Cisco Expo 2009

Modern Day SP Architectures

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Agenda

1. Business Concerns and Trends
2. Cisco's NGN Approach
3. Network Architectures
4. High Availability

Business Concerns

Achieve Investment Transformation

1. **Significantly Reduce Operating Costs (OpEx)**
2. **Save Capital Expenditure (CapEx)**
3. **Protect Investments**

Achieve Network Transformation

1. Reduce Network Complexity
2. Scale the Network
3. Converge Business and Consumer Networks

Achieve Services Transformation

1. Increase Service Flexibility and Reliability
2. Offer New Revenue Generating Services
3. Offer Service Personalization

Investment Protection: Cross Platform Integration with SPA

Simpler Operations, Lower Spares Inventory Across the Edge/Aggregation and Core Network

Shared Port Adapters (SPA)

FE/GE/10GE, POS, TDM, Circuit Emulation, ATM

Same Interfaces Edge to Core

Cisco 7304

Cisco 10000 Series

Cisco 7600 Series

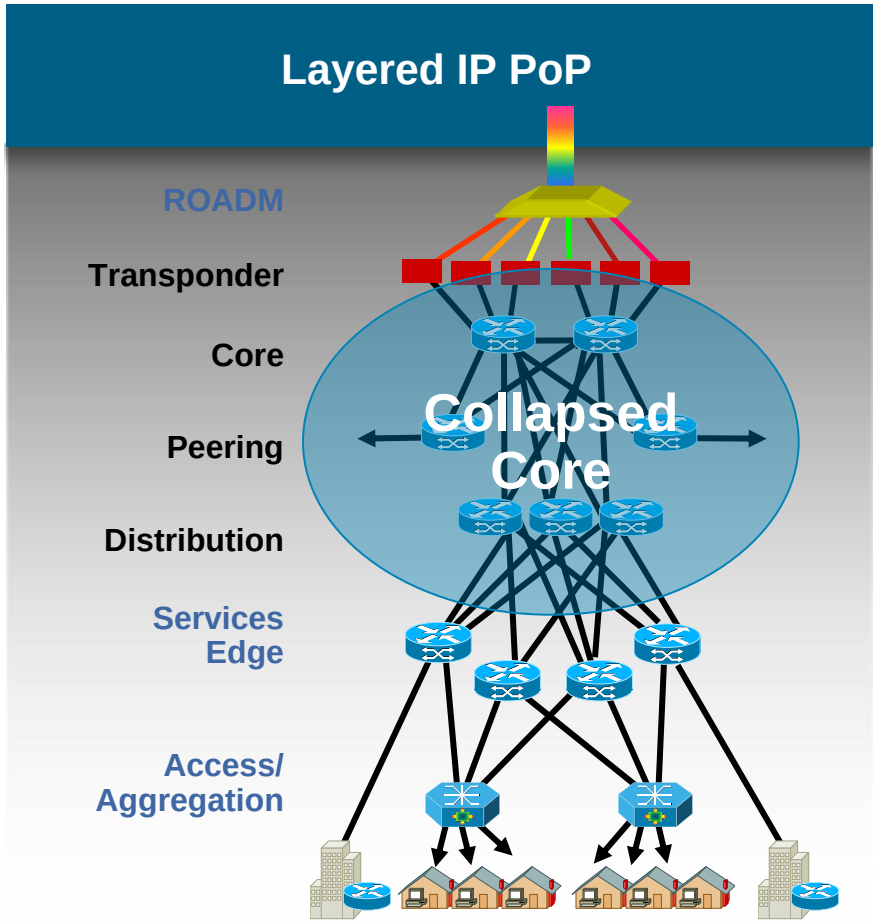
Cisco XR 12000 Series

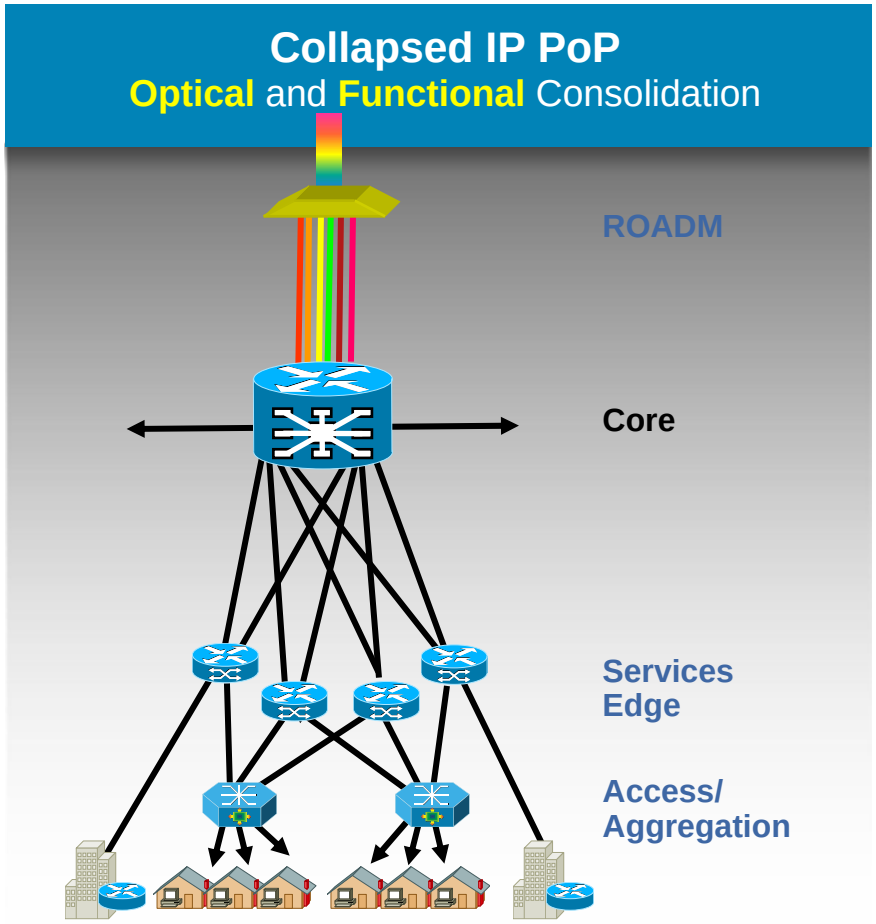
Cisco CRS-1 4, 8, 16 Slot

Cisco CRS-1 MC

No Mixed PICS! Complete Investment Protection

Reduce Network Complexity
Efficient PoP Design

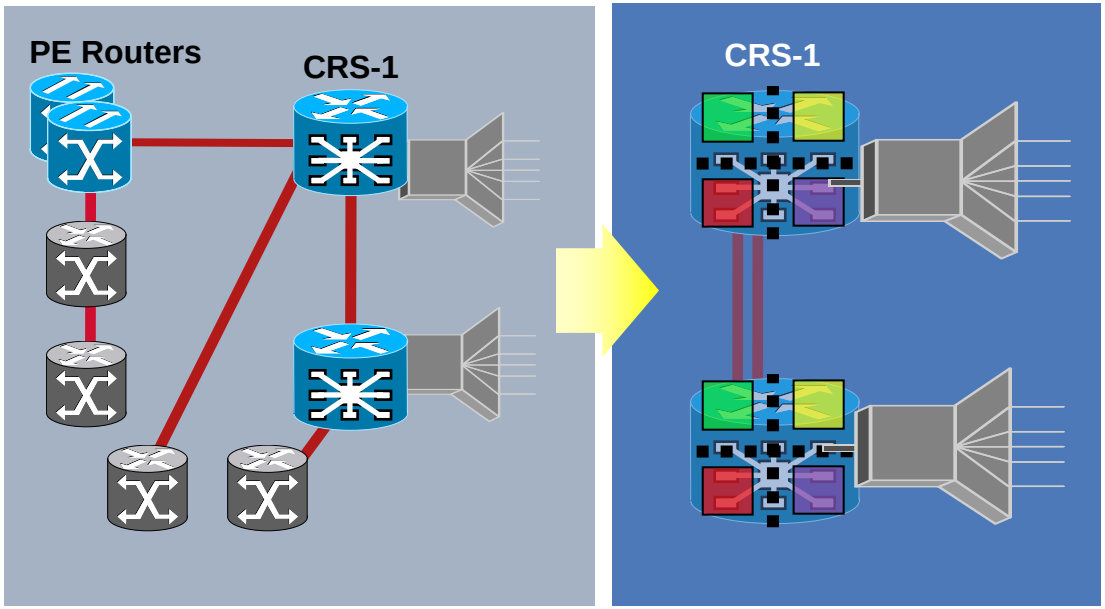


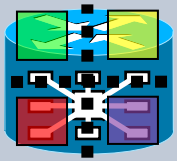


CapEx and OpEx Reduction ❯

Reduce Network Complexity
Business Case: Benefits of Secure Service Separation

Before **After**





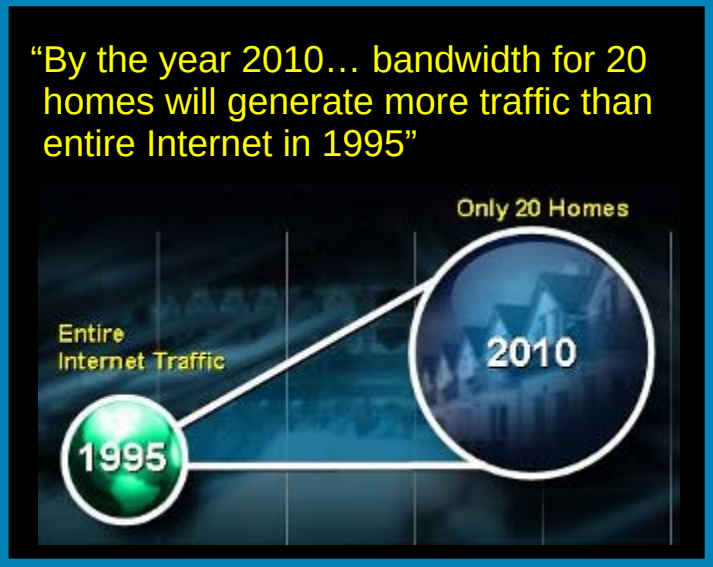
CRS-1 Multi-Instance Service Separation Architecture

