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Medijski pokrovitelji



Cisco Expo 2010

24.-26. ožujka 2010.

Hotel Le Méridien Lav
Split

Kolaboracija - nova snaga poslovne suradnje



welcome to the human network. **CISCO**



Cisco Expo
2010

Cisco IP RAN Architecture

Kolaboracija -
nova snaga poslovne suradnje



Peter Gaspar

Consulting System Engineer, Service Provider - Mobile

Agenda

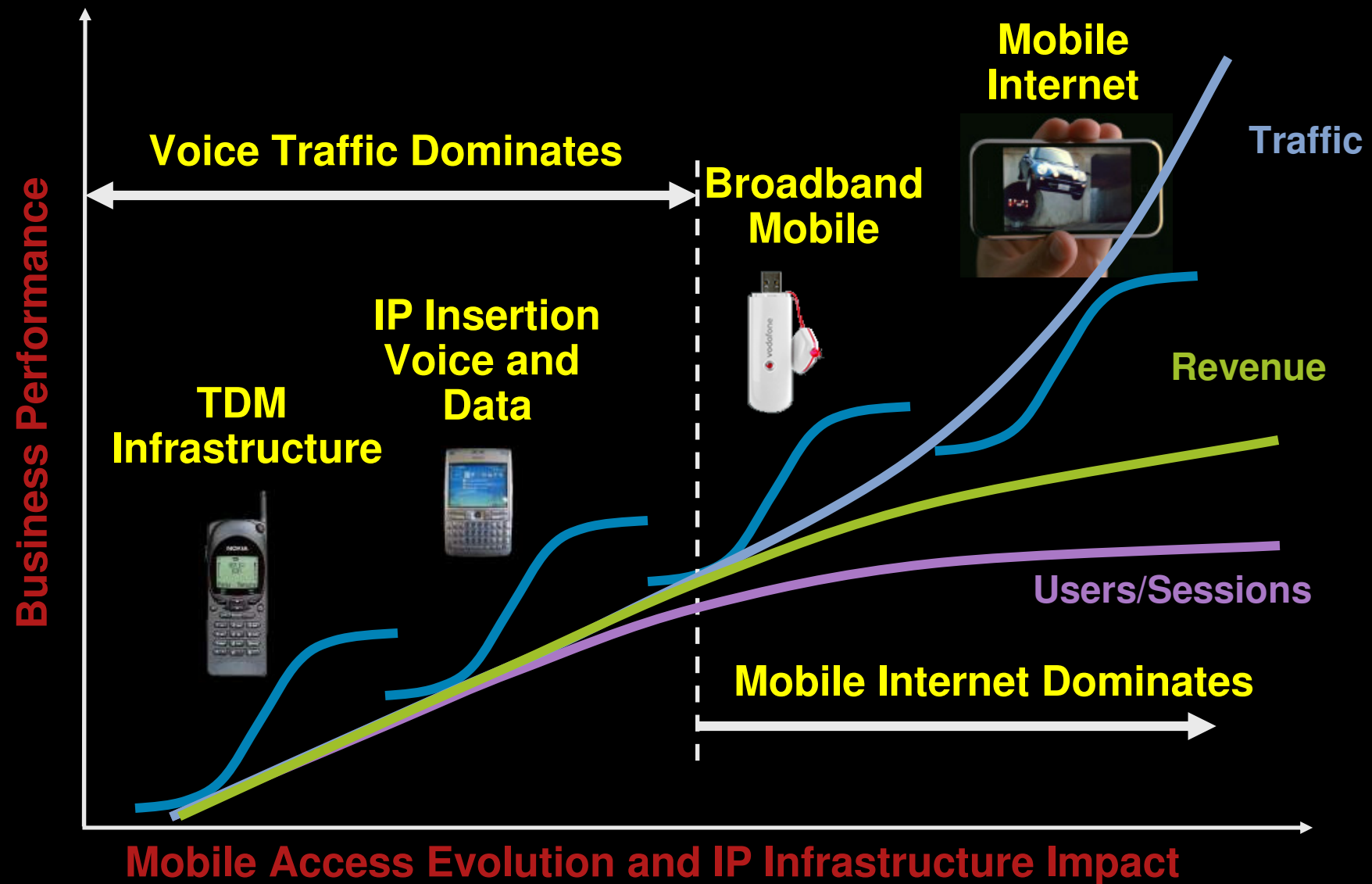
- RAN Requirements
- All-IP RAN Designs
- Legacy RAN over IP
- Cisco Carrier Ethernet Architecture
- Summary



