Network Architecture Evolution: towards all-IP

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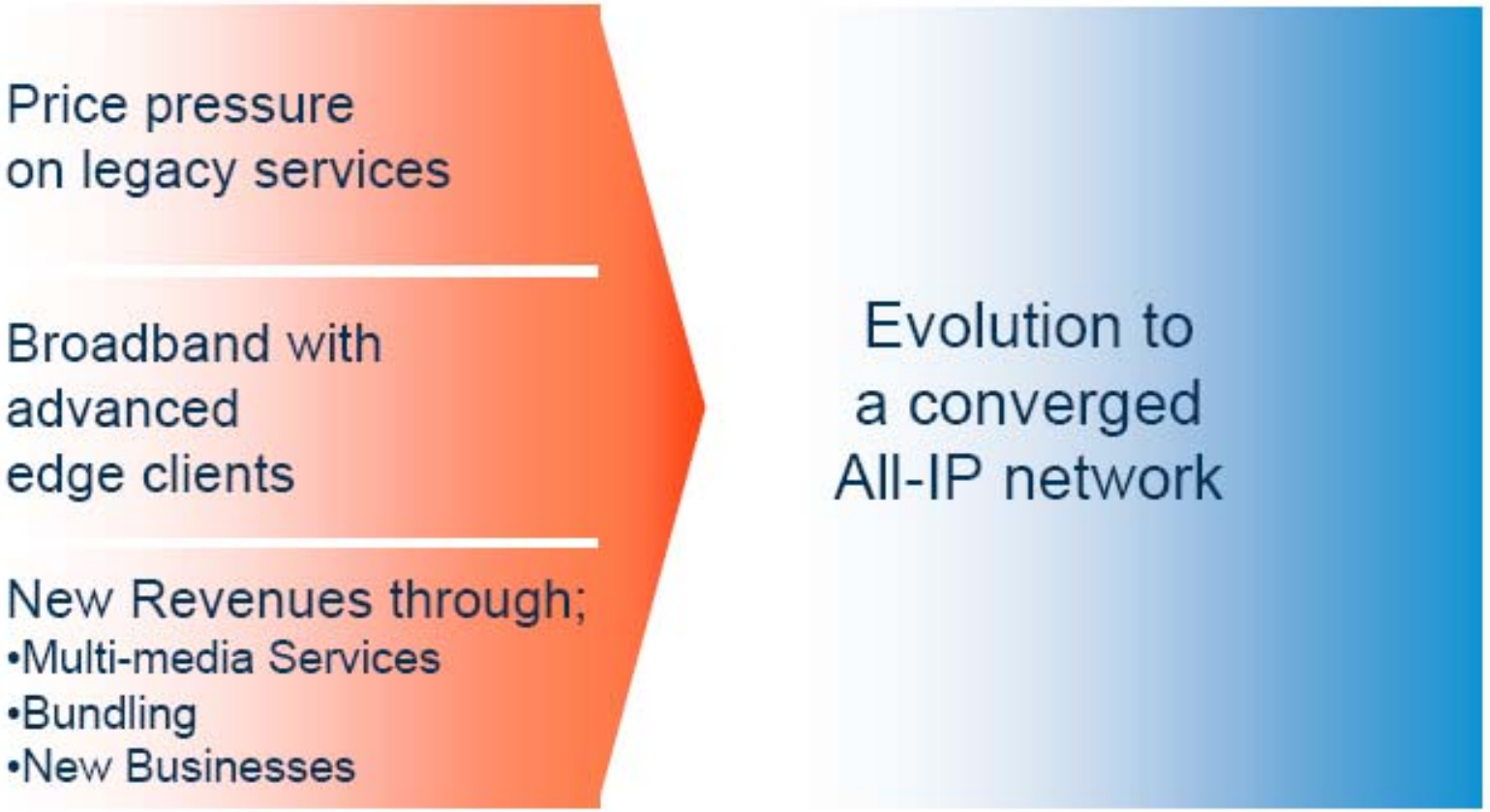
Summary

- Business drivers for going towards “All-IP”
- Technical challenges review
- Carrier grade Ethernet: telecom quality IP
- The case of metro network: the role of MPLS
- Network architecture evolutionary path
- Conclusions

Business drivers

why there is a convenience to move towards all-IP?

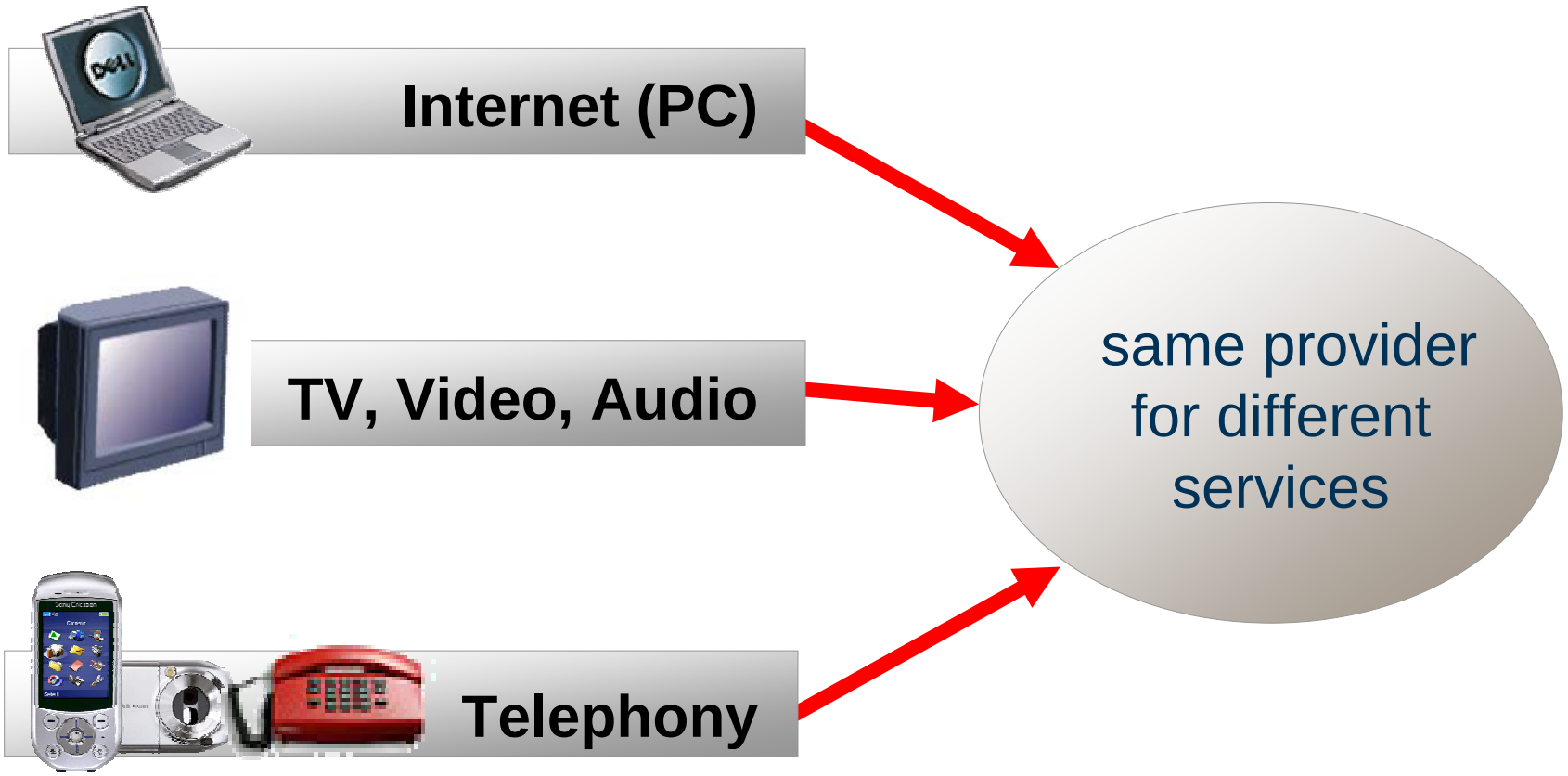
Business drivers



Business drivers

- Maturity of most voice and basic data services: price is the main competitive differentiator
- Increasing pressure at the edge of the network arising from the success of broadband and the growing abundance of embedded systems: multiple access methods must be accommodated, while keeping OPEX to a minimum (implying the need for a common underlying core network)
- Emergence of new business models, e.g. for electronic commerce and media, and service models for multi-media services such as triple play.
- Together with the dynamic network models including personal area, local area and metro networks all interacting with legacy systems, this will eventually lead towards an ambient environment in which IP technology will provide transparent connectivity

