Cisco Expo 2009

Carrier Ethernet løsninger

Per Jensen

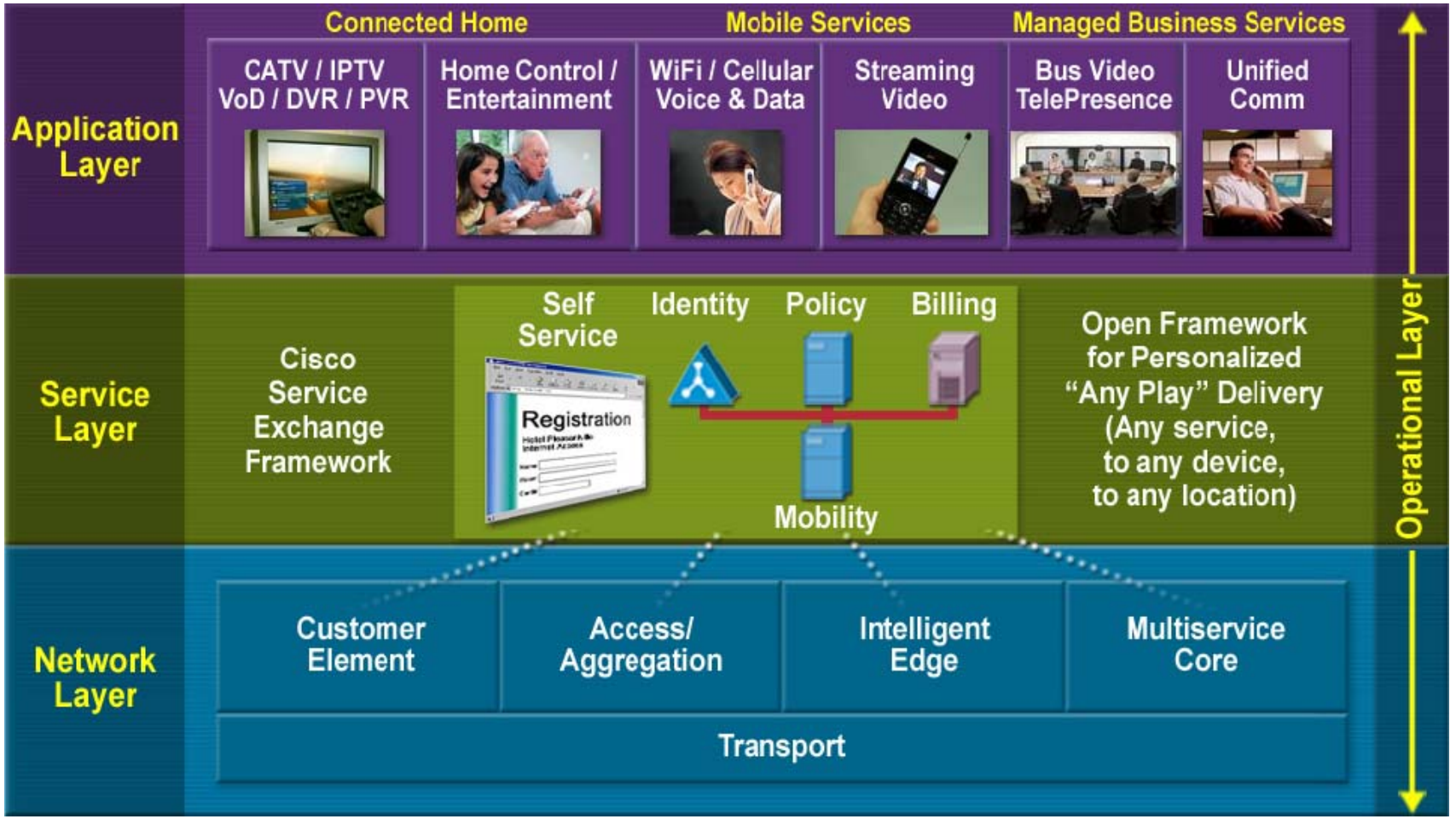
per@cisco.com

Agenda

- **IP NGN – hvad er det reelt**
- **Carrier Ethernet – services**
- **Carrier Ethernet – foundation technologier**
  - **Flexible ethernet edge**
  - **QoS**
  - **Konvergens**
  - **OAM (hvis vi når det)**
  - **CaC, Connection Admission Control (hvis vi når det)**
  - **Og der er flere.....**
- **Konklusion**

Cisco IP NGN

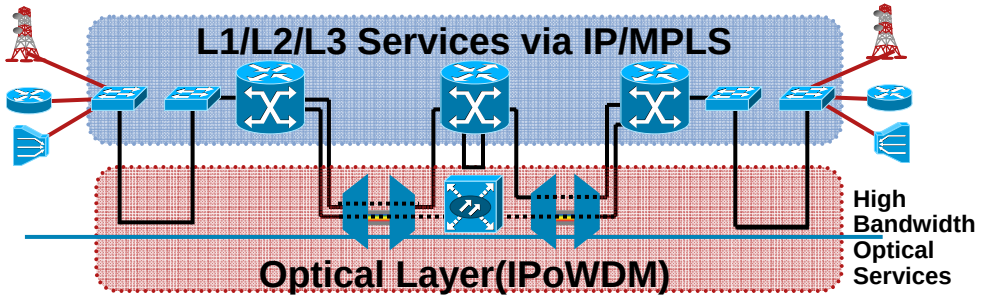
Cisco is The Leader in IP Networking



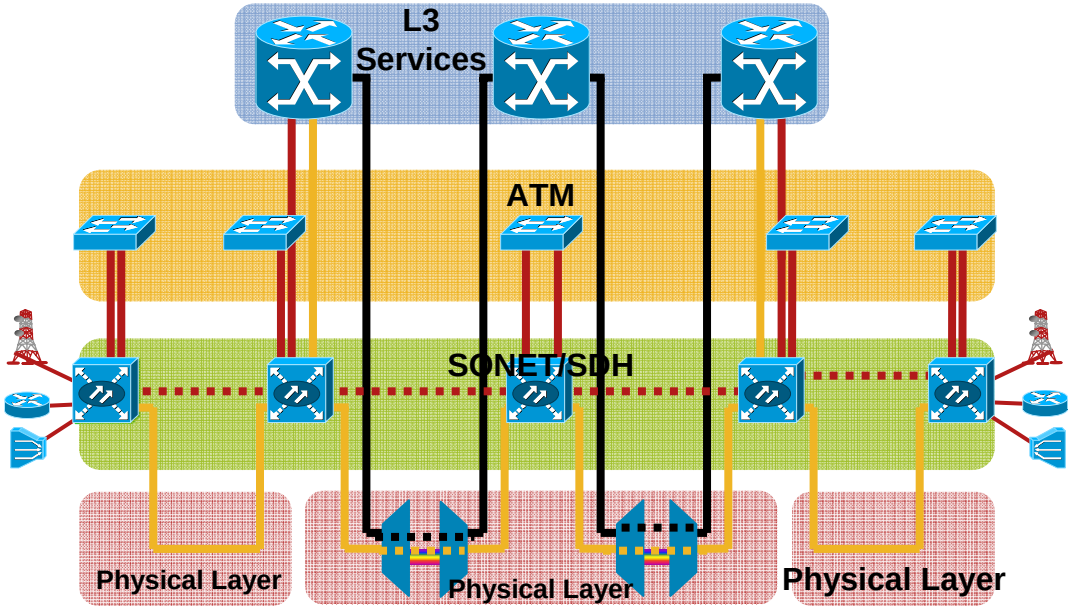
Intelligent Networking

SP Network Evolution

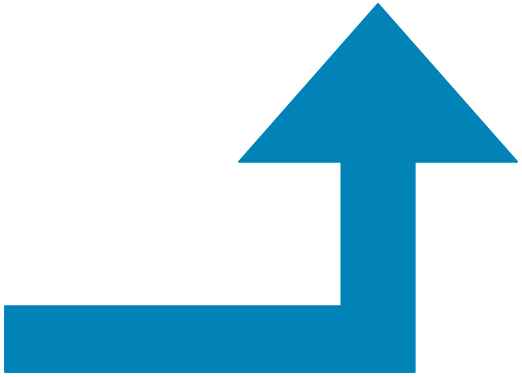
- Historic Growth
- Not built for packet initially
- Diff. Departments
- High OPEX due to layering



Tomorrow

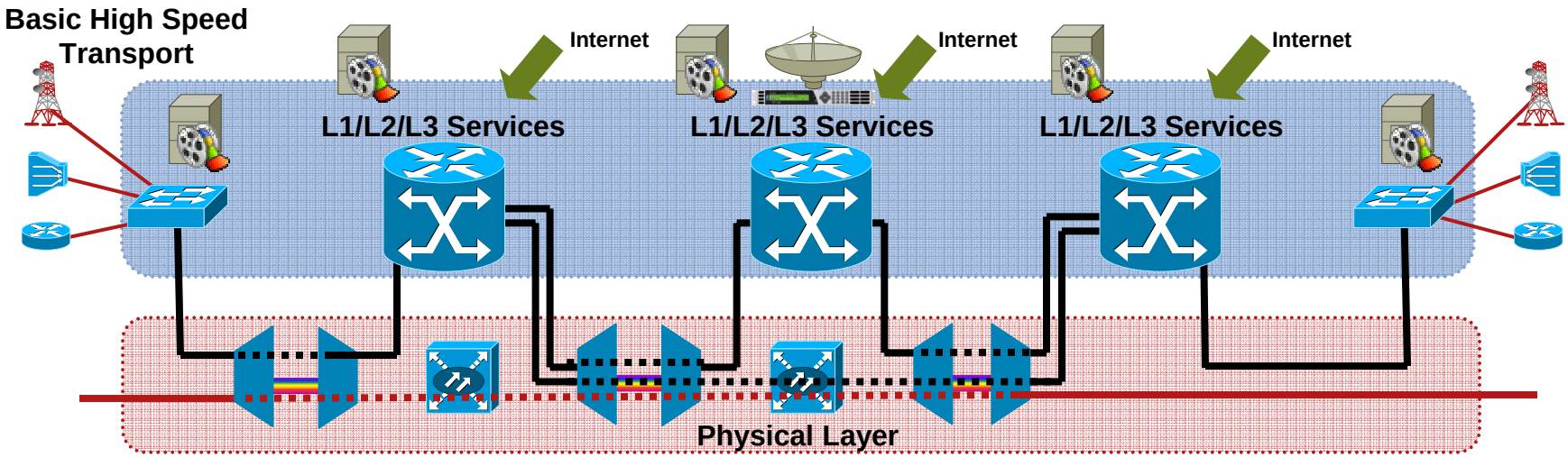


Yesterday



- Evolution not revolution
- Minimal Layering
- Similar control plane in aggregation and core

