ITU-T/OGF Workshop on NGN and Grids, Geneva 10/2006

Implications for Next Gen Networks and Grid Computing to support IPTV and IMS Infrastructures

Session 3 Management & Control
October 23-24, 2006

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AGENDA

- Goals
- IPTV
- IMS
- Web 2.0
- Grids: tight vs. loose coupling and loading
- Concept for possible standards work
- Summary

ACKNOWLEDGEMENTS:

•Dean Skidmore/IBM Global Solutions Executive IMS/SDP/NGN

•Gordon Kerr/IBM Distinguished Engineer, Next Gen Networks

Goals:

1. **Overview of IPTV, IMS and emerging Web 2.0**
2. **Examine some application/infrastructure target areas for grid and virtualization**
3. **Propose possible area for collaboration on Grid & NGN standards based on concepts of loose vs. tight coupling and loading attributes.**

Key Messages:

- **Telco and Service Providers are launching new IP-based "triple/quad play" 2005+. Leading examples are wireline IPTV and enriched mobile features with IMS (IP Multimedia Subsystem). Both IPTV and IMS are emerging –no broad industry experience yet.**
- **Telcos are driving SOA (services oriented architecture) implementations to:**
  - decouple applications via middleware from IT server/storage/network resources,
  - flexibly compose new services using standards-based technologies and protocols,
  - reuse architectural components to lower costs, time-to-revenue,
  - rapidly manage configuration, change management and services assurance with automation
- **Grid and virtualization fit naturally into SOA-based infrastructures and can support IPTV and IMS to provide immediate benefits (IT resource optimization, billing, services and management planes; possible areas in control plane).**
- **Challenges still exist to**
  1. Predict network behavior with the rise of IP-based services augmented by grids
  2. Recognize new services and loads to arise with adoption of Web 2.0, now barely anticipated by telcos
  3. Match application/infrastructures to grids in a more generalized method

IPTV Functionality

- **Internet streaming video**
  - IP packet delivery of streaming video,
  - “Best effort”, no end-end management of quality

- **IPTV**
  - Broadband xDSL access technologies (ADSL2, ADSL2+ and VDSL)
  - Manages QoS for video delivery in multicast & unicast channels
  - Integrated with network and content distribution infrastructure
  - IP-based Services Delivery Platform -- now leading with VOD
  - IPTV drives near real-time (200-2000 ms) responses
  - Entire IPTV business hinges on viewer Quality of Experience QOE defined as end-end video quality comprised of infrastructure performance and video quality.

Bandwidth demands of consumer households

Anticipated Requirements of a '*Triple-Play Network*'*

Web surfing	3.0 - 5.0 Mbit/s
Phone conversations	0.1 - 0.2 Mbit/s
Internet Gaming	5.0 - 10.0 Mbit/s
Internet appliances	1.0 - 2.0 Mbit/s
2 MPEG2 DTV	8.0 - 10.0 Mbit/s
2 video conferencing	2.0 - 3.0 Mbit/s
HDTV	12.0 - 19.2 Mbit/s
PVR	10.0 - 20 Mbit/s

TOTAL ~ 55 Mbits/s

COMMENT: Likely loading profile for consumers to peak 3pm - midnight

Source: "New Face of Television: How Standards Such As IPTV and VDSL2 Are Changing the Consumer Experience" Imran Hajimusa, GlobalComm 2006

Selected IPTV Deployments and Bandwidth 2006

- **Verizon FiOS**
  - FTTH Fiber to the Home
- **ATT Lightspeed**
  - FTTN Fiber to the Neighborhood, VDSL (20-25Mb/s)
  - Unicasting, multiple picture in picture, instant channel change
  - Vision: 18 million customers 3-5 years
- **BellSouth**
  - ADSL2+
- **BT**
- **DT**
- **Telecom Italia**

IPTV Key Standards - Architecture

- ITU Recommendation H.610: Full Service VDSL – System Architecture and Customer Premises Equipment

Defines a standard high-level architecture for the delivery of video, data and voice services ("triple play") over a VDSL access network. The various service interfaces, connection and management message flows for the video and other services are specified. The architecture is applicable to other broadband networks used for IPTV services.

- TR-058: DSL Forum Technical Report – Multi-Service Architecture and Framework Requirements

Presents a multi-service DSL architecture, discusses evolution from currently deployed DSL architectures and support for new service features such as IP-QoS and Bandwidth on demand.

- TR-094: DSL Forum Technical Report – Multi-Service Delivery Framework for Home Networks

Defines a Home Networking Architecture and functionality required to deliver multi-service applications to residential customers within a common Telco framework

Source: www.intellon.com/pdfs/IPTV_White_Paper.pdf

IPTV Key Standards – QoS over Networks

QoS Standards

- IEEE 802.1p QoS, IEEE 802.1q VLAN, CEA2007 VLAN Mapping

Service parameters such as, bandwidth required, packet delay, jitter, and loss rates.

- WAN PROTOCOLS

  ATM, Ethernet and IP protocols used to transport IPTV packets over the wide-area network specify mechanisms for achieving the desired quality of service levels.

- HOME NETWORKS FOR IPTV PACKETS

TR-094 specifies QoS requirements for home networks for IPTV packets with support of IEEE 802.1q (VLAN) and IEEE 802.1d Annex H.2 (User Priorities and Traffic Class) standards.

Source: www.intellon.com/pdfs/IPTV_White_Paper.pdf

Scalability & User QOE Quality of Experience

IPTV in early commercialization, requirements & standards emerging

Critical Telco challenges:

- **Infrastructure scaling of IPTV is critical**
  - Optimize distributed server/storage platforms (10,000-30,000 servers)
  - Sustain network performance
  - Absorb variable consumer demand spikes 10M-20M+ users
  - Automate end-end configuration and services assurance management

- **User QOE "Quality of Experience" is critical to success of IPTV**
  - Users seek fast "channel zapping", easy GUI's, HDTV quality
  - Metrics: Latency, packet loss, jitter, frozen or blocky images….

