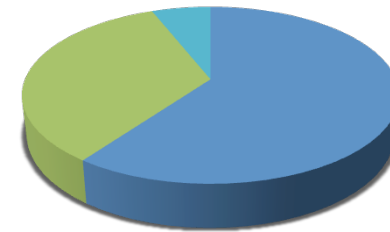# Content

- **About MEF, LSO and Vision**

- **MEF's Definition of SD-WAN**

- **MEF's SD-WAN Use Cases**

- **MEF's Vision of the Evolution of SD-WAN**
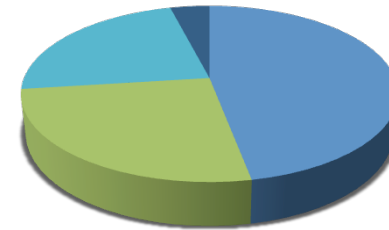
- **Summary**

MEF

MEF Created the $80B* Carrier Ethernet Market

Goal is to leverage the MEF's $80B CE base to evolve into Network-as-a-Service

■ SPs ■ Vendors ■ Others

210+ Member Companies

■ NA ■ EMEA ■ APAC ■ CALA

Global Contributions

*IHS Market Report

MEF

The Digital Economy

Complete Retooling of Networks for a Digital Economy

- A New Economy
- Hyper-connected
- On-Demand and Agile
- Assured and Secure
- Private and Public Clouds
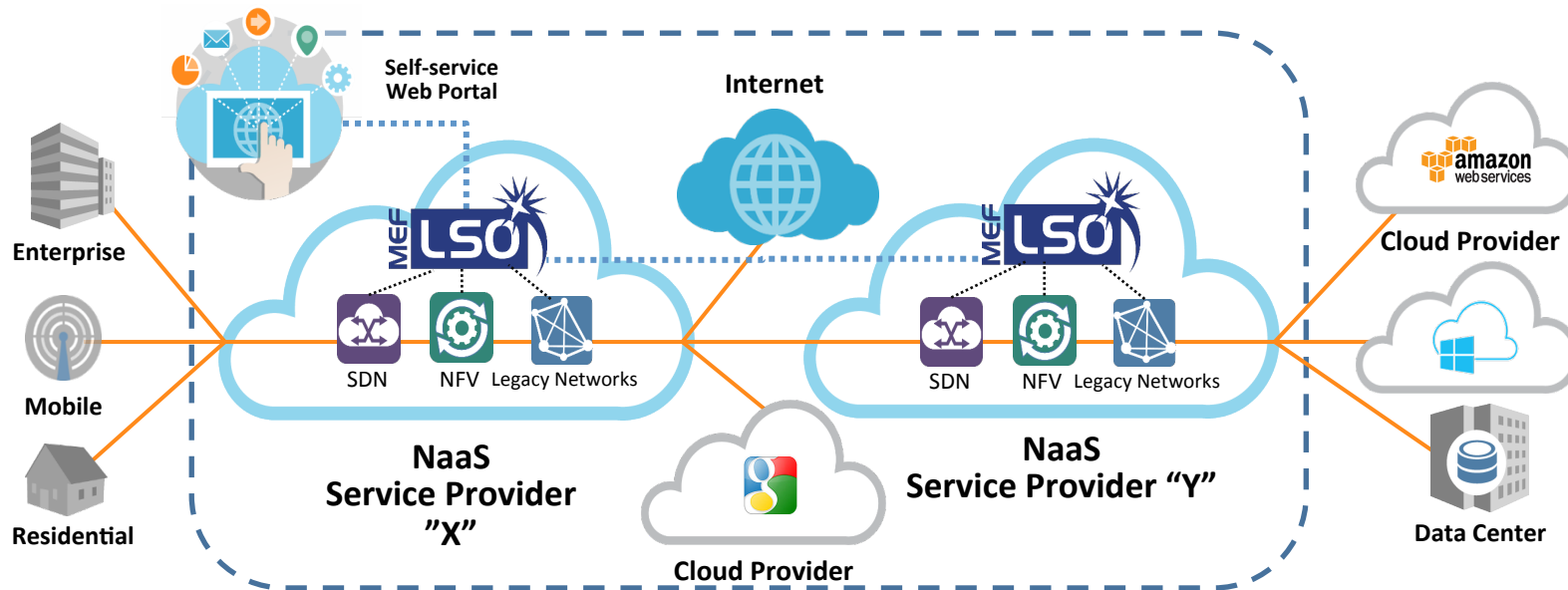- SaaS Applications
- Machine Automation

TRANSFORMATION

MEF

MEF's Vision of Network as-a-Service (NaaS)

The Third Network

Agile, Assured, Orchestrated

NaaS

Orchestrated Services						
E-Line	E-LAN	E-Tree	E-Access	E-Transit	SECaaS	App Services
Wavelength	Internet Access	L3 VPNs	IP Transit			