IP NGN: Converged Topology

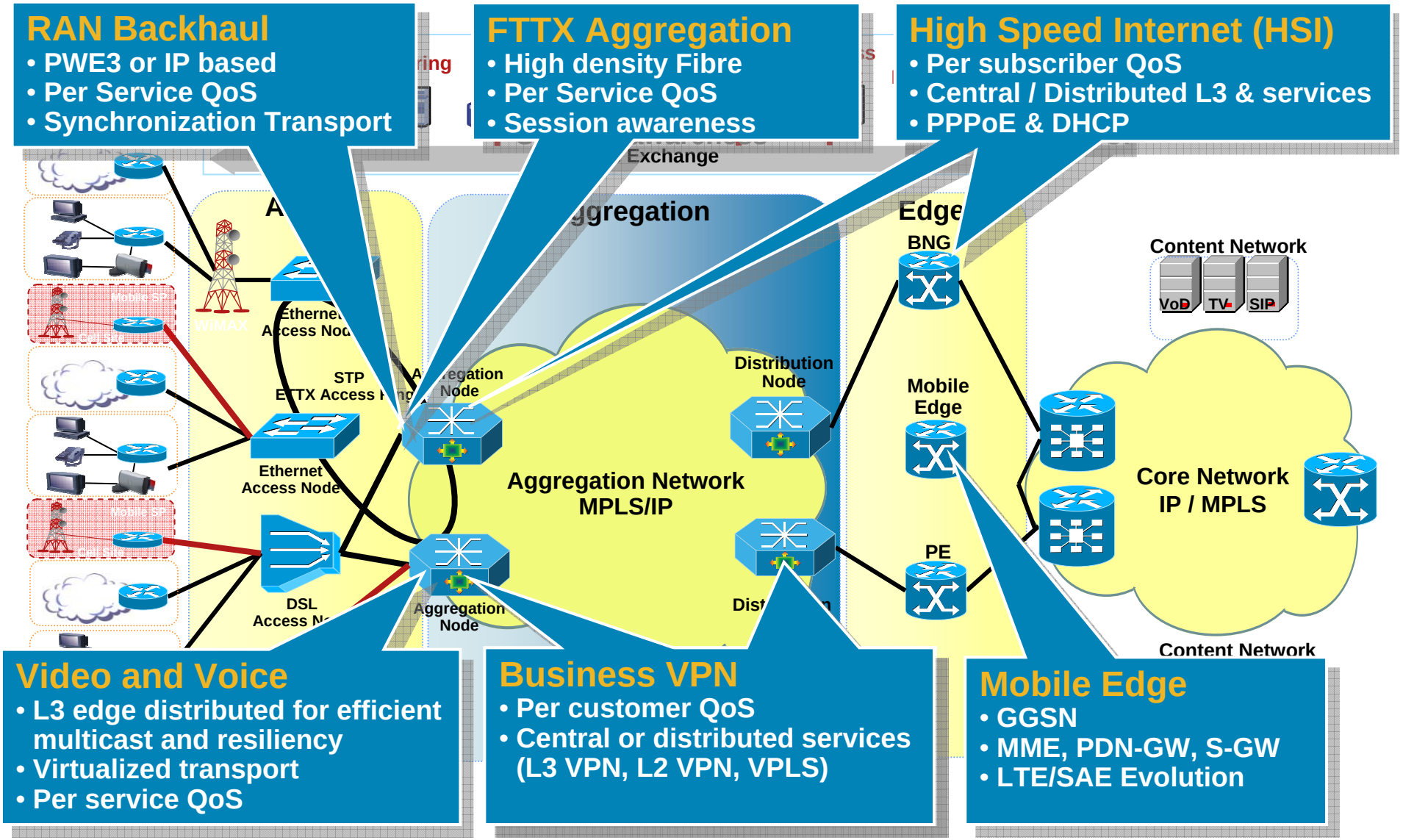


- Optical layer
  - Dark fibre and/or DWDM
  - Basic non-oversubscribed point to point high bandwidth services
  - Under lying transport for IP/MPLS infrastructure
- IP/MPLS
  - Based on an end to end IP/MPLS control plane
  - Concurrent support of L1, L2, L3 services
  - MPLS for ‘Connection oriented’ properties with Traffic Engineering, Path protection (and Link and Node protection!), P2P AND MP2MP, Superior and absolute QoS (RSVP-TE)
- Flexible injection and service points

Agenda

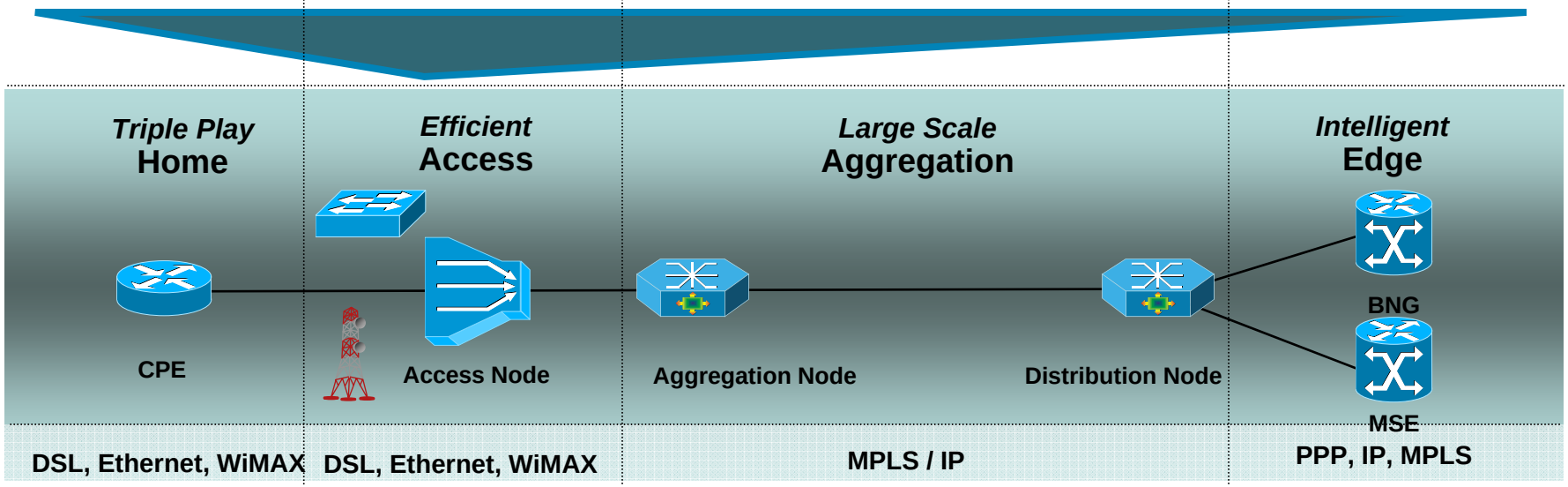
- IP NGN – hvad er det reelt
- Carrier Ethernet – services
- Carrier Ethernet – foundation technologier
  - Flexible ethernet edge
  - QoS
  - Konvergens
  - OAM (hvis vi når det)
  - CaC, Connection Admission Control (hvis vi når det)
  - Og der er flere.....
- Konklusion

Cisco Converged IPNGN Architecture



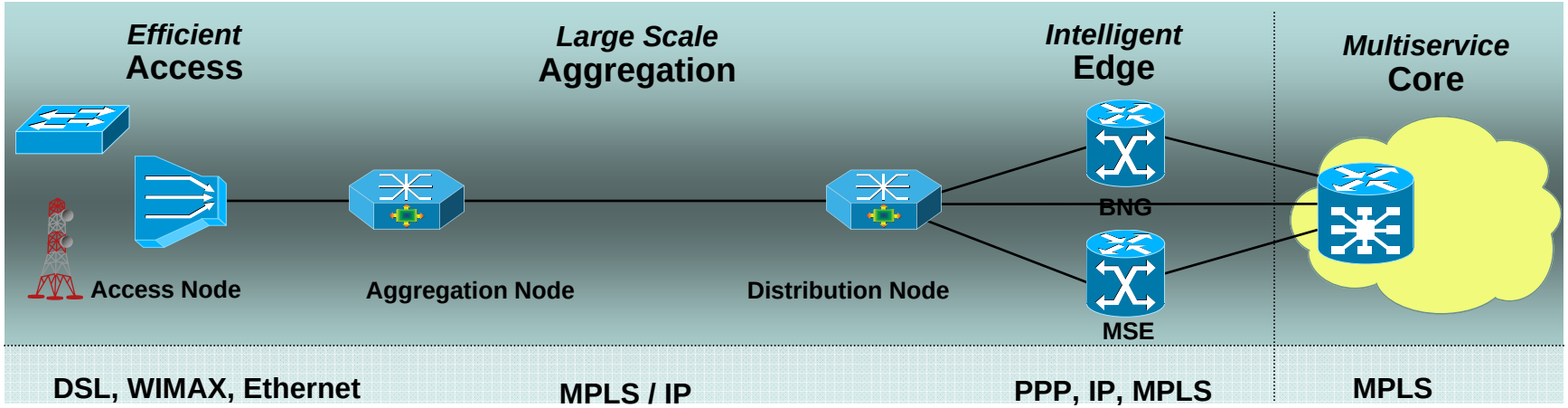
System Components Overview
Carrier Ethernet Aggregation System

CPEs	Access Nodes	Aggregation Node	Distribution Node	Edge Nodes
DSL • Linksys WAG54Gv3, WAG54GP2v2 • Cisco 1800, 2800, 3800 Ethernet: • Telsey CPV, CPL, Tilgin Vood 200 • Cisco 1800, 2800, 3800, 3400 WIMAX • Redmax SU-O	ADSL2+, VDSL, G.SHDSL • EDA 1200 • ISAM 7302/7330 • UTS AN-2000 IB • ZTE FSAP 9800 Ethernet • ME-3400 • 4924, 6524, 6500 WIMAX • Redmax AN-100U+3400	Cisco 7604, 7609S • RSP-720 • ESM 20xGE, 2x10GE, SIP-400/10xGE • Software: 12.2.33SRB EVC 1.5 infrastructure	Cisco 7609S • RSP-720 • ESM 20xGE, 2x10GE, SIP-400 / • Software: 12.2.33SRB EVC 1.5 infrastructure	Cisco 10008 • PRE3, 12.2.31SB R4 Cisco 12400 • SIP-601, 12.0.32SY3