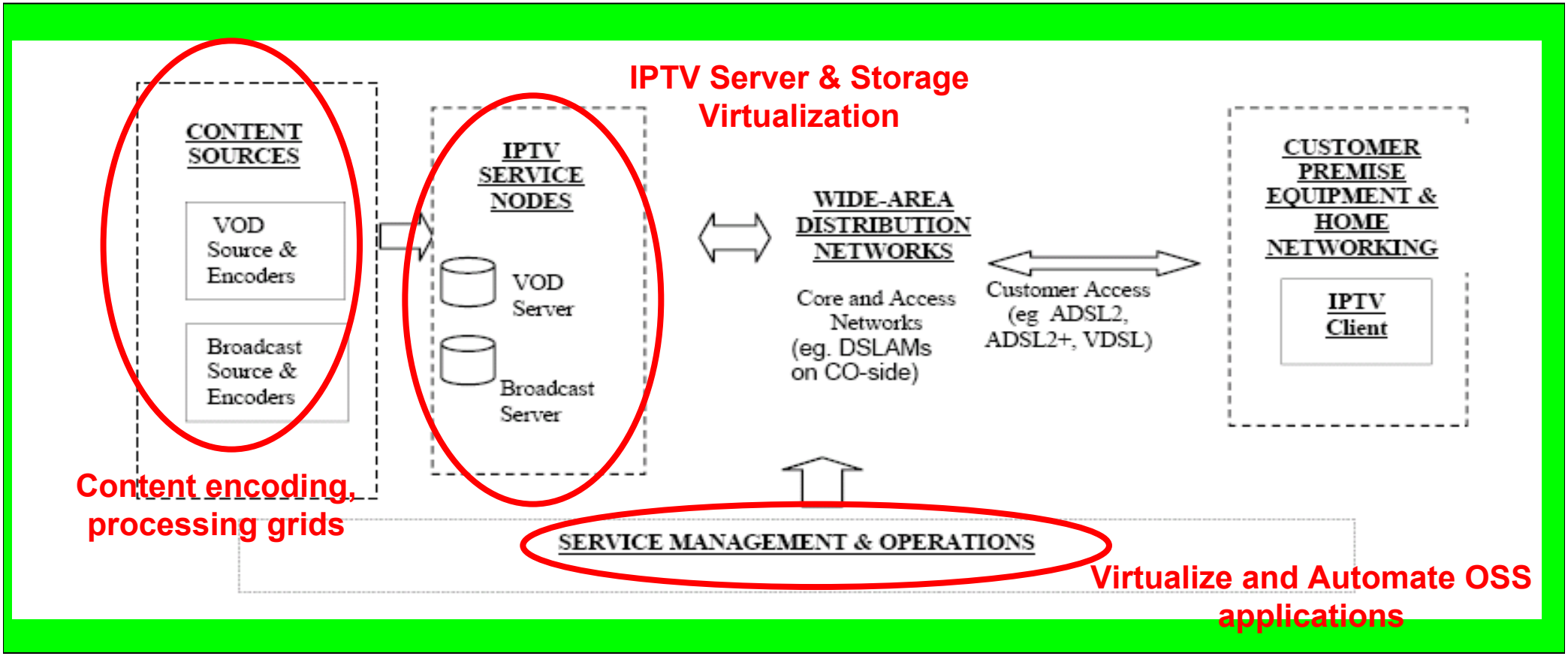
  QOE = INFRASTRUCTURE PERFORMANCE + VIDEO QUALITY

Factors Affecting Video Quality

- Network specific
  1. Delay
  2. Jitter
  3. Packet loss (<10*E-5 = “excellent svc quality”, < 2x10*E-4 is poor -- ITU-T J.241 Appendix A)

- Application specific
  1. Video codec – MPEG, H.264
  2. Encoding bit rate – CBR vs. VBR
  3. Packetization scheme
  4. Video content characterization – high motion, color depth
  5. Loss recovery technique used – FEC
  6. Audio/video lip synch (intolerable if >185 ms per “IPTV Svc Assurance” K.Kerpez, et. al.. IEEE Communications Magazine, p170, 9-2006)

Scale IPTV in 3 areas using Virtualization



This architecture is based on the comprehensive architecture and services model specified in ITU Recommendation H.610 and on the IPTV platform offered by Microsoft®

Source: www.intellon.com/pdfs/IPTV_White_Paper.pdf

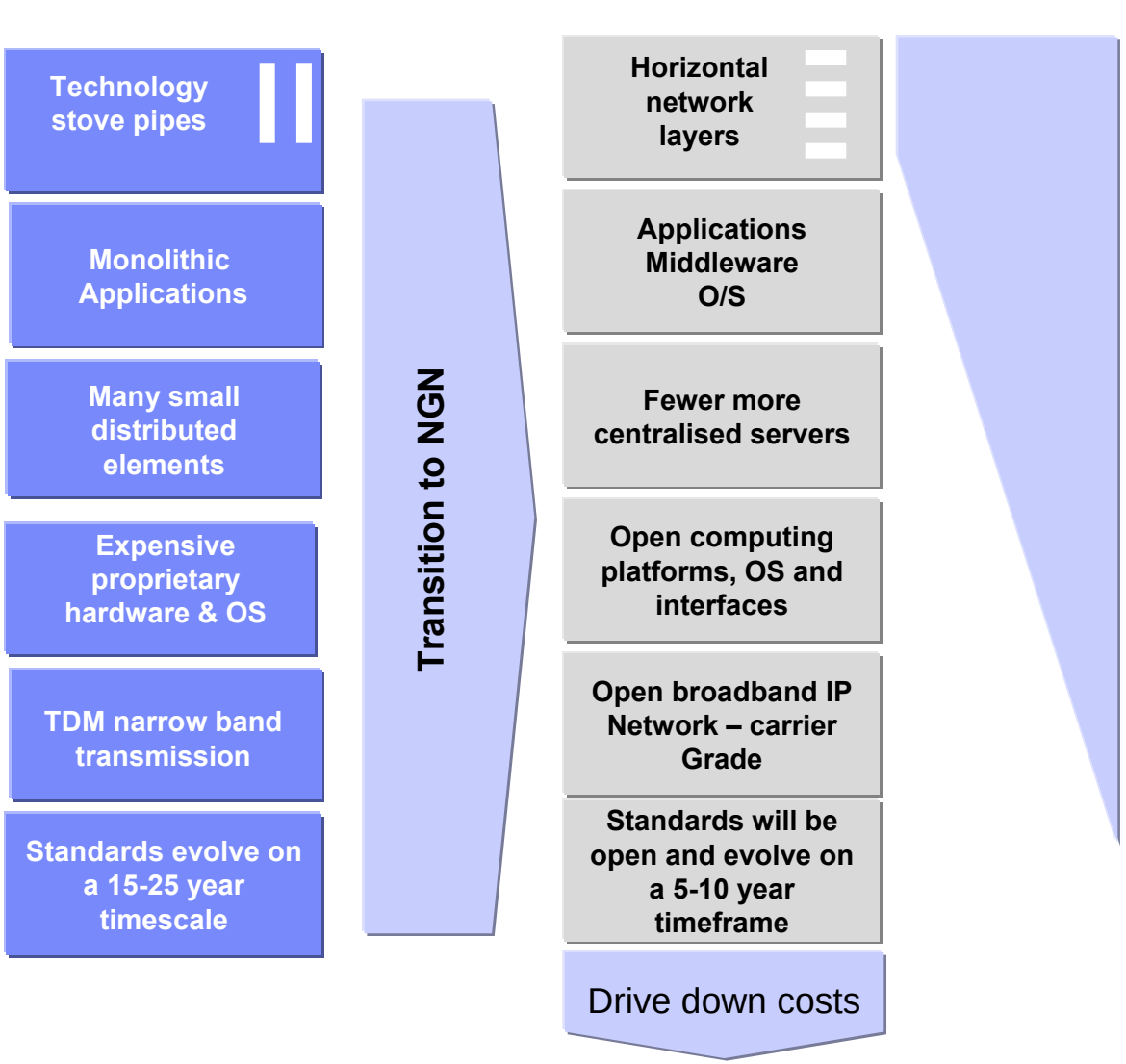
Grids can address critical issues of IPTV Scaling and QOE