MEF LSO Reference Framework
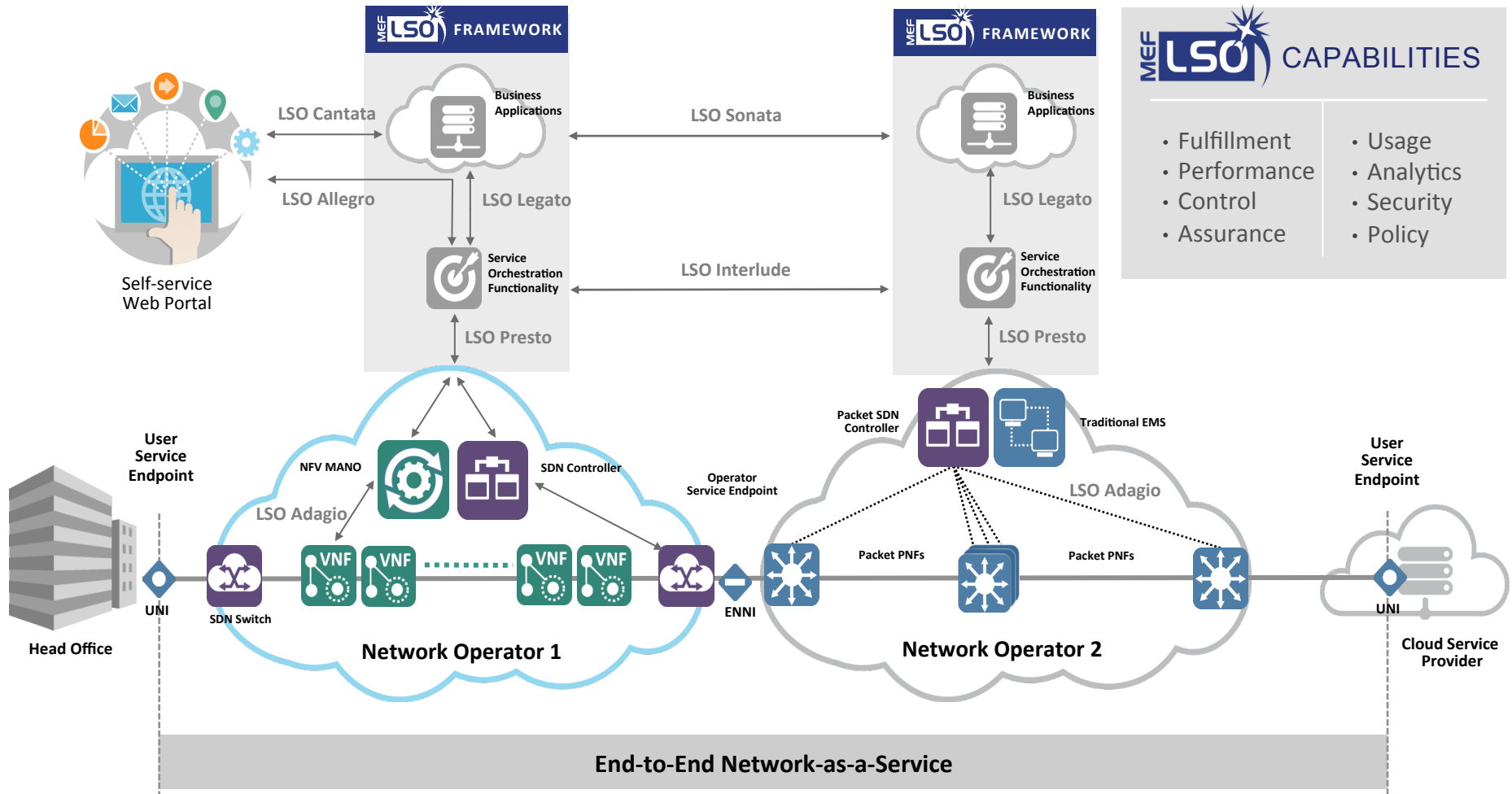
End-to-End Network-as-a-Service

EMS: Element Management System   PNF: Physical Network Function   SOF: Service Orchestration Function

Concepts: Overlay and Underlay Networks

- **Underlay Network**
  - The physical transport network
- **Overlay Network**
  - Virtual Network abstracted from the transport network (underlay network)
- **Overlay networks are tunneled over Underlay networks**
  - Using an encapsulation protocol, e.g., VxLAN, NVGRE, IPsec tunnel, etc.
- **Overlay/Underlay terminology used in DC Networking**
  - Terminology usage more recent with WAN (SD-WAN)
  - Although, MEF has defined Carrier Ethernet as a virtual overlay service

MEF

What is an SD-WAN?

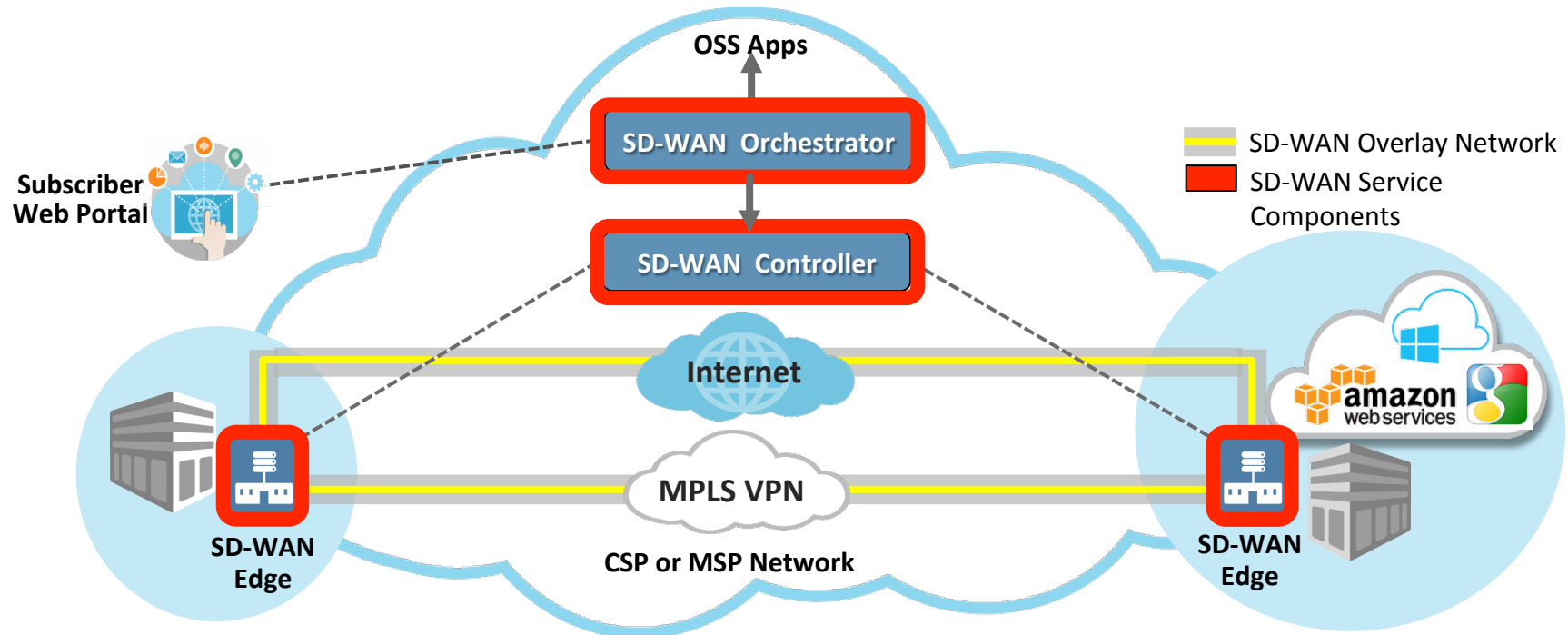- **Currently no industry standard definition but described as follows:**
  - Specific application of an SDN applied to WAN connections
  - A Virtual (Overlay) Network that runs on top of public Internet and managed networks
  - Operates over existing wireline or wireless networks
  - Has no interaction with the (underlay) network over which it operates