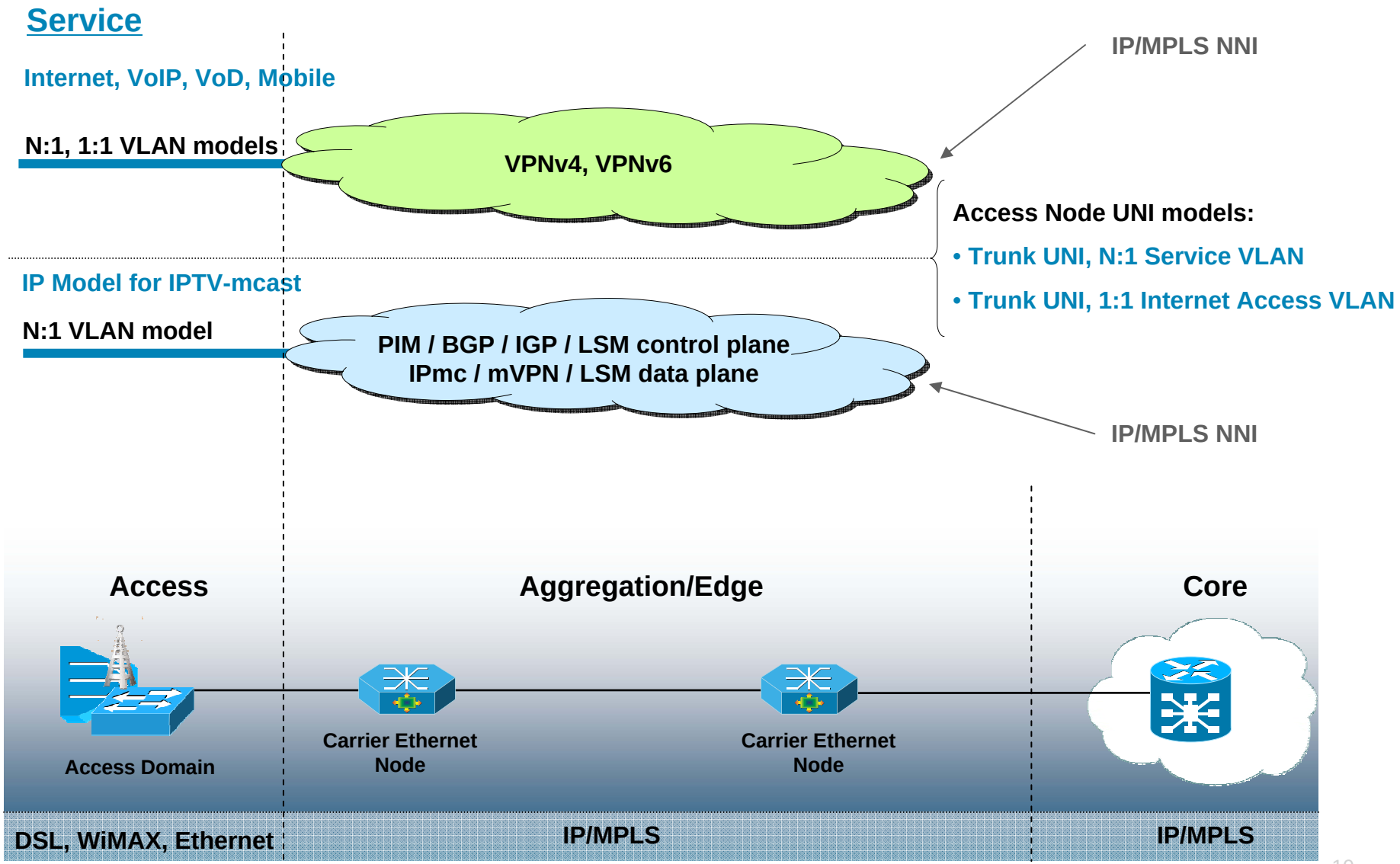
Service Delivery Models

- Overview
- Service Aggregation Models
  - Residential, Business, Wholesale
- Access Node and CPE UNI Models
  - ETTX Access Rings and xDSL Access
- IP and Ethernet Services Edge Models



