NGN and MPLS

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MPLS JAPAN Hosted by e-side

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AGENDA

- **Why NGN: The Problem**
- **MPLS Technology Set as an NGN Service Enabler**
- **NGN Service Architecture with GMPLS**
- **NGN and Future Direction with GriD**
- **Conclusions**

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Why NGN: The Problem

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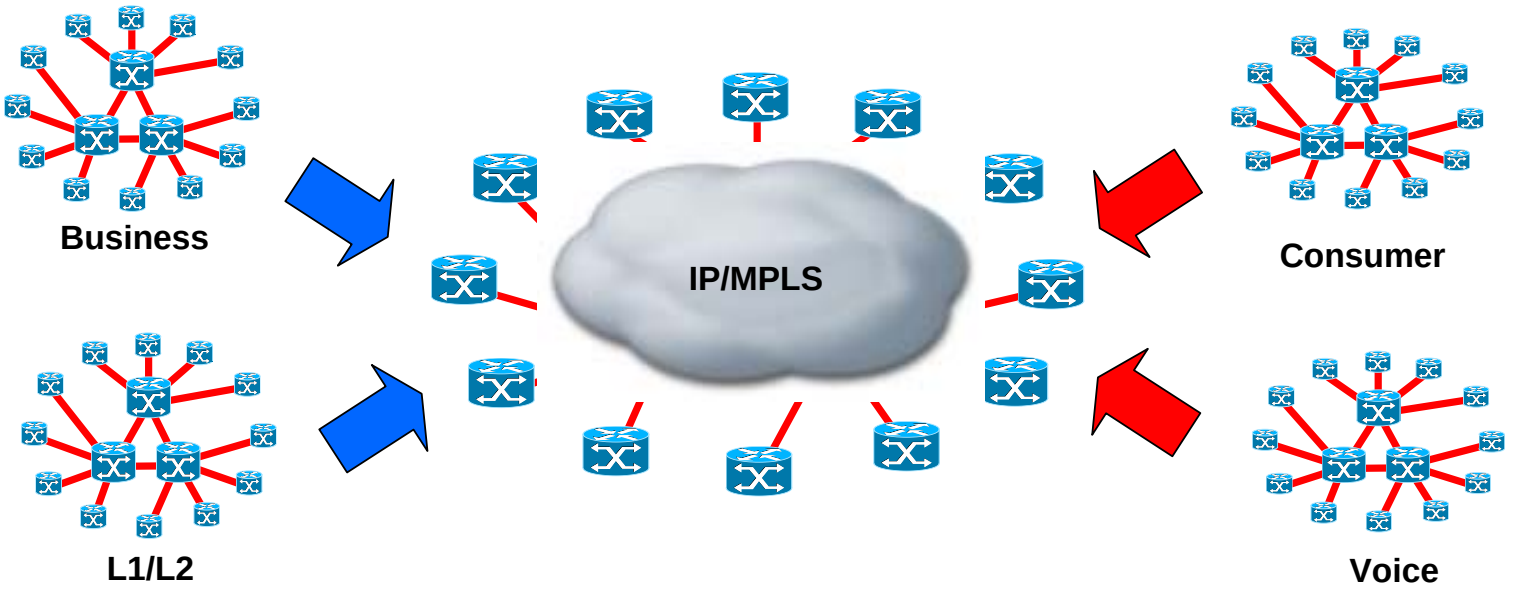
Converging the Networks



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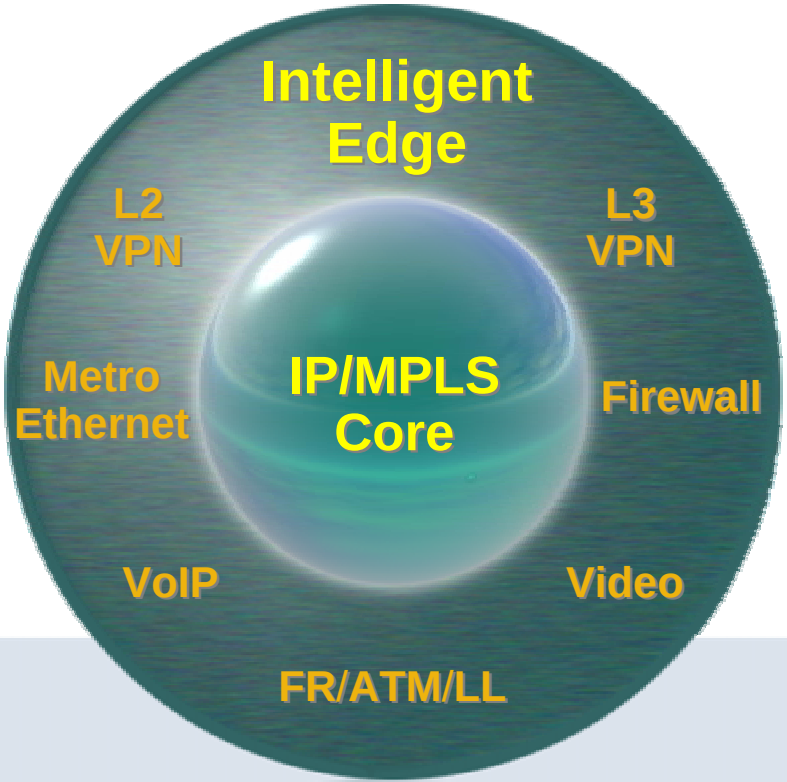
Converge services onto one network



- Virtualization
- Service flexibility
- Scalability
- Continuous operation
- Management
- Investment protection
- Security

One Network, Many Services

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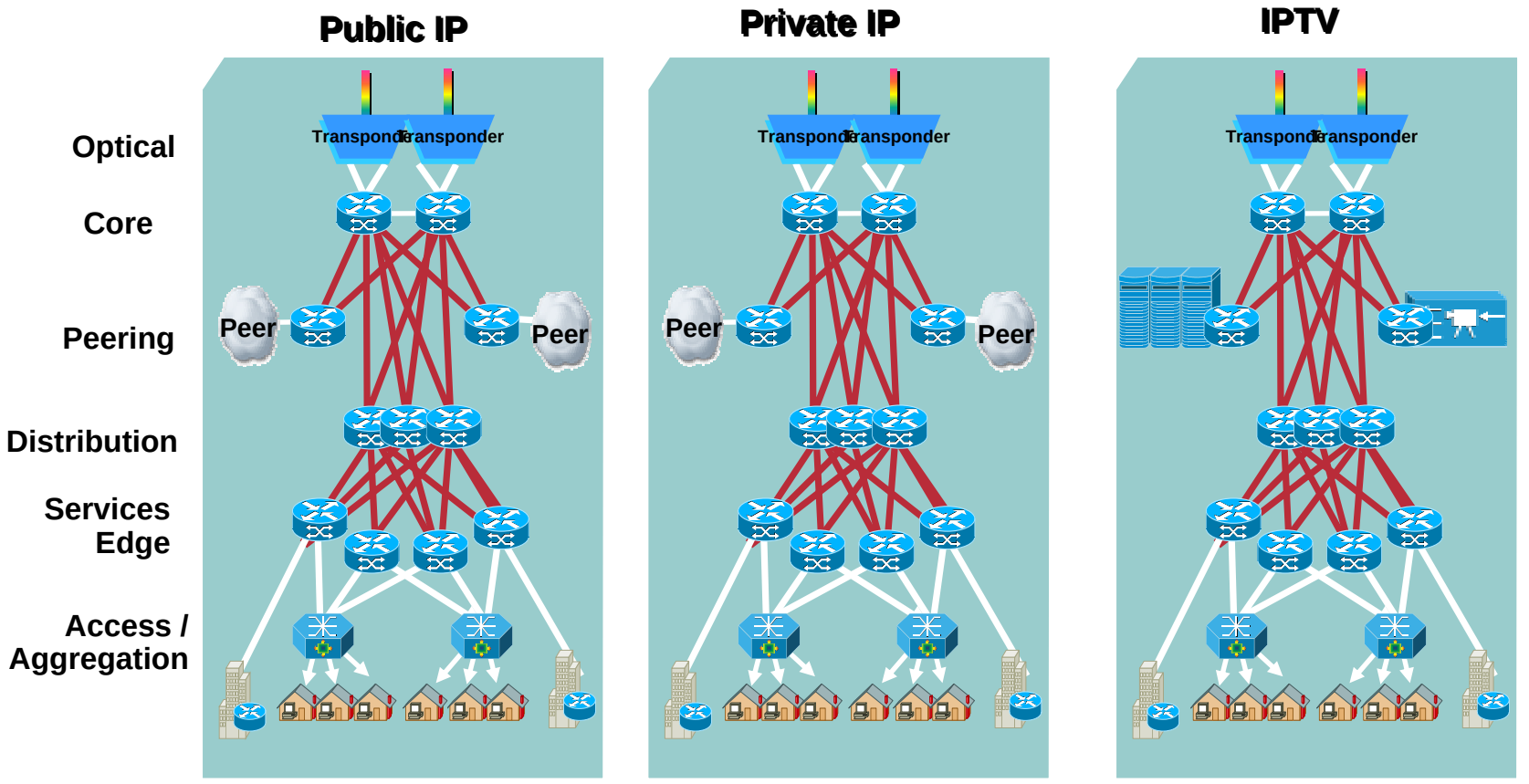
Convergence to Single Network?