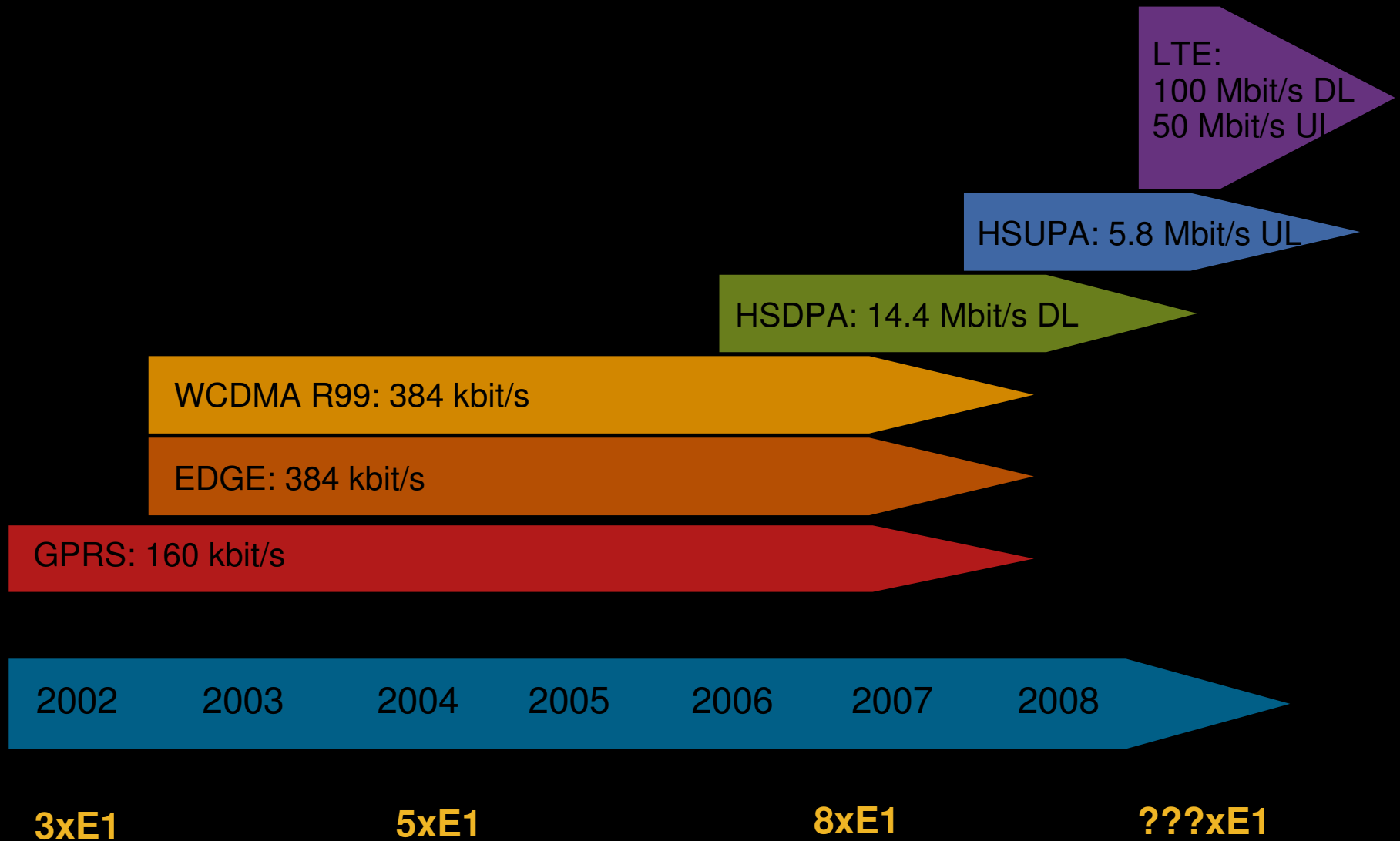
RAN Requirements



Driving New Challenges for SPs



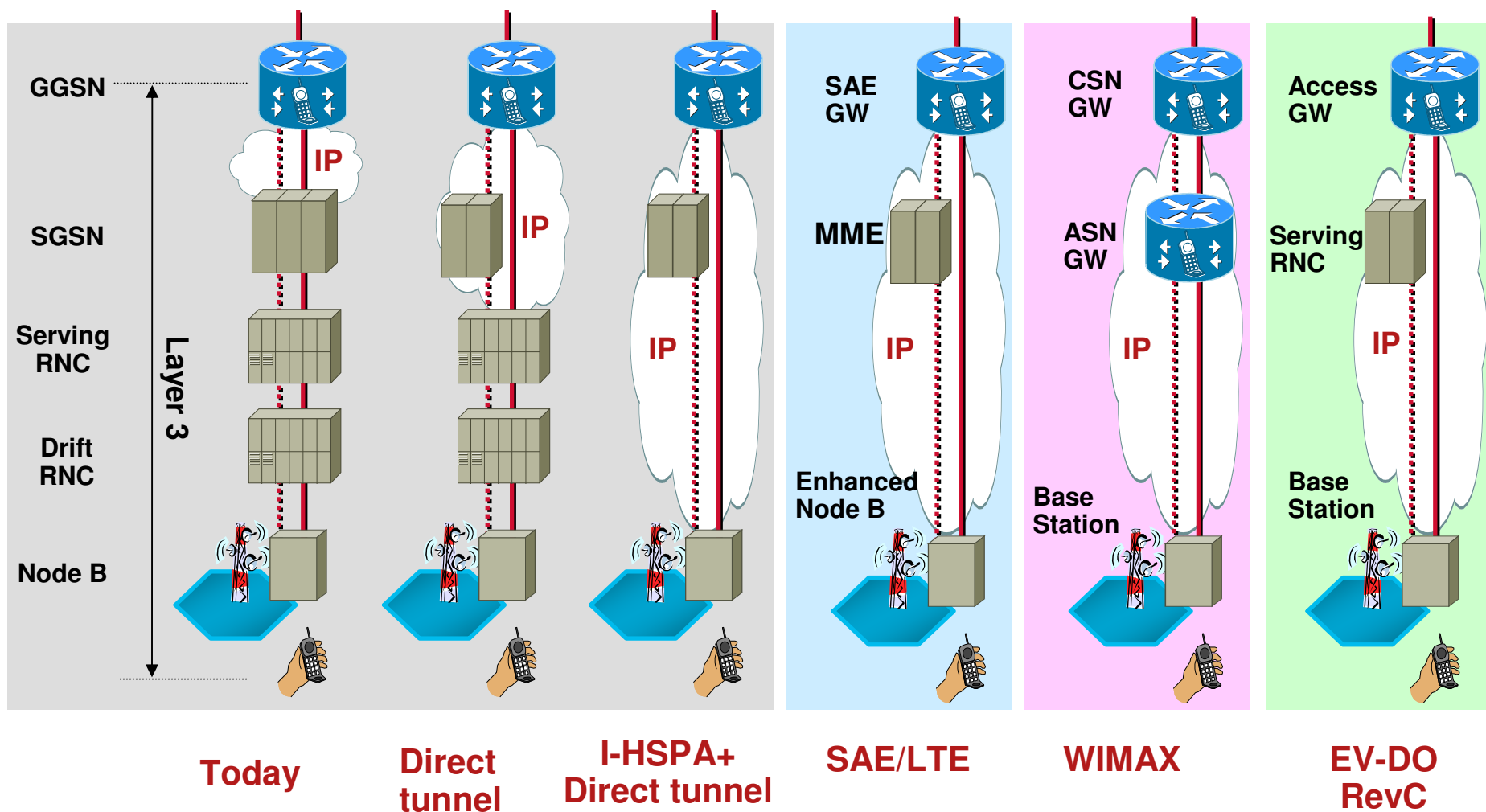
Radio evolution path



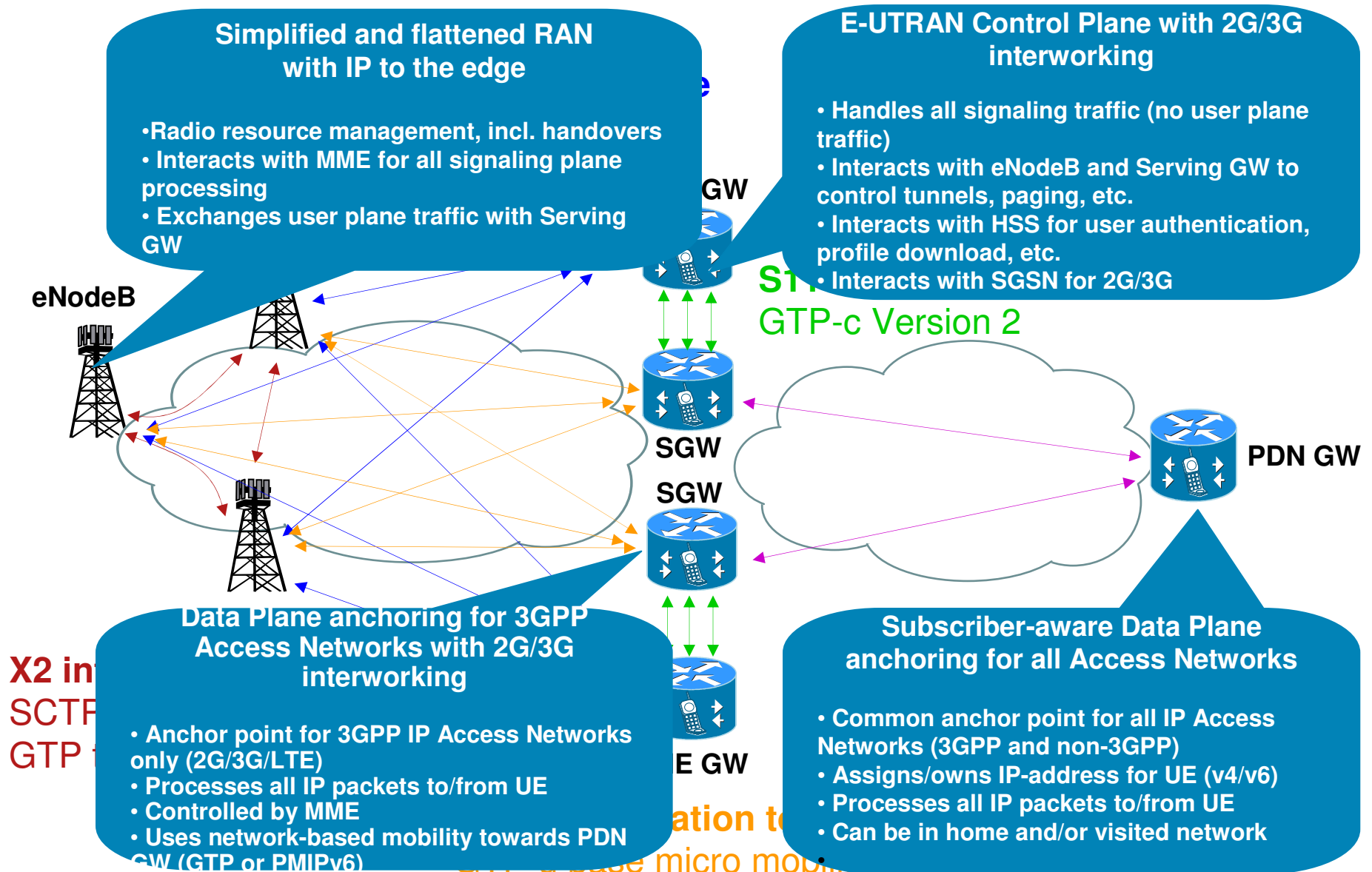
Some calculations

- 1GB quota = 7.5kbps in busy hour per user (10% of traffic in busy hour)
- 10GB = 75kbps in busy hour per user
- 200 users per NodeB – 15Mbps sustain throughput
- 7 NodeBs – Gigabit Ethernet needed (more than 100 Mbps)
- 75 NodeBs 10GE needed (more than 1 Gbps)
- Busy eNodeBs can generate up to 40 Mbps

What is next – Release 6,7,8



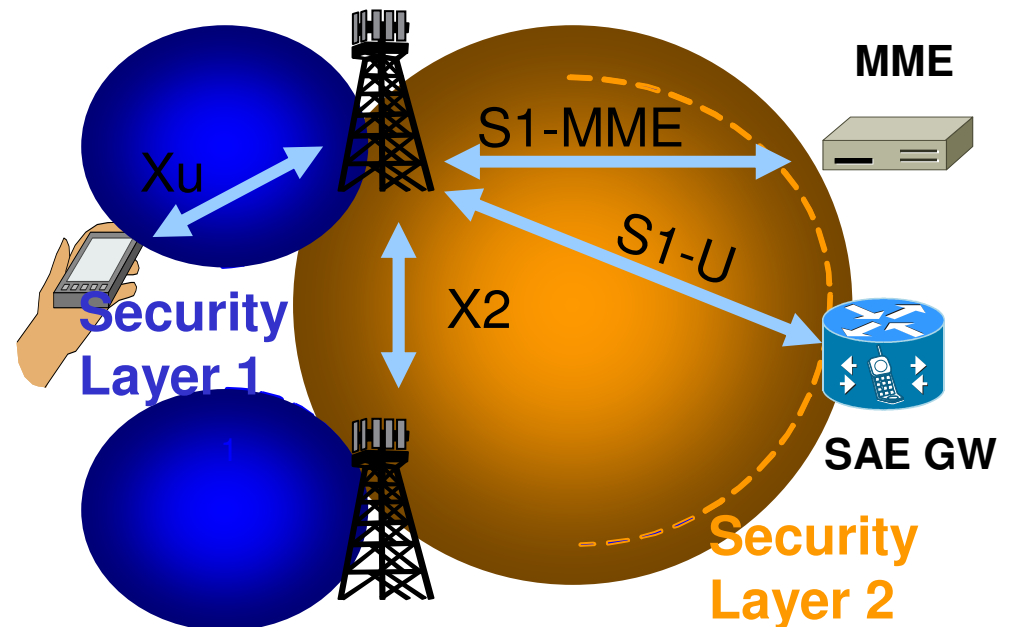
LTE/SAE System Components



Future Requirements

Backhaul Security

- IPsec ESP using IKEv2 certificate based authentication
- Tunnel mode IPsec being mandatory and transport mode being optional
 - Likely that transport mode used to protect X2 *(reduced overhead and low traffic)
- SeGW used to offload EPC and allow IPsec scaling
- Protection optional on S1-MME and S1-U
- Port based authentication on cell site demarcation



LTE RAN Requirements

- Any-to-any connectivity
- Low delay needed between eNodeBs (handover)
- Security concepts may vary
- MME may need to be distributed (messages count, delay etc.), depends on applications, not that much on mobility
- Multicast for MBMS