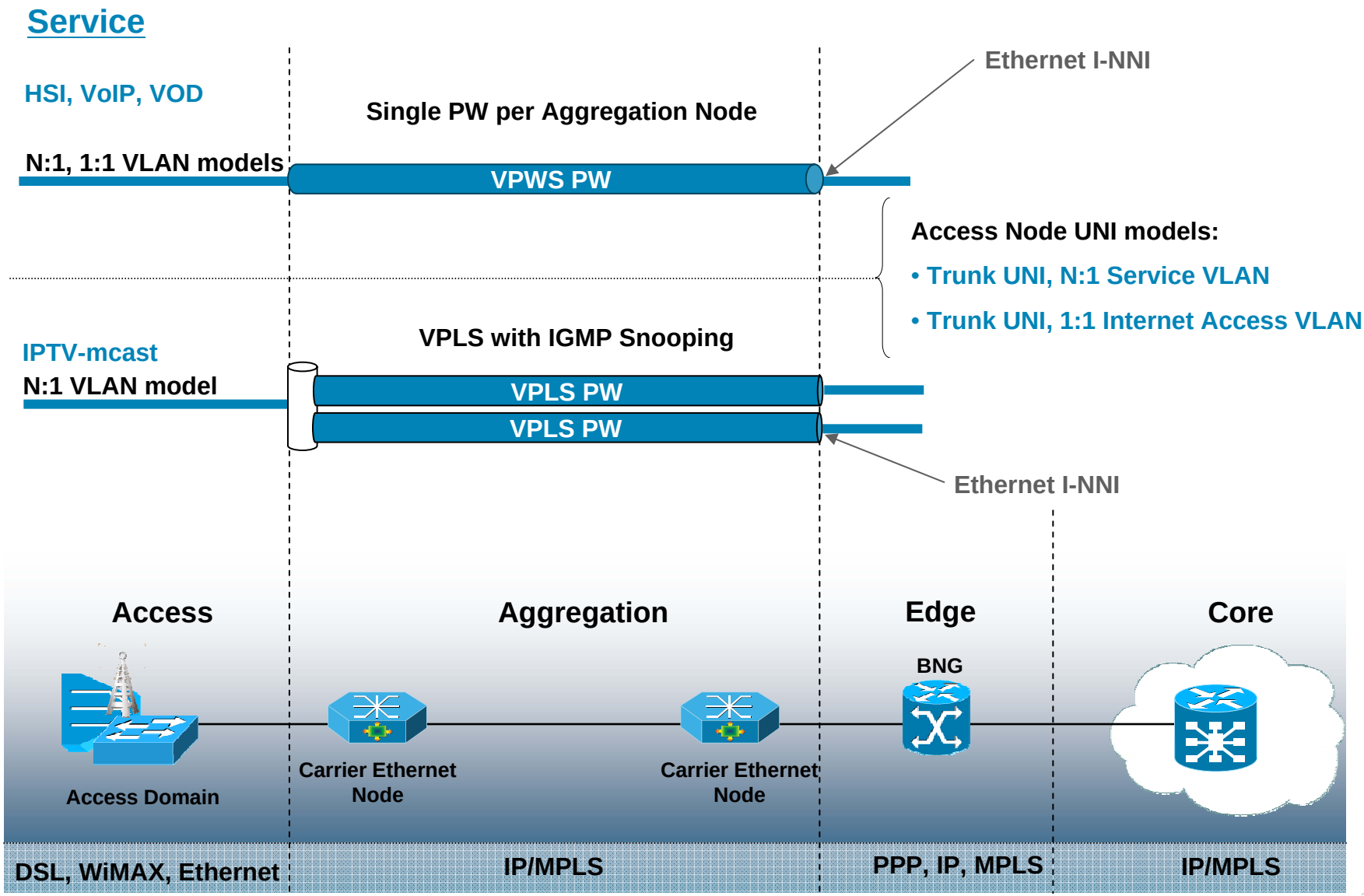
Residential Services Architecture

Distributed Edge



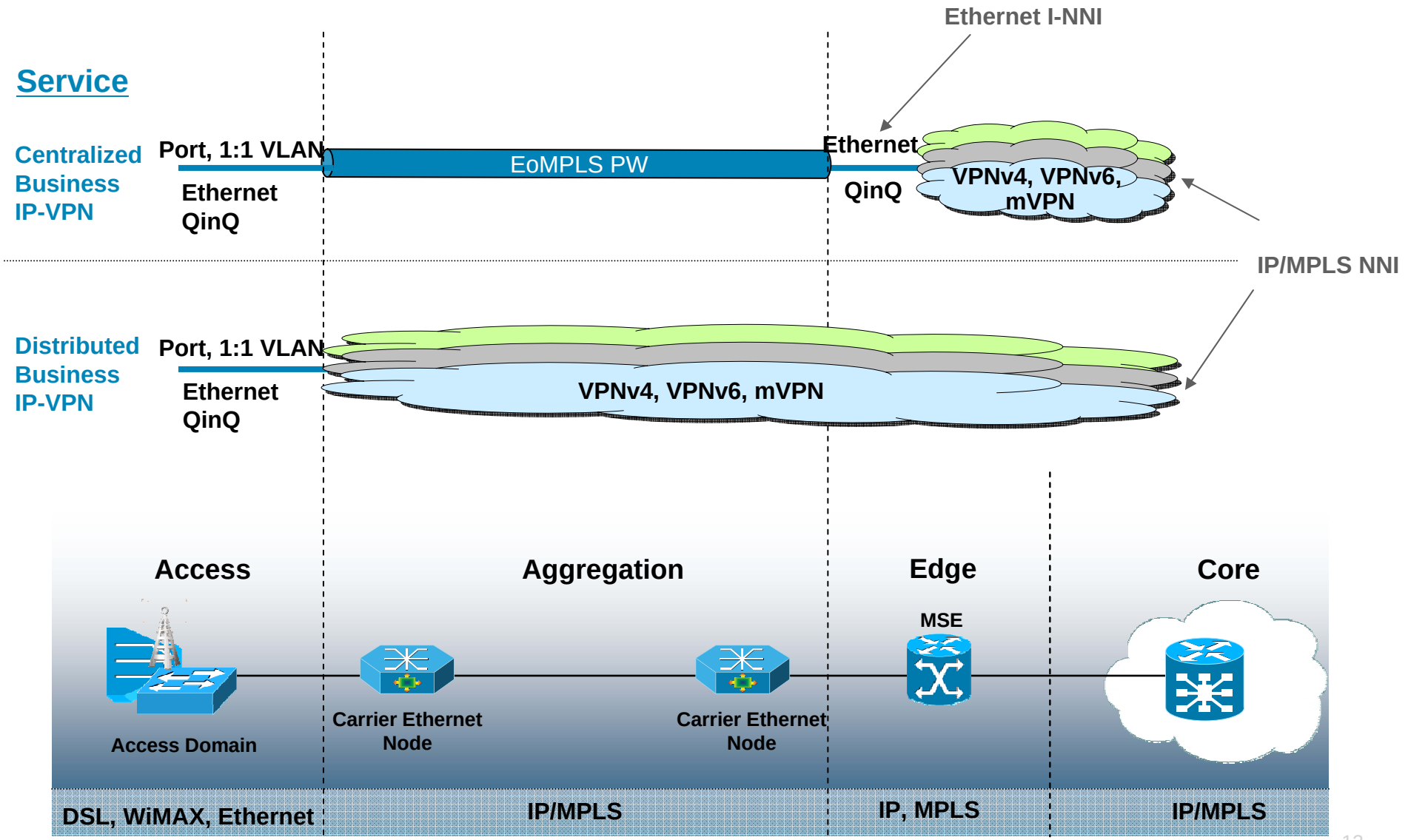
Residential Services Architecture

Centralized Edge with L2 MPLS Backhaul



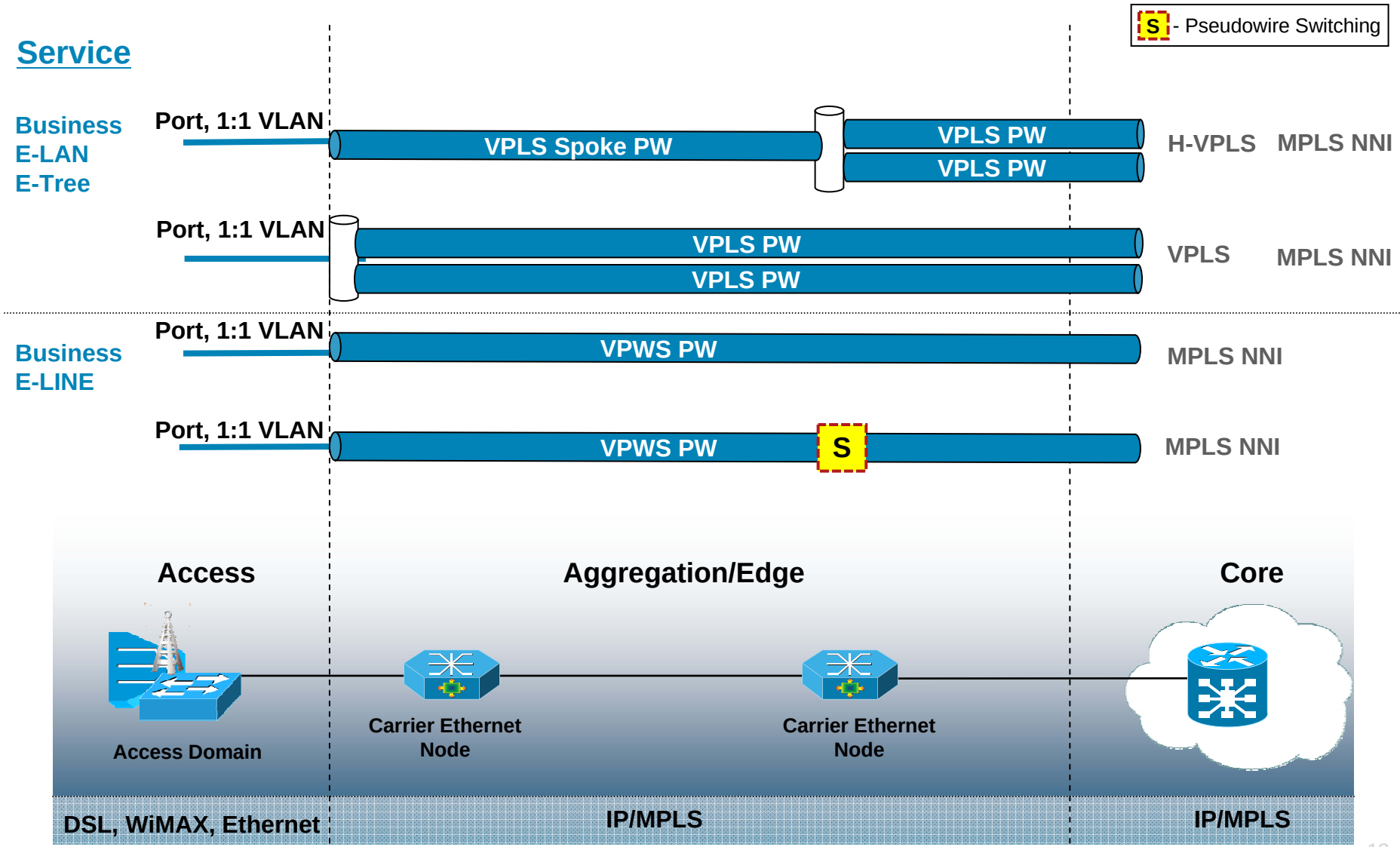
L3 Business Services Architecture

Centralized and Distributed Edge



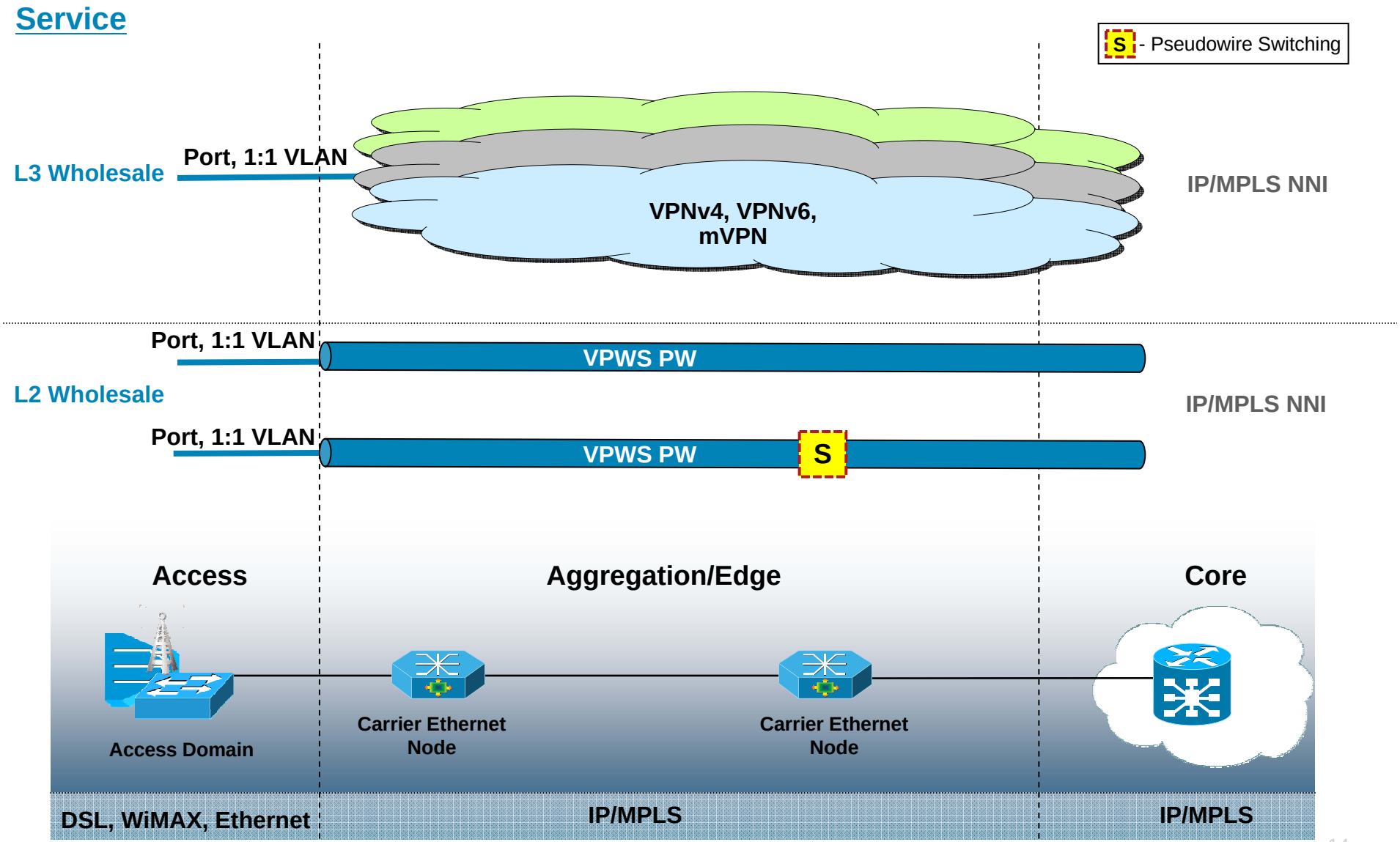
L2 Business Services Architecture

E-Line, E-LAN and E-Tree Services



Wholesale Services Architecture

L3 and L2 Transport Models



Agenda

- IP NGN – hvad er det reelt
- Carrier Ethernet – services
- Carrier Ethernet – foundation technologier
  - Flexible ethernet edge
  - QoS
  - Konvergens
  - OAM (hvis vi når det)
  - CaC, Connection Admission Control (hvis vi når det)
  - Og der er flere.....
- Konklusion

Flexible Ethernet Edge Requirements

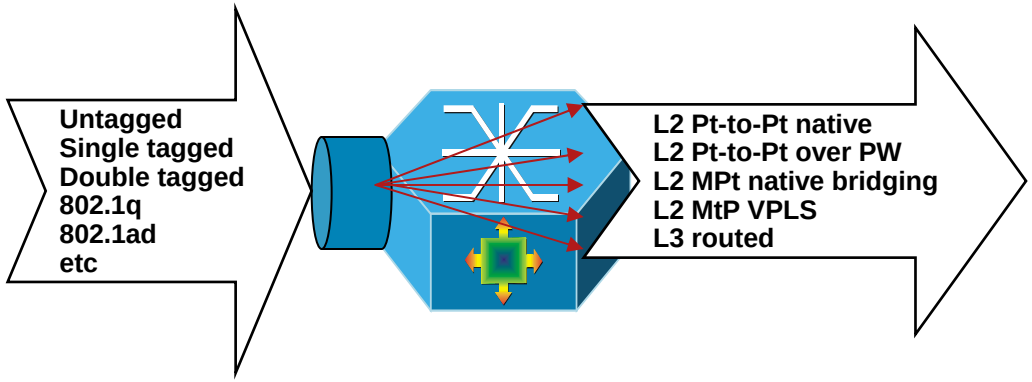
Adaptable Ethernet UNI

- Support all Ethernet Encapsulations

  802.1Q, 802.1ad, Q-in-Q, 802.1ah
- Flexible VLAN tag manipulation and translation
- Flexible frame to service mapping
- Multiple services on the same port (multiplexed UNI)
- Local VLAN significance (per-port)

Service functions

- In/out H-QoS
- Security
- High Availability
- OAM and SLA monitoring
- Flexible connectivity models
- Service instance scalability
- Standards based



Enabling Multiservice Aggregation

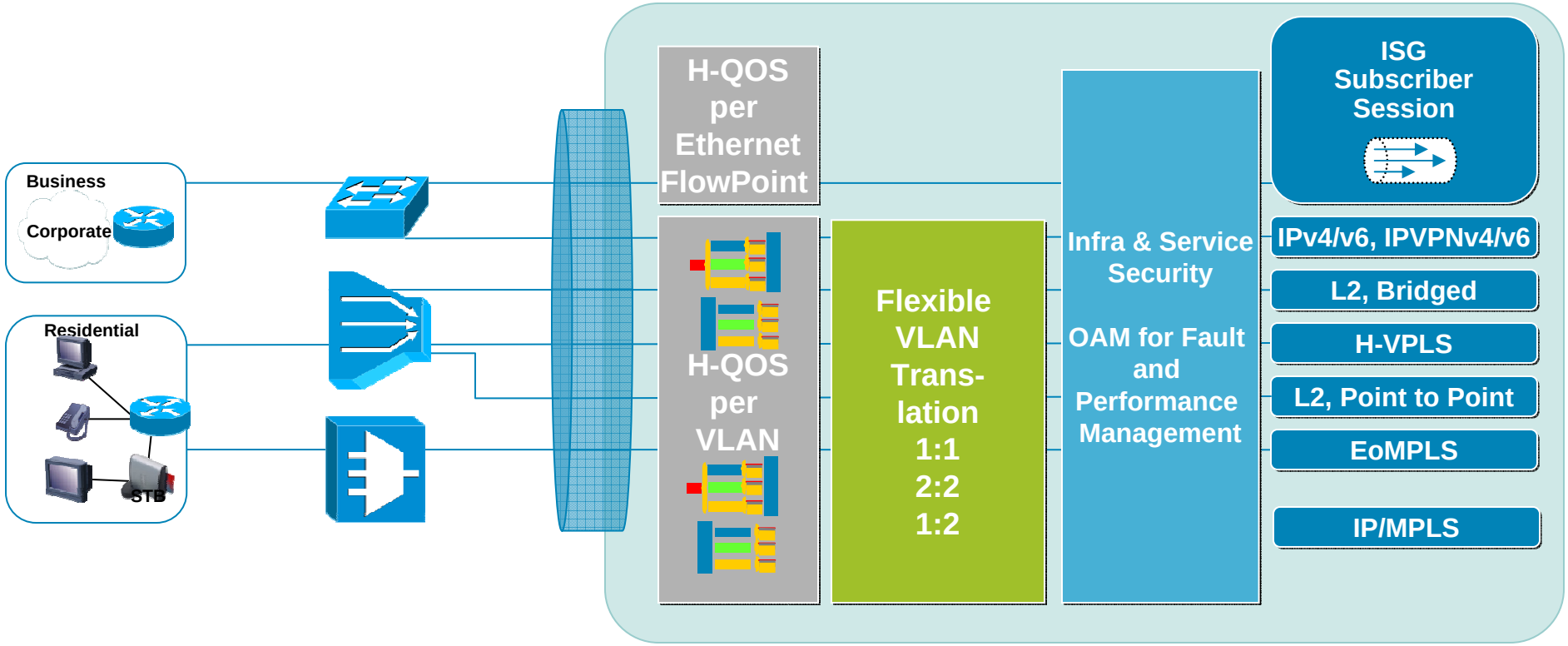
With Flexible Carrier Ethernet UNI – Cisco EVC