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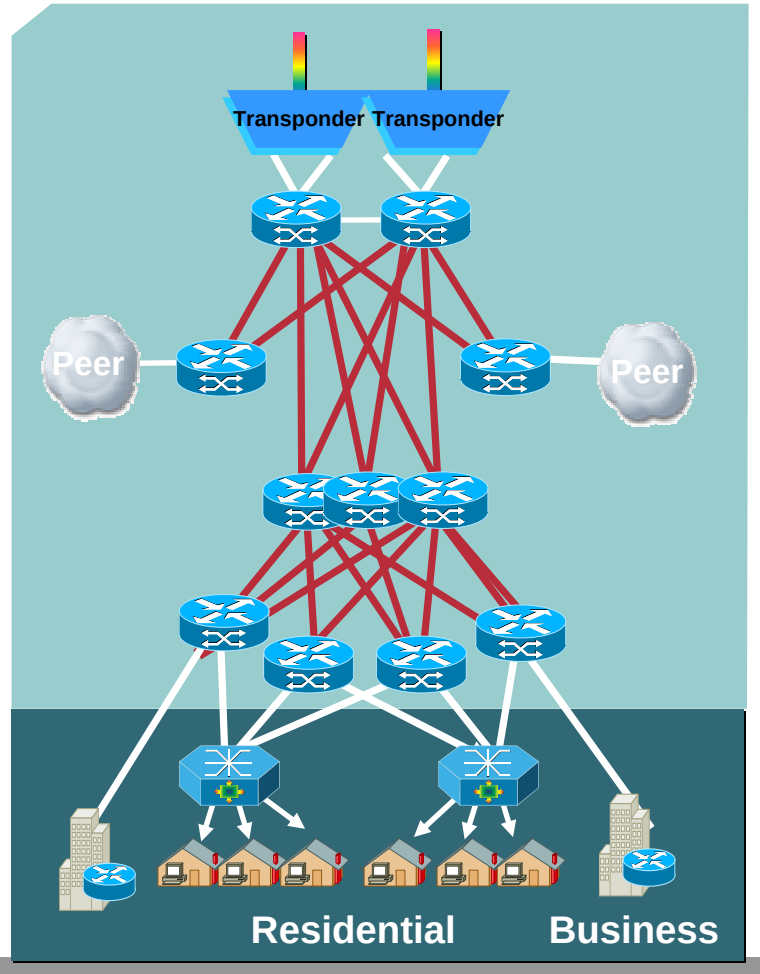
Traditional Multi-Layer PoP Design: Operational Complexity, Limited Flexibility & Scale



- Multiple systems to provision, manage, & upgrade
- Inefficient use of capital: Empty slots, unused capacity
- Many intra-PoP links to implement & maintain
- Multiple software streams to qualify
- Difficult to scale, add new services
- Industry moving towards Core/Edge convergence

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MPLS Technology Set as an NGN Service Enabler

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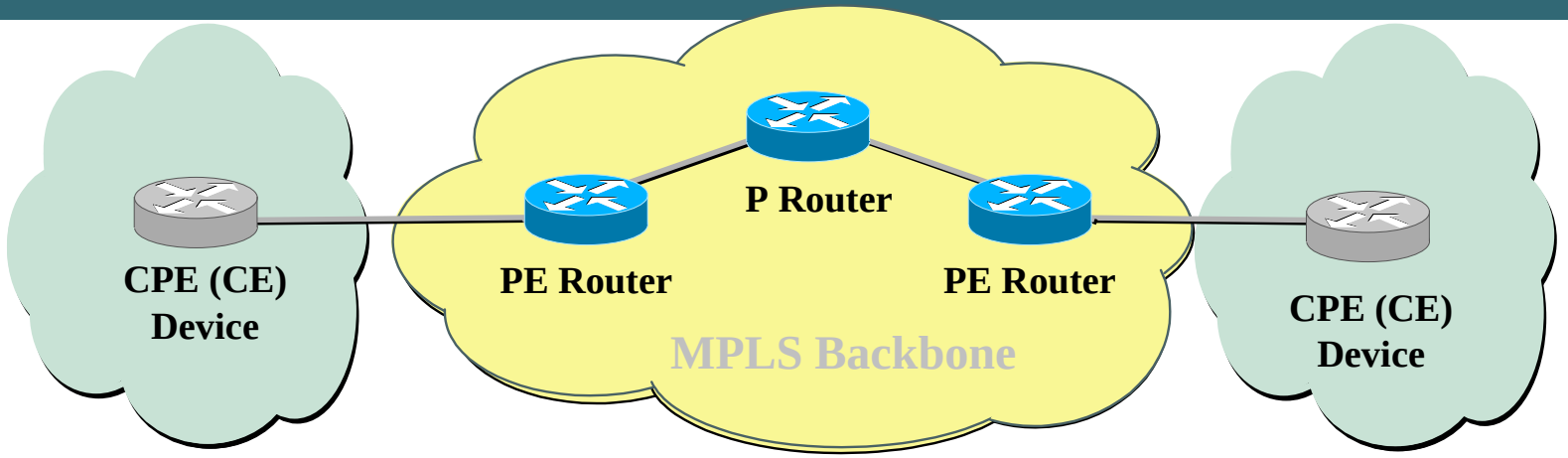
MPLS-Related Standards and Alignment with NGN



- RFC2547bis (BGP/MPLS VPN)
- Pseudowires and Pseudowire Multi-hop constructs
- MPLS x-interworking (ATM, FR, Ethernet…)
- Interprovider QoS
- MPLS NM/OAM/MIBs
- Multicast VPN
- MPLS Security
- DiffServ enabled MPLS Traffic Engineering
- Fast Network Protection with MPLS TE fast Reroute
- MPLS Performance/Reliability/QoS
- GMPLS Protection/Restoration