The triple play: a new role for provider



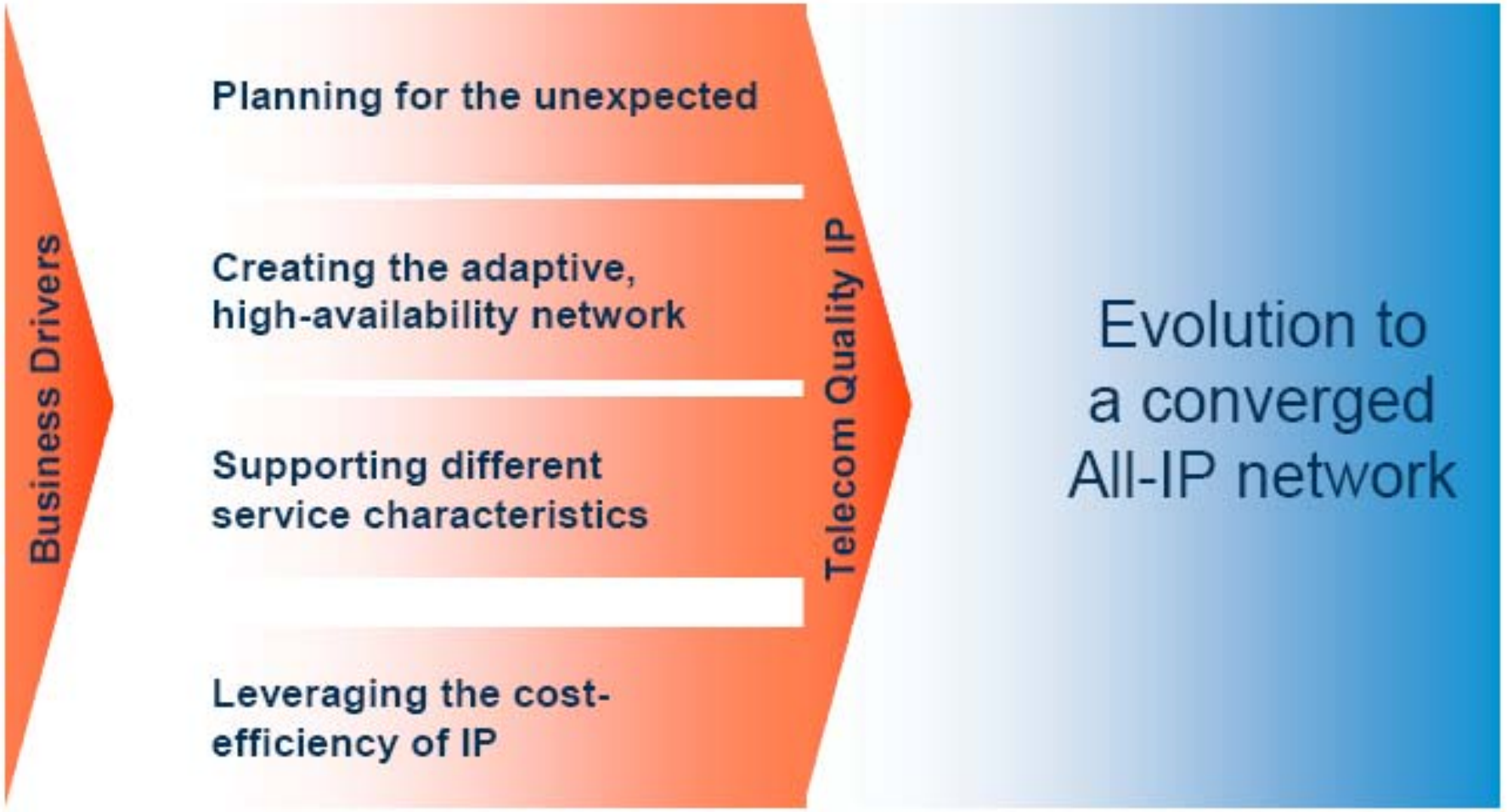
Required strategy

- Evolution strategy that both safeguards existing offerings and compensates for loss of revenue by minimizing OPEX
- This strategy must cater for growth markets, new service and application needs, regulatory challenges, competitive pressures including those from disruptive technologies, and technological evolution: **all within a framework that guarantees telecom quality!**
- Such a strategy can only be realized through the use of applications utilizing telecom quality IP

Technical challenges

what are the problems that need to be solved?

Technical challenges



Technical challenges

Planning for the unexpected

- Learn the lesson of two relevant success stories: sms and p2p traffic in IP network. It is hard to predict which new services emerge and become popular, and their consequent connectivity needs.
- The only way to plan for the unknown is
  maintain flexibility

Technical challenges

Creating the adaptive, high-availability network

- Wide variety of access methods and protocols is use: PSTN and GSM/WCDMA Evolved, SIP/H.323 based multimedia, broadband access and Wireless LAN. Other could come, such as WiMAX, IMS, DVB, etc.

- New accesses and new services raise many design questions. Defining the reference architecture of an IP network capable of tying all of this together requires a deep understanding of the systems, services, and accesses involved, their characteristics, and their supporting network control logic.

- The challenge is to use cost-efficient IP technology in a way that maintains the required characteristics in areas like availability and network security. Connectivity must not be compromised even in fault situations.

Technical challenges

Support different service characteristics

- As networks converge on IP, the full set of services from the fixed and mobile worlds, including peer-to-peer services, will be made available across all accesses.
- Both services and access networks are evolving quickly. Support for flexible and generic QoS, traffic handling and bandwidth management is a must to enable user services, conserve network resources where needed, and contain costs. IP and its technologies have the ability to support all the above and much more in new complex scenario
- Services will need to be adaptable enough to provide a good user experience, regardless of the access method being used.
- A rich user experience does not always demand for high bandwidth. In the future tha cached information could be for example the particular traits of a voice and a face in a video conversation, stored in addition to the name and the number of a contact.
- As IP transport in introduced, a key challenge is to maintain the service quality characteristics of the dedicated circuits being replaced, so that voice services are not impaired.

Technical challenges

Leveraging the cost-efficiency of IP

- One important driver for introducing IP is the cost-efficiency of the underlying transport technologies, primarily Ethernet.
- All transport nodes don’t need to be IP-aware throughout the entire network, but transport efficiency for IP is in many nodes achieved with Ethernet at low cost.
- Ethernet provides a simple, cost-efficient and unified way to connect to a transport network at a high bit-rate, while all provisioning can be done remotely, reducing operator expenditures.
- The multicast properties of Ethernet also provide a better match for services like IPTV than unicast traffic pattern implied by ATM and TDM.
- Ethernet also allows for the use of a simple, single interface for all traffic types, whether guaranteed and best effort.
- Above all, aggregation, switching and routing of a mixture of guaranteed and best effort traffic can be realized at lower cost when based on IP/Ethernet technology.
- **QoS and resilience are the main requirements to be addressed to realize a “carrier grade Ethernet”**

So…why using IP technology?