- **Content rendering and encoding**
  - **Requirements: high performance computing grids to digitally create/render TBytes of data pre/post production; encoding for distribution**
  - **Grid/virtualization: Use grids to create scalable IT optimization of server/storage HPC resources over WANs**

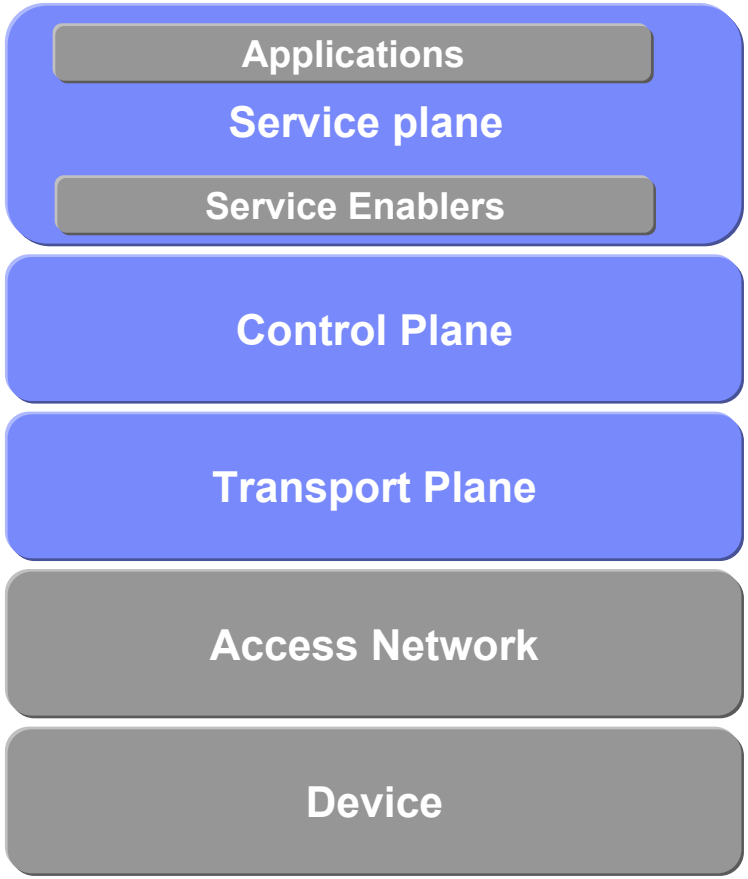
- **IPTV Service Nodes in multi-tier infrastructure**
  - **Requirements: "Regional" super head-end to acquire live TV national content , multicasts live TV delivery and manages VOD distribution. Acquires live video service and generates encoded full screen and PIP streams multicast in encapsulated in RTP transport streams. Typically has mirror-site in event of major failure.**
  - **Content Distribution: Metro tier manages content distribution to local serving tier. Typically VOD loads: 50,000 movies = 100TB, "100 hot titles"= 200GB. Expect consumer bandwidth consumption at 20-25 Mb/s by 2008+ in major cities in US**
  - **Timing/performance at local serving nodes to STB device: channel zapping ~<200 ms is key**
  - **Grid/Virtualization: Use grids to create scalable grid pools for automated content distribution, server/storage provisioning within timing and bandwidth requirements. Use grids for automated failover and disaster recovery.**

- **Service Management & Operations**
  - **Requirements: OSS/BSS services layer, including flat-rate, Real Time billing. Automated discovery, monitoring, provisioning, configuration/change management, fraud detection and services assurance with problem determination.**
  - **Grid/virtualization: Create scalable grids to optimize and automate server/storage and network resources between distributed operations centers. Drive 90+% CPU and memory utilization for required applications. Exploit intelligent orchestration of resources using grid infrastructure. IPTV deployments may have 10K-40K servers!**
  - **Leverage grids with fault tolerant computing for stateful or long-running tasks to create resilient server/storage/network infrastructures.**
- **NET:**
  - **IPTV/VOD viewer Quality of Experience (QOE) is coupled to the IPTV infrastructure.**
  - **Grid/virtualization can drive scaling, service management operations, resiliency and QOE**

IP Multimedia Subsystem (IMS) is part of a wider transformation to Next Generation Networks



IMS Layered Architecture

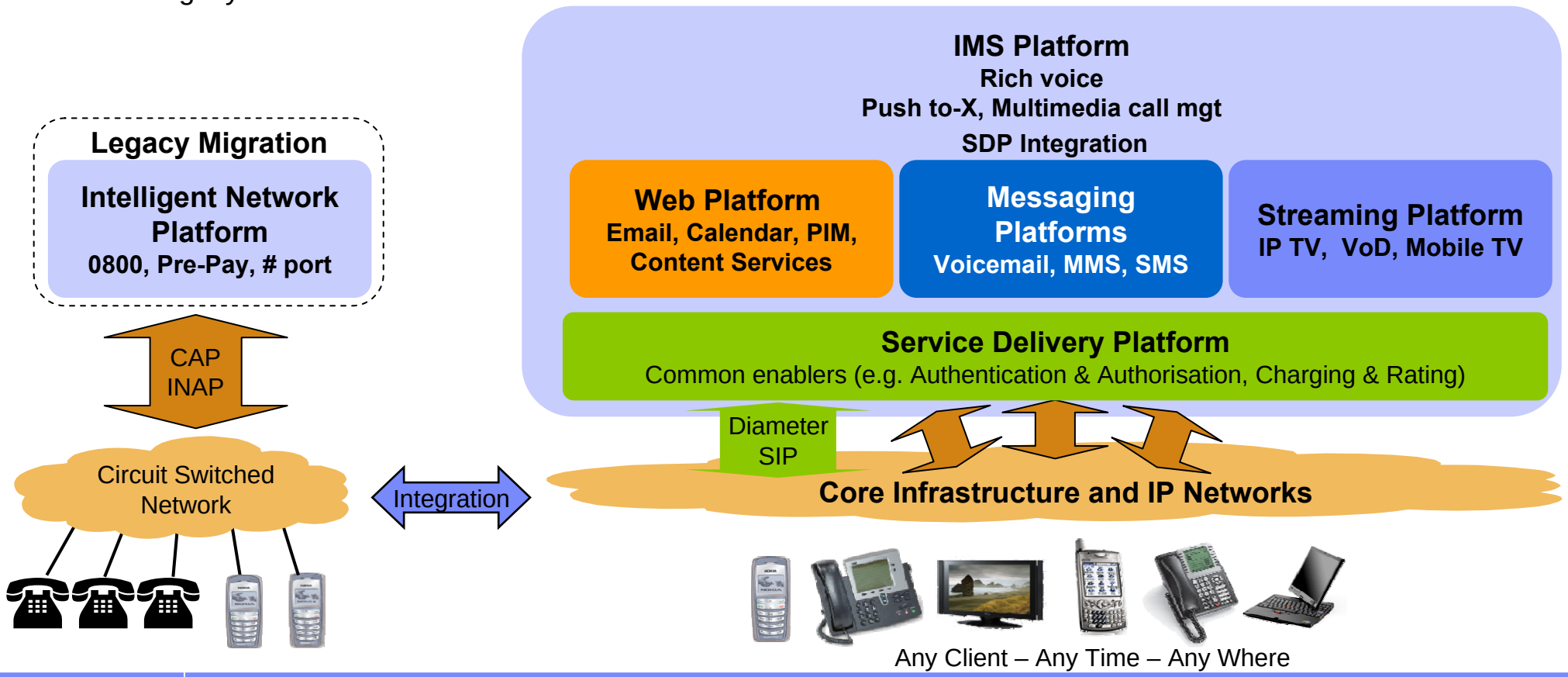


However, IMS should be considered as an evolution of service delivery platforms deployed by operators today