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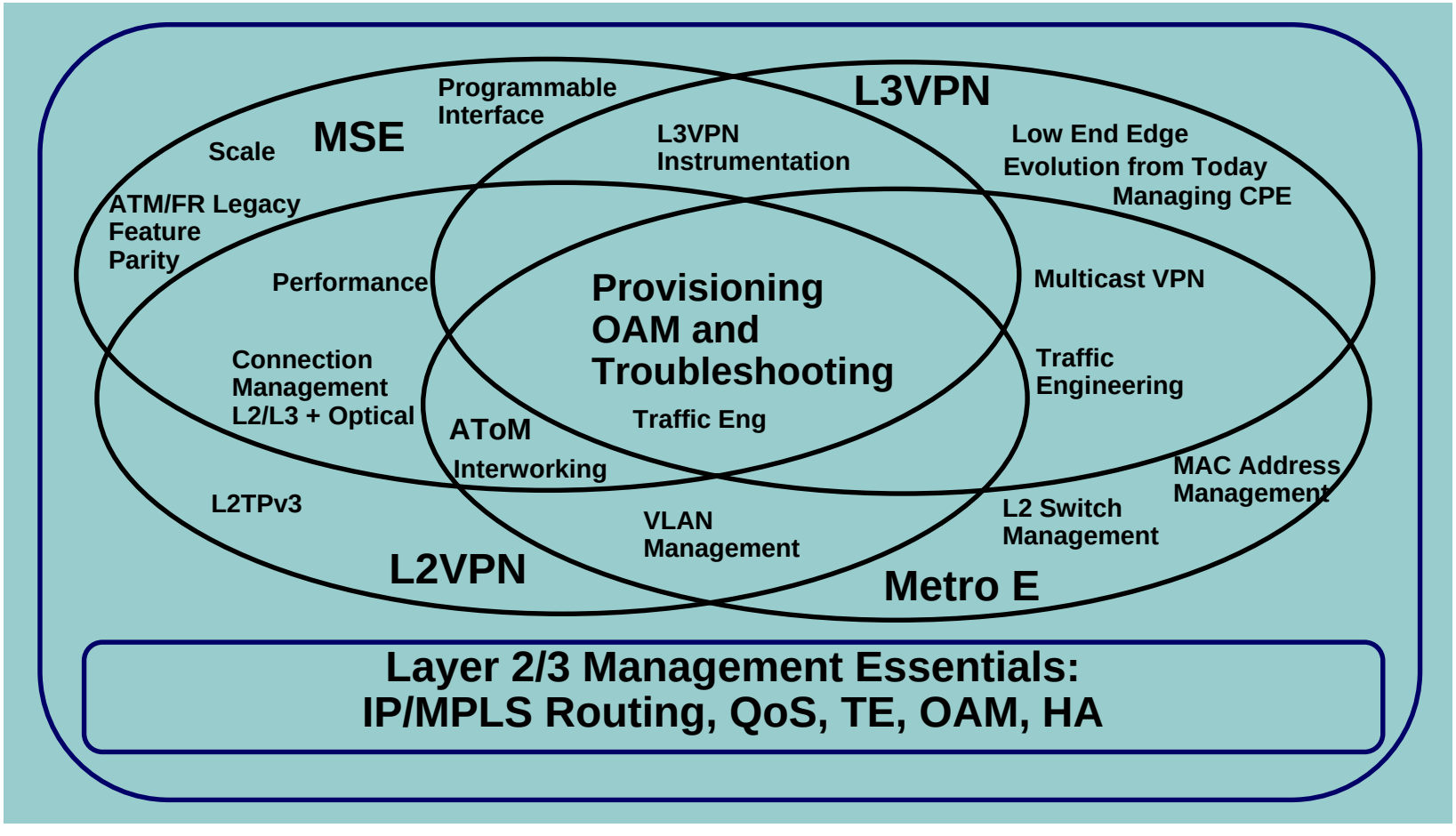
MPLS Services and Transport Network Management for NGN



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Multicast in NGN Architecture

Three Key Service Trends	*Multicast Component*
Broadband Consumer Service Enablement	***YES***
Triple-play, gaming, content delivery	***Video component in Triple Play service is 90% Multicast Video***
Peer-to-Peer Applications	
Mass delivery of customized services	***Multicast Games: Half-Life, Counter-Strike***
Flexible Service bundling	***Peer-to-Peer : Multicast Kazaa, Bit-Torrent***
Evolution of current SP offerings to Enterprises	***YES***
L1 bandwidth, L2VPN, L3VPN with value-added services	***Multicast VPN as a L3VPN Service for IPv4 and IPv6***
Improving OPEX associated with delivery of ATM, FR ..	***Multicast over ATOM, VPLS, PWS***
Customized Service delivery and bundling	
Converged Wireless and Wire line Services	***YES***
Enhanced mobility between fixed and wireless services	***Multicast and Mobile IP Integration : Department of Defense, Emergency Services, Hospitals***
IMS, 2G transition to 3G & Integration of Fixed & Mobile	***Multicast support for 3G chipset in CDMA***

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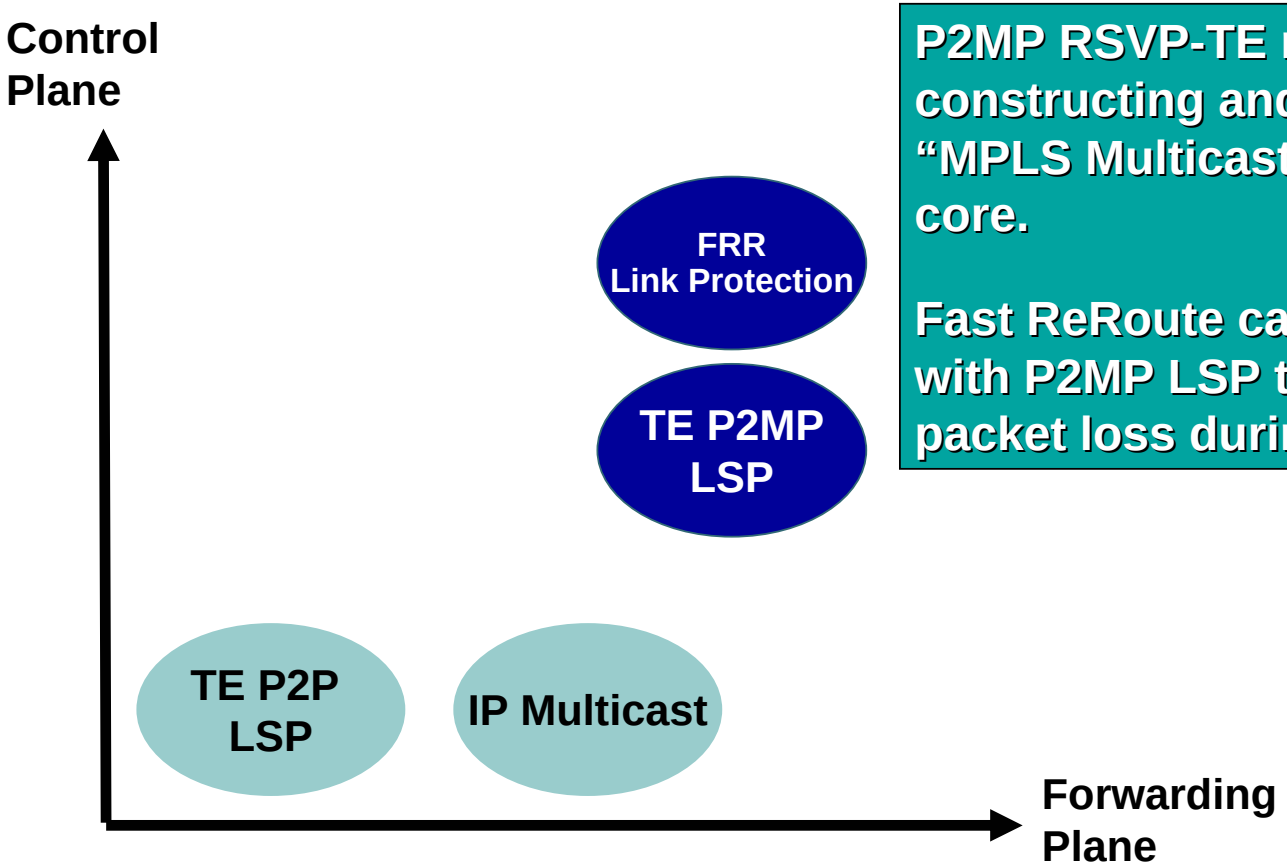
Bringing MPLS-TE to Multicast