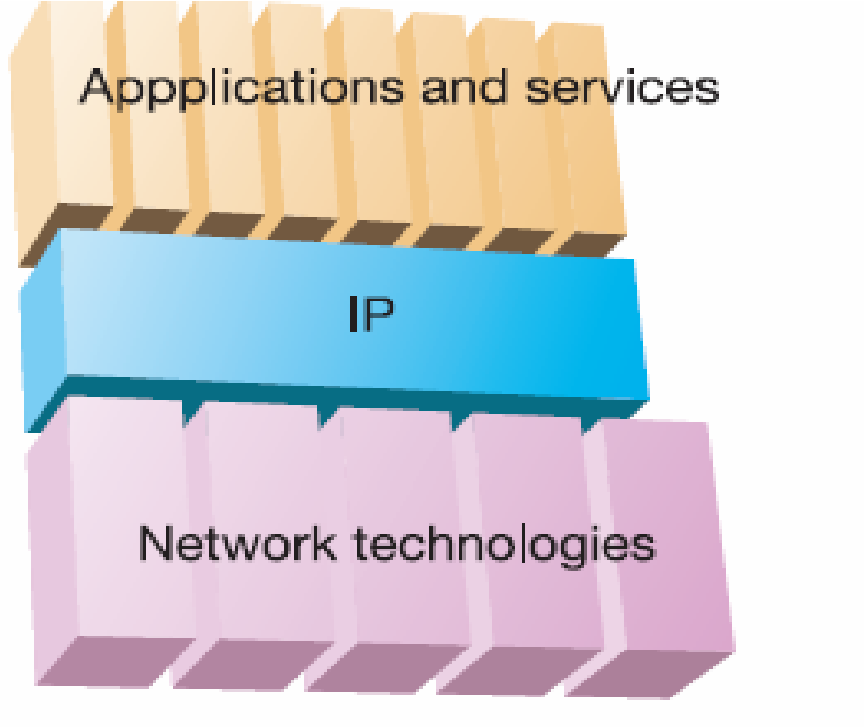
- Low cost (w.r.t. legacy technology)
- Flexible (plug&play, add a node means updating routing table)
- Suitable for packet services

Everything over IP:

Any service & application due to protocol incapsulation on IP
IP independence of stream length

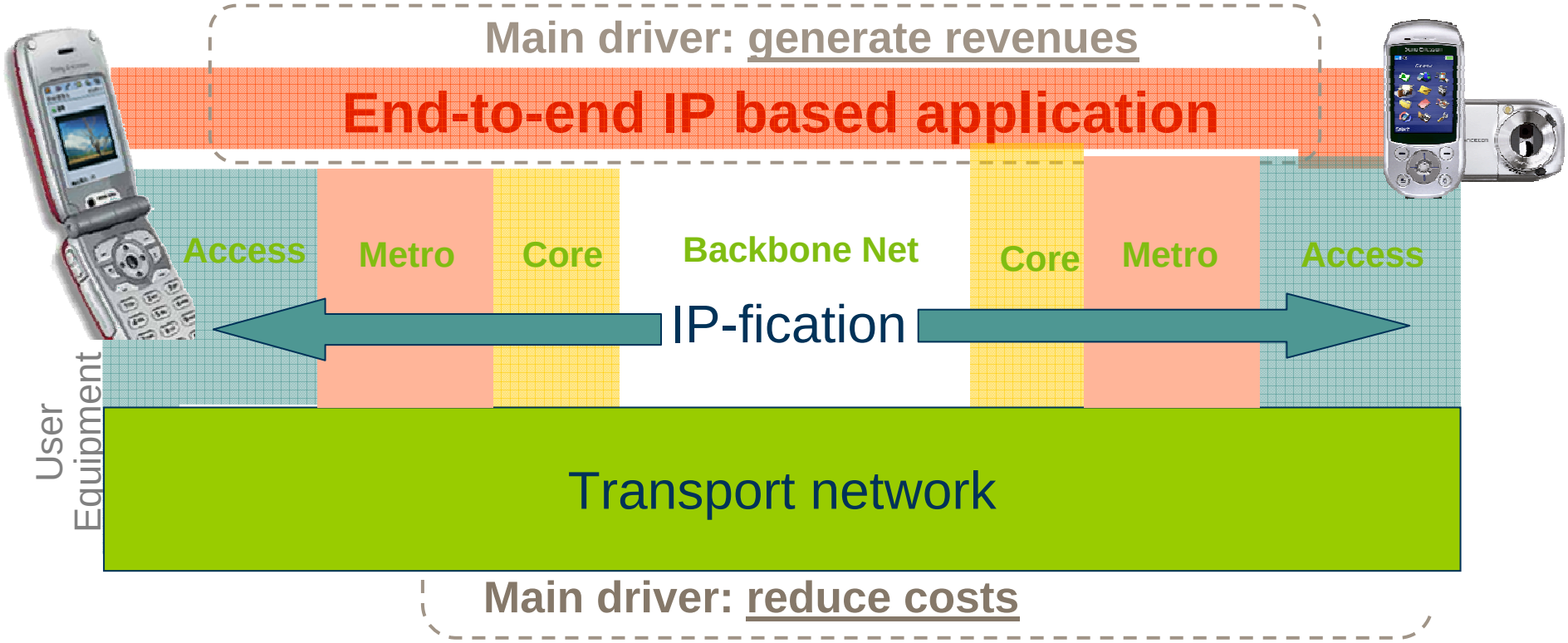
IP over everything:

Provide connectivity for any transport technology (independent of link layer)



IP anywhere = ALL-IP paradigm!