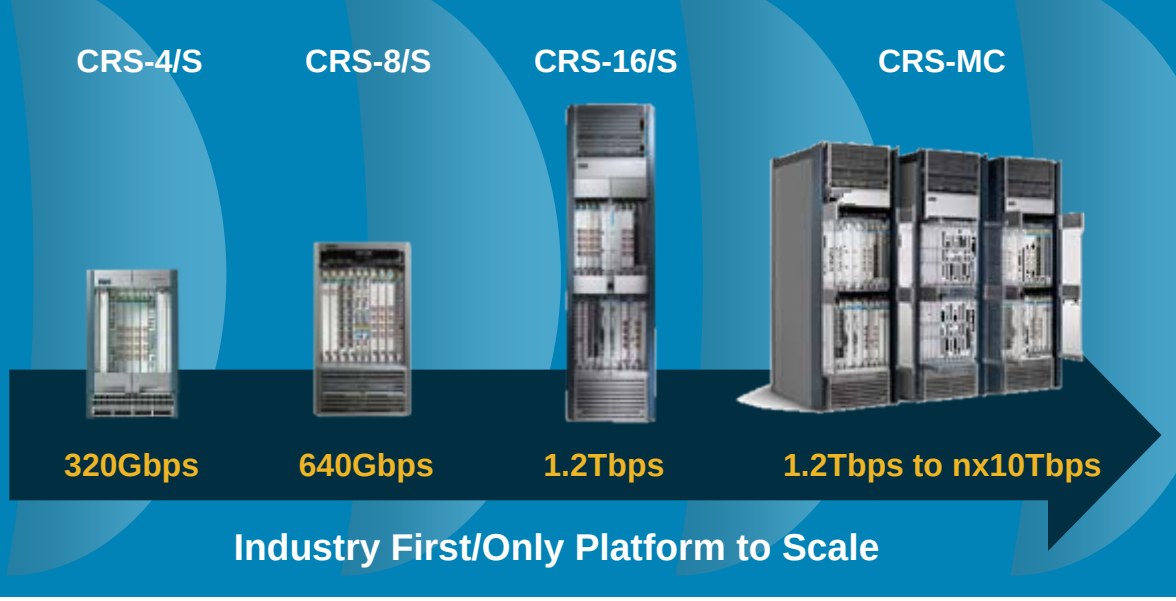
- Core (P) SDR
- L3 Edge (PE) SDR
- L2 Edge (PE) SDR
- Advanced Services SDR

1. **75%** reduction of chassis
2. Improved power and space efficiency
3. Simplified operations
4. Modular expansion of new services
5. Reduced points of failure

Scale the Network
From **320Gbps** to **nx10Tbps**

1. Global IP traffic to be 26 Exabytes per month in 2011
2. Exploding variety of video applications: IPTV, VoD, P2P, Mobile
3. IPTV users to rise from 14 million (’07) to 63 million (’11), 45% compounded annual growth





Source: Multimedia Research Group Inc., April 2007

Converge Business and Consumer Services
Cisco IP NGN Architecture

1. Access agnostic

   Ethernet, Cable, DSL, SONET/SDH, Wireless

2. Service Richness

   Subscriber aware

   Location aware

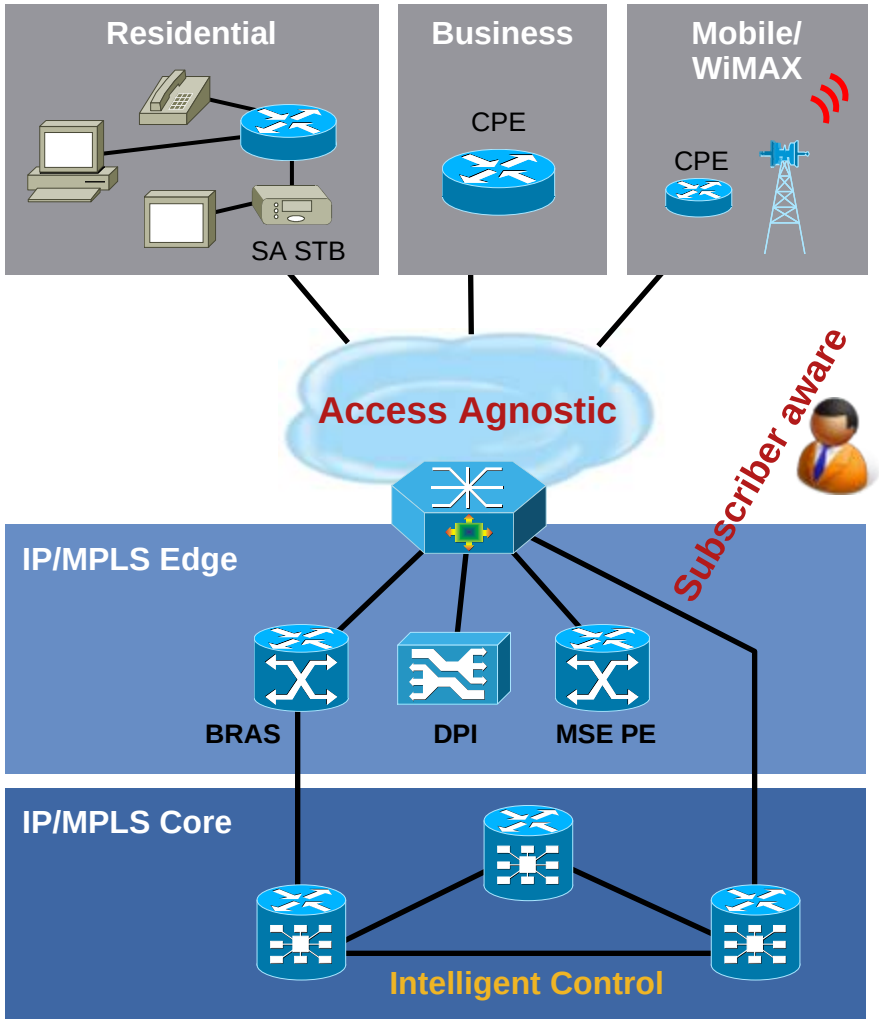
   Customized SLAs

3. Intelligent control plane

   Self-healing

   Efficient routing

   Consistent delivery



Converge Business and Consumer Networks
Business Case: Telecom Italia

Challenge

- Accelerate Metro Ethernet infrastructure convergence for residential and business users
- Provide advanced services to 100 cities and potentially reach over seven million ADSL users
- Reduce customer churn

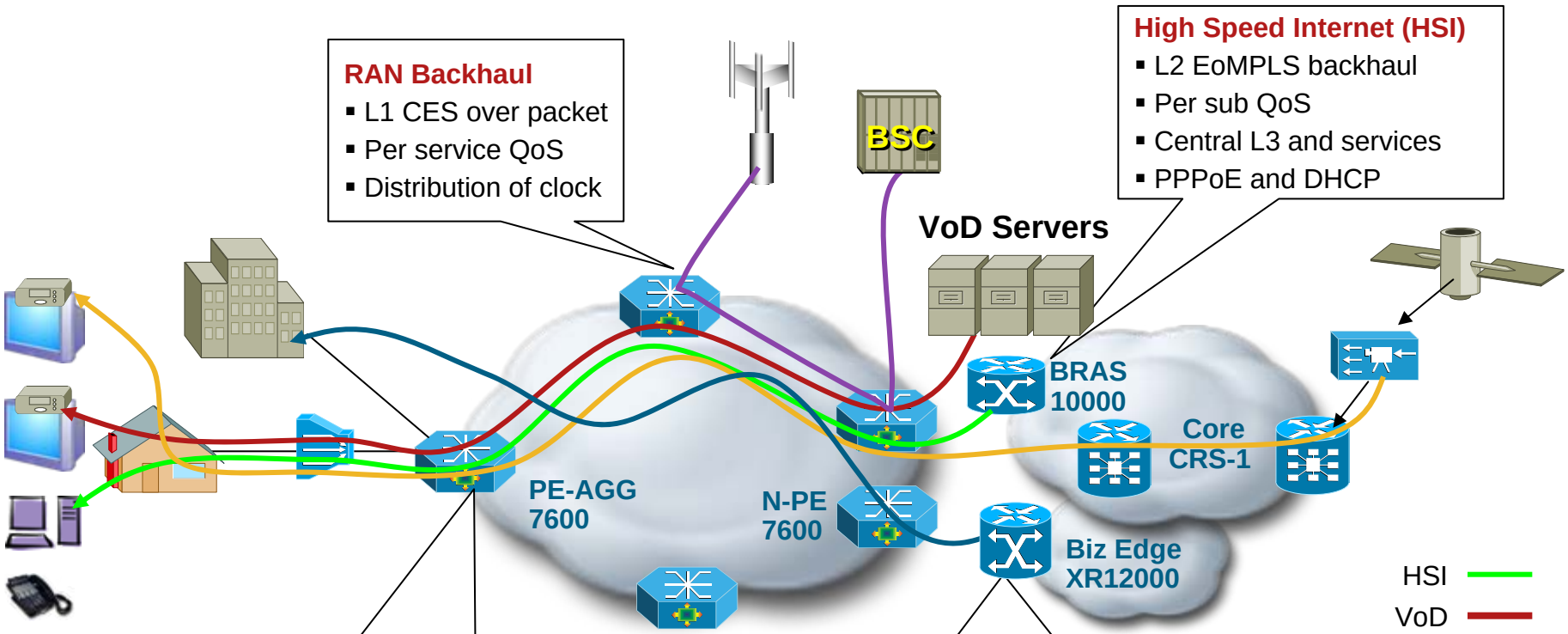
Cisco Core + Edge Solution

- Cisco **Metro Ethernet Solution (CRS-1, 12000, 7600, etc.)** with high performance IP/MPLS features
- Rich features prioritizing real time traffic and dynamic multicast for an effective video service

Solution Results

- Converged L2, L3, voice, video, and data services over **one network**
- **Standardize** service and interface on a replicable bundle
- Enhance business offerings (Managed Telephony, Security)
- Opex **savings of €200mn** (FY'06) via IP network/IT integration

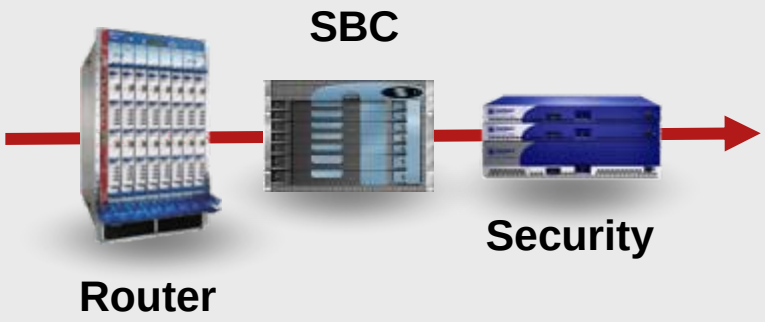
Service Flexibility
Adaptable IP NGN Architecture