Edge Distribution

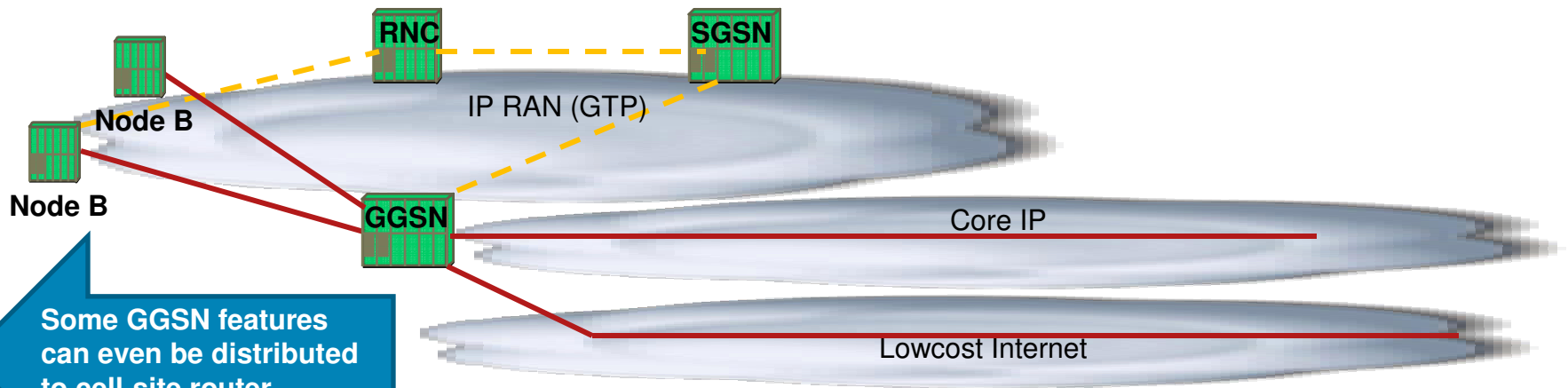
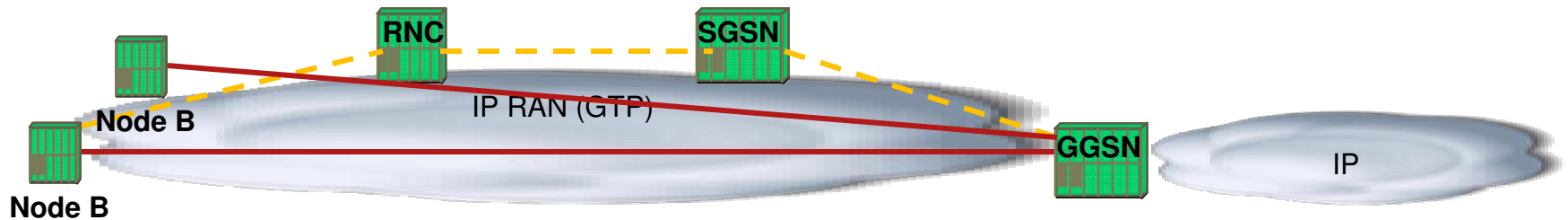
Problem Definition

- Enormous increase in mobile data
- Need for more cost efficient networks
- Video Content Delivery Networks
- Increasing peer-to-peer traffic
 - IMS
 - File sharing
 - Internet applications (Skype)
 - Machine-to-machine

Edge Distribution (Peer-to-peer)

Eliminate long runs for peer-to-peer traffic

Allow offload of Internet traffic to cheaper transports

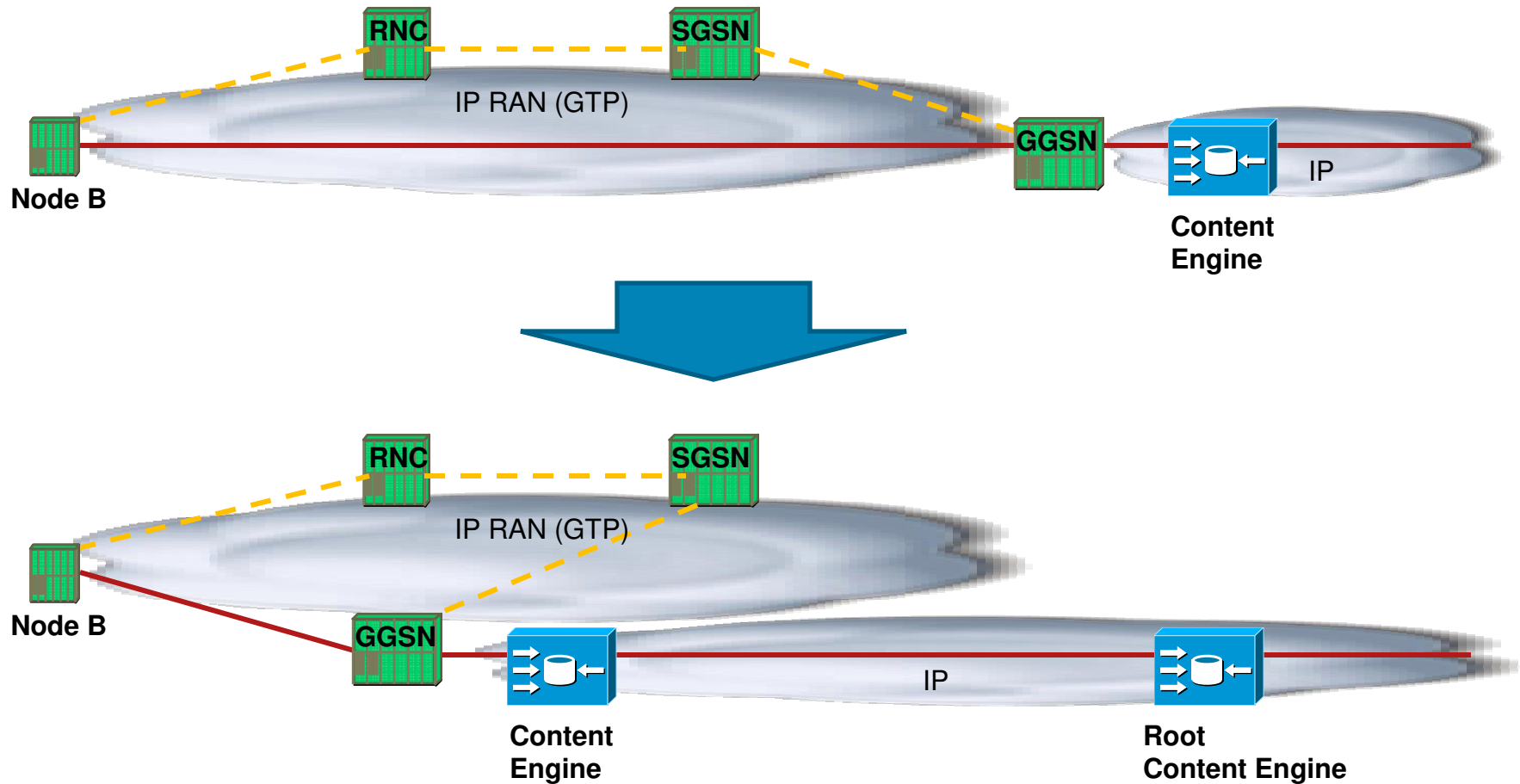


Some GGSN features
can even be distributed
to cell-site router

For HSPA needs Direct Tunnel support
LTE model is similar

Edge Distribution (Content Networks)