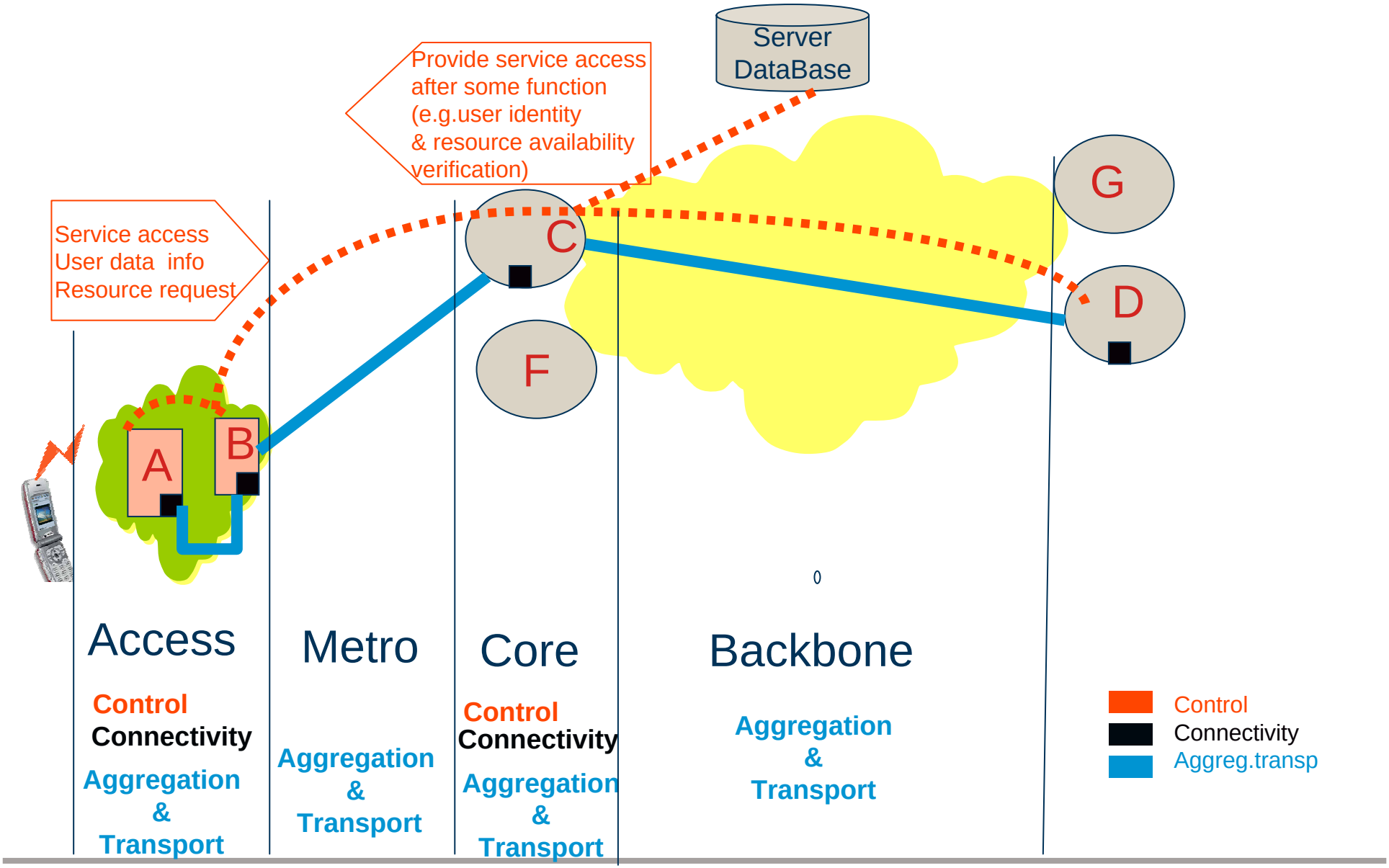
What “All-IP” means



The term “All-IP network” refers both to:

1. an enabler, together with other associated technology, to provide enhanced integrated service set, independent, as far as possible, of the access system used
2. transport technology as enabler to achieve decreasing OPEX

Network segments & their functions



The case of the Metro Network

Metro business drivers

- Metro Network segment is targeted by customers investments to deliver new services and get increased revenues
- Business Drivers now:
  - 3G/3,5G Mobile Backhauling
  - Fixed Broadband (Residential xDSL) traffic growing
  - IPTV/HDIPTV (Virtual HFC is the driver)
  - Multioperator Bit-Streaming SLAs
- 2/3 years
  - Access Optical Networks deployment (xPONs)
  - MVNO (Mobile Virtual Network Operators)
  - BVNO (Broadcaster Virtual Network Operators)
- Technical driver:
  - GBE as the standard universal network interface
  - Micro/femto Mobile Broadband coverage

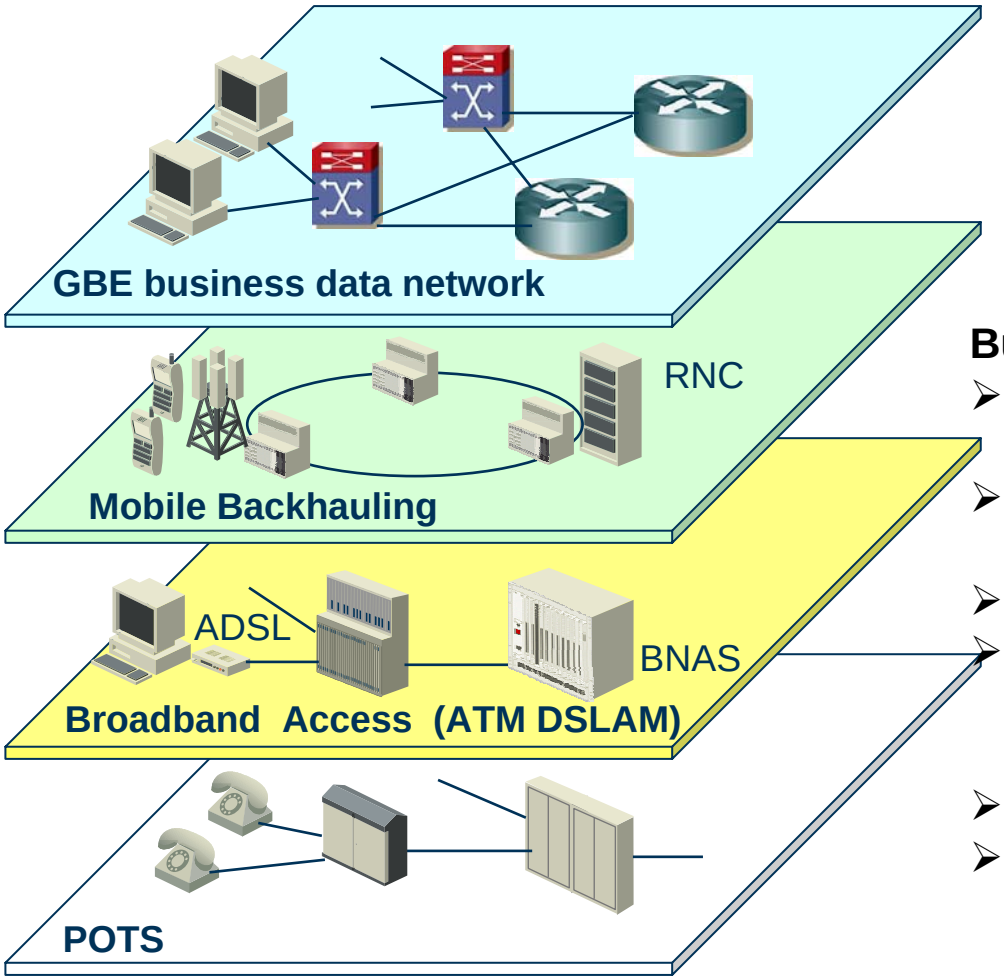
Technical challenges

MPLS-based architecture

- A recognized approach is to use IP/MPLS nodes in metro and core network to support the more complex, dynamic, meshed topology in this area.
- The metro and access parts of the transport network are often built using a mixture of IP routing, MPLS/VPLS tunnelling and Ethernet switching technology, according to the needs of the customer segment being served.
- The use of MPLS provides an autonomous control plane that efficiently handles resilience and changes to the resource allocation in the transport network.
- Experience of IP and MPLS shows that operators can make savings in both OPEX and CAPEX, as well as by having a powerful management system and an efficient control plane.

Convergence in the Metro Network

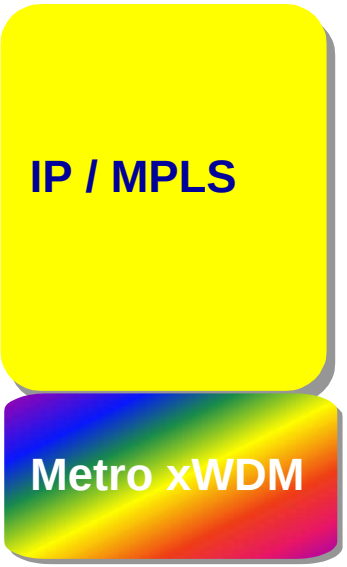
Simplify metro network, de-layering, scale-up for optimization