Flexible Mapping of subscribers to services

Flexible VLAN translation

Dynamic Residential Subscriber Sessions with RADIUS

Business VPN L2&L3 Bitstream wholesale, E-Line, E-LAN, E-Tree Services

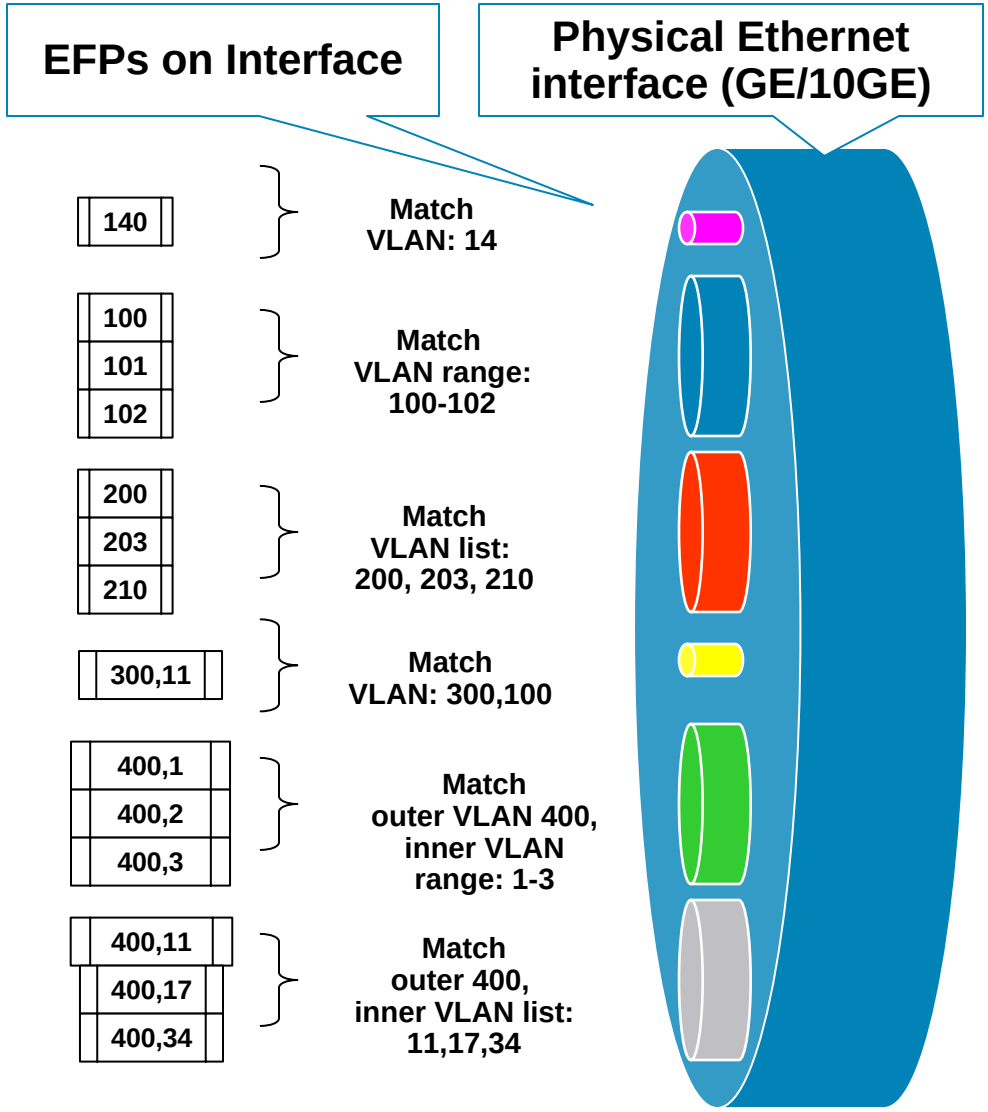


Cisco EVC UNI

Flexible Frame Matching with Ethernet Flow Points

EFPs ...

- Provide classification of L2 flows on Ethernet interfaces
- Are also referred to as EVC service-instances
- Support dot1q and Q-in-Q
- Support VLAN lists
- Support VLAN ranges
- Support VLAN Lists and Ranges combined
- Coexist with routed subinterfaces
- Both EFPs and routed Subinterfaces support H-QOS
- Future integration with Radius Infrastructure for L2 AAA



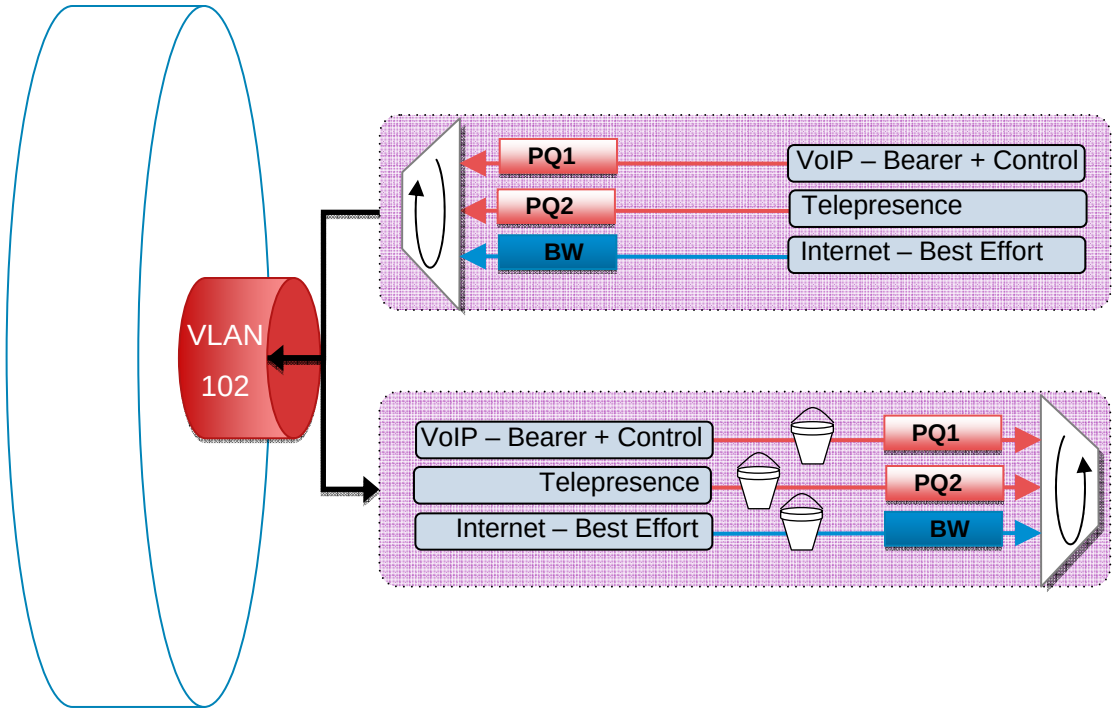
Agenda

- IP NGN – hvad er det reelt
- Carrier Ethernet – services
- Carrier Ethernet – foundation technologier
  - Flexible ethernet edge
  - QoS
  - Konvergens
  - OAM (hvis vi når det)
  - CaC, Connection Admission Control (hvis vi når det)
  - Og der er flere.....
- Konklusion

Theme of Application Management Emerges
Transport Services vs. Managed Application Services

Transport Service	Managed Application Service
▪ Service = CIR/PIR pipe with applications hosted by third parties ▪ SLA defined by transport parameters ▪ Residential HSI = 5Mbps down, 1Mbps up, no guarantee for streaming quality ▪ Business VPN = CIR and PIR, jitter, delay, loss guarantees, no app. guarantees	▪ Application hosted by provider ▪ SLA is defined by Quality of Experience (QoE) expectation ▪ Video = One artifact per two-hour movie ▪ Voice = No sound quality impairments, blocked calls rare
Network QoS Requirements ▪ Shape and drop packets over CIR, leverage TCP back-off ▪ QoS can change dynamically per sub (turbo button, bandwidth on demand) ▪ Transport SLA must be enforced per subscriber	Network QoS Requirements ▪ QoE mapped to network QoS requirements ▪ QoS same for all subs of a particular app ▪ No need to enforce transport SLA per sub, user per-service SLA instead
HSI and Business VPNS	**Residential VoIP and Video**

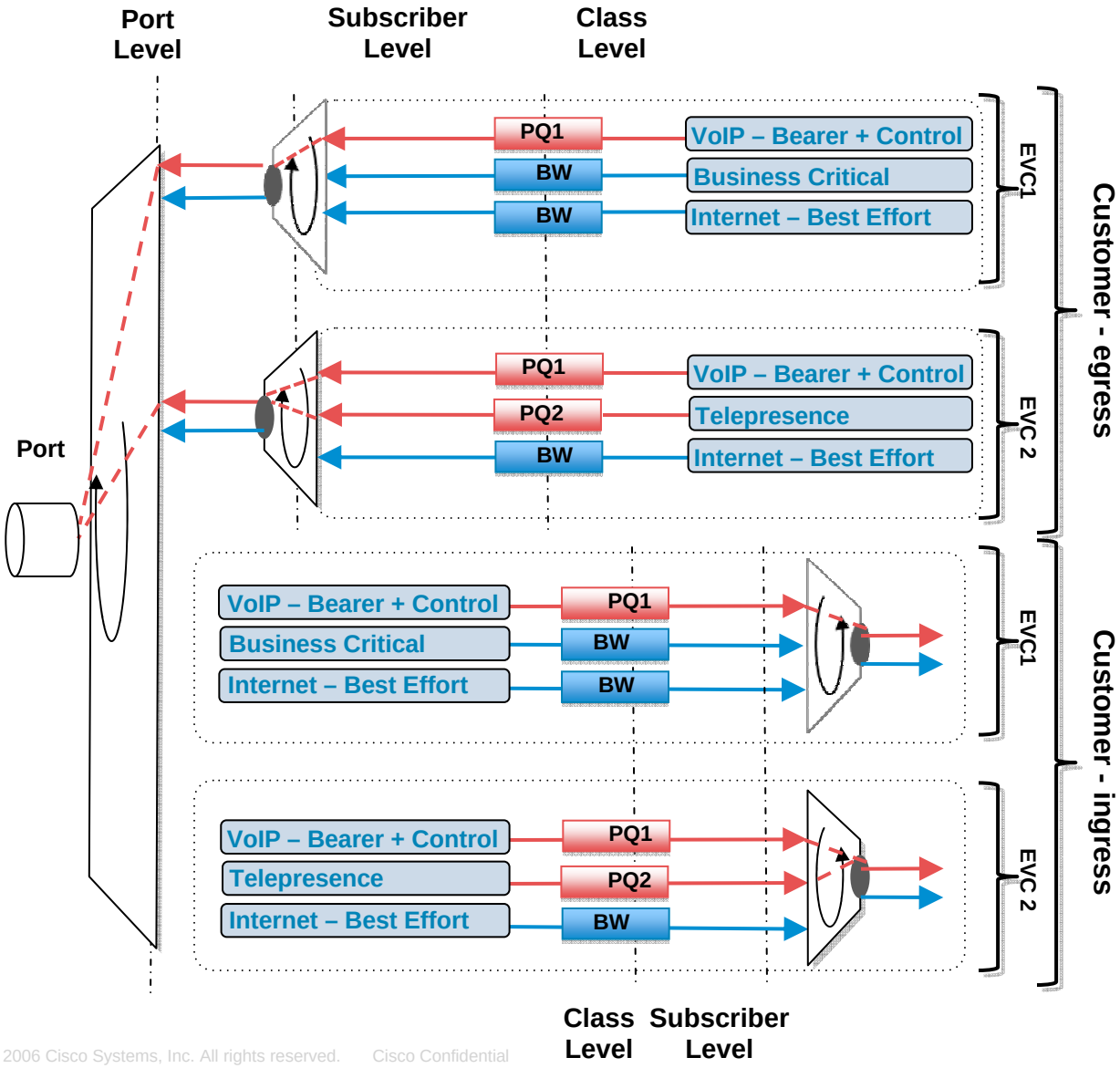
UNI SLA QOS Enforcement



- **Symmetric** (ingress / egress) enforcement of max / min bandwidth and DiffServ behaviour per customer (VLAN)
- **Hierarchical** scheduling & shaping
- **Dual Priority Queue** for Voice and Video
- **Scalable** (thousands of customers/VLANs)