MEF is working to create a standardized SD-WAN Service Definition

SD-WAN Service Components

OSS Apps

SD-WAN Orchestrator

Subscriber Web Portal

SD-WAN Controller

SD-WAN Overlay Network

SD-WAN Service Components

Internet

MPLS VPN

SD-WAN Edge

CSP or MSP Network

SD-WAN Edge

amazon web services

- **SD-WAN Edge**
  - Performs Traffic steering, Application classification, QoS and Security policy enforcement
- **SD-WAN Controller**
  - Centralized control of SD-WAN Edge devices

- **SD-WAN Orchestrator**
  - Service orchestration and policy management for application performance, security and traffic steering over different WANs
  - Interfaces to customer web portal, OSS apps and SD-WAN Controller

Fundamental SD-WAN Service Functionality

- **Traffic steering over secured tunnels between SD-WAN Edges**
  - Encryption over all WANs: Internet (broadband), MPLS VPN, LTE, Wi-Fi, etc.
  - SD-WAN service can operate over different CSP / ISP WANs
- **Real-time QoS performance measurements over each WAN**
  - QoS PMs used to determine which WAN to steer packets based on QoS Policies
- **Application-based traffic steering based on QoS or Security Policies**
  - Send Skype for Business traffic over Internet if packet loss < 1% and packet delay <70ms
  - Block all sites from accessing cloud-based storage, e.g., box.com
- **Security postures using defense in depth principles**
  - Protection from Internet, public clouds, BYODs, etc.
  - Firewall, DDOS, IPS/IDS, ATP, DLP, dynamic ACLs, etc.
- **Zero Touch Provisioning**
  - Making a business service installed with the automation of a residential service

MEF

Why an SD-WAN Service?

Subscriber Benefits

- **Large OpEx Savings**
  - Steer traffic from expensive MPLS VPN to Internet when QoS policies met
- **Application-based QoS Management**
  - QoS Policies/Metrics per Application used to steer traffic over different WANs
- **Quickly add temporary or remote Sites**
  - Over ubiquitous Internet using wired or wireless connections
- **Achieve High Availability & Path Diversity**
  - Run SD-WANs over different ISPs