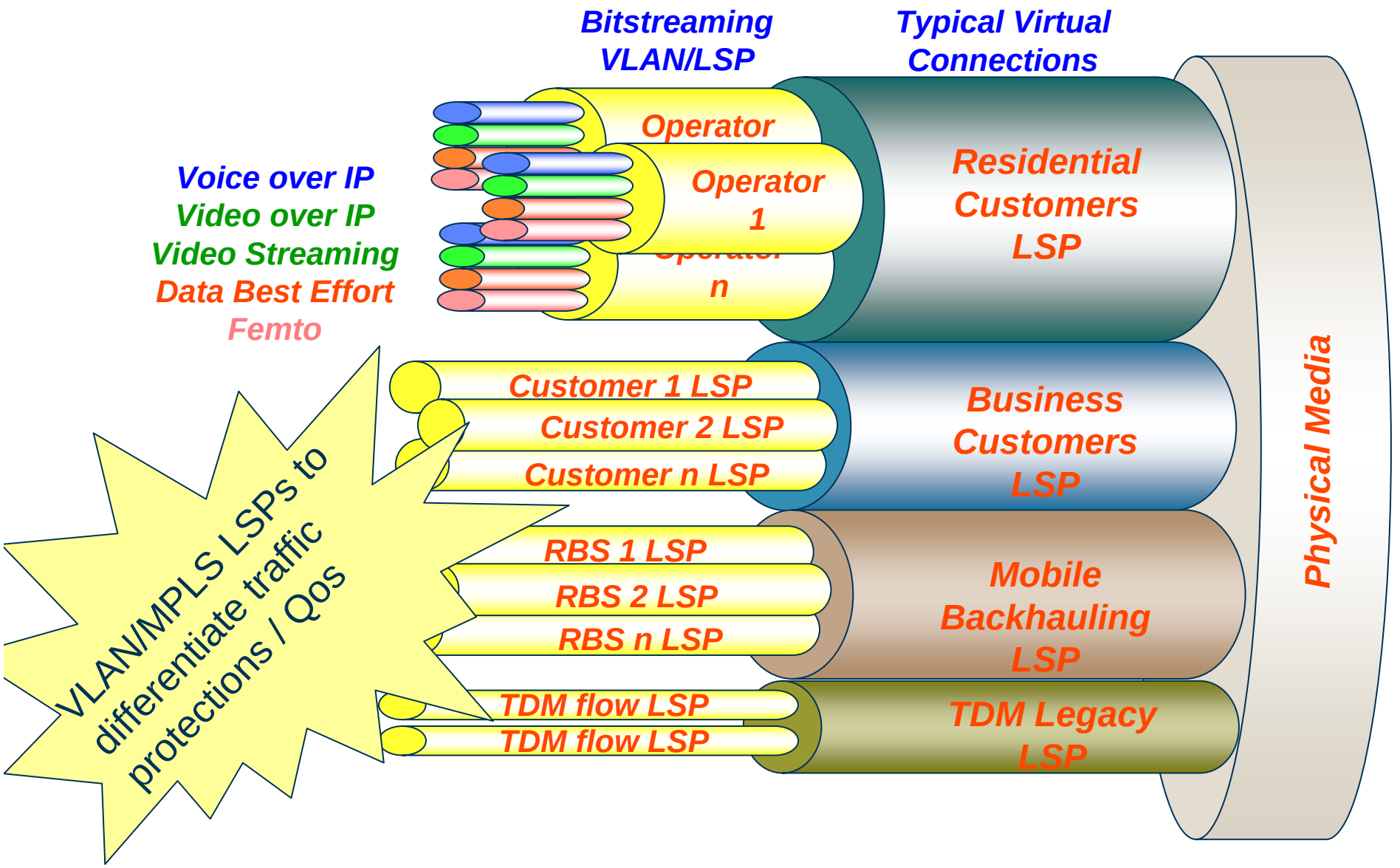
Business Drivers:

- **Fixed Broadband (xDSL, OAN)**
- **3G/3,5G Mobile Backhauling**
- **IPTV/HDIPTV**
- **GBE as "the standard network interface"**
- **Bit Streaming**
- **MVNO,BVNO**