Linecards with Scalable H-QoS

3-Level Hierarchy Example



Agenda

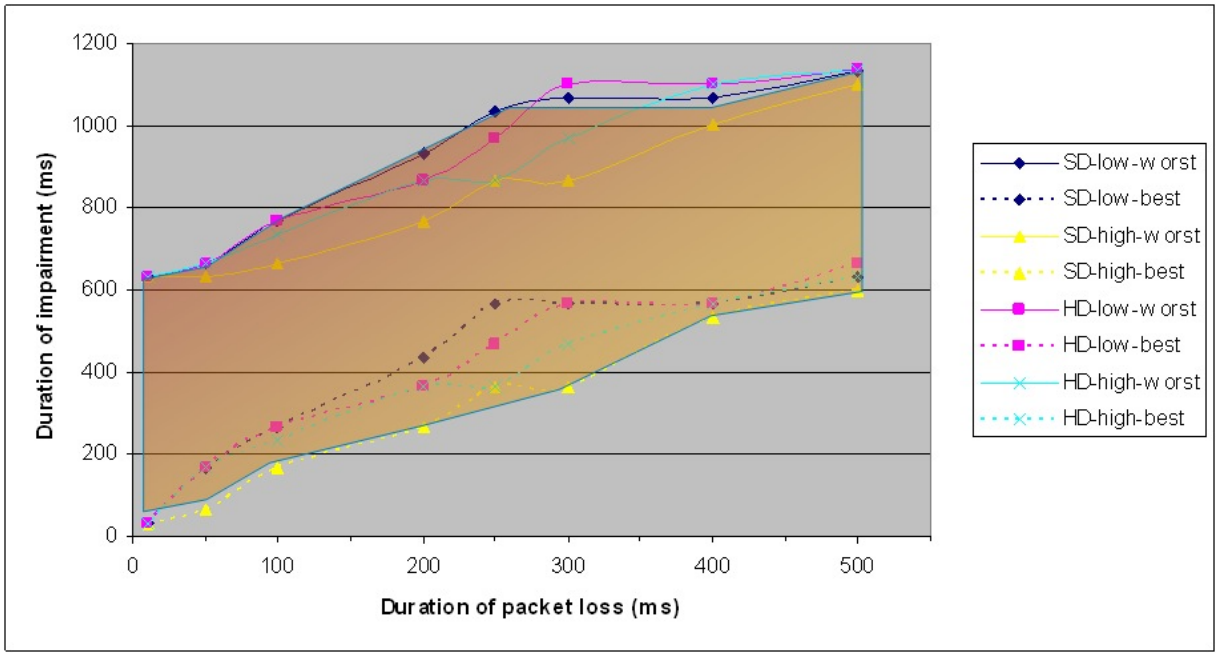
- IP NGN – hvad er det reelt
- Carrier Ethernet – services
- Carrier Ethernet – foundation technologier
  - Flexible ethernet edge
  - QoS
  - Konvergens
  - OAM (hvis vi når det)
  - CaC, Connection Admission Control (hvis vi når det)
  - Og der er flere.....
- Konklusion

Tight SLAs – Requirements

- **End-to-End fast service recovery for all network failures**
  - Common target of 50msec - reference from SONET/SDH world
  - But often not required for all services..
- **Challenge with packet-based networks**
  - Diversity of L1, L2 and L3 technologies (i.e. Optical, Ethernet, IP)
  - Inter-working between those technologies
  - Diversity of network topologies
  - Diversity of service types
- **Strong requirement for optimal design and operational simplicity**

Fast Convergence - MPEG Video Example

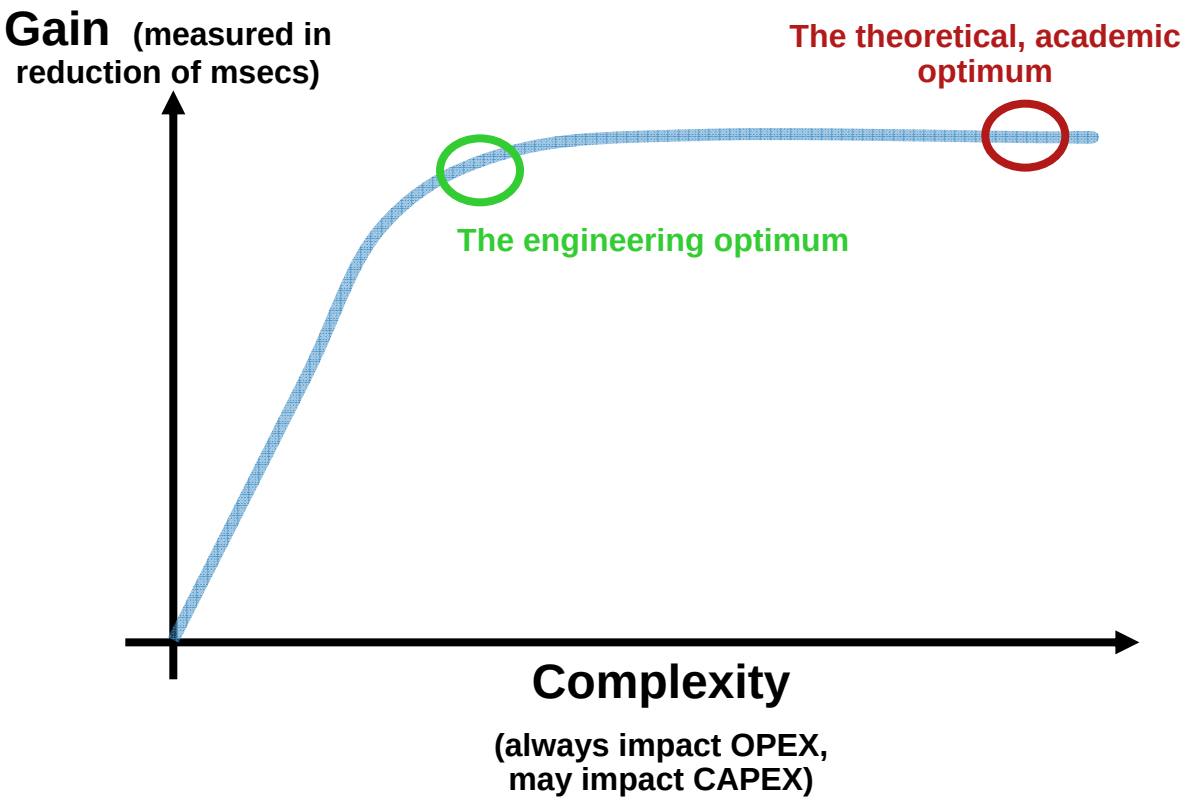
Real vs. Perceived Requirements



- <1 or 2 seconds: humans do not bother
- <200msec: humans do not notice
- <50msec: humans have a perception of being better off

Requirements often dictate complexity of the design

Tight SLAs and The Simplicity Principle



Simplicity should be the guiding rule of all Tight SLA designs

Tight SLAs for CE/MPLS Infrastructure

Technology Options Overview

- **Service Recovery = Protection (super-fast) and Restoration (fast)**
- **IP/MPLS fast convergence baseline has improved dramatically**

  IGP Fast Convergence (FC) broke the barrier of <200msec restoration time

  Powerful and simple baseline tool for all L2 and L3 services, covering multiple failures

  Combined with BGP PIC* ensures fast convergence for IP/IPVPN service edge

  It is simple – a built-in property of the IP/MPLS network

- **Protection with IP Fast ReRoute (FRR)**

  Tool to improve on IGP FC for some topologies (e.g. Two-plane designs)

  Provides local protection with <50msec recovery

- **Protection with MPLS TE FRR**

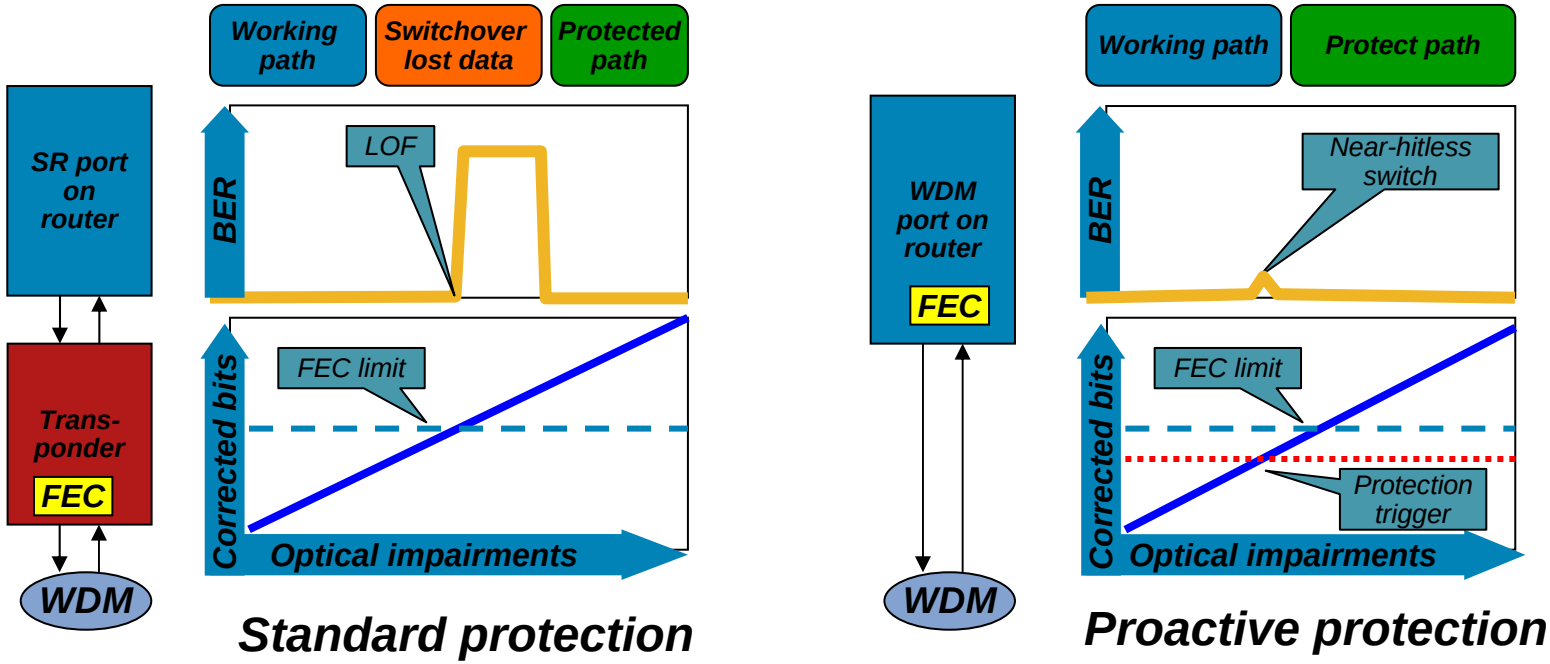
  Local Link and Node Protection for deterministic <50msec recovery