This approach will:

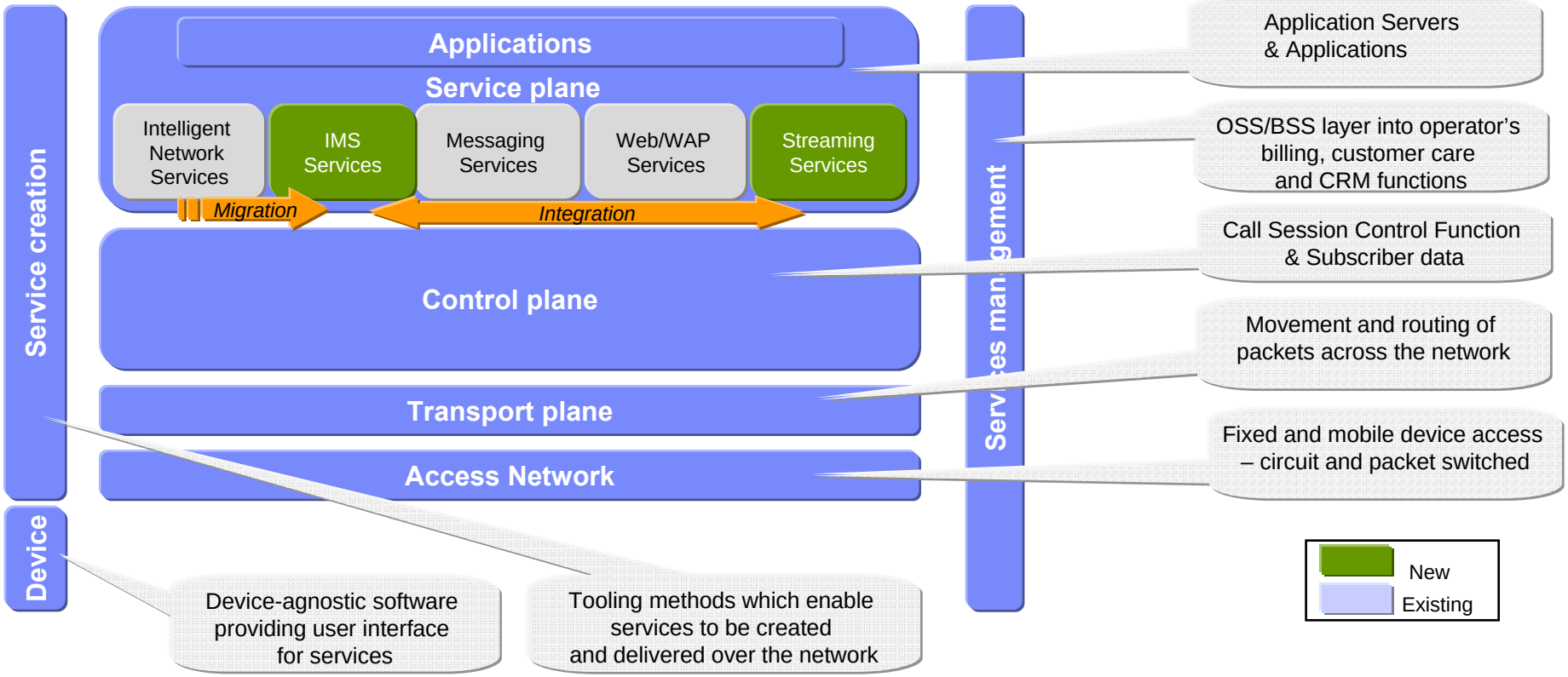
- Minimise cost
- Provide a gradual transition path
- Include legacy users in new services

Integration between SDP components and deployment of common enablers is not dependant on IMS



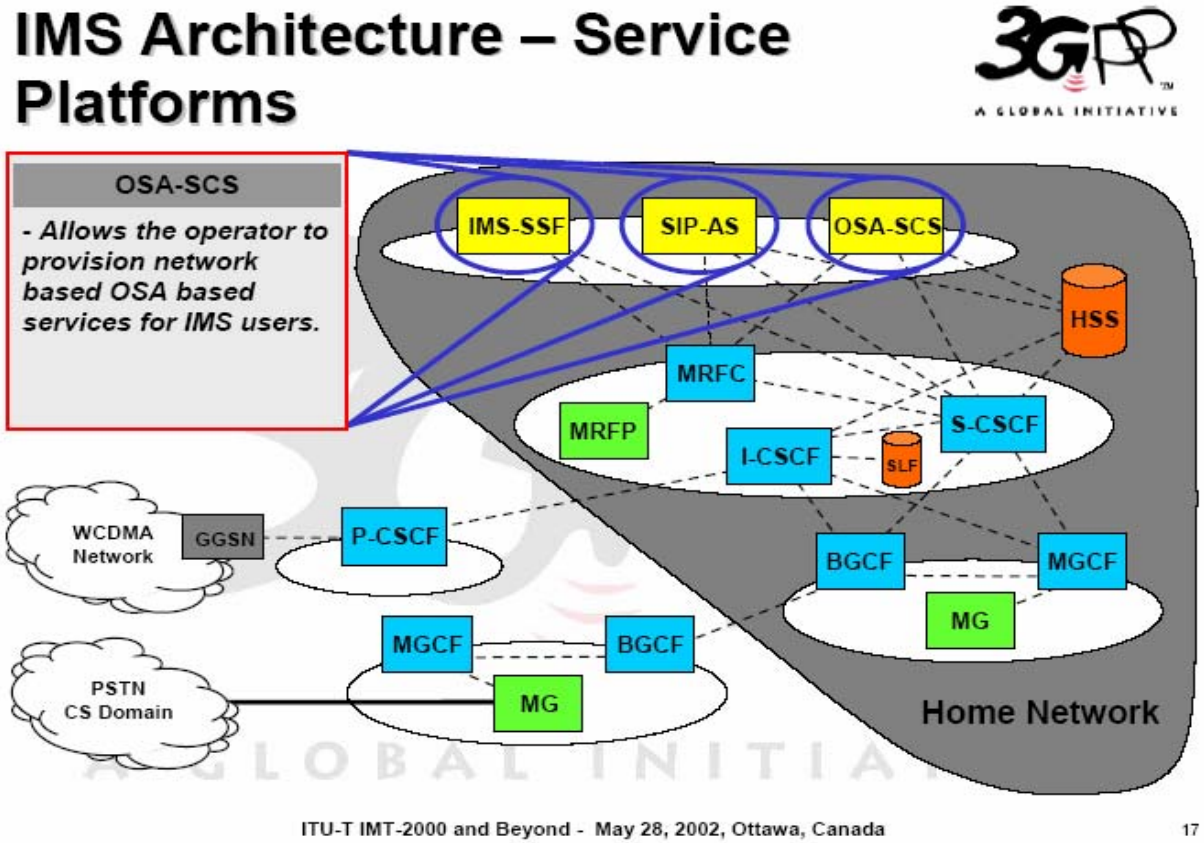
The target NGN architecture is access network agnostic and has common open service platforms for rapid service delivery and interoperability