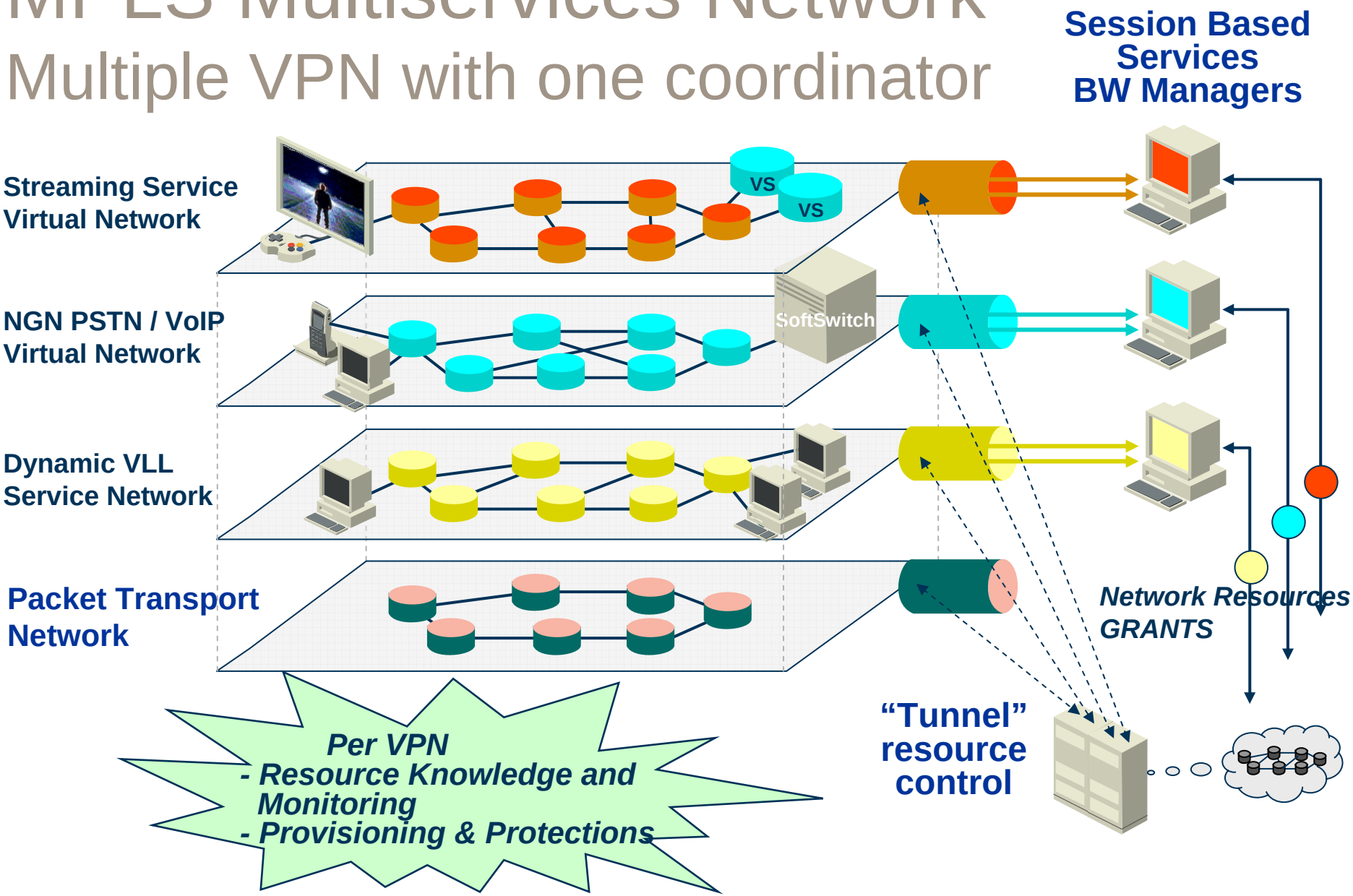
Target metro network layering



Services Architecture



MPLS Multiservices Network
Multiple VPN with one coordinator



Metro networks: conclusions

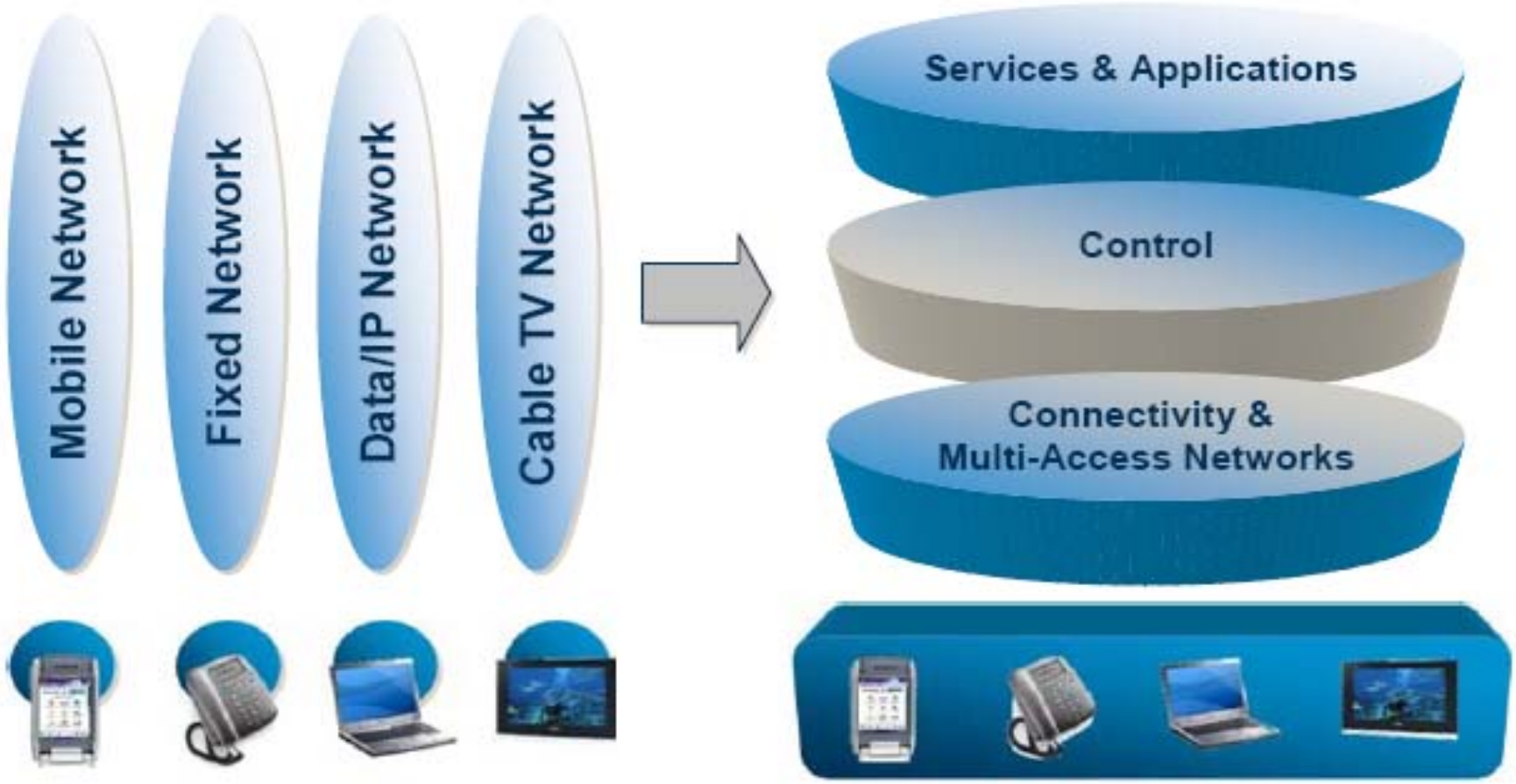
- A Connection Oriented architecture is required in order to dimension network resources in a deterministic way
- Reference standards to be taken into account are those which impose requirements on memory and computational resources allocation
- User Service Availability require sophisticated protection mechanisms
- Virtual network architecture complexity require the introduction of an automatic Control Plane

Network architecture evolutionary path

From Vertical to Layered Architecture

Past: one network for each service/device

Future: common net for all services/devices; services independent of connectivity & control