Eliminate repeating video traffic in the transport network



For HSPA needs Direct Tunnel support
LTE model is similar

Characteristics of the future RAN

- Increasing traffic
- End-to-end IP approach
- Components with Ethernet interfaces
- Direct connection between NodeB and the Access Gateway (Direct Tunnel)
- LTE specifics (any-to-any, multicast, security)
- Distribution of Edge
- IP/MPLS or Ethernet aggregation are the suitable technologies



All-IP RAN Designs



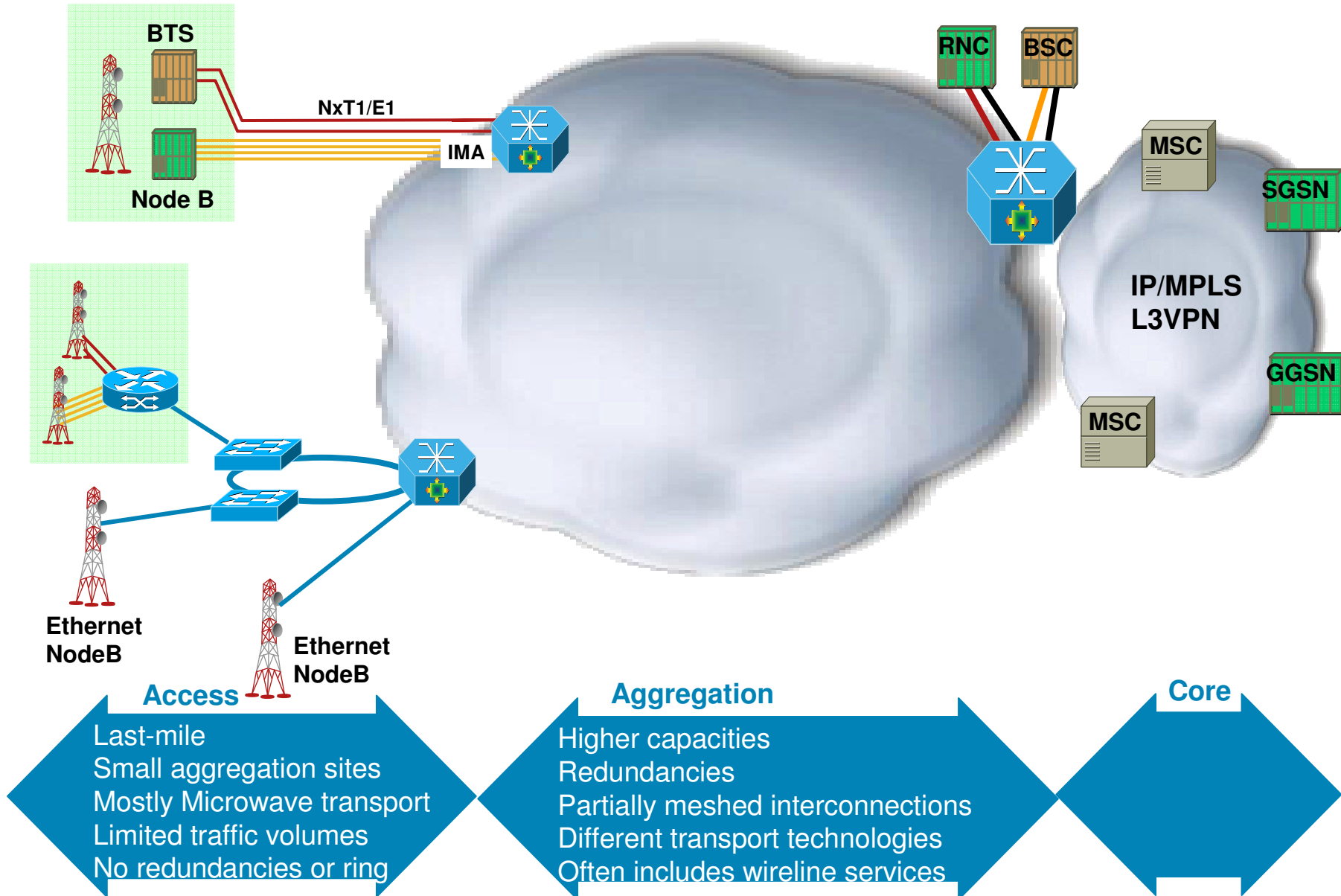
Specifics of the mobile operators transport network

- Network provider is also the customer of the network, therefore he needs to take care of all services:
 - IP Routing
 - Own SLAs (O&M, QoS etc.)
 - Multicast
 - Security
 - ATM and TDM services for 2G and legacy 3G
- Layer 2 and Layer 3 services are necessary
- This leads to optimized design where for example the CE and the PE functions may be combined

Contradicting Characteristics of RAN Aggregation

- Scaling of services
 - Number of VPNs limited
 - Number of VLANs and MACs limited
 - Low number of Queues needed despite H-QoS
- Scaling of ports
 - Low number of end devices on cellsite
 - Limited number of rings in aggregation and pre-aggregation
- But, still needed
 - High bandwidth needed
 - Carrier grade architecture (reliability, redundancy etc.)
 - Hardened devices