Next Generation Network architecture



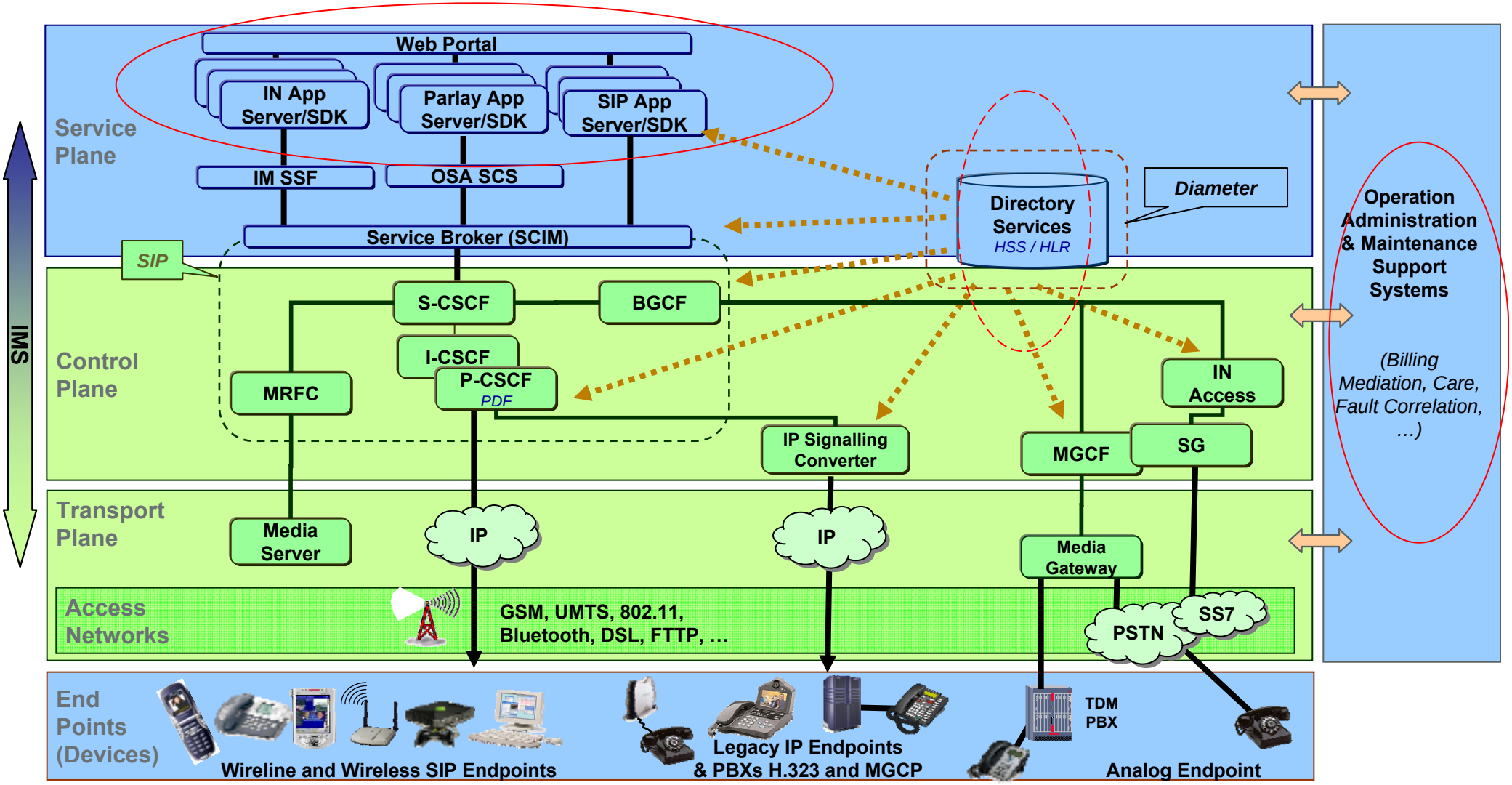
The network 'intelligence' lies in the service plane, which is mission-critical for enabling operator revenues

IMS Architecture is well documented. Grid opportunity in Services and Management Planes. Possible opportunity parts Control Plane.



Grids/Virtualization Opportunity to Augment IMS

= Best grid candidates 2006-2007



Performance requirements: Guidance for Grids

	Hard Real Time	**Soft Real Time**	**Internet Time**	**Business Time**
Example	50 µsec e.g. Sonet line card	**50 msec** **e.g. TCAP transaction**	**1 to 2 sec.** **e.g. SMS message**	**Minute & +** **e.g. Provisioning flow**
Typical Execution Environment	VxWORKS Wind River, etc.	JAIN SLEE/J2SE **SIP servlets**	**J2EE**	**J2EE**
Interaction Capabilities	Not Applicable	Intra IMS Service Orchestration	Inter SP Service Choreography	Process Choreography