P2MP RSVP-TE replaces PIM for constructing and maintaining "MPLS Multicast" states in the core.

Fast ReRoute can be combined with P2MP LSP to minimize packet loss during link failure.

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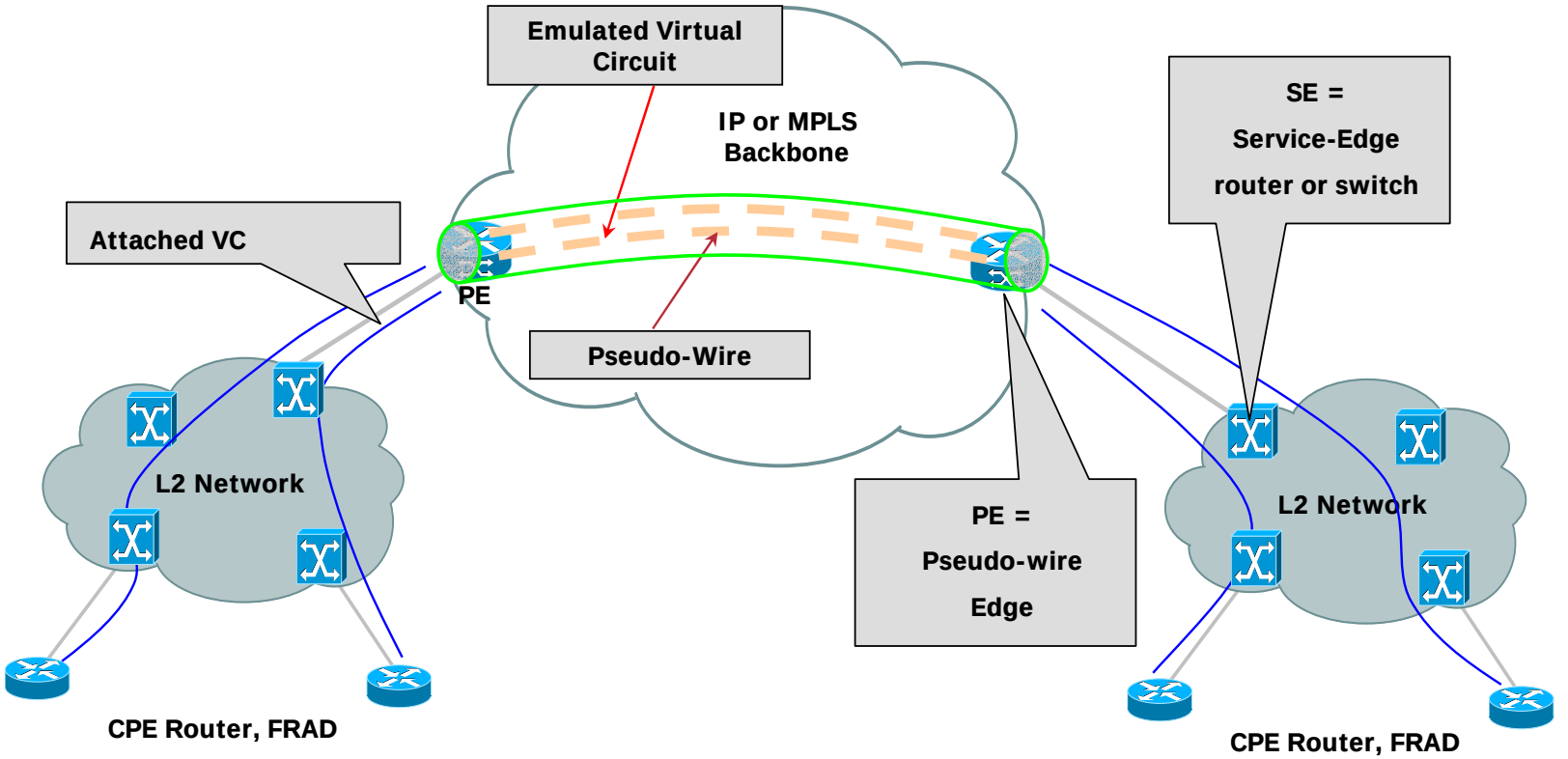
Pseudo-Wire Emulation Edge to Edge and NGN



L2transport over IP = L2TPext / L2TP-eth

L2transport over MPLS = pwe3-ethernet / pwe3-mpls-cp

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NGN Service Architecture with GMPLS

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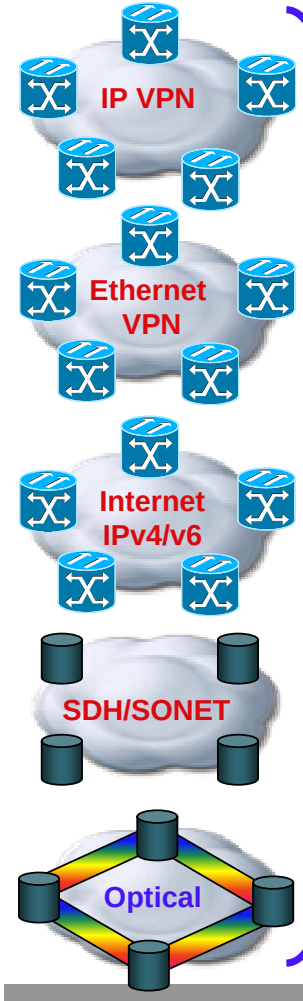
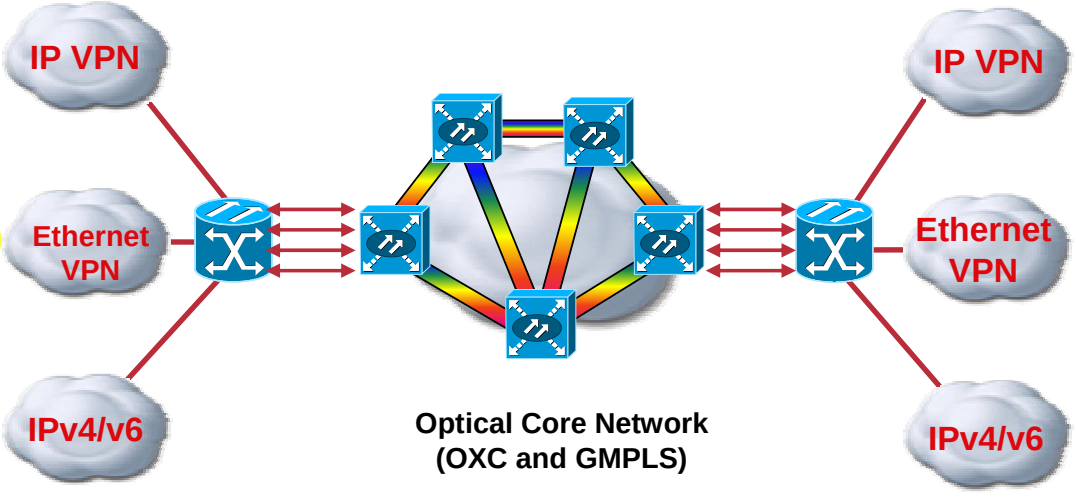
IP+Optical NGN Evolution