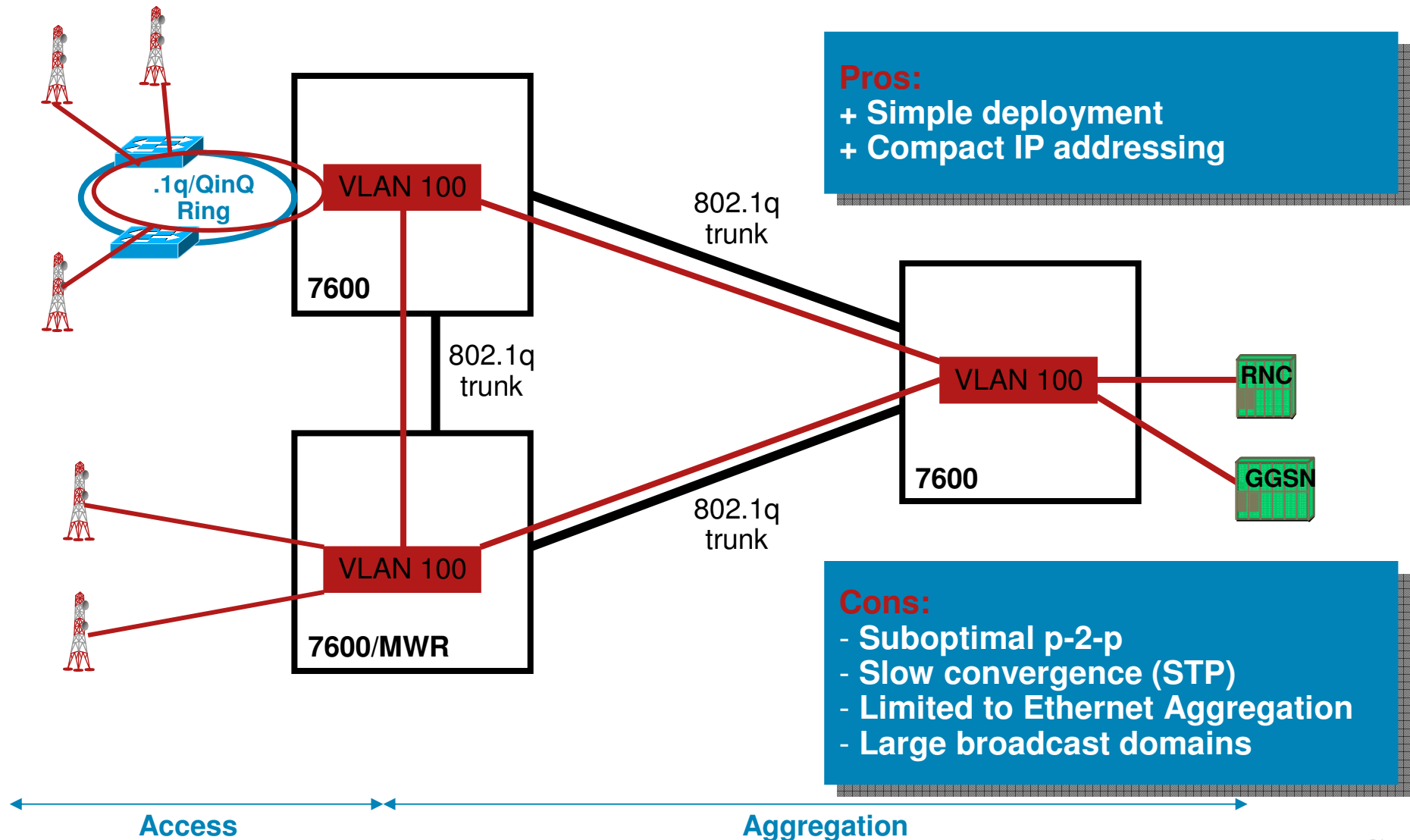
RAN Transport Hierarchy



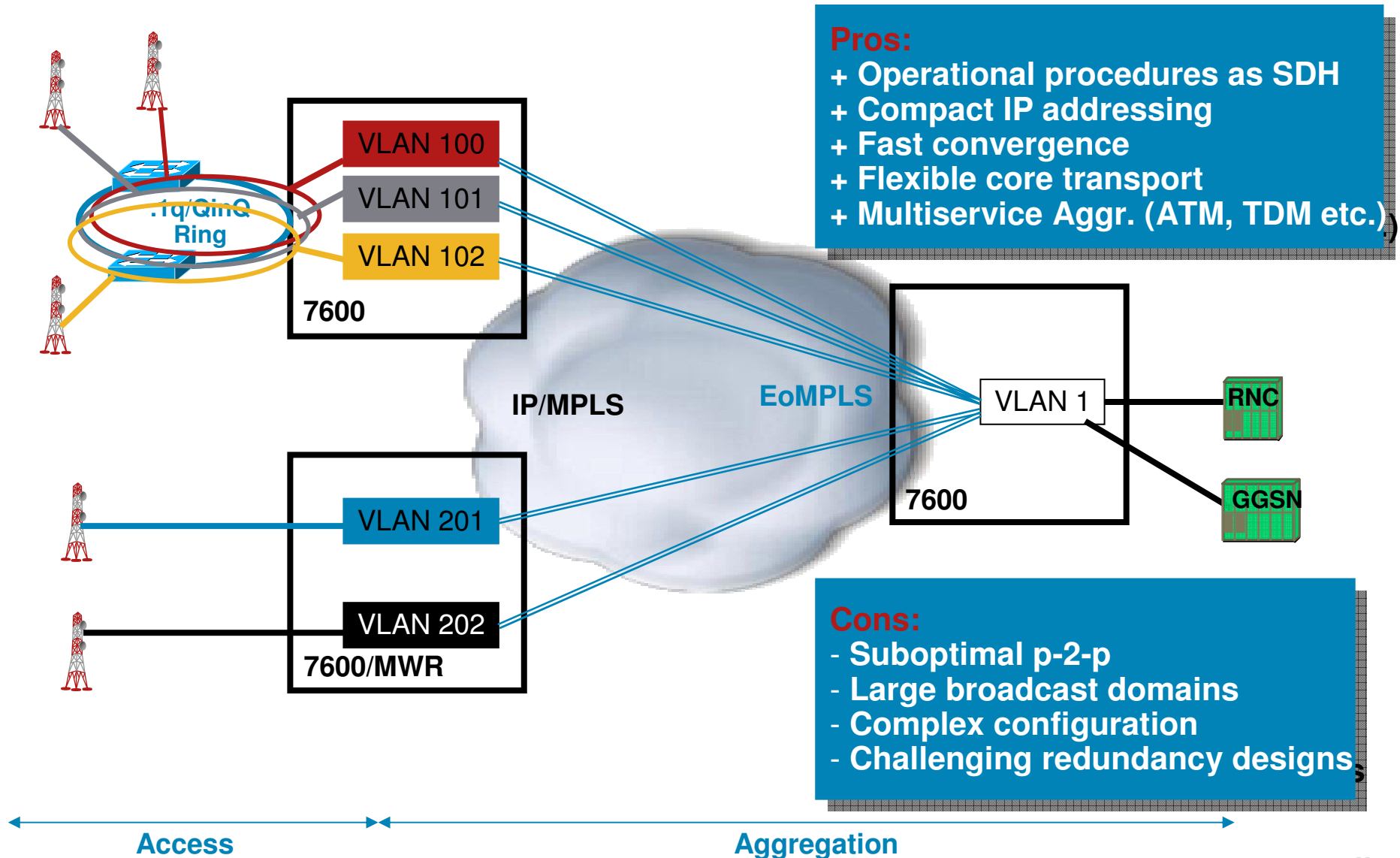
Aggregation Technologies

	MPLS	PBB-TE (802.1ah, 802.1Qay)	MPLS-TP
Multiservice	Yes (including L3VPN, ATM, TDM)	Ethernet L2 only	L2 only
Switching capacity	High	High	High
Interoperability	Yes	Limited	Limited
Transport	Any	Ethernet Only	Any
Any-to-Any	Yes	No	No
Multicast	Yes	No	No
Core Interop	Native	L2 to L3 handover needed in Core	L2 to L3 handover needed in Core
Service distribution	L3VPN, GGSN SAE/PDN	No	No
Maturity	Mature	Early adoption	Early adoption