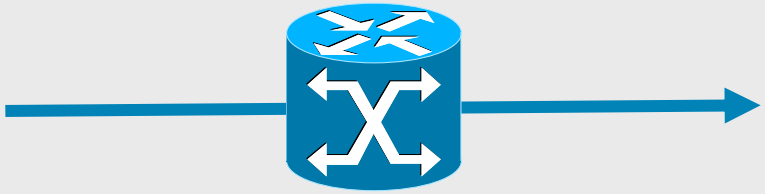
The Right Solution for All Your Services

Service Flexibility
Integral Services Delivery

Appliance-Based Service Delivery:
Overlay Services with Many Platforms



Cisco Integral Service Delivery:
Service Inherits Router Characteristics



Router + SBC + Security

XR12000 (Business)

7600 (Residential)

Requires 3rd Party Integration → **Fully Integrated**

Inferior SLA Guarantees → **Higher Availability, Improved QoS**

Complex Management → **Lower TCO (Space, Power, Mgt)**

New Revenue Generating Services
Network Based Security: SAVVIS

Challenge

- Sell new services to existing L3VPN managed service customers
- Use existing hardware infrastructure to minimize Capex
- Deploy a solution that can easily scale

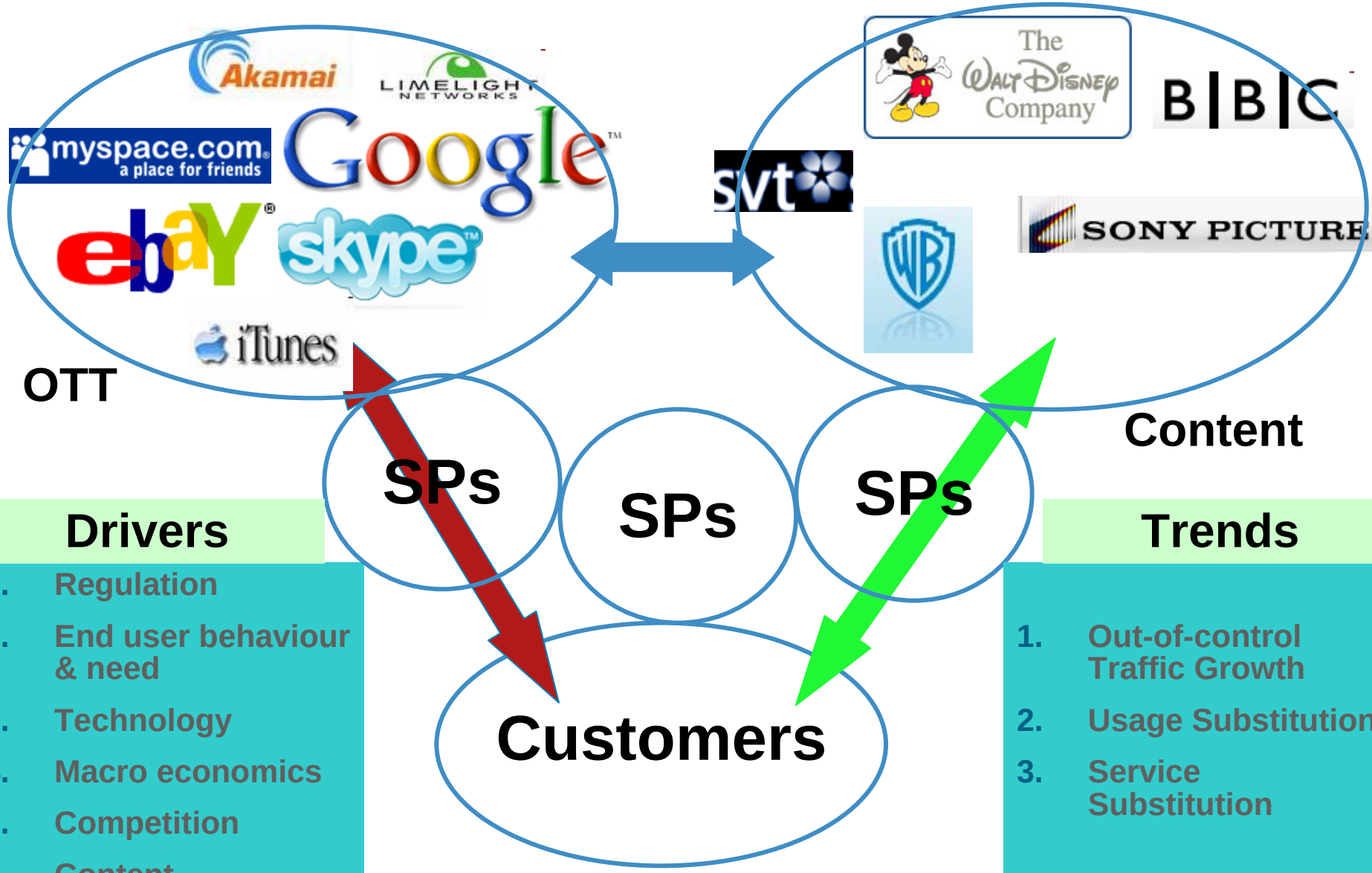
Cisco Core + Edge Solution

- Upgrade existing **Cisco 12000** systems for L3VPN services to IOS XR
- Add XR12000 **Multi-Service Blade** with Virtual Firewall Software

Solution Results

- New service offering with **minimal** cost and effort
- **Scalable** by adding additional Multi-Service Blades as needed
- Route awareness for B2B integration

Other Service Provider Challenges



Drivers

1. Regulation
2. End user behaviour & need
3. Technology
4. Macro economics
5. Competition
6. Content

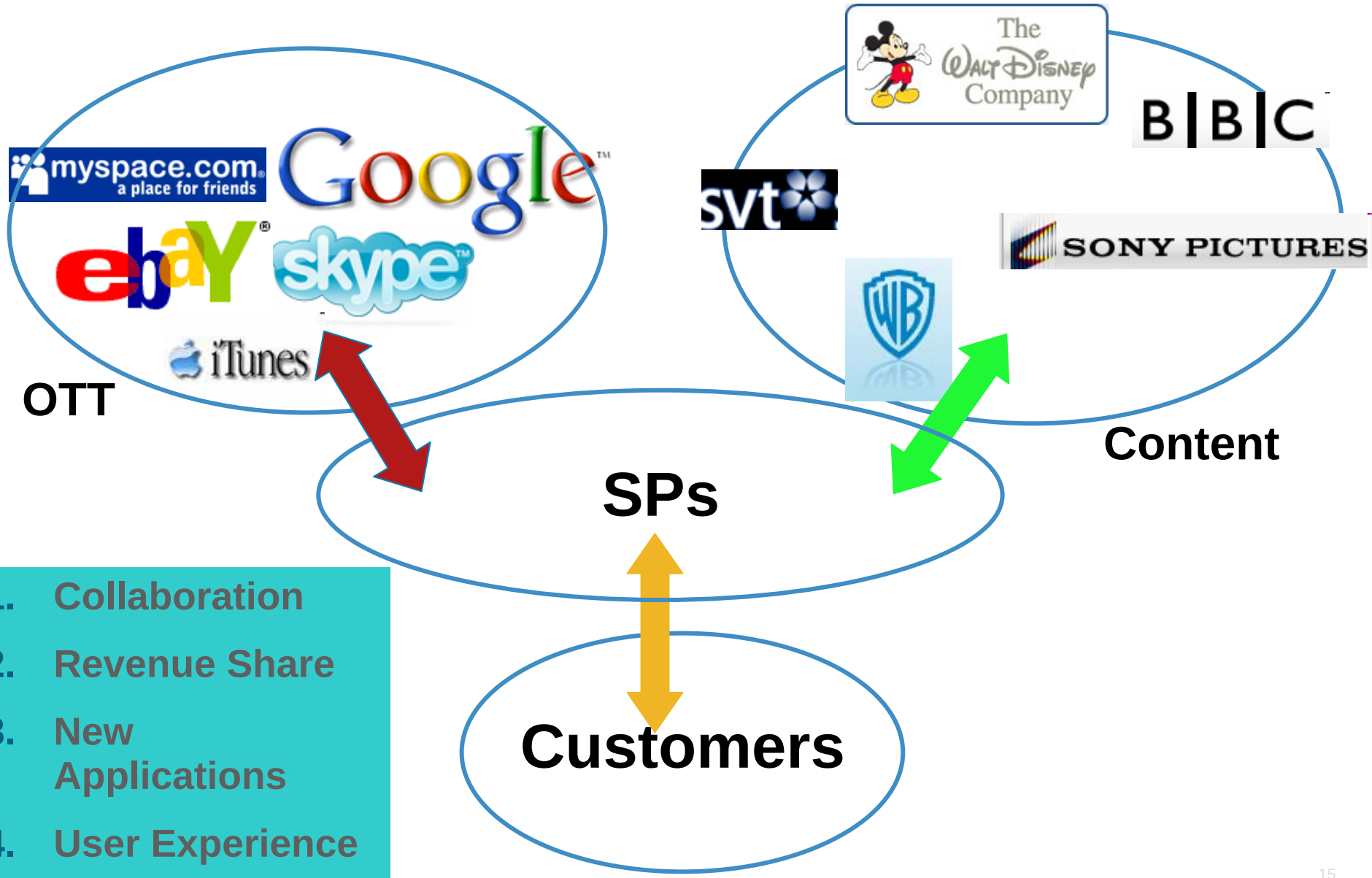
Trends

1. Out-of-control Traffic Growth
2. Usage Substitution
3. Service Substitution

Addressing the issues to allow evolution

1. End to End Integrated Solutions
2. Consistent information correlation and processing
3. Intelligent networking
4. Cooperation
5. Quality user experience
6. Lead to……