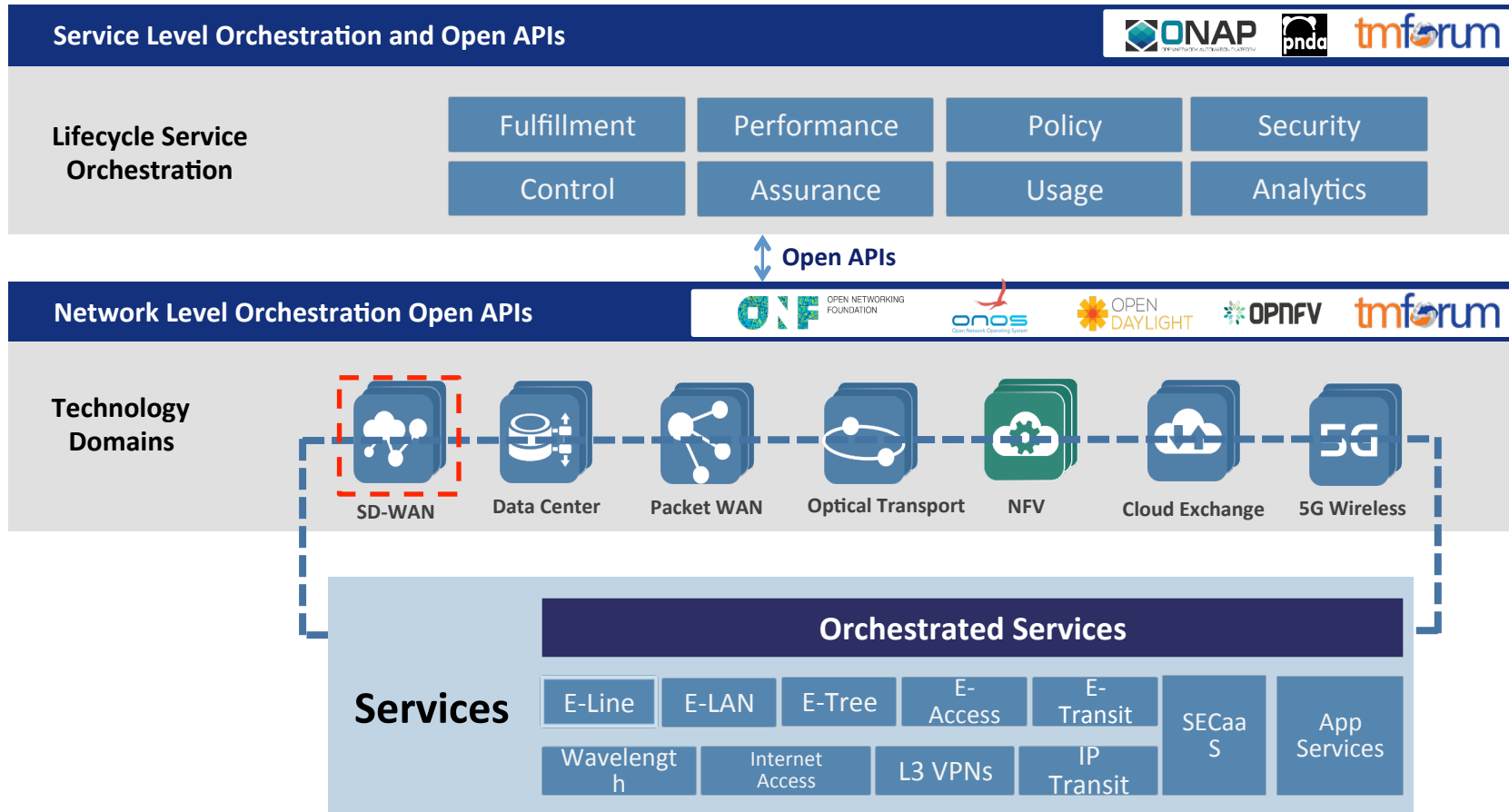## Service Provider Benefits

- **Lower OpEx via Automation**
  - Zero-touch provisioning of SD-WAN Edges
- **Self-Service Customer Portals**
  - Faster Time to Service Revenue
- **Quickly add off-net sites via Internet or LTE**
  - No need for inter-provider peering with off-net access network providers
- **Enter Competitor or Incumbent Markets**
  - Deliver SD-WAN service to subscribers even if you don't provide network access to the site

MEF

MEF's SD-WAN Use Cases

MEF's Intra-Operator LSO

Service Level Orchestration and Open APIs ONAP pnda tmforum

Lifecycle Service Orchestration

| Fulfillment | Performance | Policy | Security |
| Control | Assurance | Usage | Analytics |

↕ **Open APIs**

Network Level Orchestration Open APIs ONF OPEN NETWORKING FOUNDATION onos Open Network Operating System OPEN DAYLIGHT OPNFV tmforum

Technology Domains

SD-WAN Data Center Packet WAN Optical Transport NFV Cloud Exchange 5G Wireless

Orchestrated Services

Services

| E-Line | E-LAN | E-Tree | E-Access | E-Transit | SECaaS | App Services |
| Wavelength | Internet Access | L3 VPNs | IP Transit | | | |

MEF

SD-WAN Service using MEF LSO Reference Architecture (RA)

Self-service Web Portal

LSO Cantata

LSO Allegro

Business Apps

LSO Legato

Service Orchestration Functions (SOF)