Key elements for layered architecture

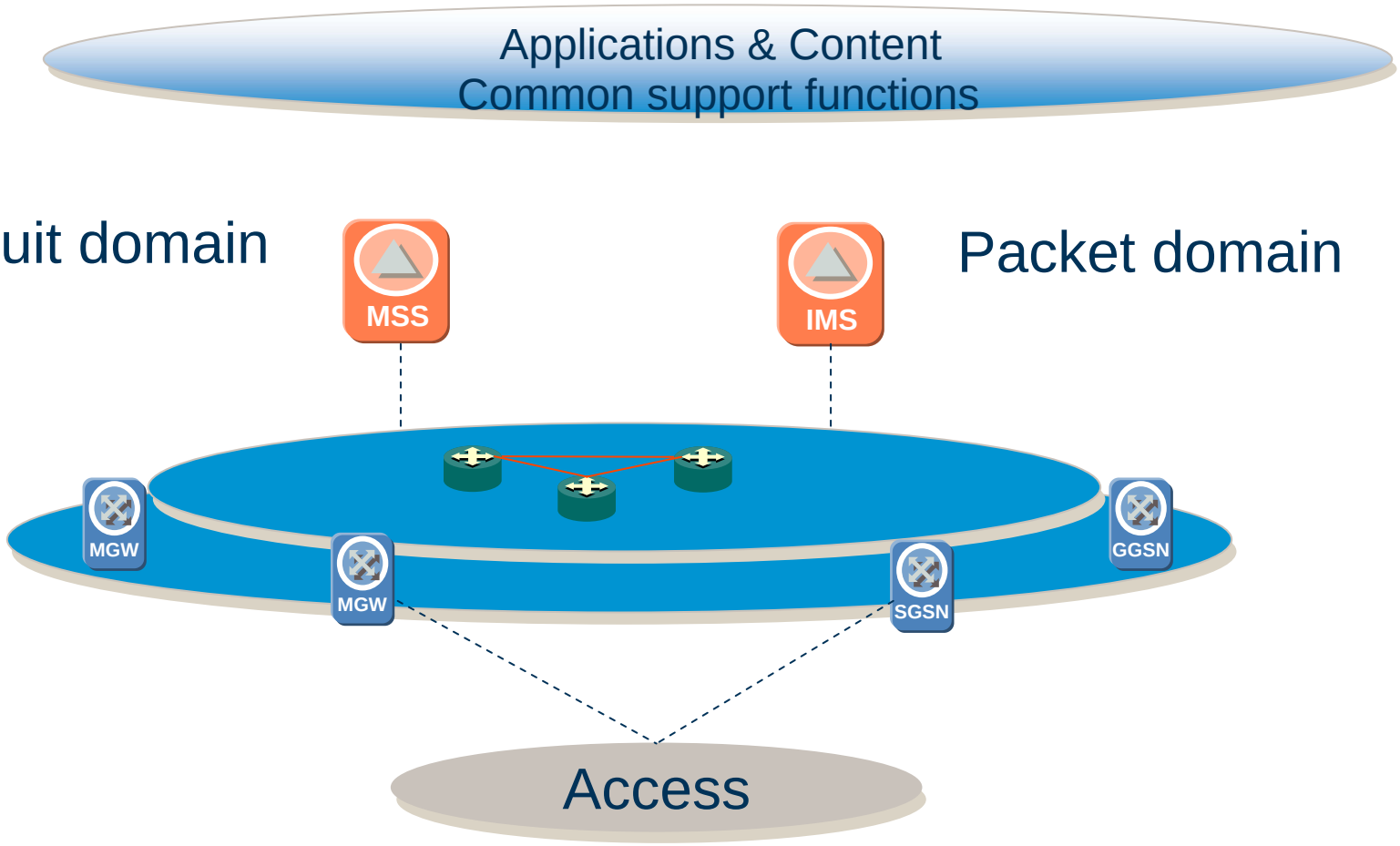
IMS:
Enabler for service layer

Softswitching:
Separated Control & Connectivity

EU1

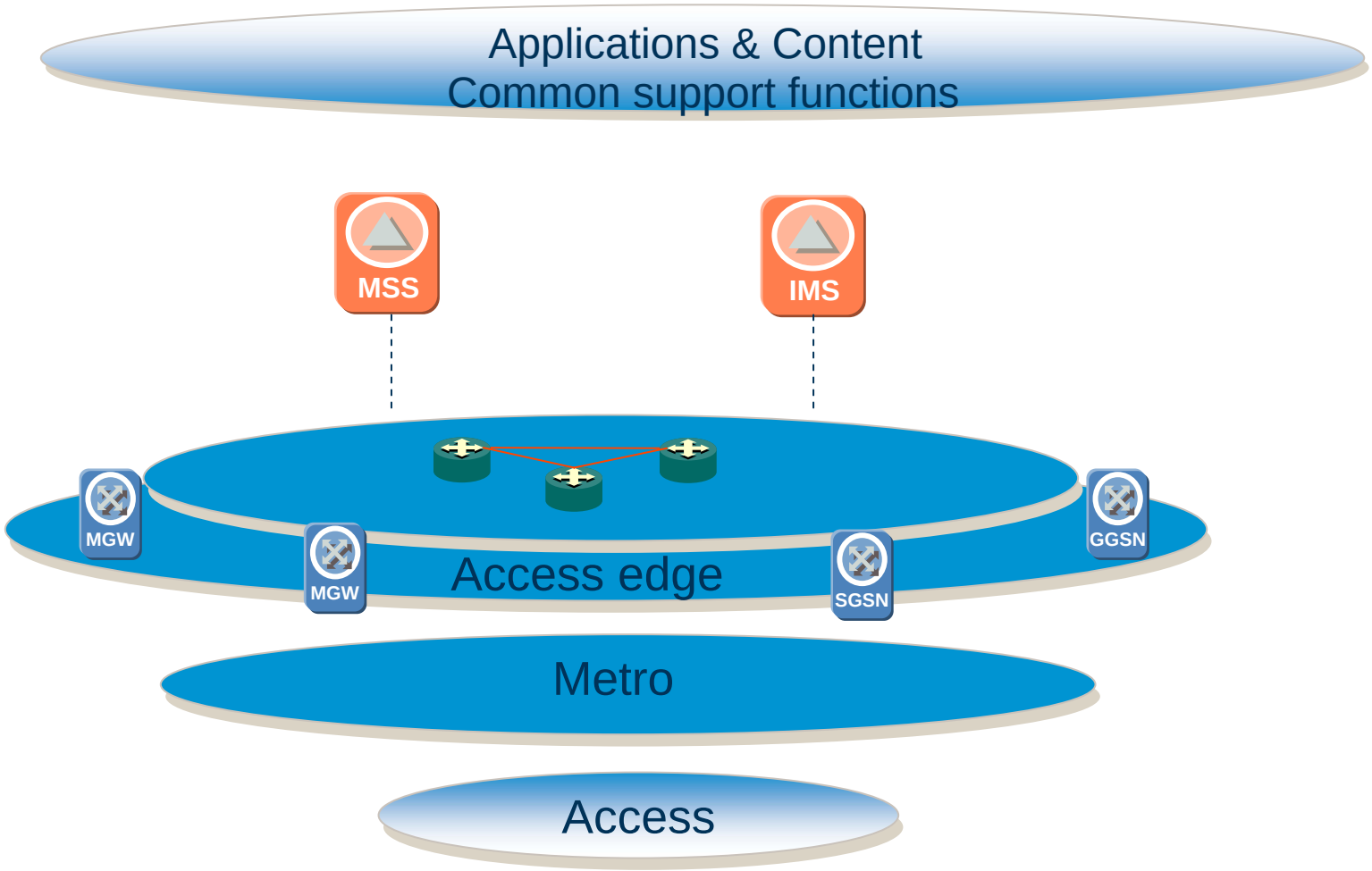
IMS introduced as service enabler

Leveraging IP infrastructure



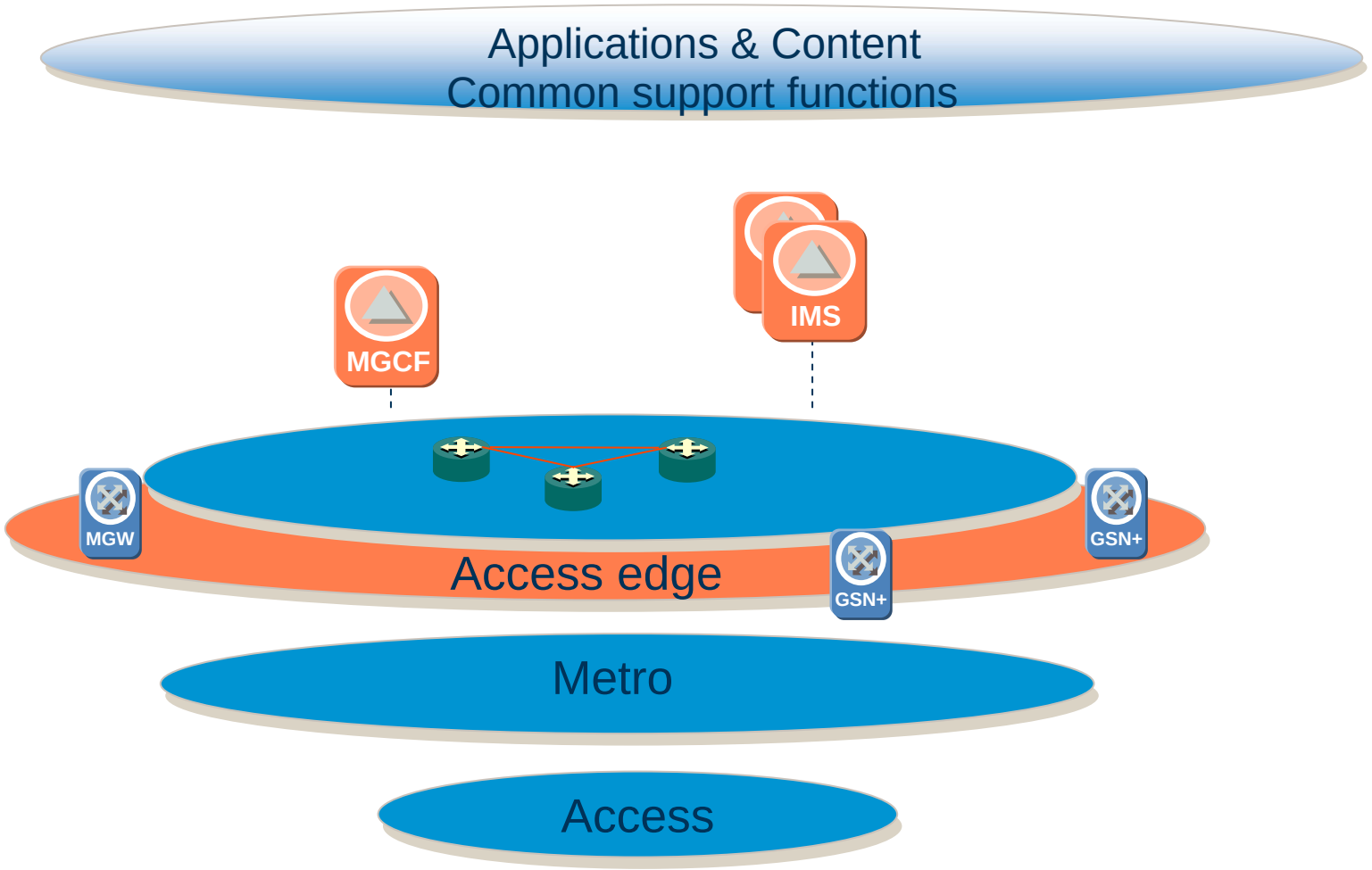
IP pushed towards metro and access

IP down to node RBS and BTS, GSN nodes evolved



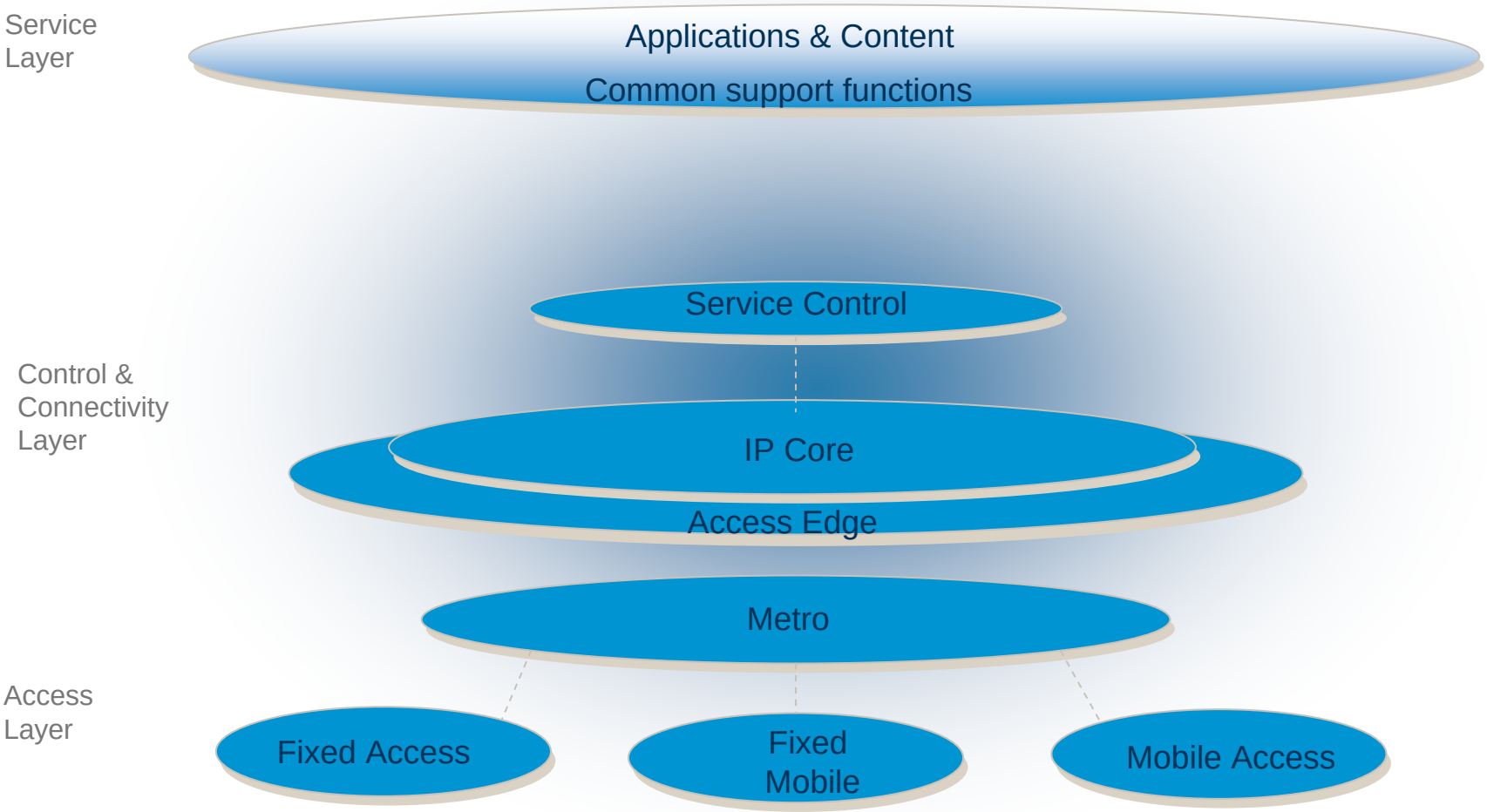
Mobile IP telephony a reality

MSS evolved to GW control function - a fully IMS based network