Future Evolution – Desired outcome



1. Collaboration
2. Revenue Share
3. New Applications
4. User Experience

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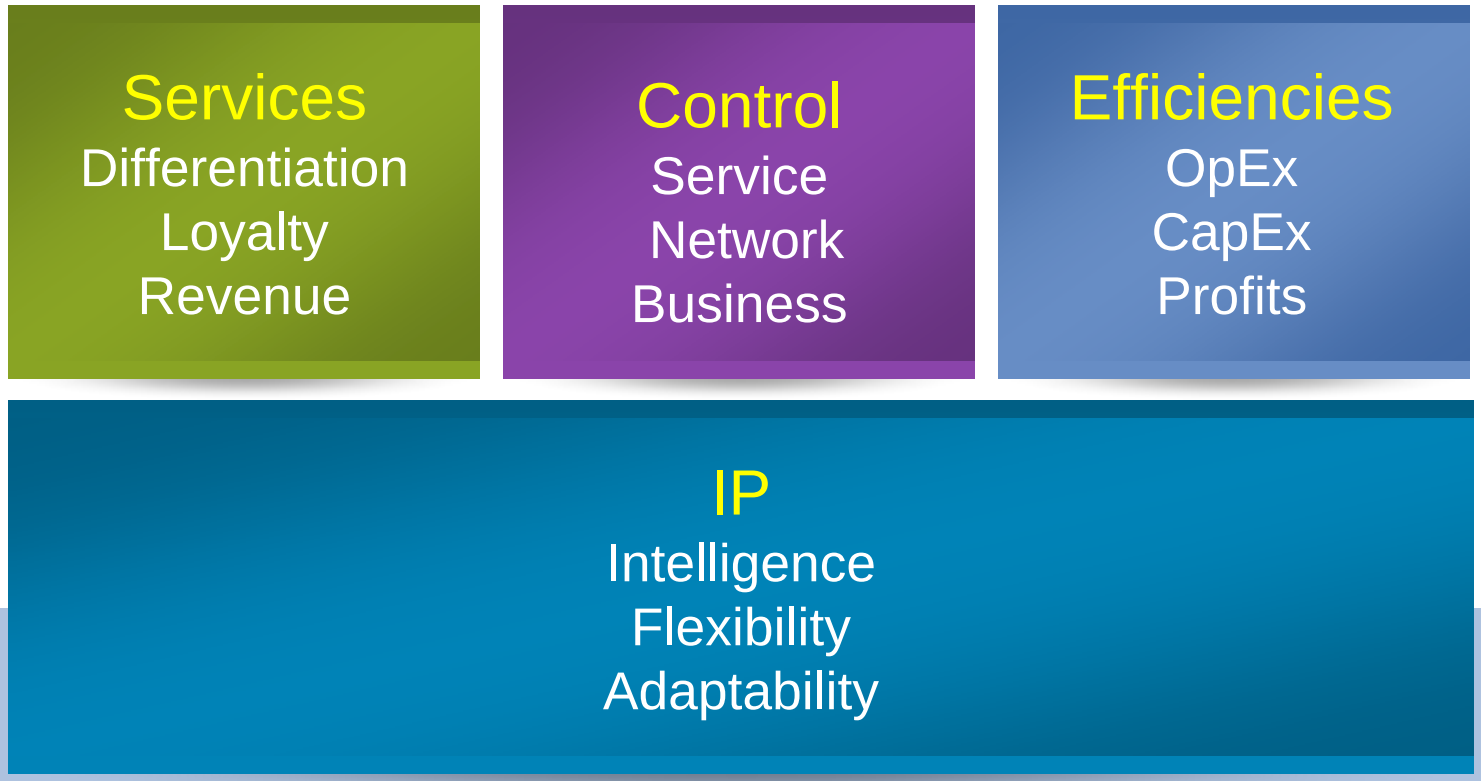
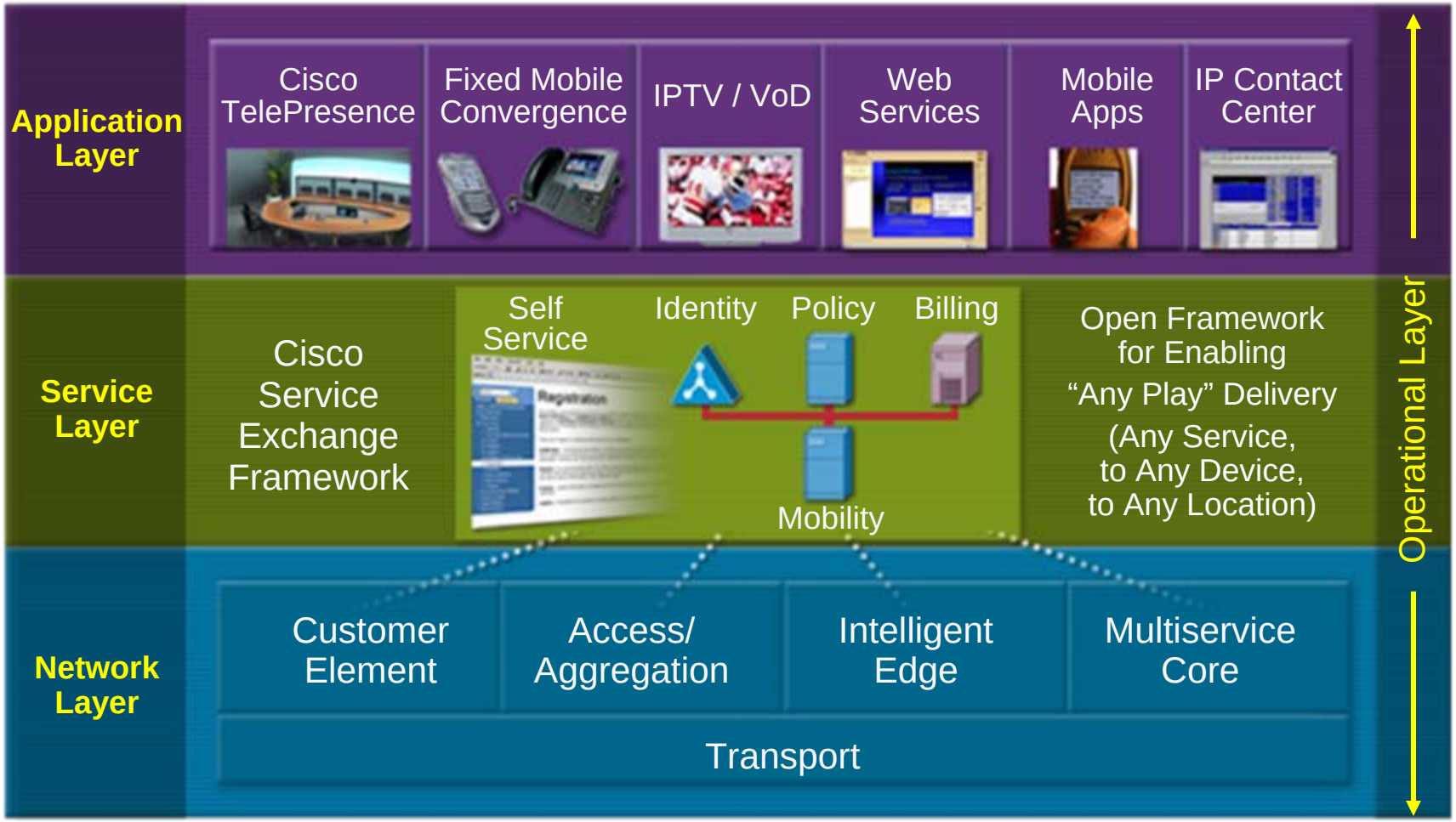
Service Providers Are Driving Towards…