Animated foil

Web 2.0 - Future services for telcos? New loads on network…

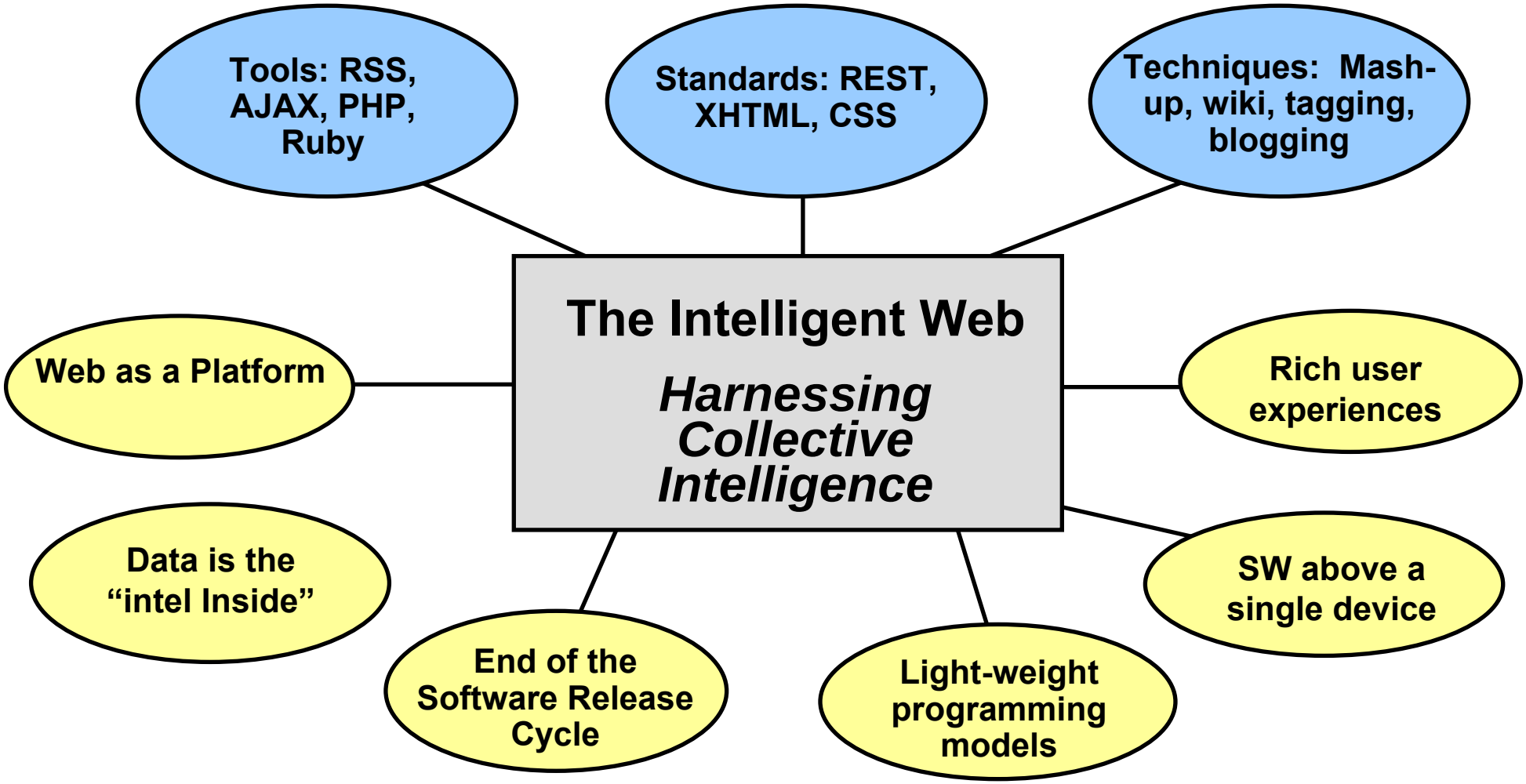
- Origin of the term was Tim O'Reilly's article: http://www.oreillynet.com/lpt/a/6228
- It is about design patterns and business models for the next generation of software
- Real-time business
- Using real-time communication to get work done; connecting with colleagues and business partners, finding experts
- Activity-based Computing
- Focus on the work instead of the tools; support semi-structured work patterns
- Social networking
- Amplifying the value of working together; capturing the wisdom of crowds

Web 2.0 is about connecting people and amplifying the power of working together

IMPLICATIONS

1. Large groups or communities of interest will require reliable broadband networks, often in "mass events".
2. As Web 2.0 grows, telco networks will see loading through content aggregators.
3. Grids can strengthen telco IP-based infrastructures to be resilient under dynamic loading.

Web 2.0 – Emerging Themes for Collaboration



Observations on applicability of Grids for IP Services

- **Grids and virtualization have proven capabilities in high performance computing, virtualization of IT systems, workloads and more recently data.**
- **Current grid/virtualization strengths exist for IT resource optimization, applications in Services, OAMP and selected Control Plane elements (e.g, HSS). Timing affords "soft real-time" to "Internet" time millisecs to minutes. Operations here may be considered "loosely coupled" between applications and resources**
- **Grid applicability is limited in Control, Transport and Access Planes, often with dedicated, optimized devices. Timing here requires micro- to low millisec range for real-time ops. Operations here may be considered "tightly coupled" between applications and resources.**
- **Little consideration has been given to explore applicability of grid operations to match IP-based NGN services and their planes.**

Concept for standards work on NGN and Grid

- **Challenge: Limited experience and standards around launch of IP-based NGN services and consistent methods to augment and match these services with grid & virtualization.**
- **Proposal: Begin work to address Challenge with goal of creating a valued standard or recommendation. Possible steps could include:**
  - Assess IPTV and IMS full service architecture as basis for grid suitability
  - Define IP-based service usage cases around IMS, IPTV and Web 2.0 variants. Suggest IPTV scaling, QOE and Services Mgmt; for IMS begin Services and OAM Planes.
  - Explore attributes of applications (IPTV/VOD, gaming, VOIP, etc.), dynamic loading, timing requirements for infrastructure and network. Assess loose coupling vs. tight coupling of elements and operations to support the applications in the NGN architecture.
  - Describe and map selected applications and workflows to determine if types of NGN services can be matched to grid operations. Can NGN services and grids be usefully categorized or a new valuable taxonomy can be created?
  - Assess with a gap analysis if existing standards exist or could be extended
  - Propose a route to standardization or creating useful Recommendations from ITU-T, OGF and other organizations.
- **Benefits: Creating a standard or recommendations could improve deployment and adoption of NGN services, markedly improve time-to-revenue of telcos and help drive services offerings at lower risk.**

Thank You!