LSO Presto

SD-WAN Controller

LSO Adagio

Site

SD-WAN Edge

WANs

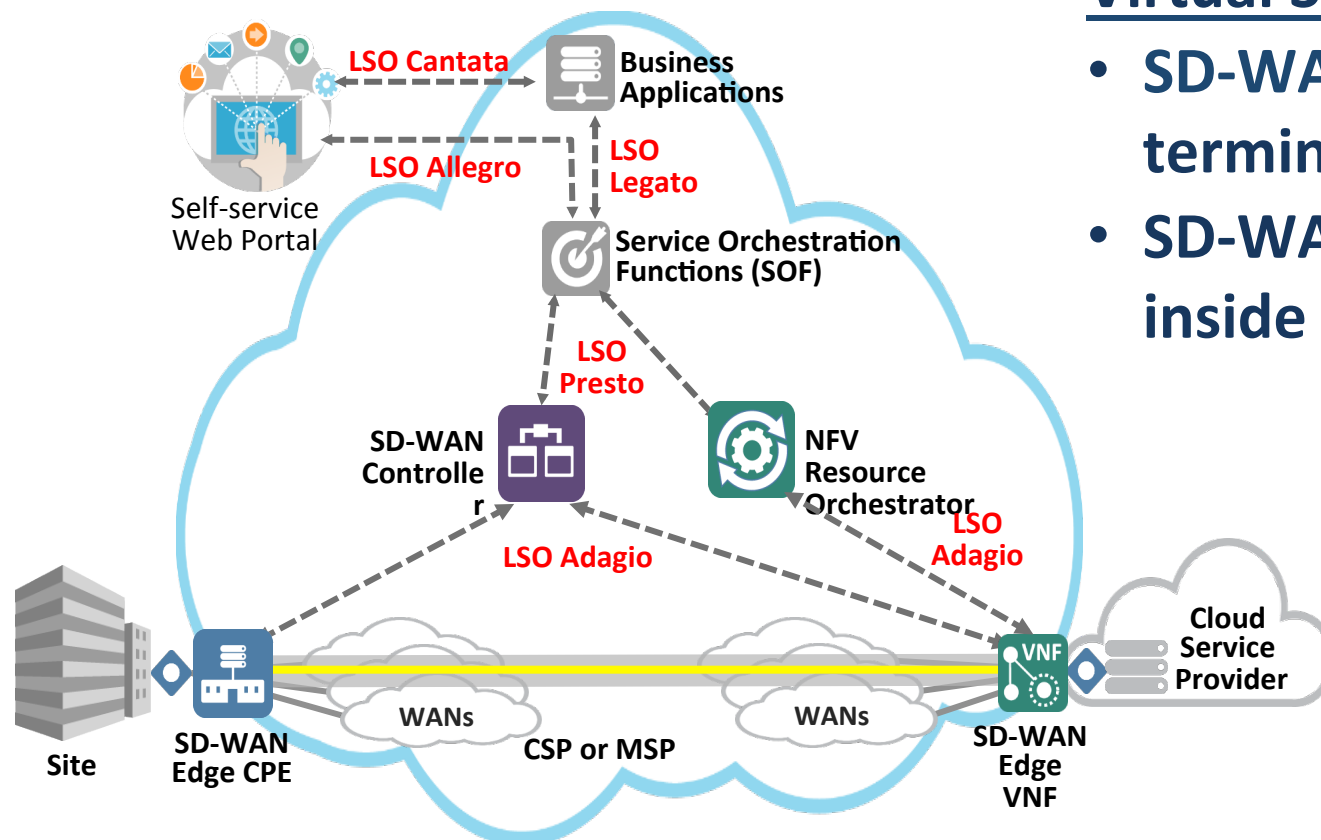CSP or MSP

WANs

SD-WAN Edge

Site
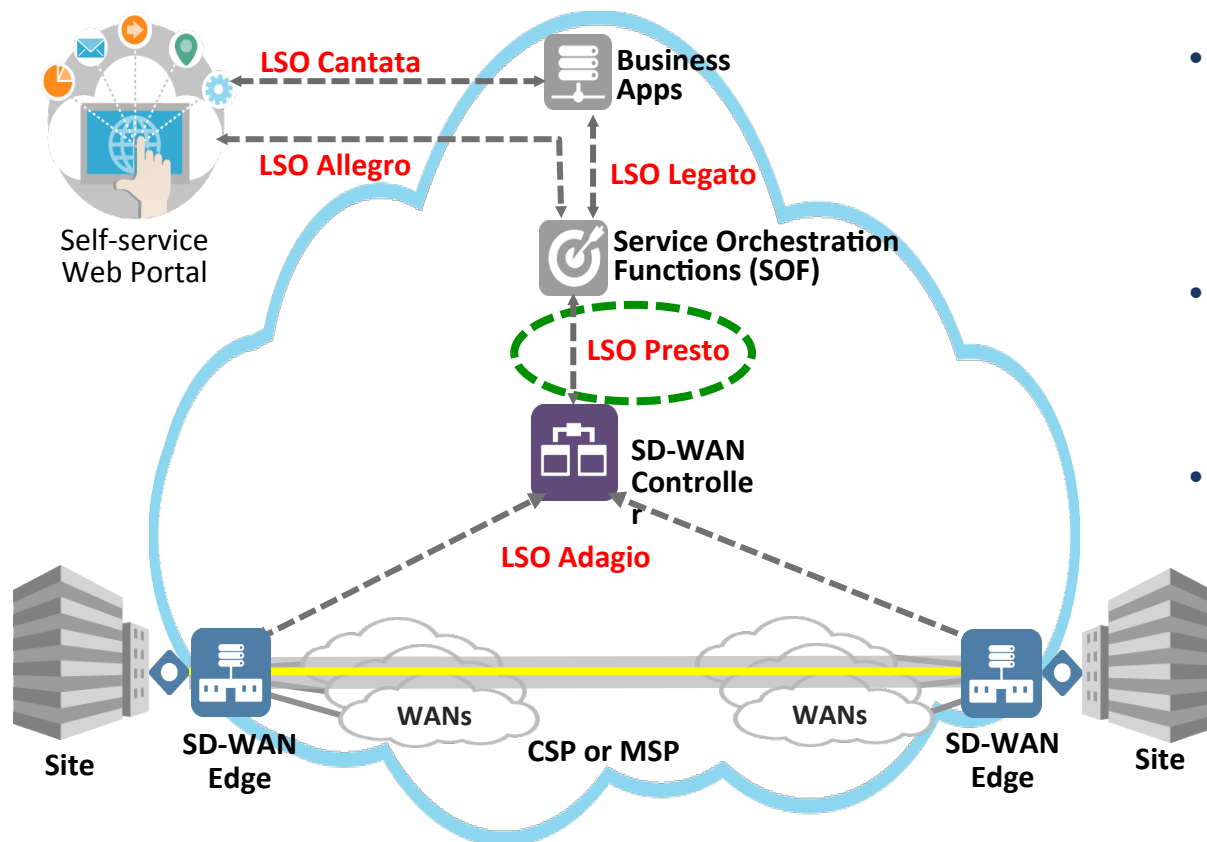
Presto Interface

- **Enables a Service Orchestrator to manage different vendor SD-WAN Controllers**