Drivers:

- Service Virtualization using LR/VR
- BW Guarantee, BW protection
- Multi- layer TE for IP+Optical
- P2MP TE
- MPLS/GMPLS Interworking
- IPv4, IPv6 unicast and multicast Services

IP/MPLS/ GMPLS



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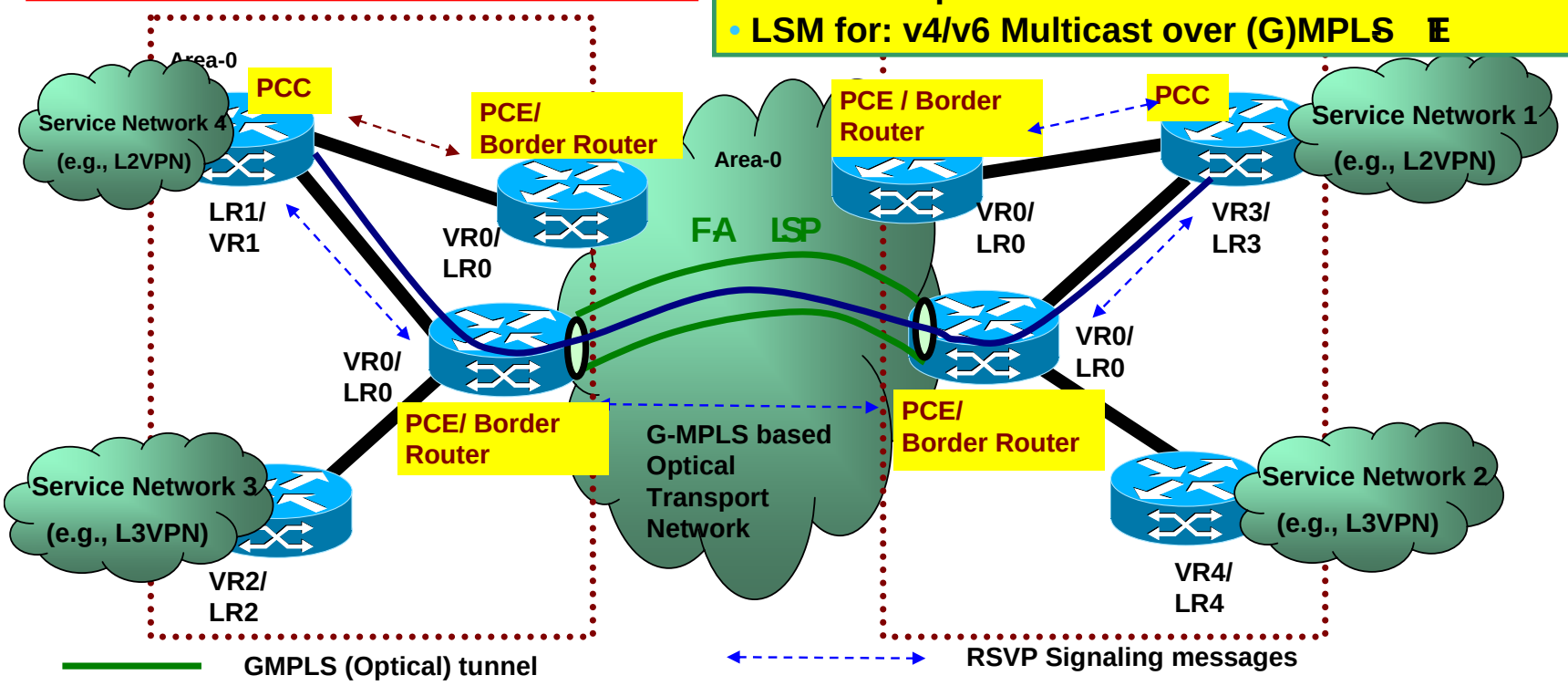
Next Generation IP+Optical Networks: A Vision

- LR/VR: Service Virtualization
- Border Model: Logical separation of IP & Optical admin. Boundaries
- 6PE/6VPE for IPv6 over GMPLS

- PCE for :
  - Inter AS/Area Path Computation
  - MPLS/GMPLS Interworking
  - Multi Layer TE
  - P2MP path calculation
- LSM for: v4/v6 Multicast over (G)MPLS TE



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NGN and Future Direction with GriD

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The GRID Network

- Were is the GRID?
- How do we build it? Own, lease, share,..
- Multiple Fiber bundles, Lambdas……big BW !!
- Fast provisioning
- High flexibility
- Scalable
- BW on demand
- Large investment - what is the business case?

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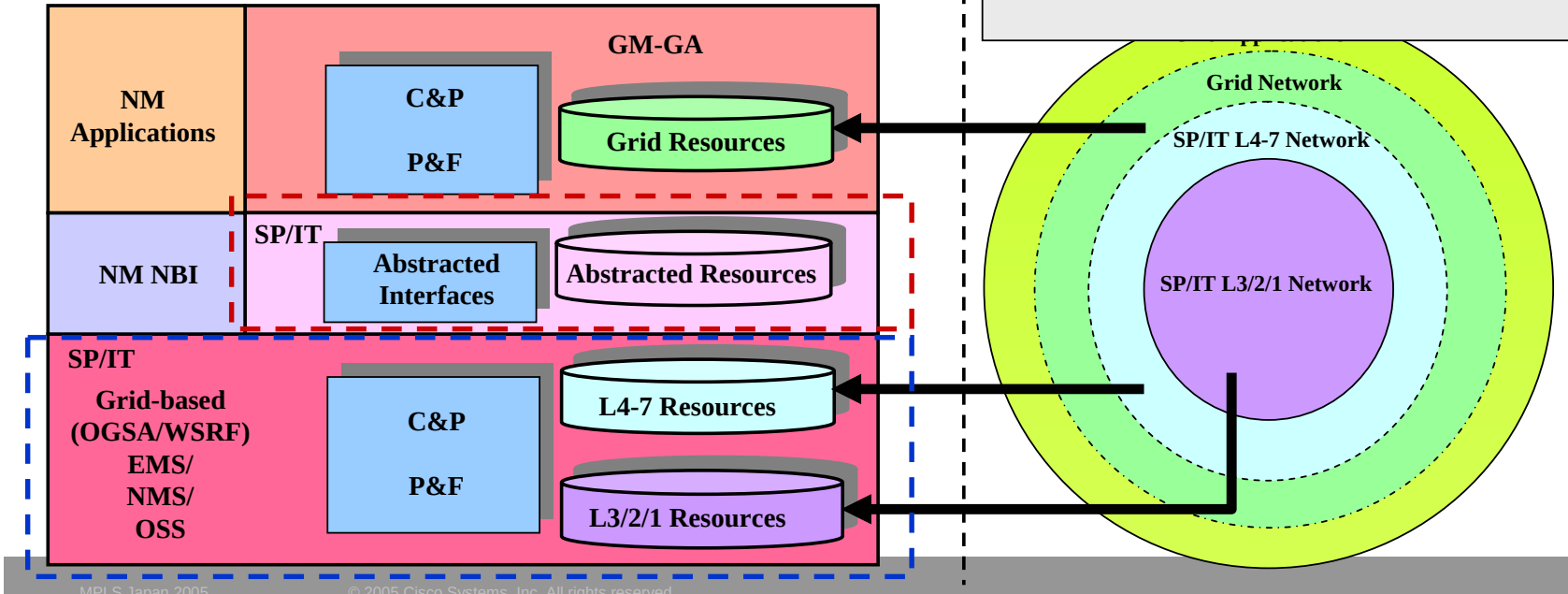
Grid based EMS/NMS/OSS and Abstract Interfaces