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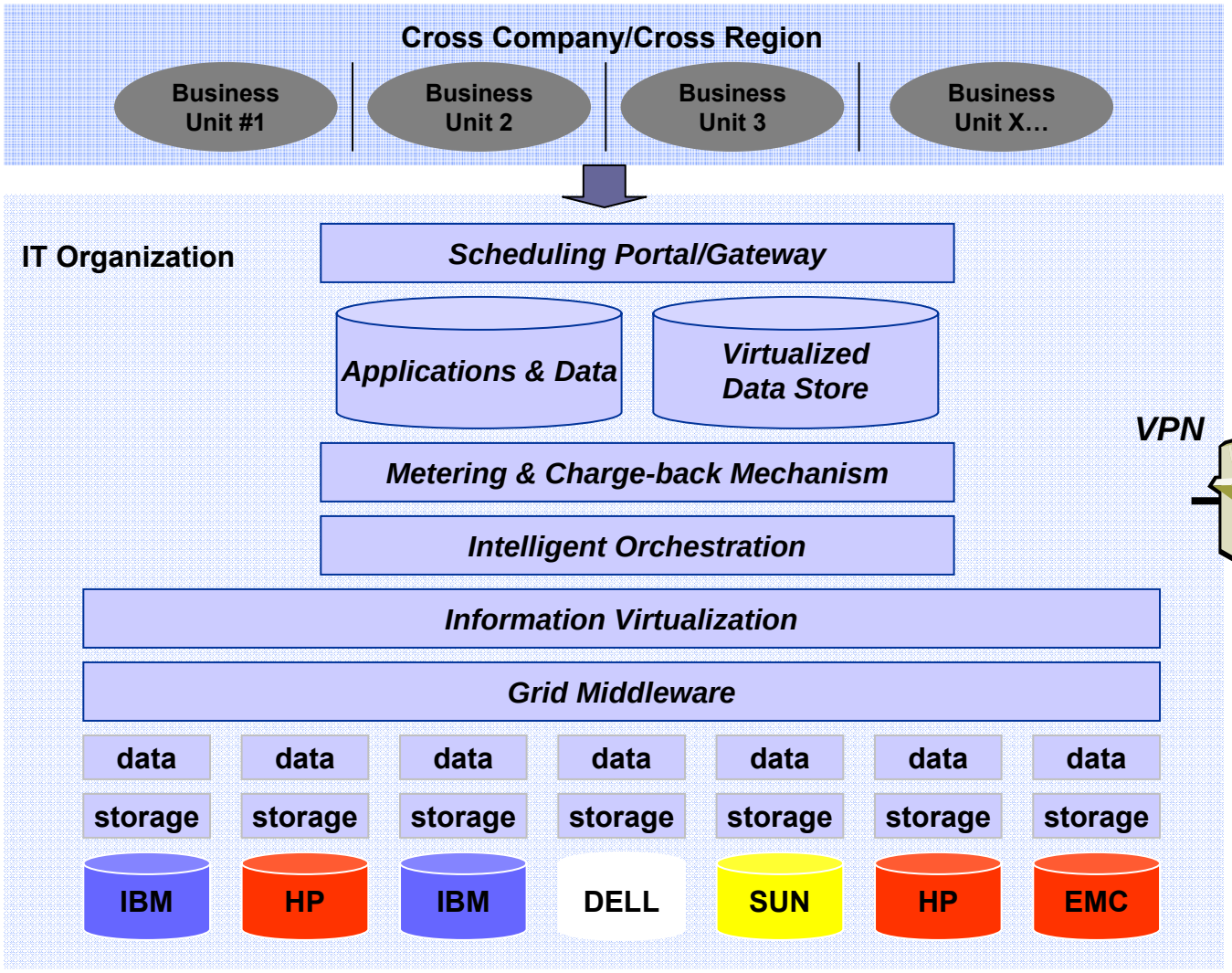
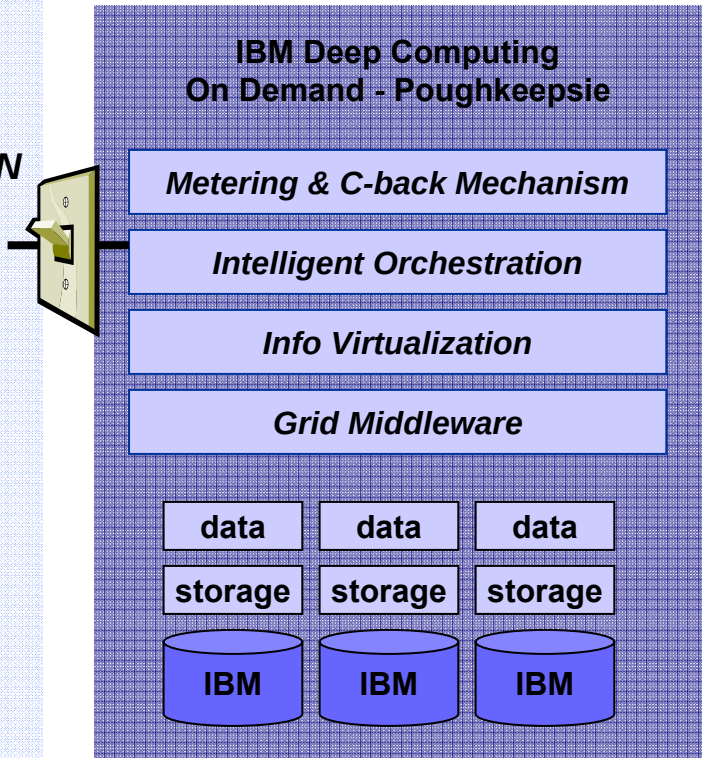
IBM Services Based Grid Reference Architecture



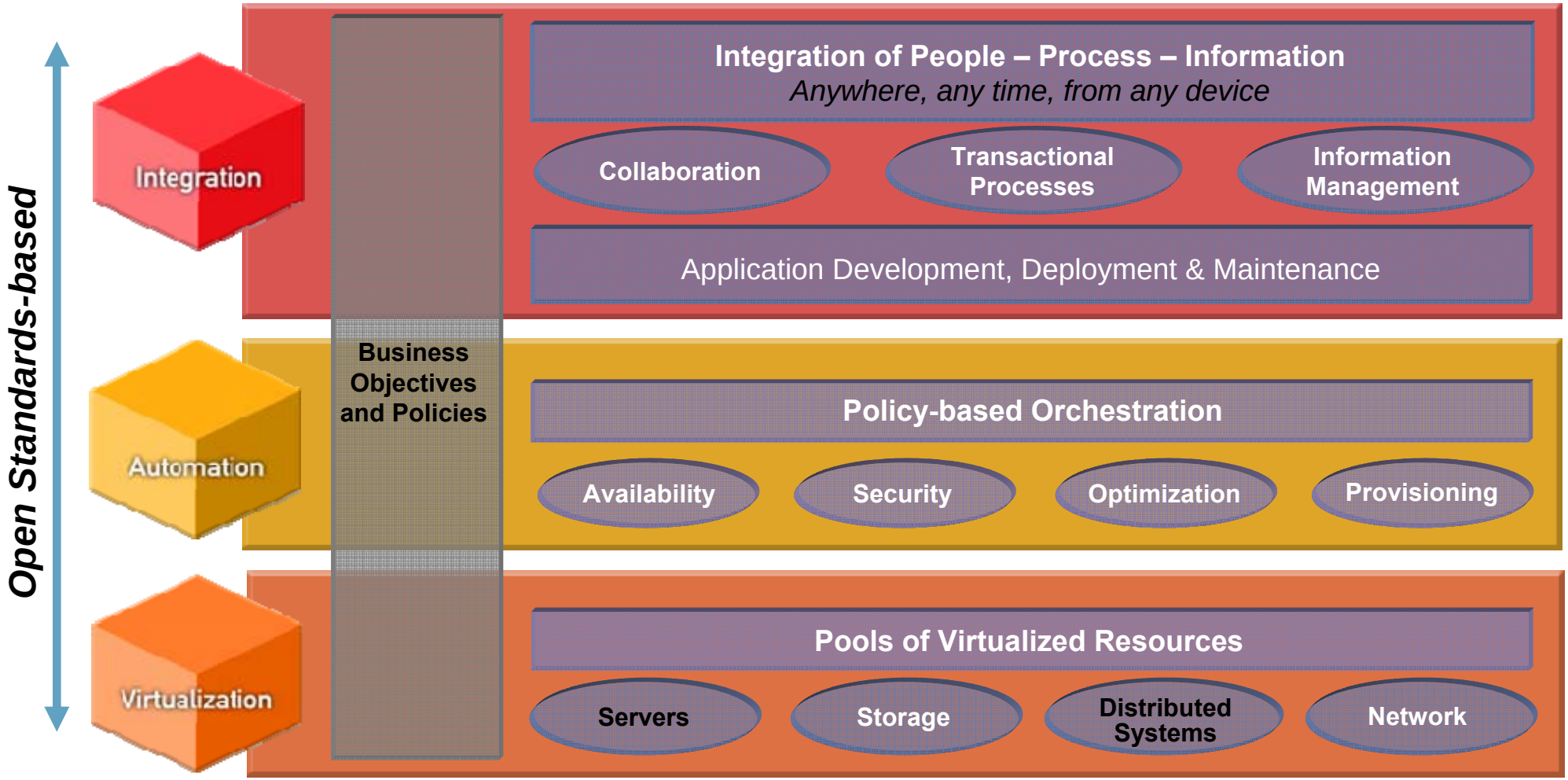
Applications can use some or all available grid services