- **SD-WAN Controllers manage SD-WAN Edges in their domain**

- **MEF OpenCS SD-WAN Project focusing on functionality (SOF) at the Presto Interface**
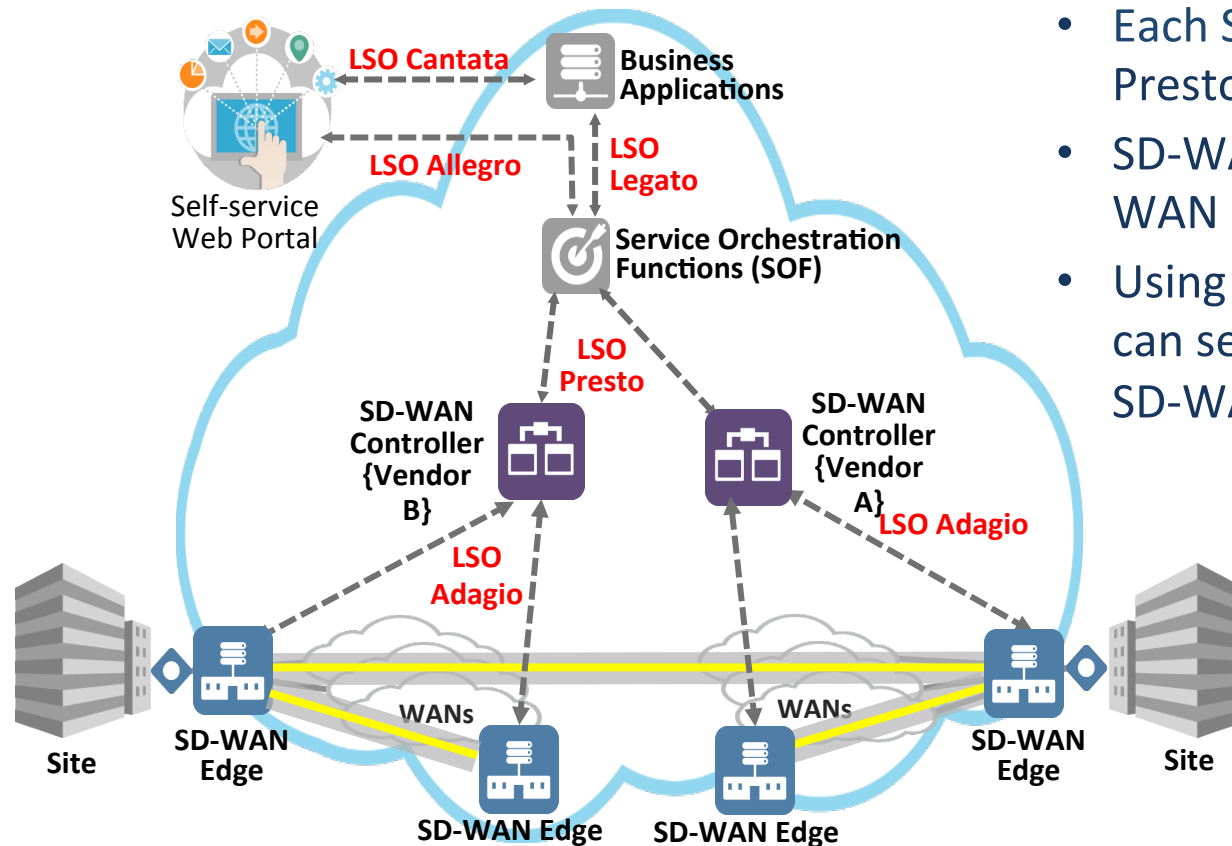
MEF

SD-WAN Service with Virtual SD-WAN Edge

Virtual SD-WAN Edge

- **SD-WAN Edge VNF which terminates**
- **SD-WAN connection runs inside of server**

SD-WAN Service with SD-WAN Edge vCPE

SD-WAN Edge vCPE

- SD-WAN Edge VNF which terminates SD-WAN connection runs on vCPE
- Ability to add more virtual network services as new VNFs on vCPE

LSO Cantata

Business Applications

LSO Allegro

LSO Legato

Self-service Web Portal

Service Orchestration Functions (SOF)

LSO Presto

SD-WAN Controller

NFV Resource Orchestrator

LSO Adagio

LSO Adagio

VNF VNF

Site

SD-WAN Edge CPE

WANs

CSP or MSP

WANs

SD-WAN Edge vCPE

Site

MEF

SD-WAN Service Using Multiple Vendor SD-WAN Controllers

Presto Interface

- Each SD-WAN Controller supports Presto Interface
- SD-WAN Controllers manage SD-WAN Edges in their domain
- Using Presto, Service Orchestrator can setup SD-WAN across each SD-WAN domain