  Seamless service restoration (make-before-break)

  Applies to all transit MPLS link and node failures

*** BGP PIC – BGP Prefix Independent Convergence**

IP/MPLS optical integration - IPoDWDM



IP / optical integration enables the capability:

- **To identify degraded link using optical data (per-FEC BER)**
- **Start protection (i.e. by signaling to the IGP) before traffic starts failing, achieving hitless protection in many cases**

MPLS FRR, IP FRR, IS-IS fast convergence : all achieve near zero outage for slow failures

Tight SLAs for L3 Services

- **Leverage IP/MPLS infrastructure tight-SLA technologies**
  - IGP Fast Convergence
  - MPLS TE FRR
  - MPLS IP FRR
- **Optimize L3 PE forwarding plane for fast convergence**
  - BGP Prefix Independent Convergence
  - IP Multicast PIM Fast Convergence
  - Multicast only Fast ReRoute (MoFRR)

Multicast only Fast Reroute (MoFRR)

- MoFRR = Multicast only Fast Reroute

  Misnomer – no relation to MPLS TE FRR

- MoFRR provides the capability to instantiate resilient multicast trees for the same content

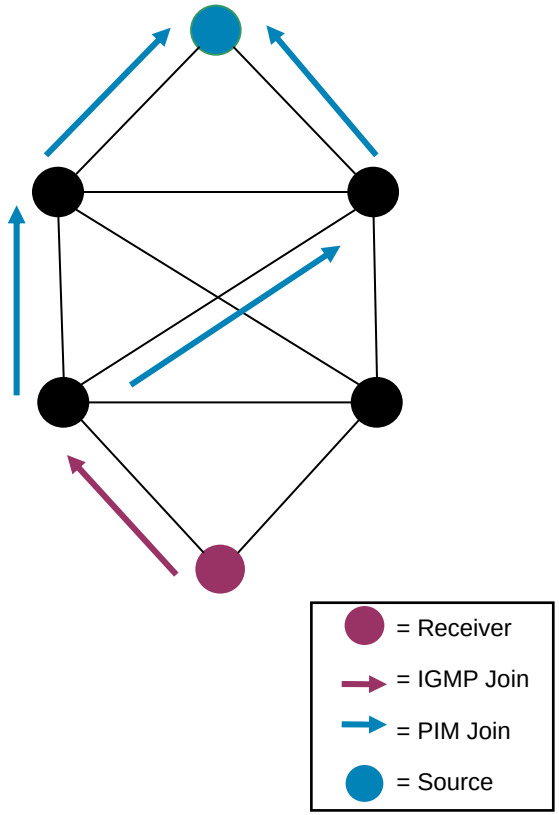
  If receive IGMP or PIM join on downlink and have multiple paths to source send joins on two paths

  Leverage IGP Link-State database and knowledge of how networks are designed to ensure streams are path diverse

  Feed connected receivers from only one of the two received streams

  Monitor the health of the primary stream and upon failure, use the secondary

- A simple approach from a design and deployment and operations perspective
- Can be used for both lossy and lossless approaches and be implemented in the network or on the video end system
- MPLS TE and MTR are options in topologies that do not support MoFRR
- See [FARINACCI]



Agenda

- IP NGN – hvad er det reelt
- Carrier Ethernet – services
- Carrier Ethernet – foundation technologier
  - Flexible ethernet edge
  - QoS
  - Konvergens
  - OAM (hvis vi når det)
  - CaC, Connection Admission Control (hvis vi når det)
  - Og der er flere.....
- Konklusion

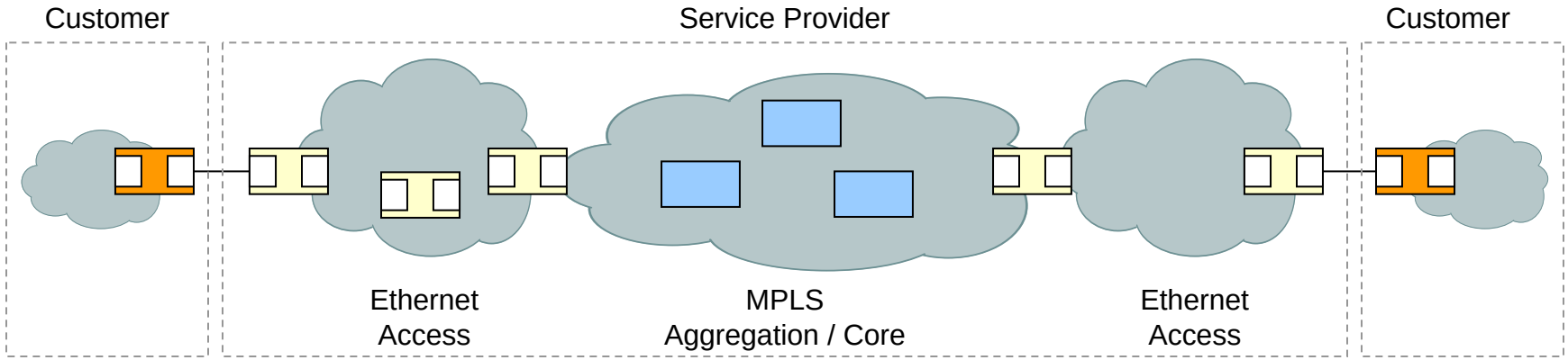
Streamlining MPLS Ethernet Operations

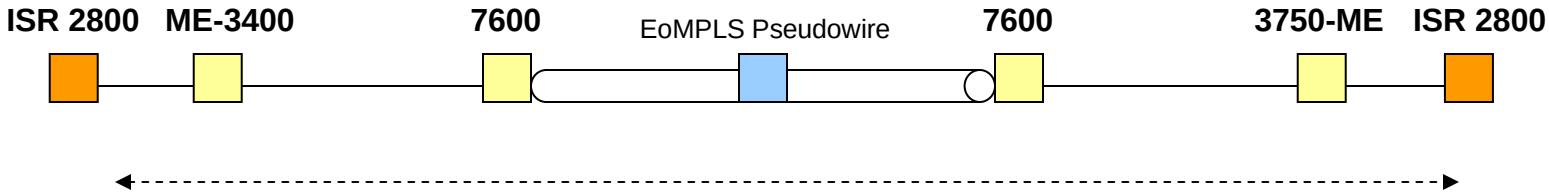
End-to-End OAM Requirements

- **Ethernet and IP/MPLS network instrumentation and OAM are key requirements**
  - Fundamental for fault management and performance monitoring for both transport and service layers
  - Rich instrumentation and OAM translates into operational savings for carriers
- **IP/MPLS and Ethernet already provide very extensive instrumentation**
  - Based on dynamic control plane and OAM
- **Number of MPLS Ethernet OAM enhancements**
  - Number of MPLS OAM enhancements – VCCV-BFD, MS-PW OAM
  - MPLS and Ethernet OAM inter-working for event translation
- **Any end-to-end OAM scheme must be simple and optimized**
  - Because it must be super reliable
  - And have minimal operational overhead