• **NBI: An EMS or a device (routers, switches) may provide north-bound management interfaces to be used by NMS/OSS or other applications**

C&P: Configuration & Provisioning
P&F: Performance & Fault Management
NM NBI: Network Management North-Bound Interfaces
GM-GA: Grid Middleware (OGSA/WSRF based) Serving Grid Applications
Abstracted Interfaces, Resources: OGSA/WSRF based; Needed to hide network details from GM-GA

- **While the NBI exposes much more information, the information exposed via the abstract interfaces (A-I) are abstracted and restricted**
- **Example, NBI may provide detail interfaces for MPLS VPN configuration, such as VRF, MP-BGP, hub-and-spoke configurations, but A-I will provide only interfaces like "join/leave vpn"**
- **NBI may provide routing related interfaces, such as for configuring OSPF, but A-I will not**



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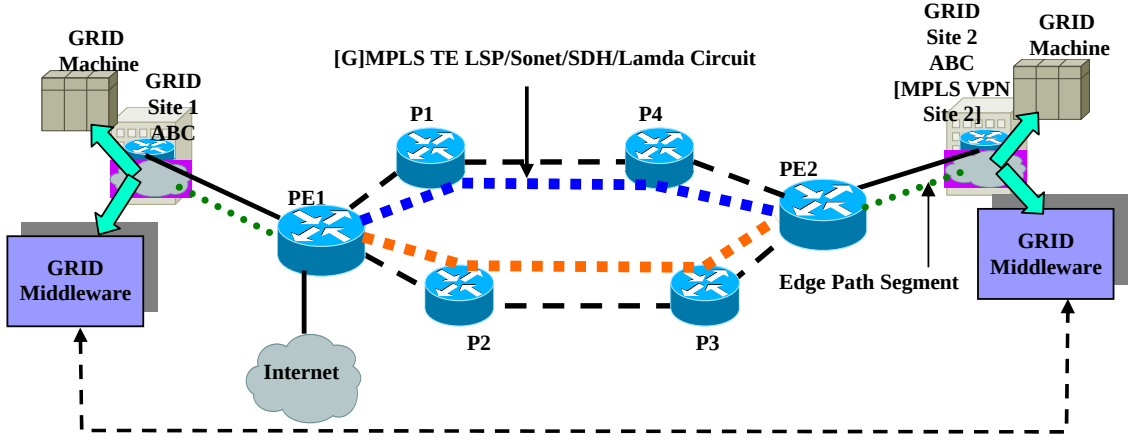
Abstraction Example: Path and QoS Abstraction

- *Path* (in Operator/SP/Carrier domains): Concatenation of any combination of following:
  - Segments on Edge links
  - Tunnel/Circuit/LSP in the core

- QoS: Example, Platinum QoS, which can be any of (depending on support)
  - DiffServ EF
  - Relevant IntServ QoS
  - Priority queue + DS-TE tunnel + FRR protection



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Why Abstracted, Restricted Resource Exposure – Network Technology Angle

- **Grid Middleware components serving typical Grid Applications should not be dependent on underlying wide varieties of networking technologies**
- **Either abstract or hide details**
- **For example, Abstract or hide details of**
  - ***Path*: ATM PVC, MPLS LSP, GMPLS LSP, Sonet/SDH Circuit or a Lightpath**
  - **VPN: L2VPN, L3VPN**
  - **QoS: DiffServ, IntServ, MPLS, etc.**

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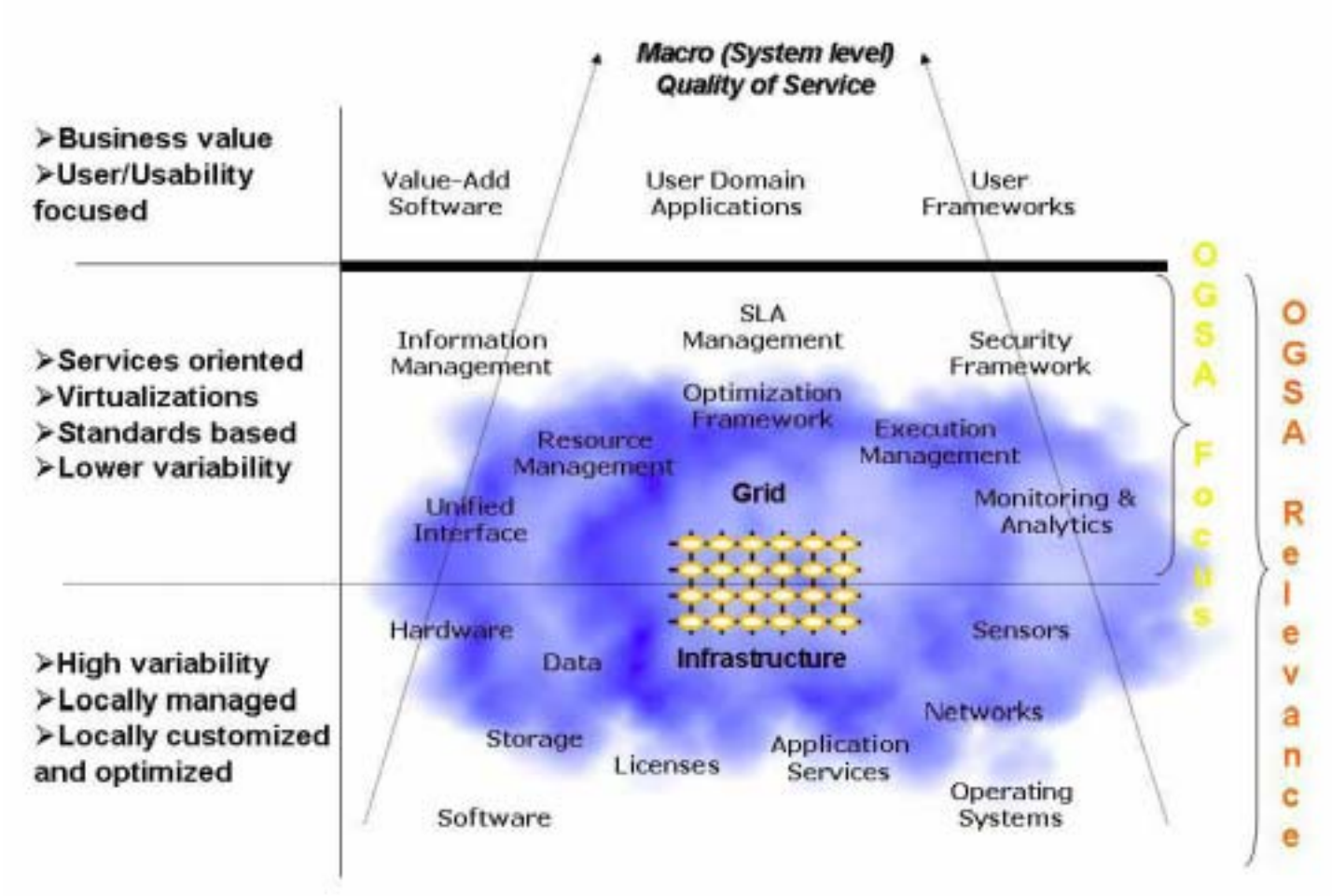
Conceptual View of Grid Infrastructures