MEF

The Evolution of SD-WAN

App Performance Management — Application Assurance

L4-7 Point Service Management — L4-L7-as-a-Service

APIs

Security Management — Security-as-a-Service

Overlay Performance Management — IP VPN Tunnel

Physical Underlay Management

Mobile Broadband

CE

TDM

Broadband

MEF
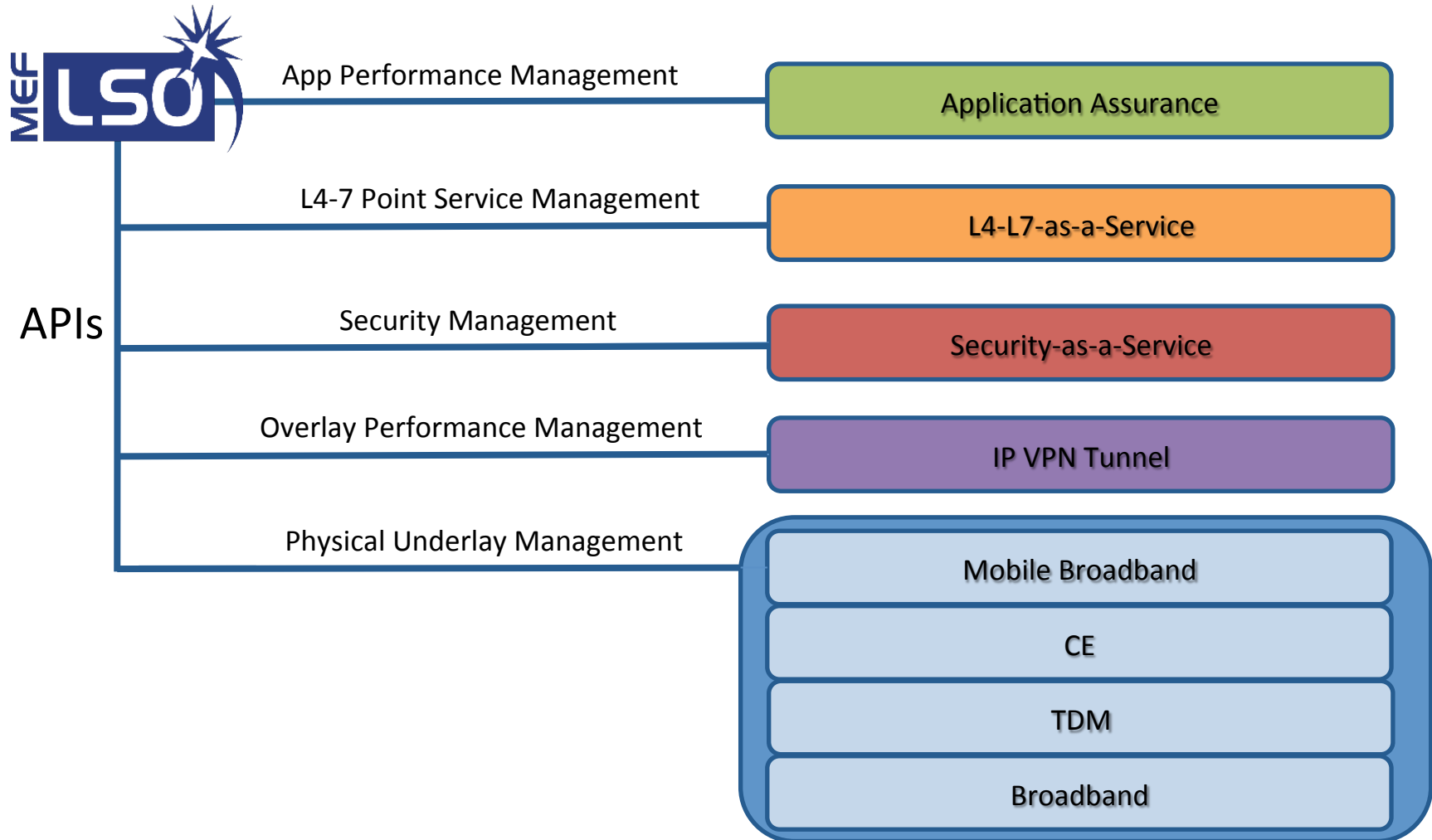
Overlay Model as a Network-as-a-Service

LSO-LSO to Automate Ordering of the Access Networks

Self-service Web Portal

Cloud APIs

Cloud Orchestrator (CLO)

East-West Sonata and Interlude APIs

Automated ordering of access loops (CE, MPLS, Broadband, 5G, etc.)