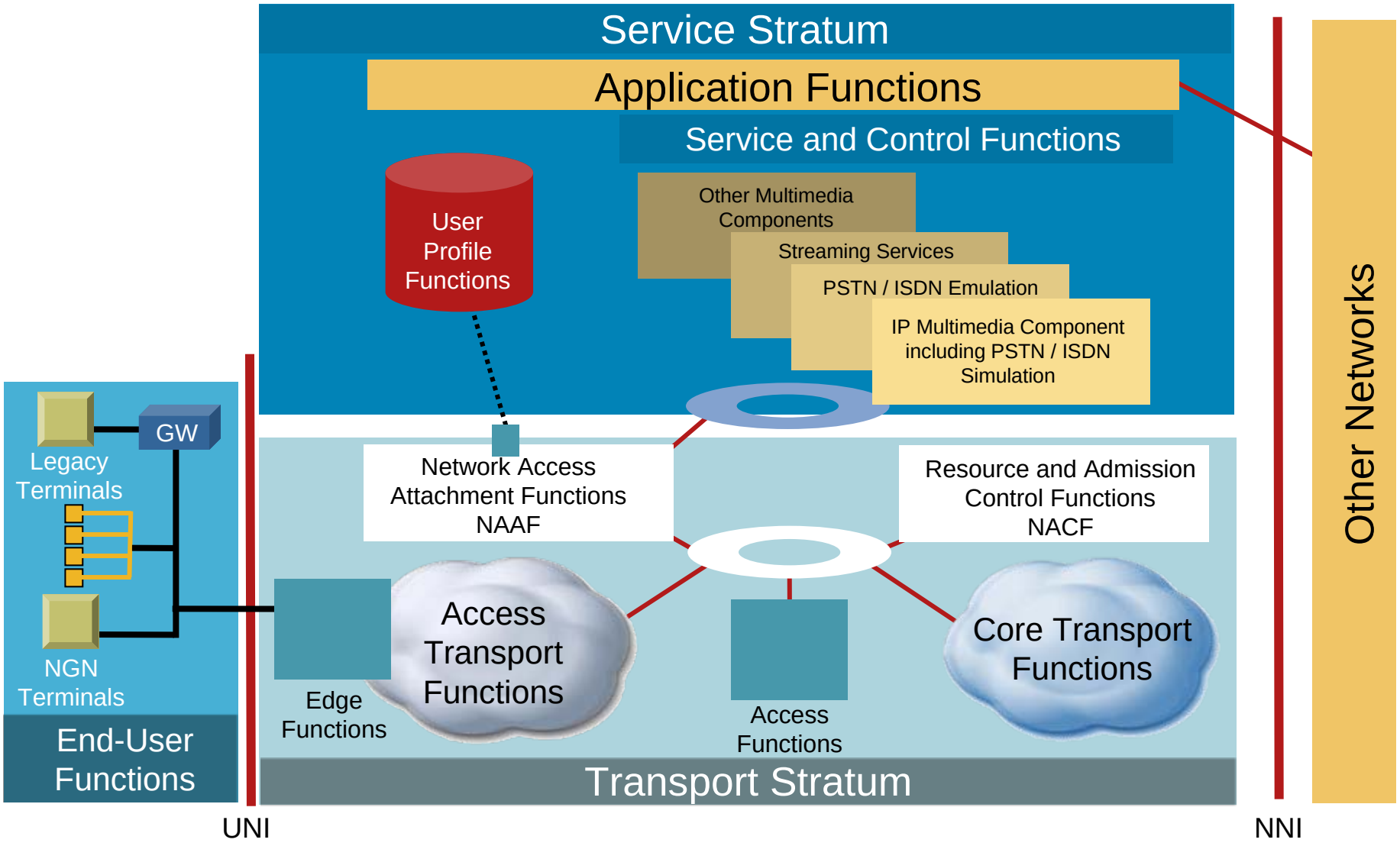


Cisco IP NGN Architecture

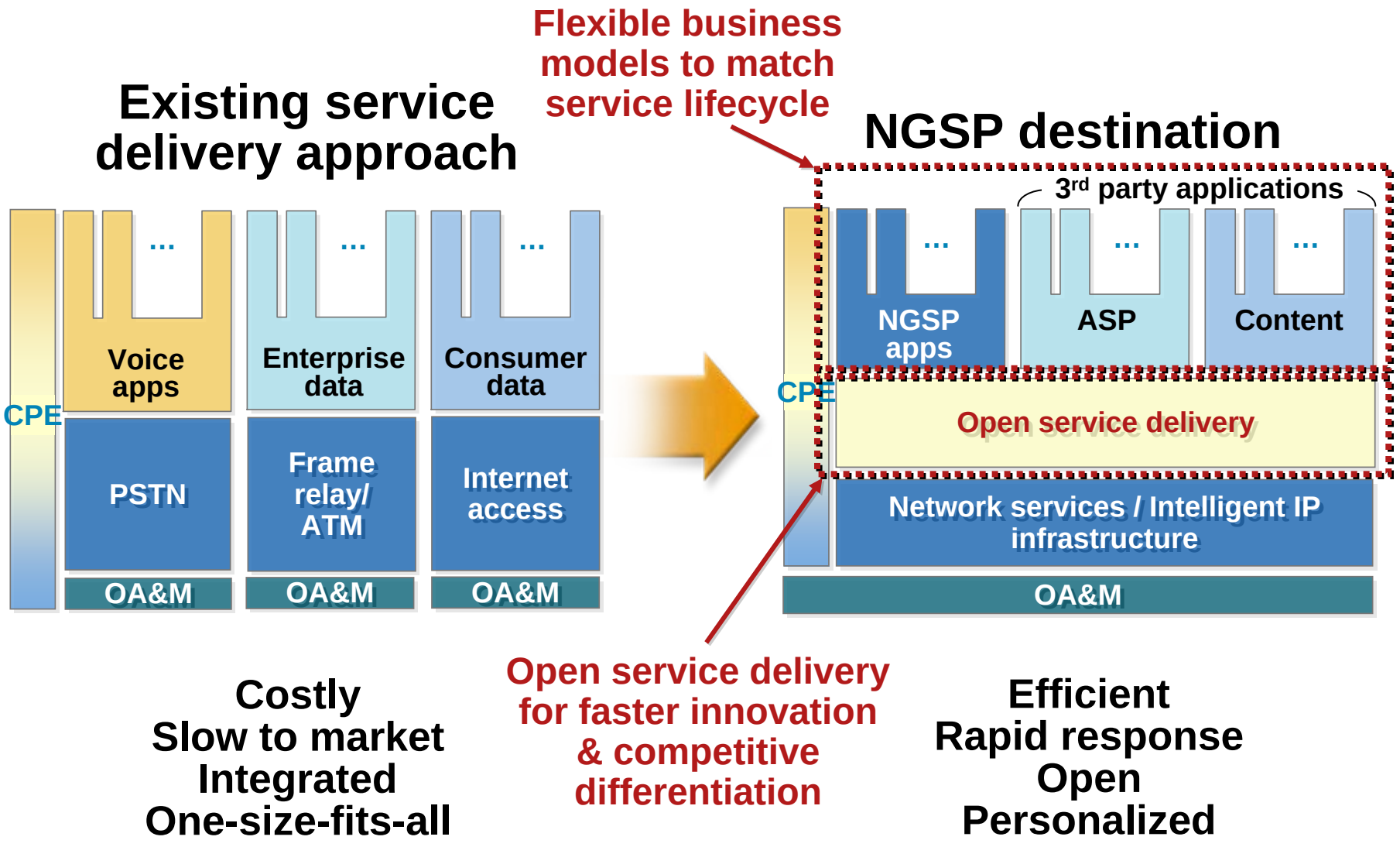
Enabling Connected Life Experiences



NGN Architecture Model



Service Innovation Is Key to Incremental Revenue Generation



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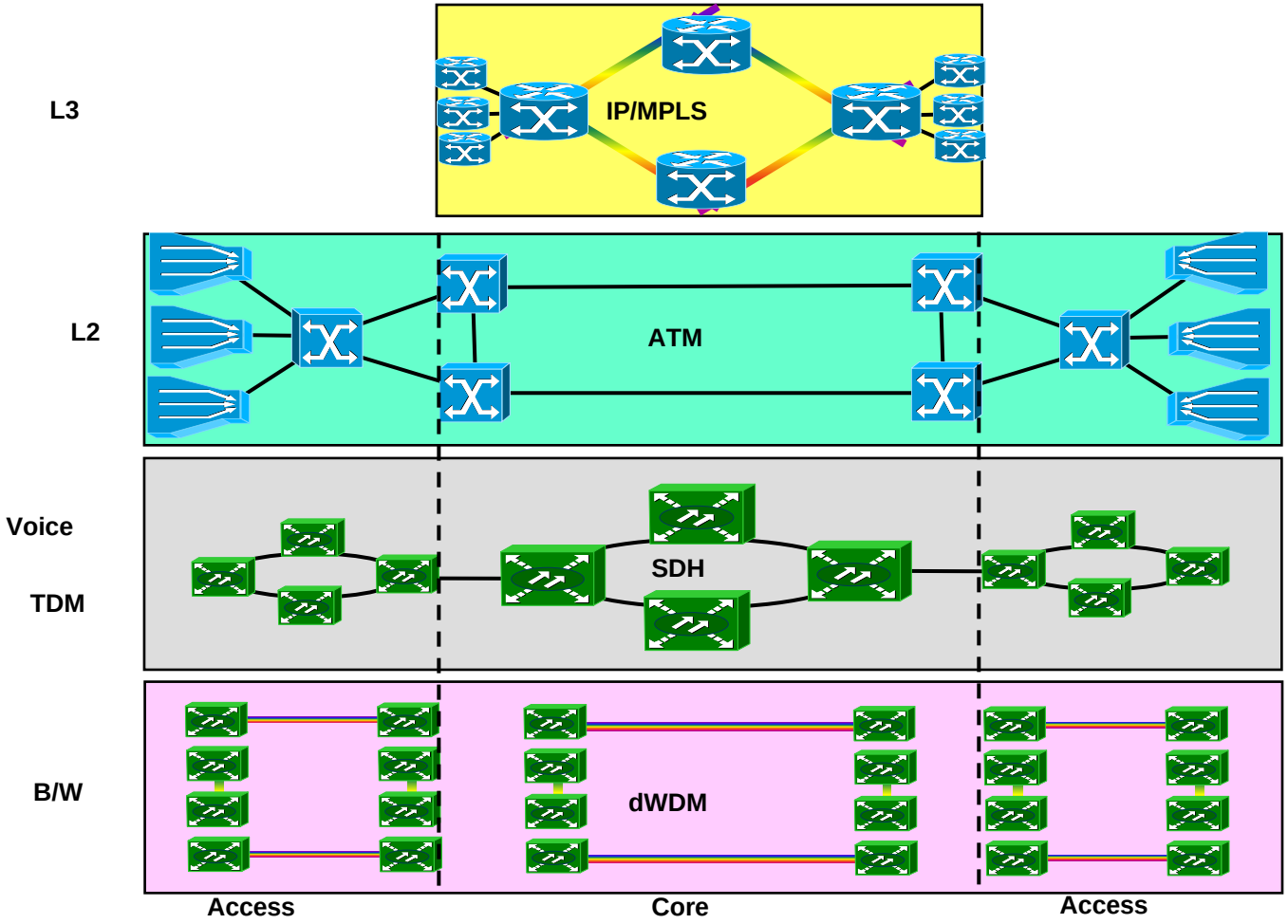
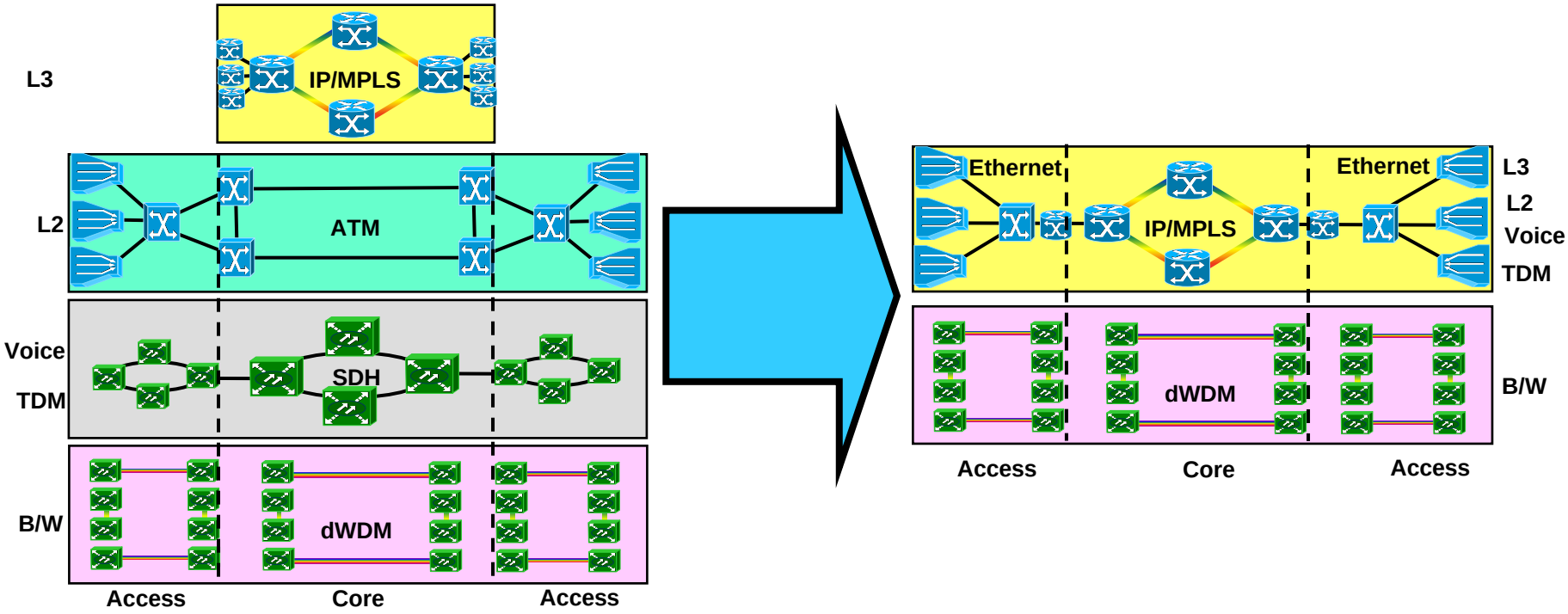
Today