IPTV Key Standards – Compression Overview

STANDARDS	TYPICAL QUALITY	BANDWIDTH
MPEG-1 (ISO/IEC)	VHS	1.5 Mb/s
MPEG-2	SDTV to HDTV	1.5 to 19.2 Mb/s
MPEG-4	DVD, variable as needed, media objects	<100 Kb/s possible
MPEG-4 Part 10 (H.264/AVC) & VC1	HDTV	~ 10 Mb/s

IBM On Demand Operating Environment Implementation
Delivers Unique Value

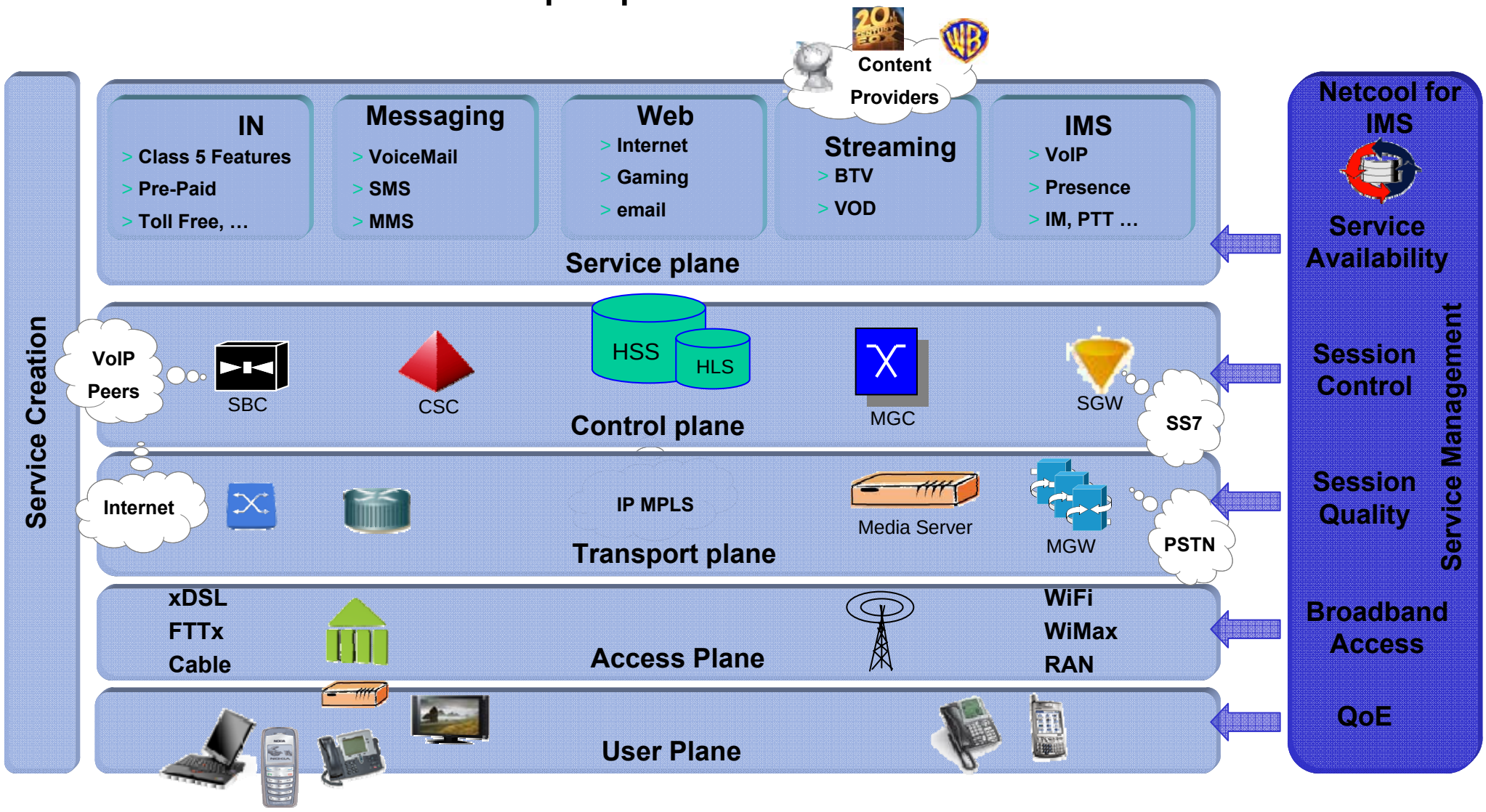


Current Limitations on Video QOE Standards

- ITU – R B.500
  - **Subjective assessment of video quality**
  - **Needs human interaction**
- PSNR – Peak Signal to Noise Ratio
  - **Simple, uses an objective quality measure**
  - **Not correlated to human vision**
- Quality scale – mapping to MOS (Mean Opinion Score)
  - **1≤MOS≤5**
    - **5: Excellent, imperceptible**
    - **1: Bad, very annoying**

NET: Current video standards may not be adequate in IPTV environment. No direct standard exists for "IPTV Viewer QOE"

Netcool for IMS value proposition



Service Management Challenges in IMS

- Variety of access mechanisms – PCs, PDAs, IP-phones, residential gateways, mobile devices
- Interactions between IMS end-points will involve application and session layer protocols over multiple architectures, multiple technologies and multiple service providers
- Session events, charge detail records and performance indices are now produced by many more network elements for a single session
- Sessions can now involve multiple types of media that can adversely affect the quality of the overall end user experience if those media types are not managed
- Complex interactions between soft-switches, proxies, media gateways, session border controllers, application servers and databases

3rd party issue? Capacity overload? CAC-policy denial? DOS attack? Database timeout? Messages stuck in queues? BPEL exception? NEP/ISV bug?