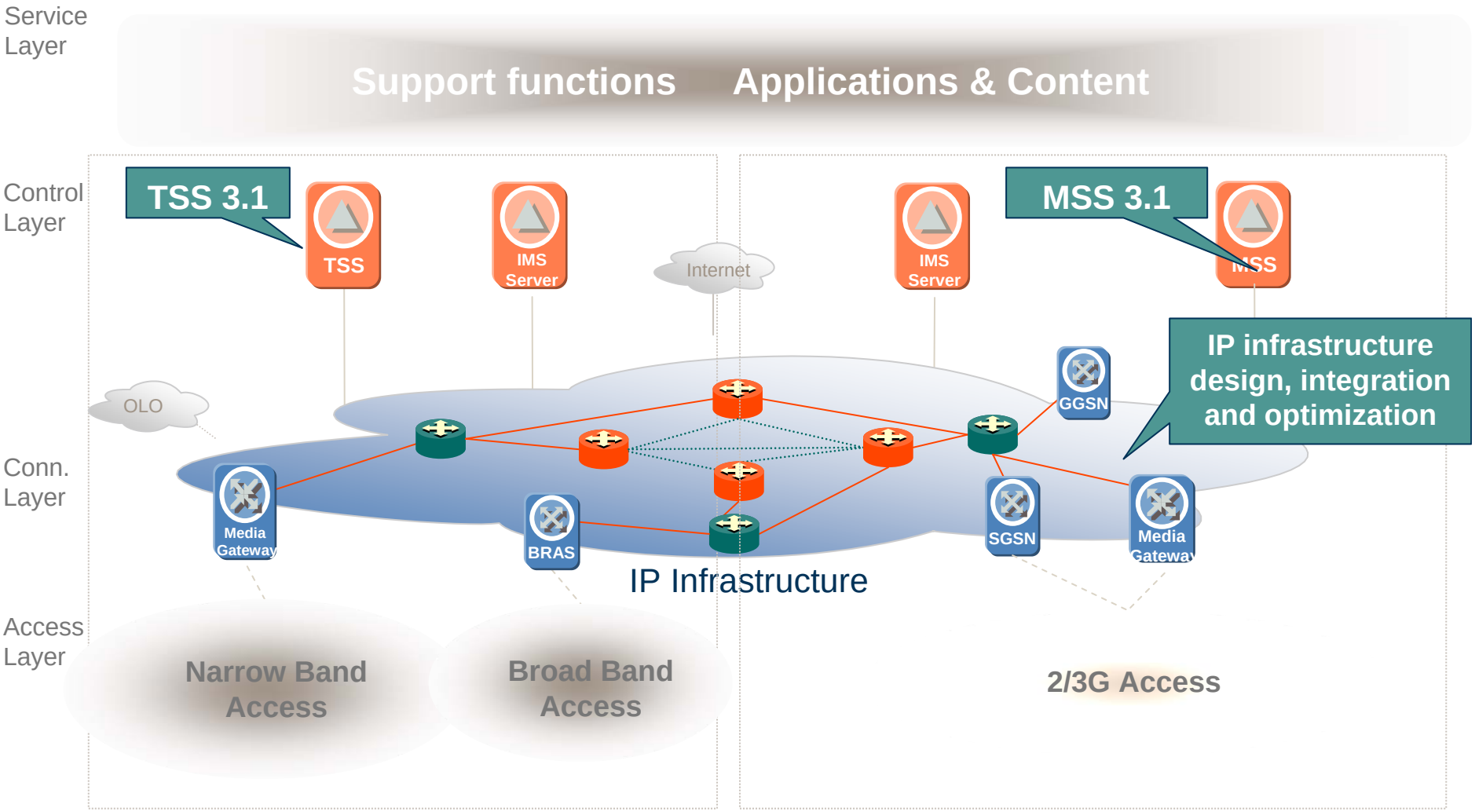
A converged multi service network

IP in all parts of the network



Common IP infrastructure

Common physical network, different logical networks



Market opportunity

Evolve towards “all-IP” multi-service infrastructure

- **Exploit**
  - mature IP technology and existing IP infrastructure to transport the fast growing volume of user and signaling traffic
- **Assure**
  - that the IP infrastructure has the telecom grade characteristics

A cost effective way to grow business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