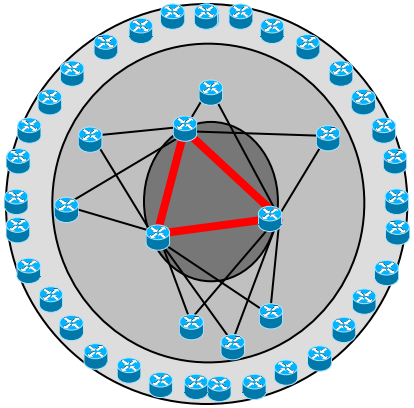


The NGN evolution



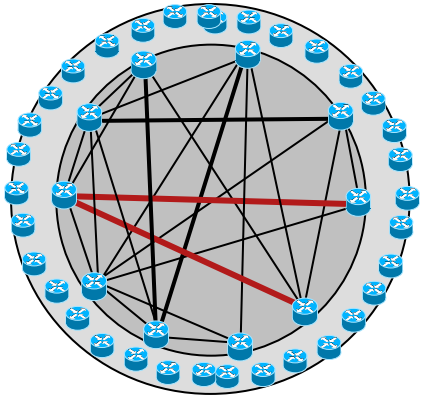
Network Hierarchy

Core Hierarchy



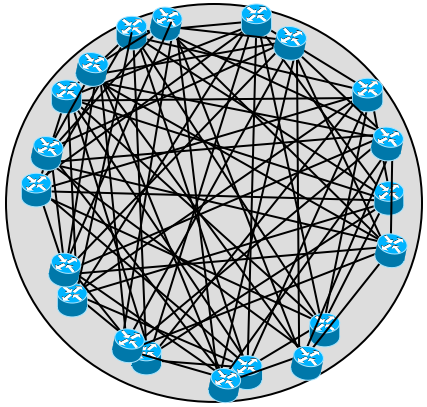
1. 3-level hierarchical structure
2. Regional, inner core, outer core
3. Very high bandwidth in core (multiple 10Gpbs nearing 40gbps in inner core)

(Partial) Core Mesh



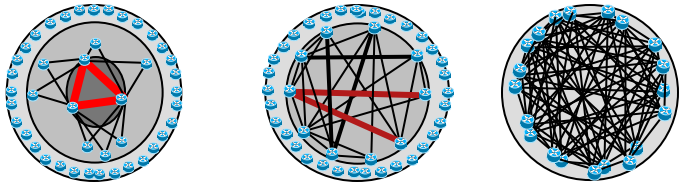
1. 2-level hierarchy following the physical topology of fibers
2. Regional, core
3. Considering required traffic distribution
4. N*10G - possibility to grow to 40Gbps/100Gbps

Full Backbone Mesh



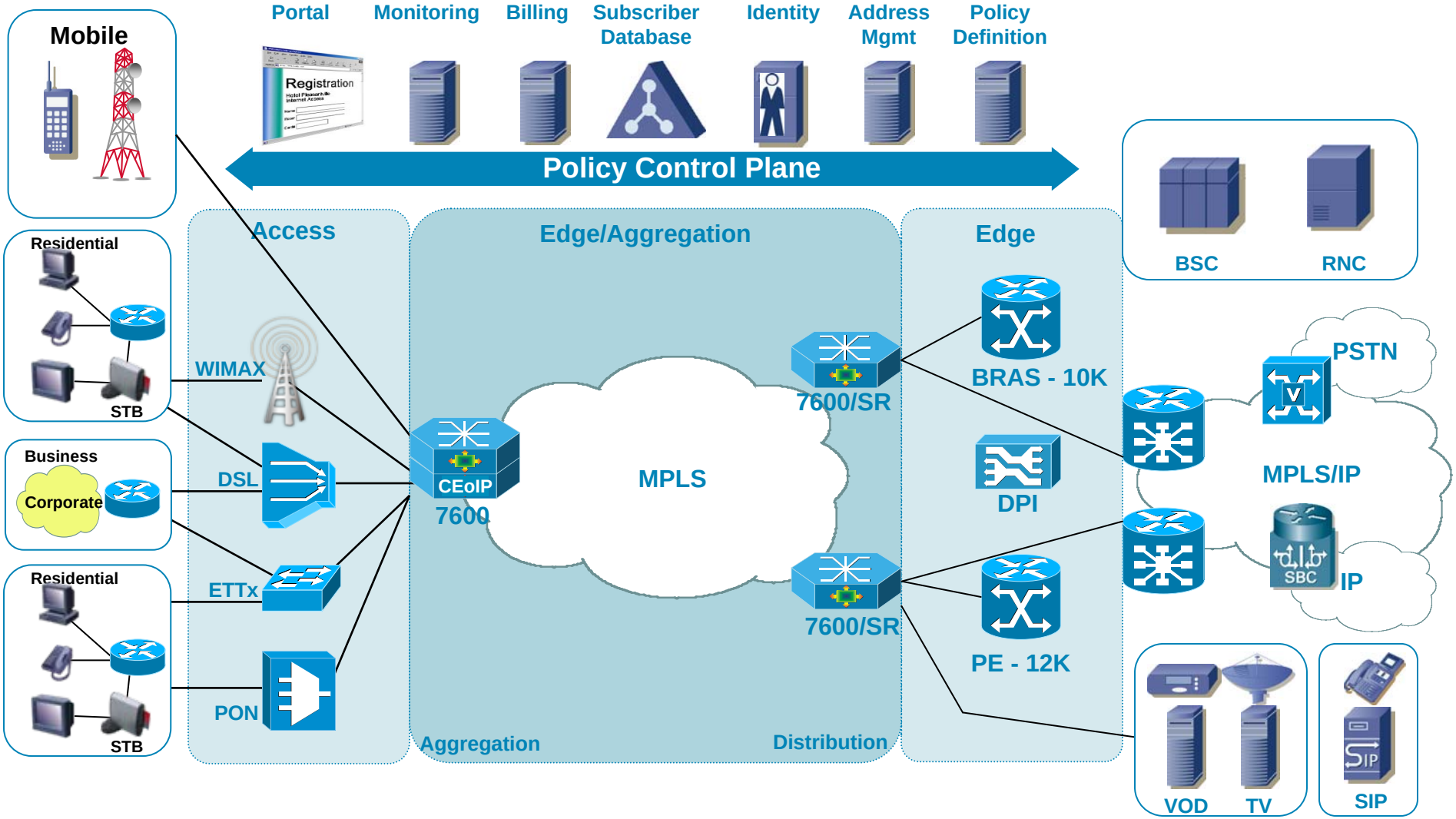
1. No hierarchy
2. Flat

Network Hierarchy



	CAPEX Routers & Links	OPEX Provisioning Cange management Capacity Planning Troubleshooting	Complexity	Network Availability	Scalability	References
Core Hierarchy	high low	high low	high low	high low	high low	yes
Core Mesh	high low	high low	high low	high low	high low	yes
Full Backbone Mesh	high low	high low	high low	high low	high low	no

Next Generation MultiService Architecture Overview



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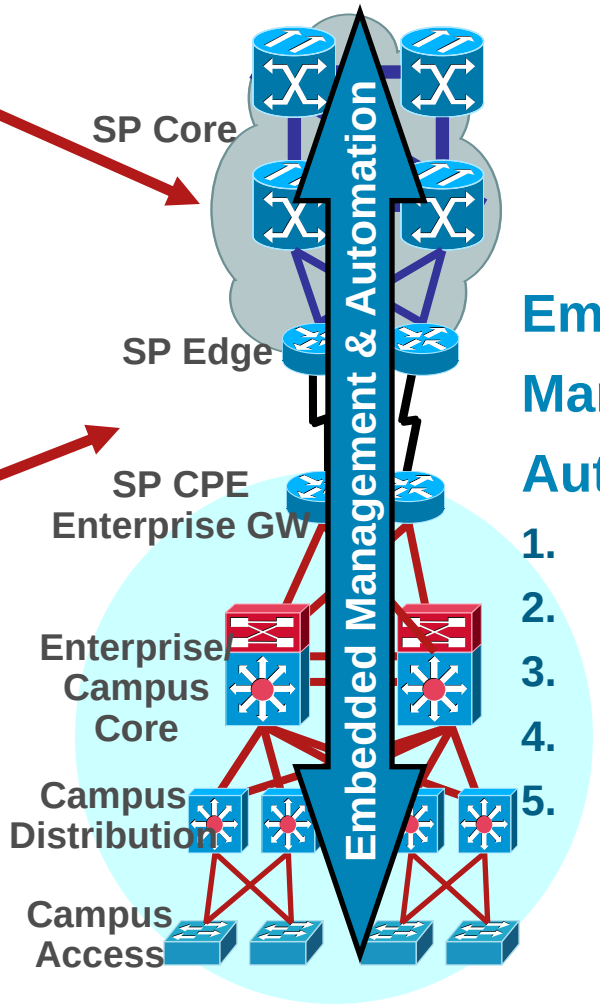
HA Feature Toolbox: End to End

Network Level Resiliency

1. NSF Awareness / NSR
2. IP Event Dampening
3. Bi-Directional Forwarding Detection (BFD)
4. Fast Convergence
   - BGP Convergence Optimization
   - iSPF Optimization (OSPF, IS-IS)
   - Multicast Subsecond Convergence
5. Fast Rerouting (IP and MPLS)

System Level Resiliency

1. Control/Data Plane Resiliency:
   - HSA, RPR, RPR+, Stateful NAT/IPSec/FW,
   - NSF /w SSO including MPLS
   - BGP Nonstop Routing
   - Control Plane Policing, GLBP, HSRP,
   - Warm Reload
2. Planned Outages: ISSU, Warm Upgrade
3. Link Resiliency:
   - Line Card Redundancy with Y-Cable
   - Link Bundeling (Etherchannel/POS-Channel)