Mission Critical Cloud Applications

VM

UNI

Presto APIs

CPE

Internet ISP 1

SD-WAN Controller

NFV MANO

SDN Controller

SDN Switch

SD-WAN

UNI

CE/MPLS/5G

VNF

SD-WAN

VNF

VNF

SDN Switch

GW

NaaS Service Provider

UNI
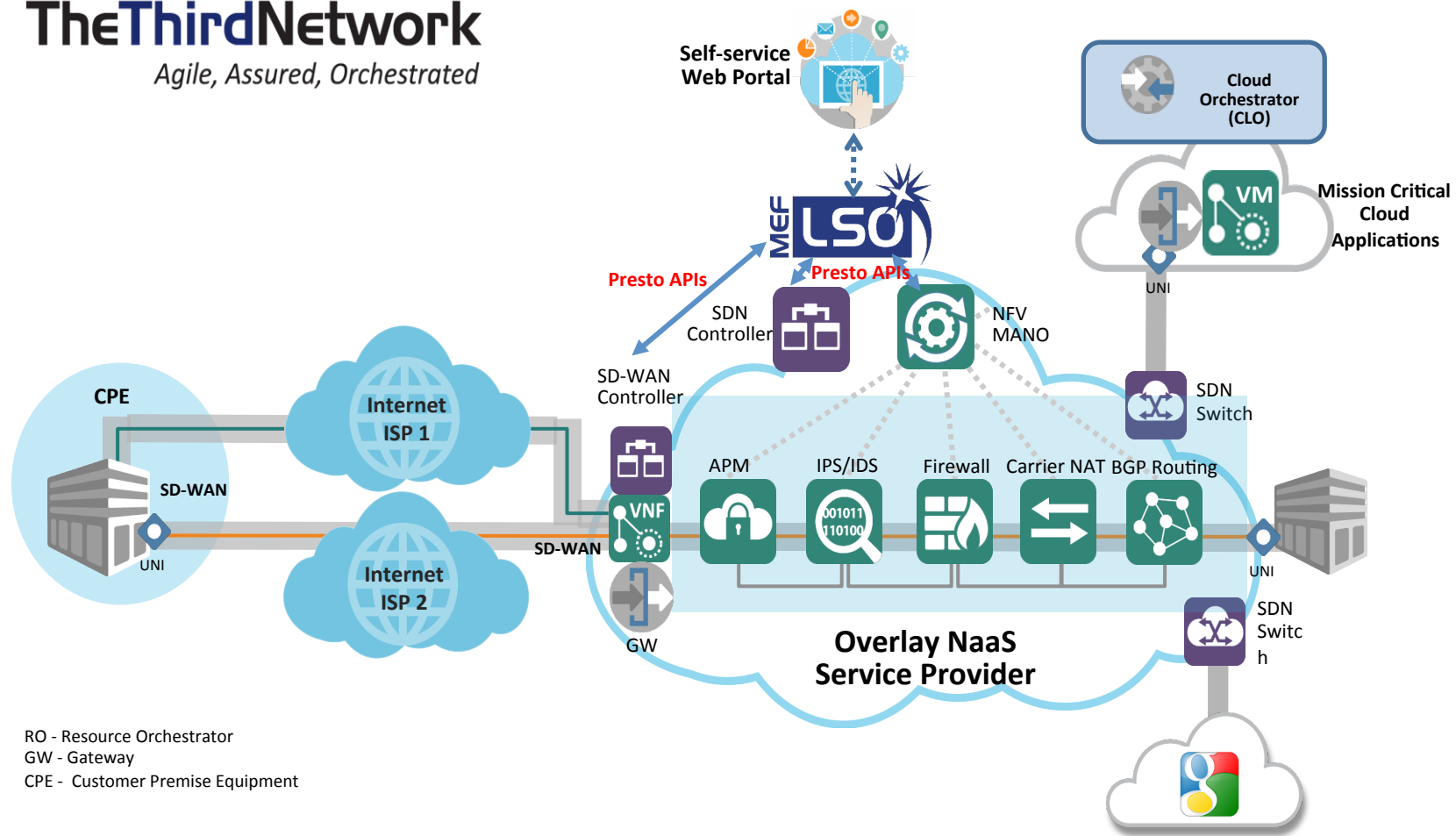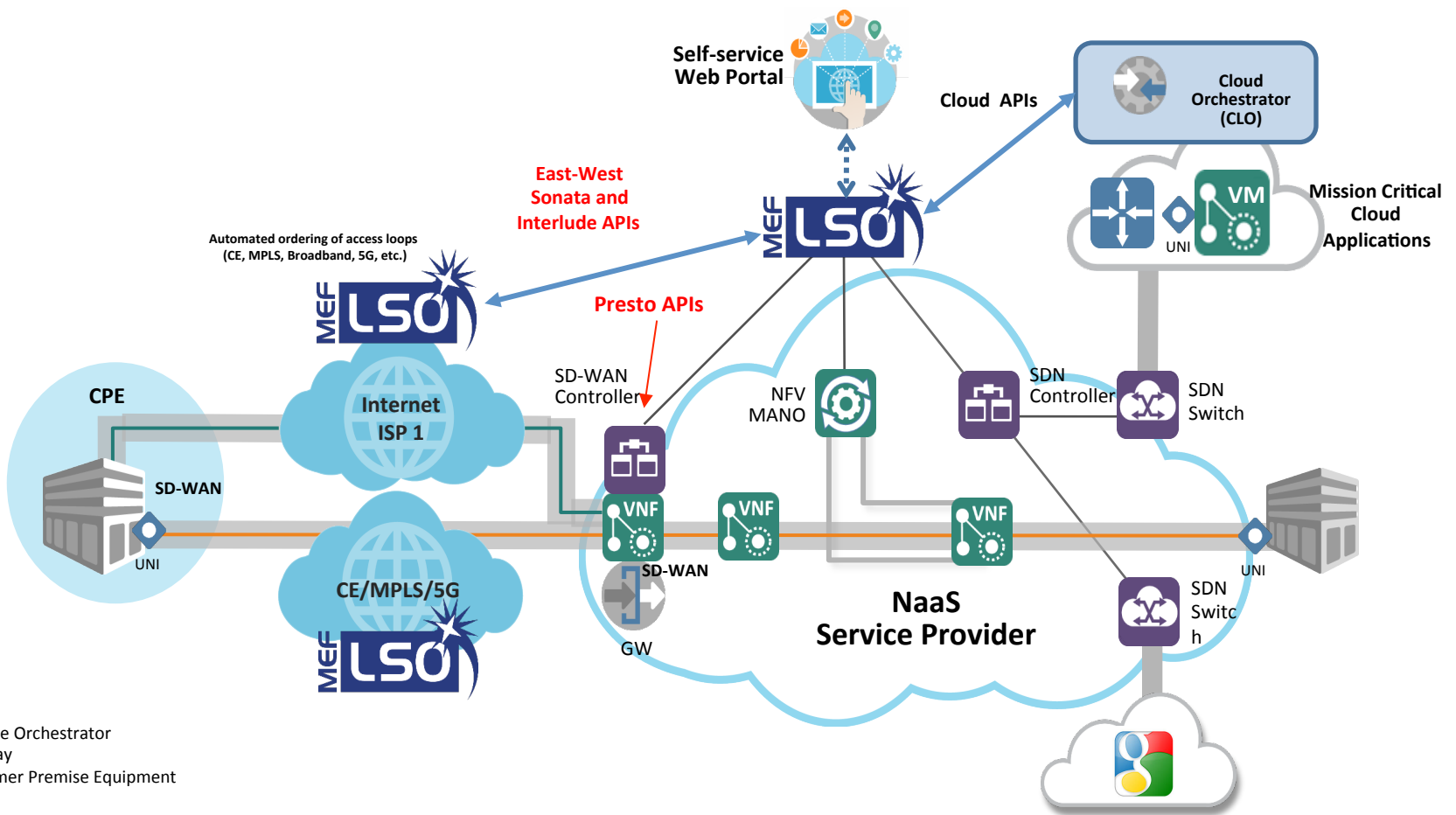
RO - Resource Orchestrator
GW - Gateway
CPE - Customer Premise Equipment

MEF

Key Takeaways...

- **SD-WAN provides a virtual overlay service**
  - Does not interact with the underlay (transport) network
- **SD-WAN provides tremendous benefits to SPs and Subscribers**
  - Service Agility, Time to Service Velocity, ⬇OpEx, Application-level awareness
- **MEF work on SD-WAN Services will help industry move forward**
  - Managed SD-WAN offerings done with MEF LSO Reference Framework
  - SD-WAN Project Reference Implementation of various use-cases
  - Standardized SD-WAN Service Definition

Industry White Paper of Third Network Services

http://mef.net/tgn