Deploying Carrier Ethernet OAM

Ethernet Layer 2 VPN services

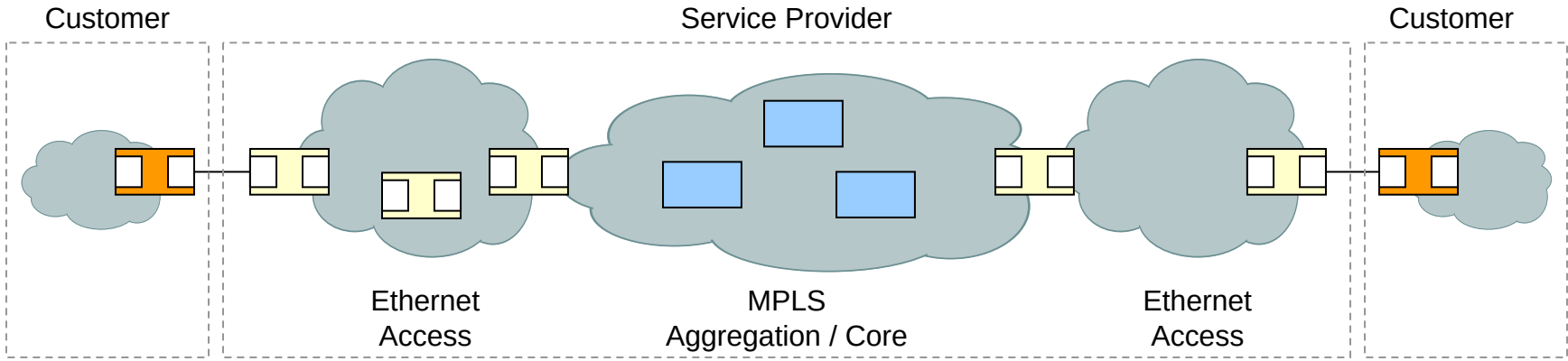


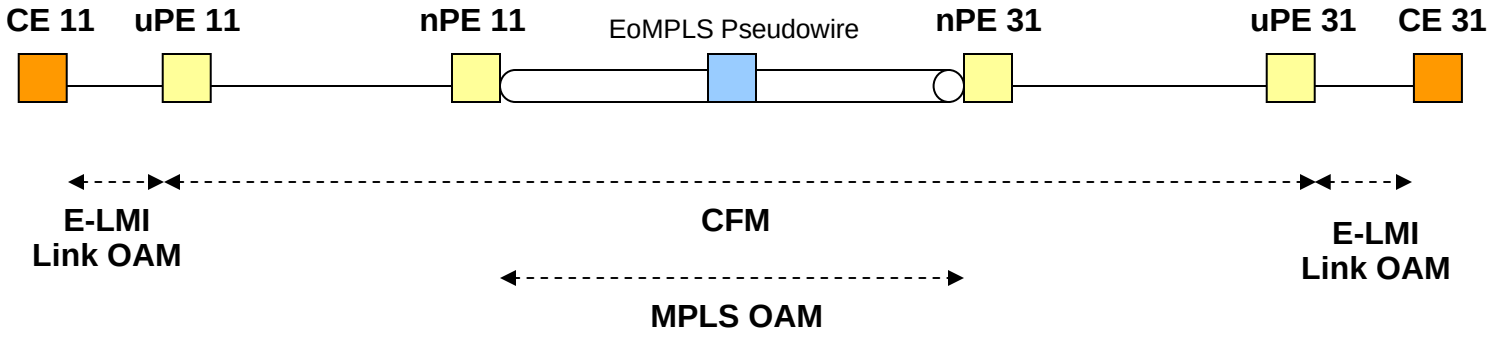


Point-to-Point Ethernet Service

Deploying Carrier Ethernet OAM

Ethernet Layer 2 VPN services



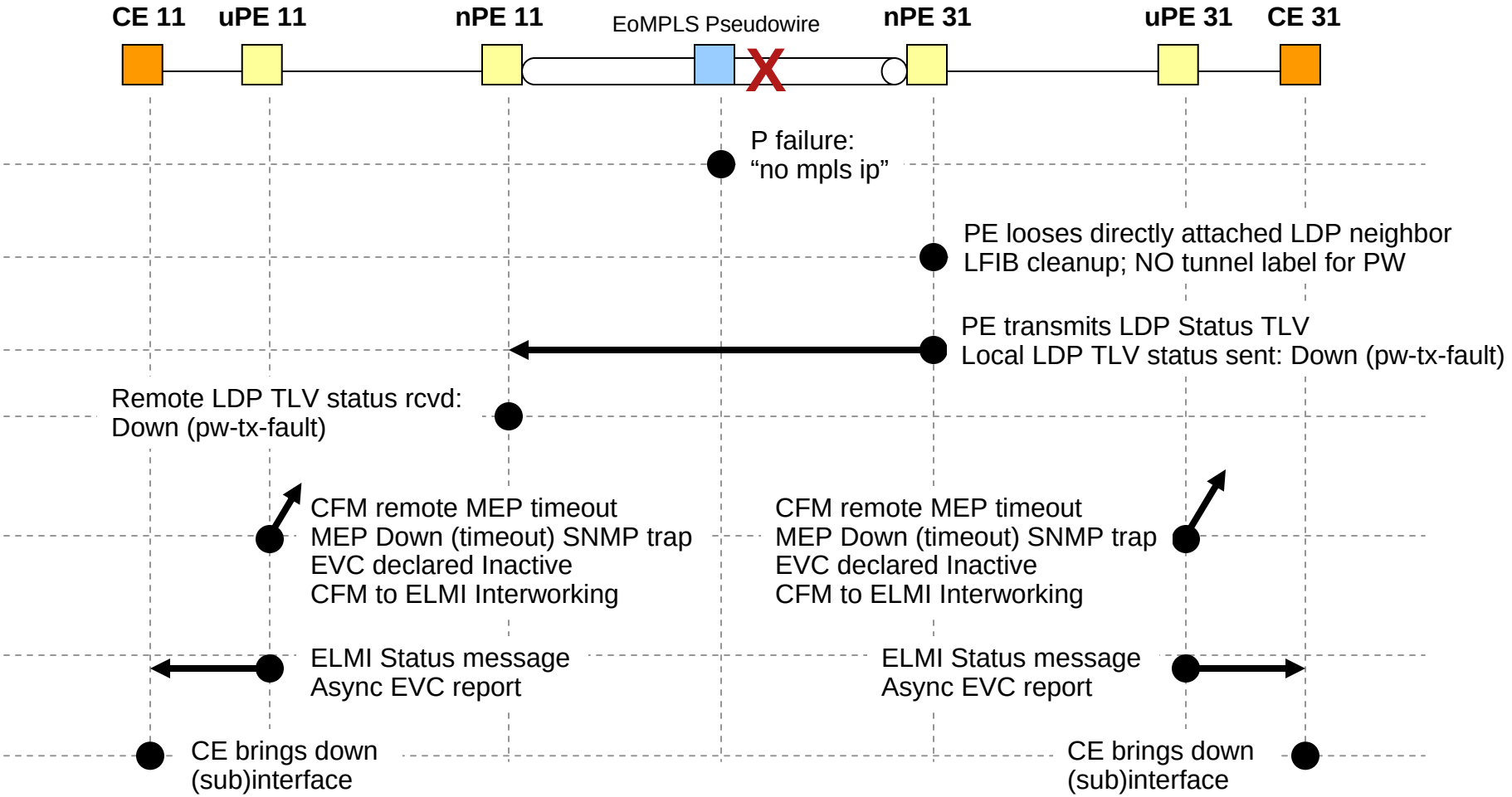


OAM protocol positioning

Deploying Carrier Ethernet OAM

Ethernet Layer 2 VPN services

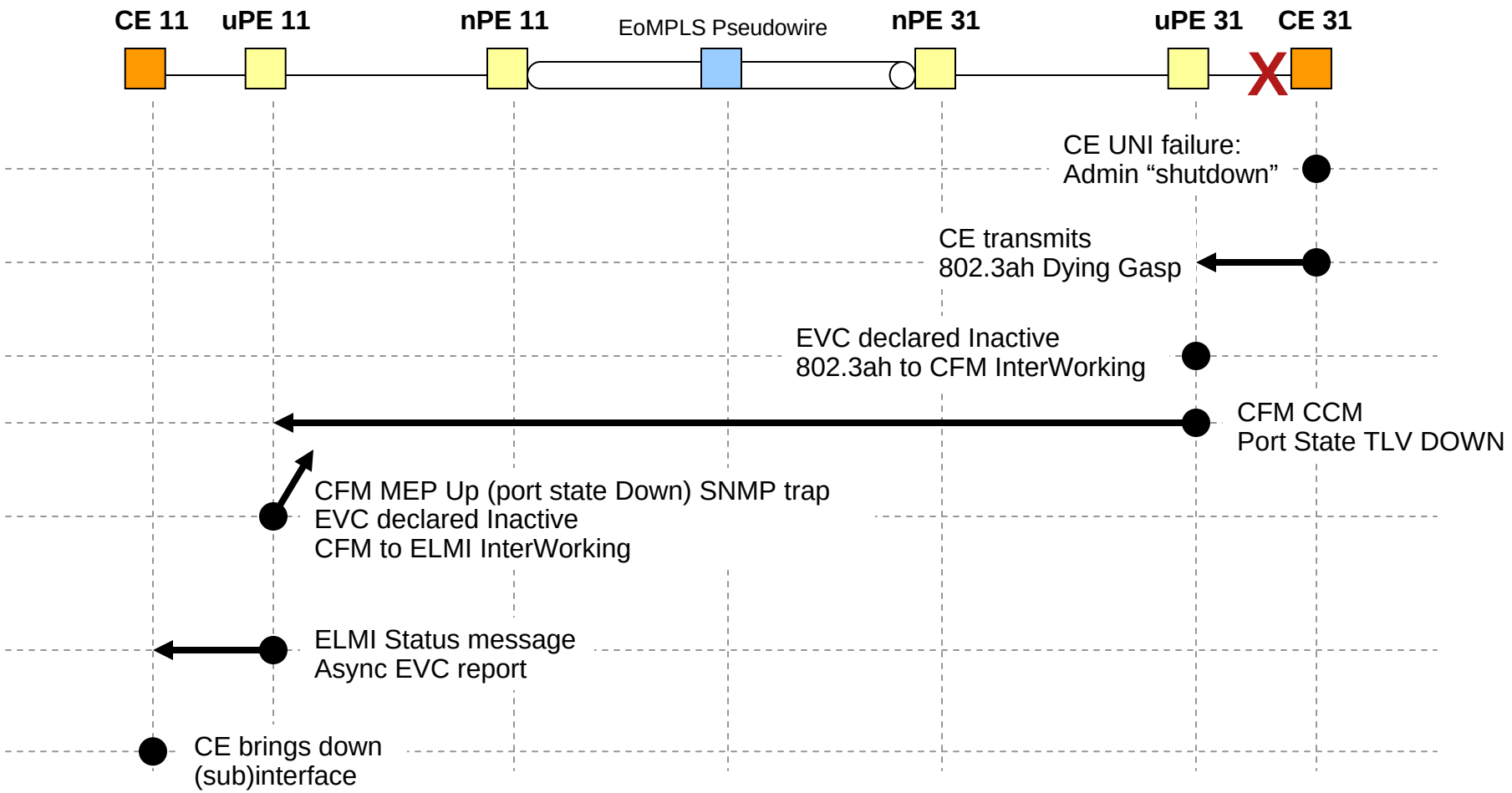
Failure scenario: MPLS P node



Deploying Carrier Ethernet OAM

Ethernet Layer 2 VPN services

Failure scenario: UNI failure

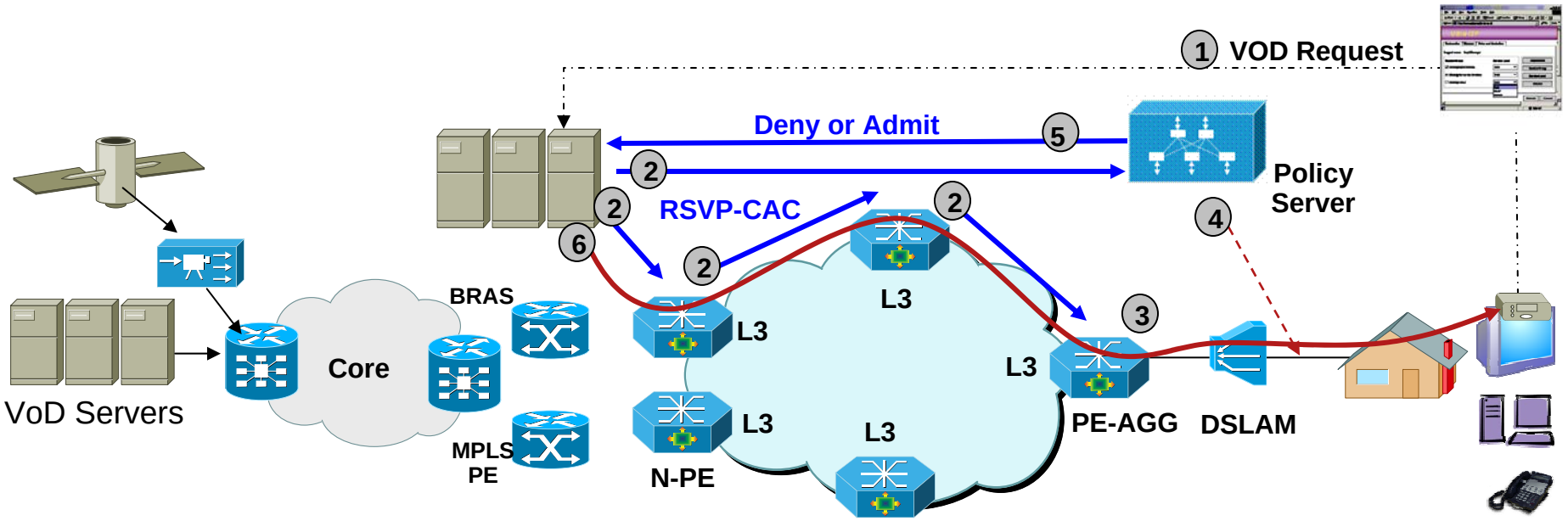


Agenda

- IP NGN – hvad er det reelt
- Carrier Ethernet – services
- Carrier Ethernet – foundation technologier
  - Flexible ethernet edge
  - QoS
  - Konvergens
  - OAM (hvis vi når det)
  - CaC, Connection Admission Control (hvis vi når det)
  - Og der er flere.....
- Konklusion

Cisco's Integrated Video CAC

- **Integrated Video CAC approach combines two methods**
  - **On-path RSVP-CAC**
    - **Topology aware, handles dynamic topology changes**
    - **DSCP based implementation eliminates scale challenges experienced with Intserv**
    - **Proven scale – tested to 50-100.000 sessions with 500 set ups per second**
    - **Layer 3 required at PE-AGG to implement path-based CAC**
  - **Off-path CAC based on Policy Server for DSL line congestion**
- **VOD stream will be denied if business rules of either fail**
- **Prioritize blocking of Free VOD vs. Pay VOD in network failure scenarios**



Agenda

- IP NGN – hvad er det reelt
- Carrier Ethernet – services
- Carrier Ethernet – foundation technologier
  - Flexible ethernet edge
  - QoS
  - Konvergens
  - OAM (hvis vi når det)
  - CaC, Connection Admission Control (hvis vi når det)
  - Og der er flere.....
- Konklusion

Konklusion

- **Carrier Ethernet Arkitektur**
  1. **Testet – Cisco NSITE**
  2. **Testet – uafhængigt, se http://www.lightreading.com/document.asp?doc_id=126173&print=true**
- **Husk altid – SSS ☺**
  - **Simple**
  - **Scalable**
  - **Supportable**