Embedded Management & Automation:

1. CiscoWorks
2. MPLS OAM (ISC)
3. EEM
4. GOLD
5. .....

28

Network Protection (<50msec)

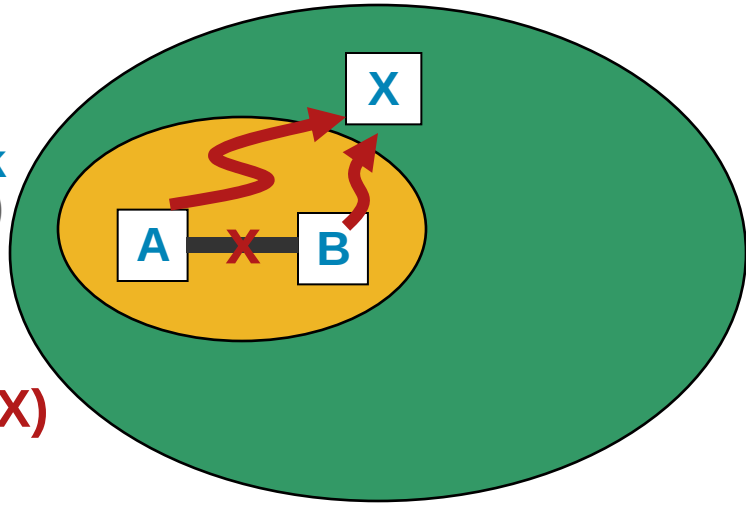
1. Precomputed, Pre-installed, Local, Prefix-Independent
2. MPLS FRR

   Deterministic, Mature, Deployed
3. IPFRR

   Not-Deterministic, Recent but Lower Opex

IP Fast Reroute (IPFRR) Concepts

1. **Limited Area of failure**
   - **Failure of Link A <--> B** and topology change impacts only **subset of network** (orange layer, confirmed by FC project)
   - **Outside this area** subset routing is consistent (green layers)
2. **Find a consistent point in the network (X)**
   - X is not impacted by the failure
   - X can be reached independent of failure
   - X forwards traffic to any destination /wo AB
   - From X all packets flow to their destination while avoiding the failure (and without knowledge of the failure)



Consistent routing

Impacted area of topology change

1. **Several proposal to IETF**

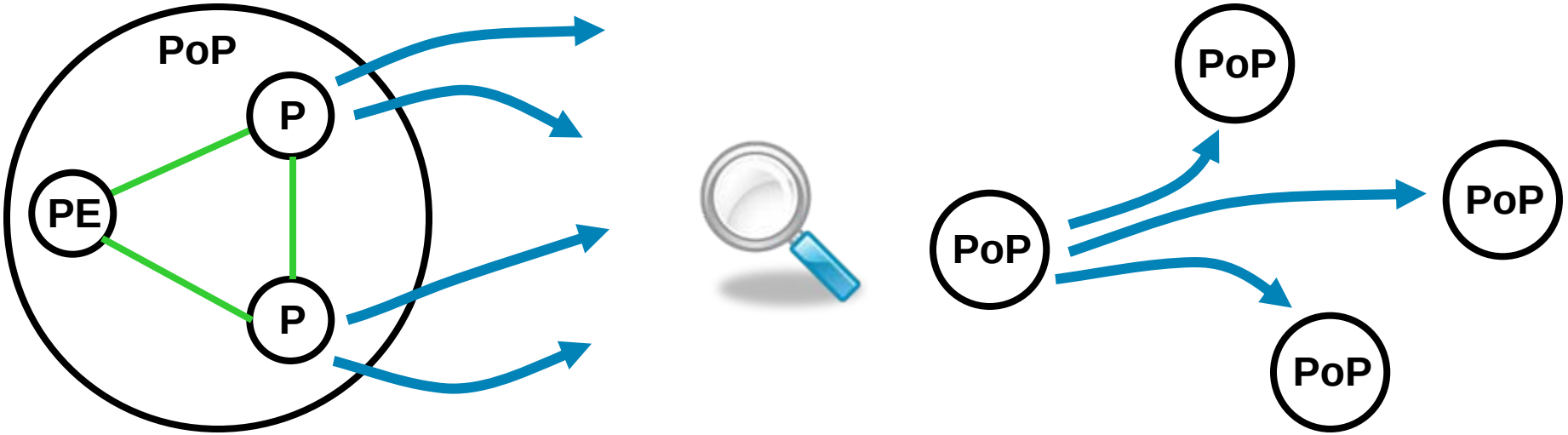
   Release Point, Downstream Routes, Loop-Free Alternates, U-Turns, Not-Via Addresses
2. Consists of

   Loop Free Alternates (aka: Downstream Routes)

   Not-Via Addresses

   Ordered-SPF Algorithm

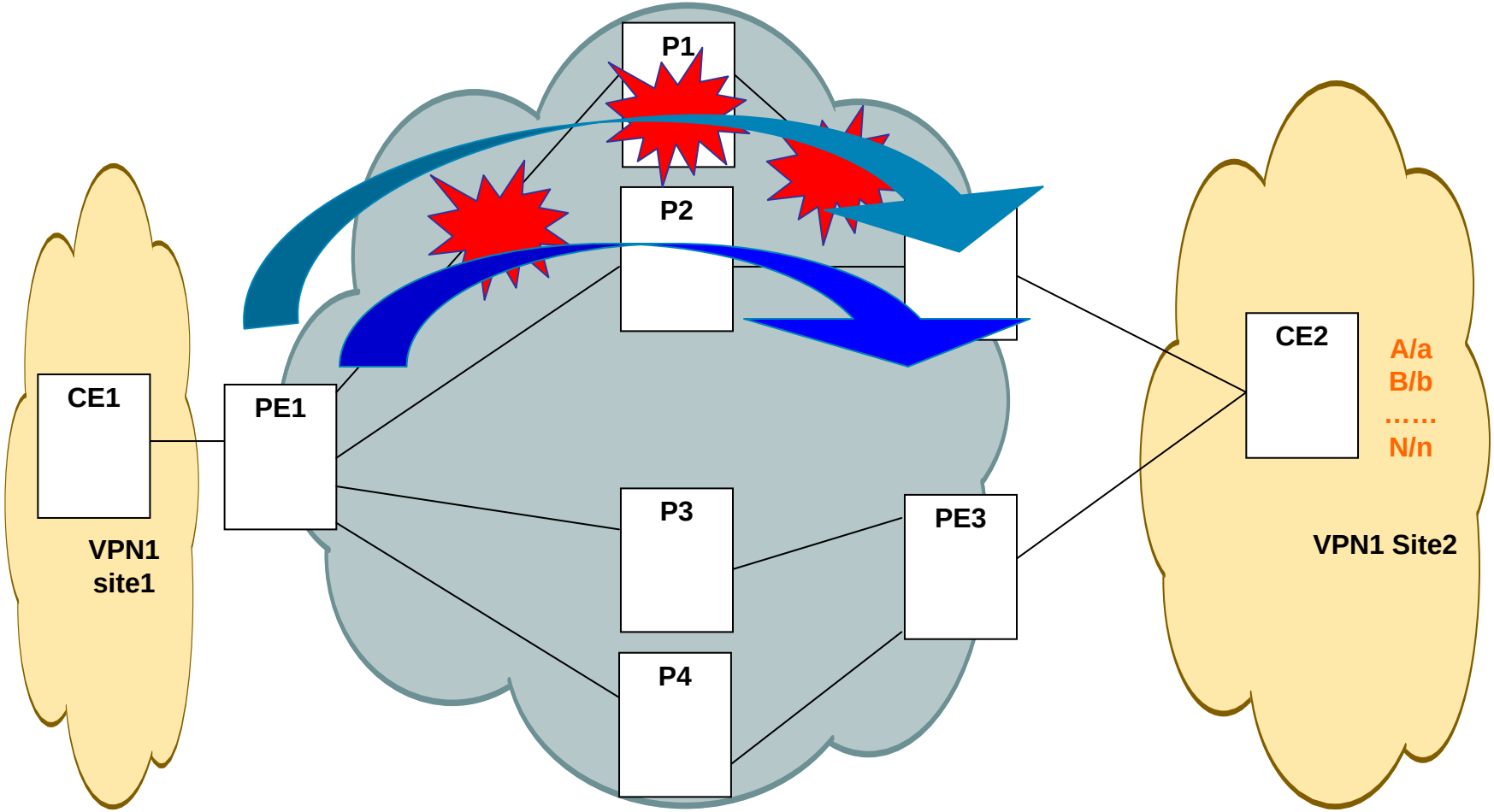
IPFRR to scale MPLS TE FRR



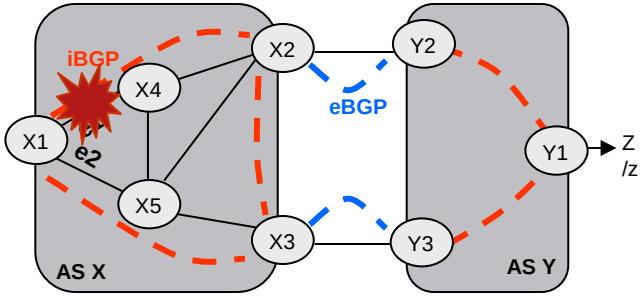
1. IPFRR in the PoP
2. MPLS TE FRR between PoP's
3. Simpler full-mesh of TE tunnels (scale, inter-area)