http://forge.gridforum.org/projects/ogsa-wg



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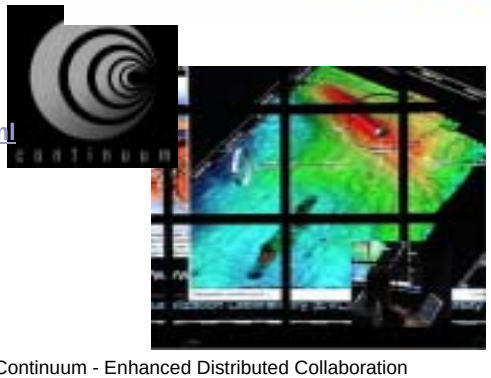
Some Grid Applications

- **HEP**
  - **Today 1 PetaByte per sec**
  - **Tens of PetaByte 2008**
  - **1 ExaByte 2015**

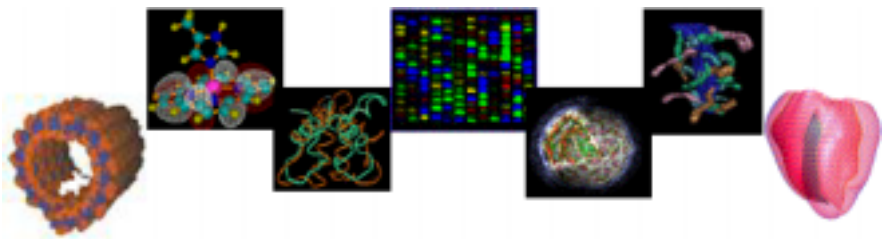
- **Distributed Visualization**
  - http://www.evl.uic.edu/cavern/optiputer/
  - http://www.evl.uic.edu/cavern/continuum/indexmain.html
- **3D visualization tools are used**
- **Key tools needed to process & analyze approximately 64 Tbyte of data by 2008**



Continuum - Enhanced Distributed Collaboration
http://www.evl.uic.edu/cavern/continuum/indexmain.html

GeoWall2 (NSF) - GeoScience Advanced Visualization
http://www.evl.uic.edu/cavern/optiputer/geowall2.html

- **Remote screening- Mammography**
  - **Digitized image results 75MB**
  - **Radiologist performs 100 patient readings per day (1 image every 30sec)**
  - **16 images per patient results in 16 * 75MByte = 1.2GByte**
  - **100 patients screened remotely means 1.2 Gbyte data every 30 sec**



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Future Needs

- **Change form processor centric to BW dominated computing**
  - http://www.calit2.net/news/2002/9_25_optiputer.html
  - **Around 2010 Grid applications will require an International Distributed Cyber Infrastructure based on**
  - **Petascale computing, exabyte storage, and terabit networks**
- **Terabit challenge**
  - http://www.cmf.nrl.navy.mil/CCS/
  - **Terabit global Large Data SOA**
  - **Integrate federated, distributed computational grids, realtime sensors, and digital historical information**
  - **Scalable to support exponentially increasing data**
  - **Privacy, authenticity and security demands: InfoAssured**
  - **Affordable … highly available … E2E QoS/QoP flows**
  - **Legacy and rapidly evolving technology integration**
  - **Perf, NetOps, Information Assurance tools/sensors**

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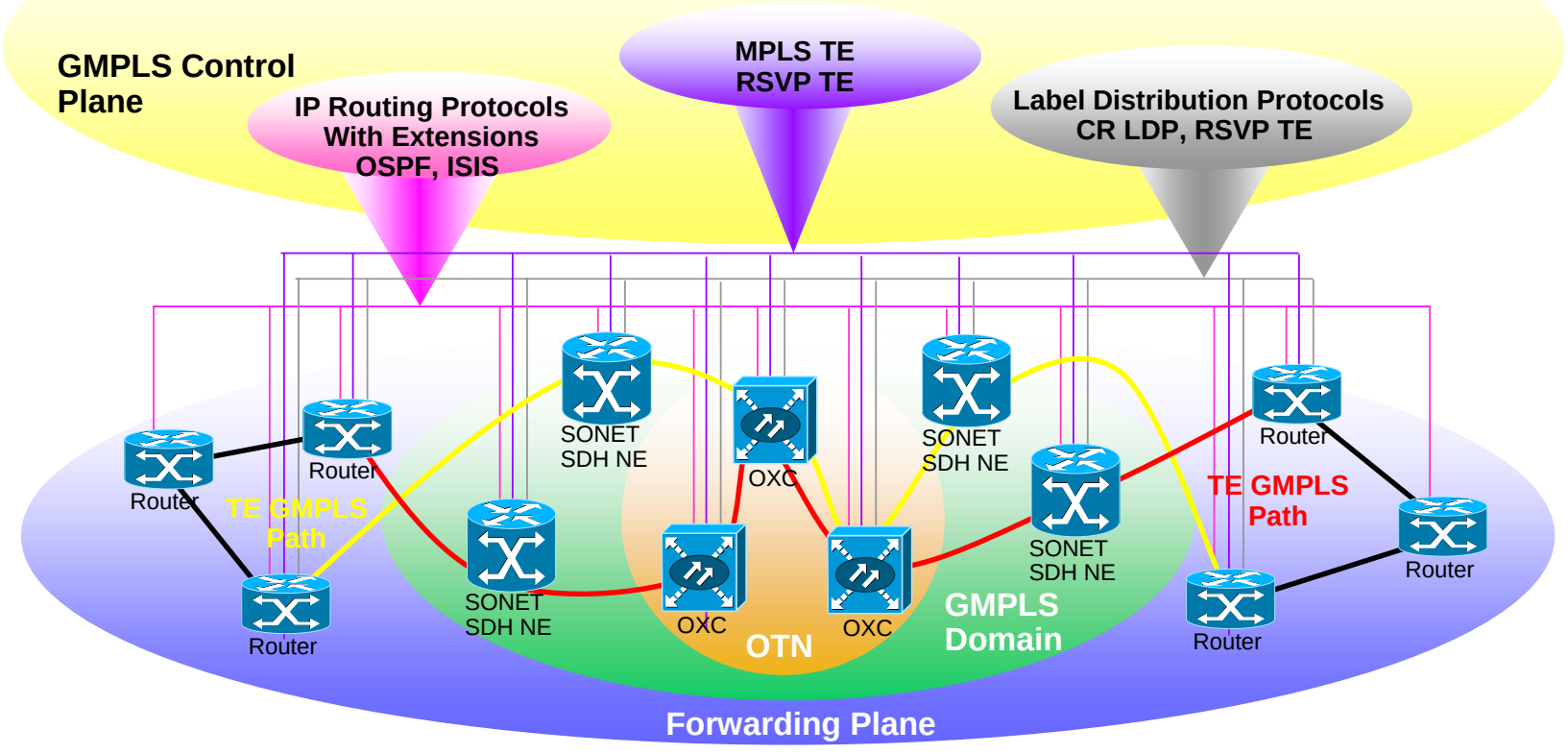
IETF GMPLS / Peer

http://www.ietf.org/html.charters/ccamp-charter.html

- *GMPLS control plane supports multiple switching and forwarding planes*
- *Introduces new functions to accommodate circuit-oriented optical network regimes*