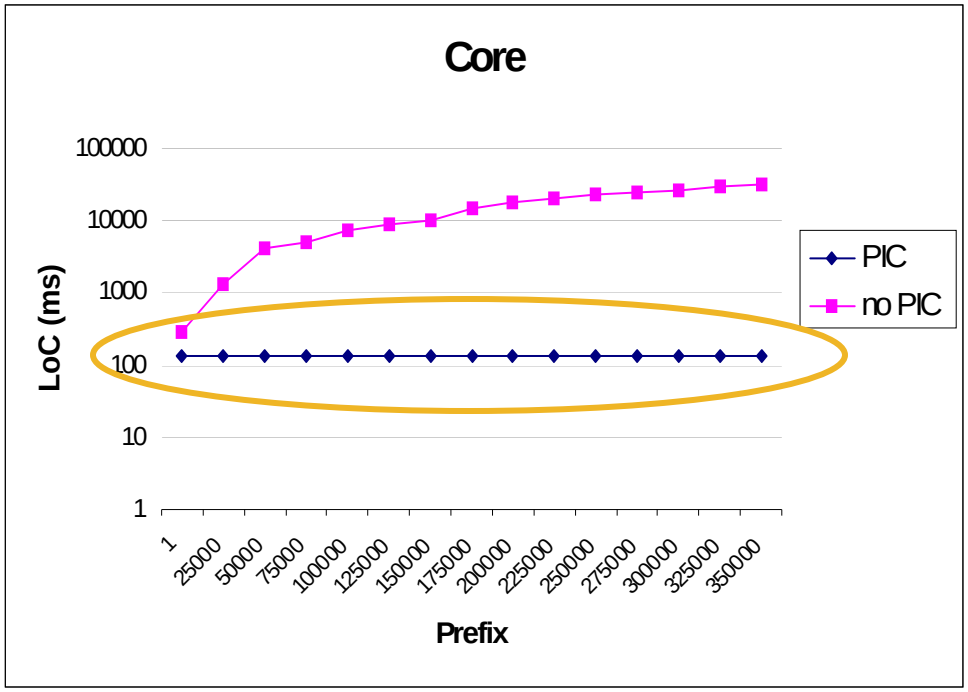
BGP PIC Core

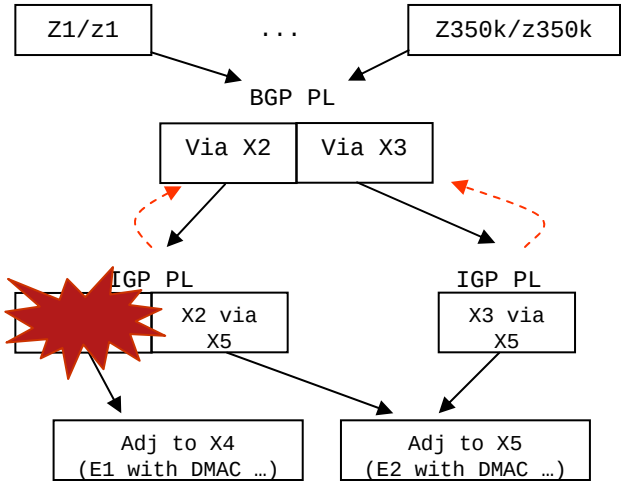
Convergence Independent of VPN/BGP Route Scale



Characterization
BGP PIC Core Analysis





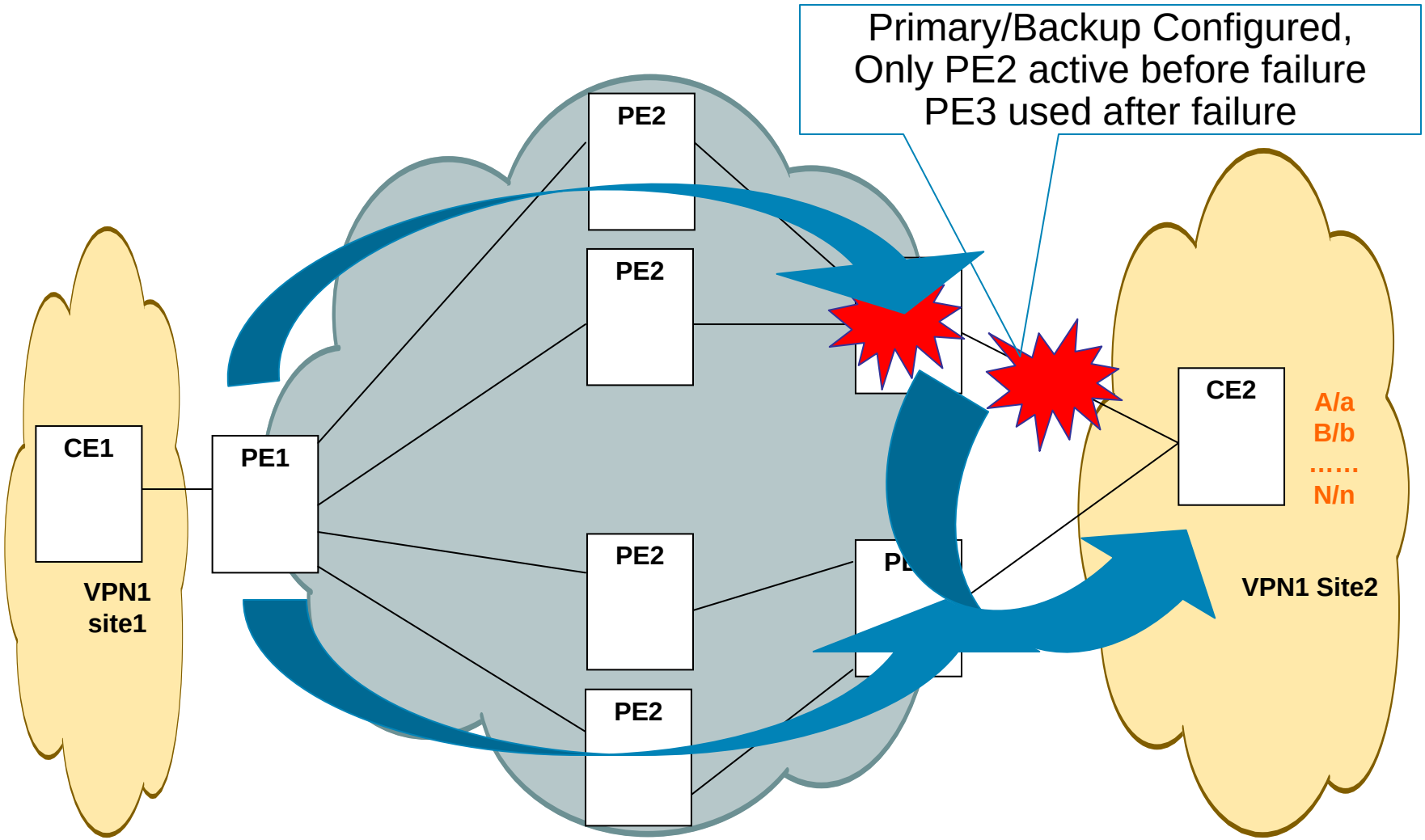


1. BGP PIC Core:

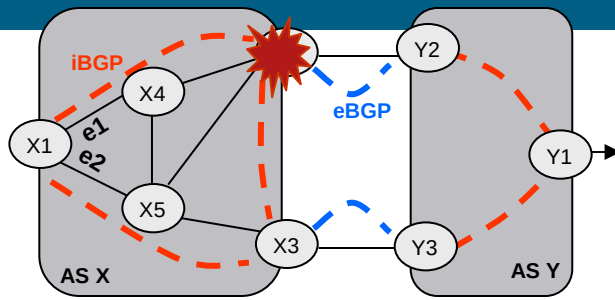
   Sub-second convergence upon PE uplink failure

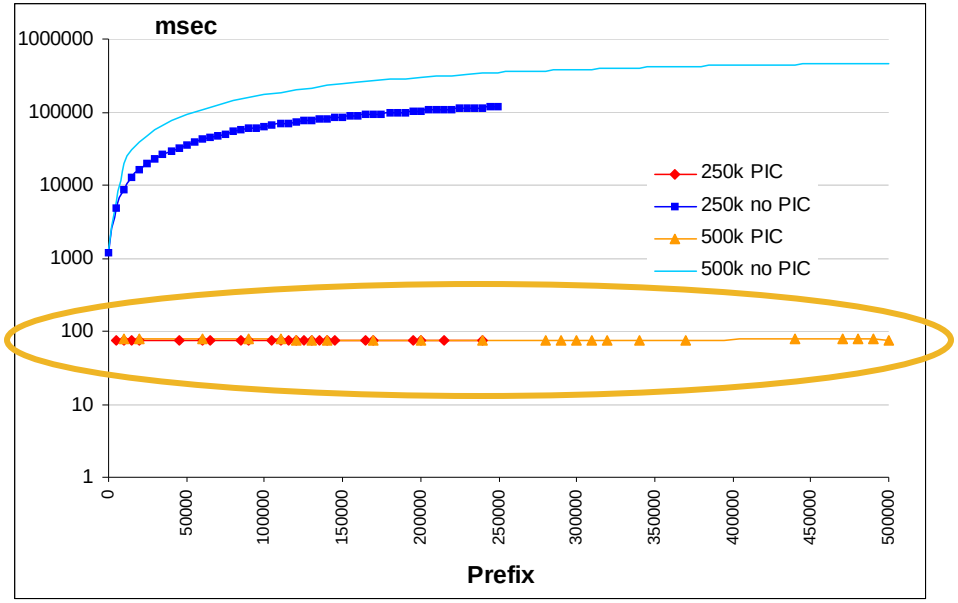
Prefix Independent Convergence for Edge Failures (a.k.a PIC Edge)

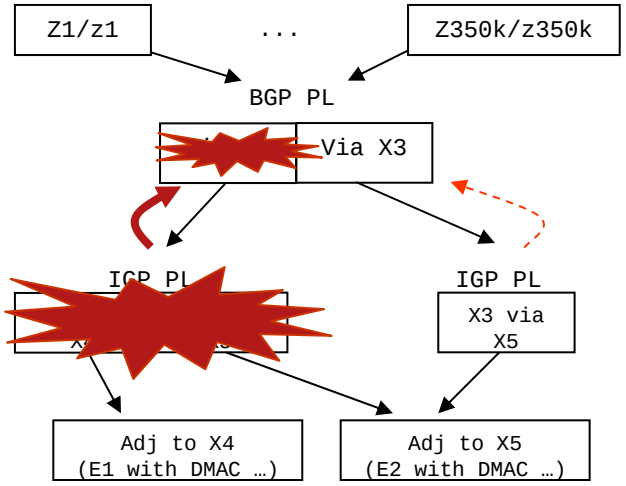
PE-CE link failure: With BGP PIC



Characterization
BGP PIC Edge







1. At IGP Convergence time, the complete IGP PL to X2 is deleted. SW FIB walks the linked list of parent BGP PL and in-place modify them to use alternate ECMP best nhops or enable alternate next-best nhops. This is quick because the BGP PL sharing is efficient.
2. The control plane convergence still occurs in the background (blue curve) but its slowness does not impact dataplane connectivity and hence the T-SLA experience

Conclusion

1. Specific Business concerns
2. Specific Architecture Concerns
3. Core and Edge is universal – Wireless/Wireline
4. High Availability
5. Security
6. Longevity
7. Simplicity

Breakout Session Evaluation Form

Your session feedback is valuable

Please take the time to complete the breakout evaluation form and hand it to the member of staff by the door on your way out

Thank you!