GMPLS = MPLS + MPλS + N

- **where N is MPLS control of new switching planes**
- **draft-ietf-ccamp-gmpls-architecture-07.txt**



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ITU-T G.ASON / Overlay

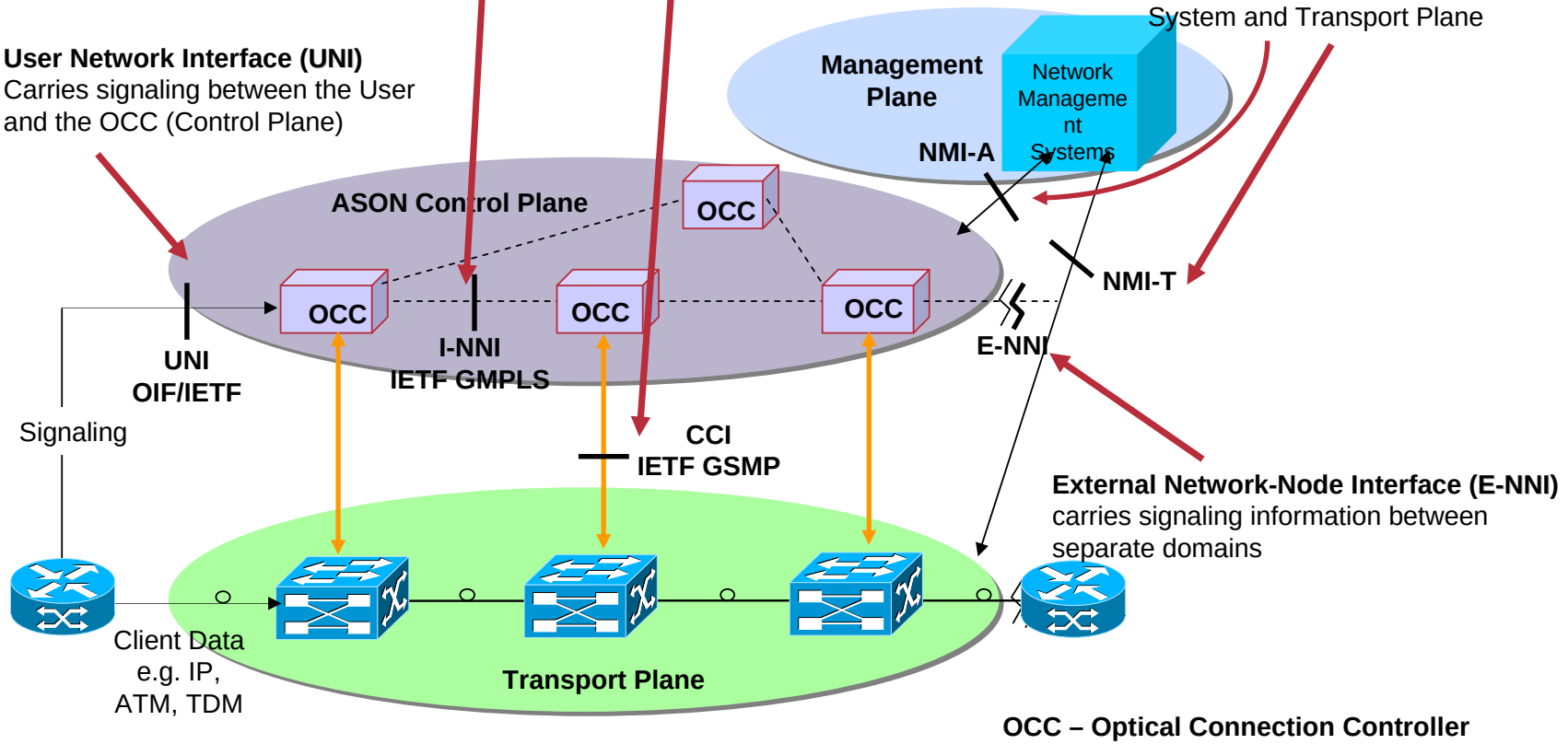
http://www.itu.int/ITU-T/

Internal Network-Node Interface (I-NNI)
Carries signaling messages between OCCs within a single domain
Either single operator or subnetwork

Connection Controller Interface (CCI)
Instructs switches to make connections across ports
Some topology information may be carried

Network Management Interfaces (NMI-A & NMI-T)
NMI-A between Management System and Control Plane
NMI-T between Management System and Transport Plane

User Network Interface (UNI)
Carries signaling between the User and the OCC (Control Plane)



OCC – Optical Connection Controller

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GUNI - Grid User Network Interface
GMPLS and OUNI Extensions

GUNI Functionality	Details
Direct service invocation	User/client requests a specific Grid service Client directly attached to the transport network and is member of the service signaling process. Client implements the signaling and the neighbor discovery functions
Indirect service invocation	User/client requests a specific Grid service through an agent Client invokes transport network services using proxy signaling Integration of UNI based services without UNI based functionality in each client
Optical transport format for control messages	Circuit/wavelength/frame switching with out of band signaling Flow/burst/packet switching with signaling packets or control bursts Hybrid switching
Flexible bandwidth allocation	Allows for wavelengths, sub-wavelengths, wavelengths bundle allocation Includes multi homing, dual homing, OVPN, Ethernet and G.709
Claim of existing agreements	Allows for wavelengths, sub-wavelengths, wavelengths bundle allocation Includes multi homing, dual homing, OVPN, Ethernet and G.709
Automatic, timely light-path setup	Automatic neighbor discovery Automatic service discovery Might be related to agreement covering future time interval
Fault detection, protection, restoration	Necessary to support variety of Grid service requirements and sensitivity levels Support of different protection and restoration signaling schemes
Propagation of service agreements and related events	Asynchronous event support for adaptive application services Ability to notify requester about events causing service provisioning problems
Traffic classification, grooming, shaping, transmission entity	Mapping of data traffic to transmission entities like bursts at physical (data) layer Mapping of control messages for in-band signaling
Control and data plane security	Control plane security credentials and policy information Data plane transport security

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Network Scaling

	2005 Today	0 - 2 Years	3 - 5 Years	5 - 15 Years
Optical Streams	1- 10 Gbps	10- 40 Gbps	120- 640 Gbps	1- 10 Tbps
Optical Ctrl Plane	STATIC Provisioned	DYNAMIC GMPLS	DYNAMIC Burst/JIT GMPLS	DYNAMIC Burst/Flow GMPLS
Control Plane	STATIC Tunnel	DYNAMIC SIP	SIP QoS / QoP	
LAN / WAN Technology	IPv4 10GE OC12 4xSDR IB	IPv6 10GE 4x/12x SDR/DDR IB	IPv6 100GE 12xQDR IB 64 128 IB	All Optical System Interconnect
Security Devices	1.0G IPv4 FW, K5, 3DES, CBs, KGs, NTAM	10G KGs HAIPEs, CAC, FEON, PKI, NTAM	40G HAIPE Scalable GFP Encrypter	640G HAIPE GFP Encrypter

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Conclusions

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Conclusions

- **MPLS technology as innovative foundation for NGN**
- **Technology is evolving to facilitate convergence and service creation**
- **Optical and GMPLS can become key NGN service architecture foundation**
- **Moving to the future MPLS and Optical very relevant to GriD applications**

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Domo Arigato!

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