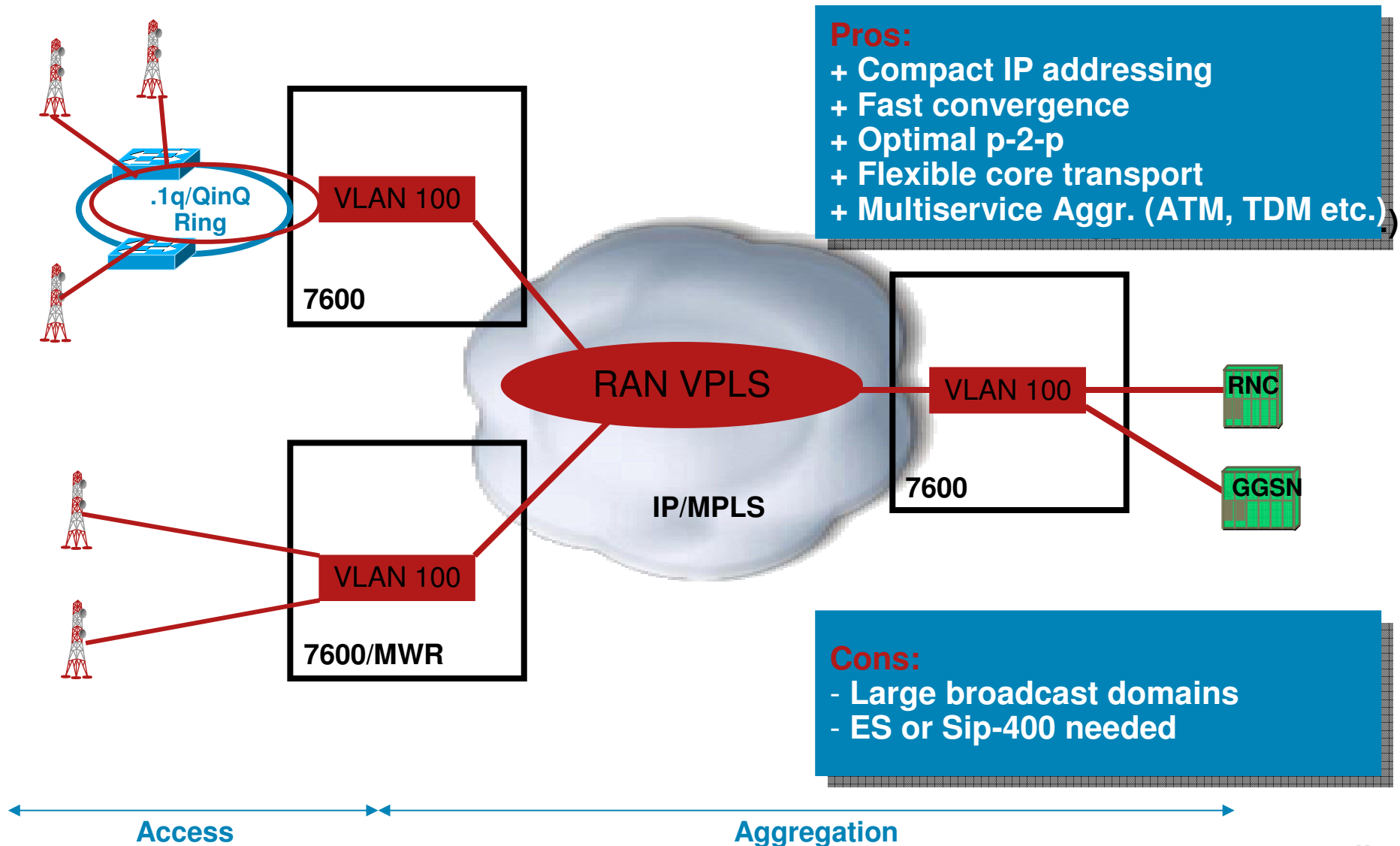
All-IP RAN Aggregation - RSTP



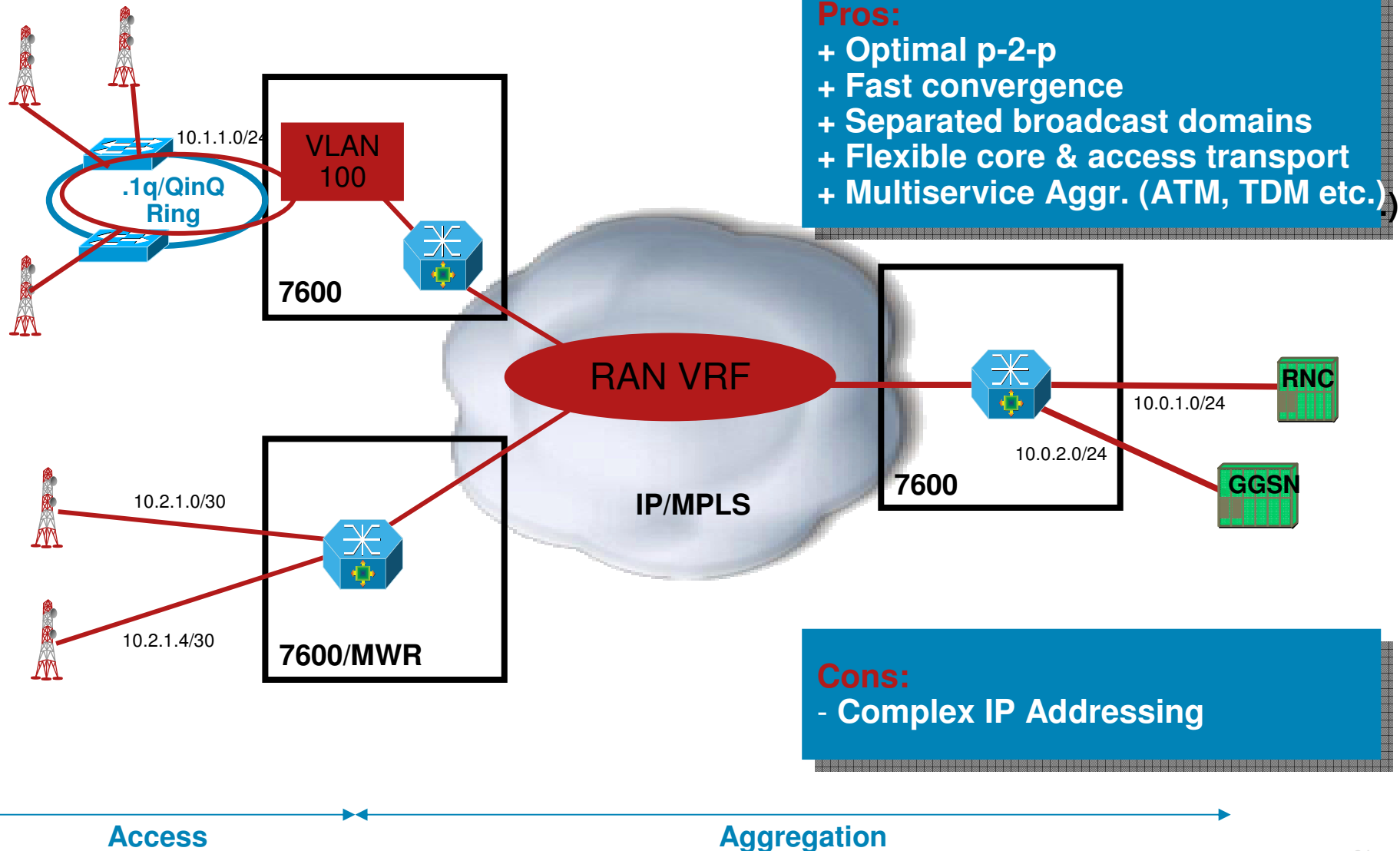
All-IP RAN Aggregation – EVC/MPLS-TP



All-IP RAN Aggregation - VPLS



All-IP RAN Aggregation – L3VPN



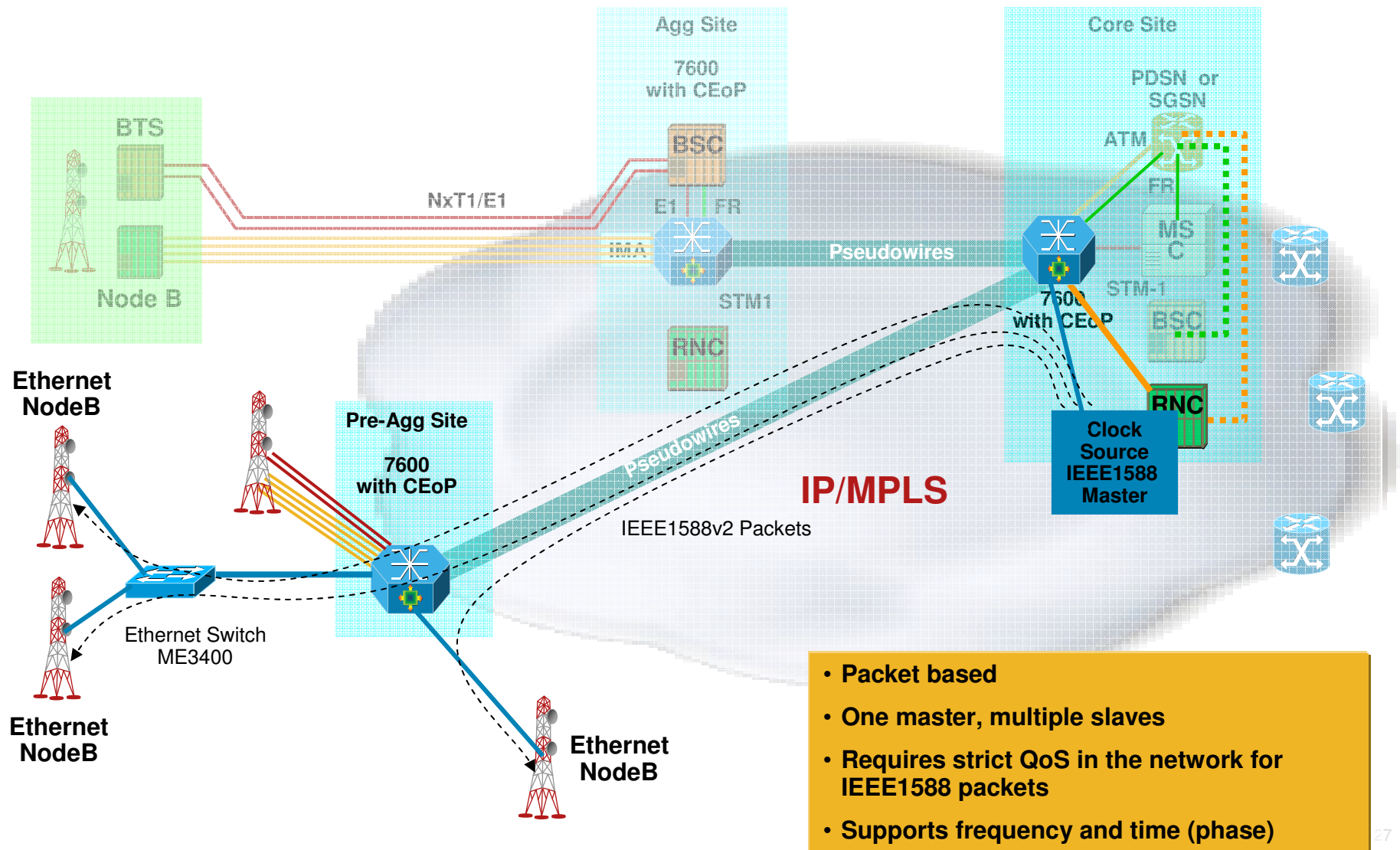
All-IP RAN Design Conclusions

- The Access is usually native Ethernet with REP if possible
- Aggregation is either native Ethernet or MPLS, whereby:
 - The question mostly is, where the line between MPLS and Ethernet should be made
 - MPLS is more flexible and multiservice
 - Ethernet is more cost efficient
- Any-to-any connectivity between NodeBs will be more important in LTE than now
- Layer 2 or Layer 3 decision depends on operators preference and operational procedures

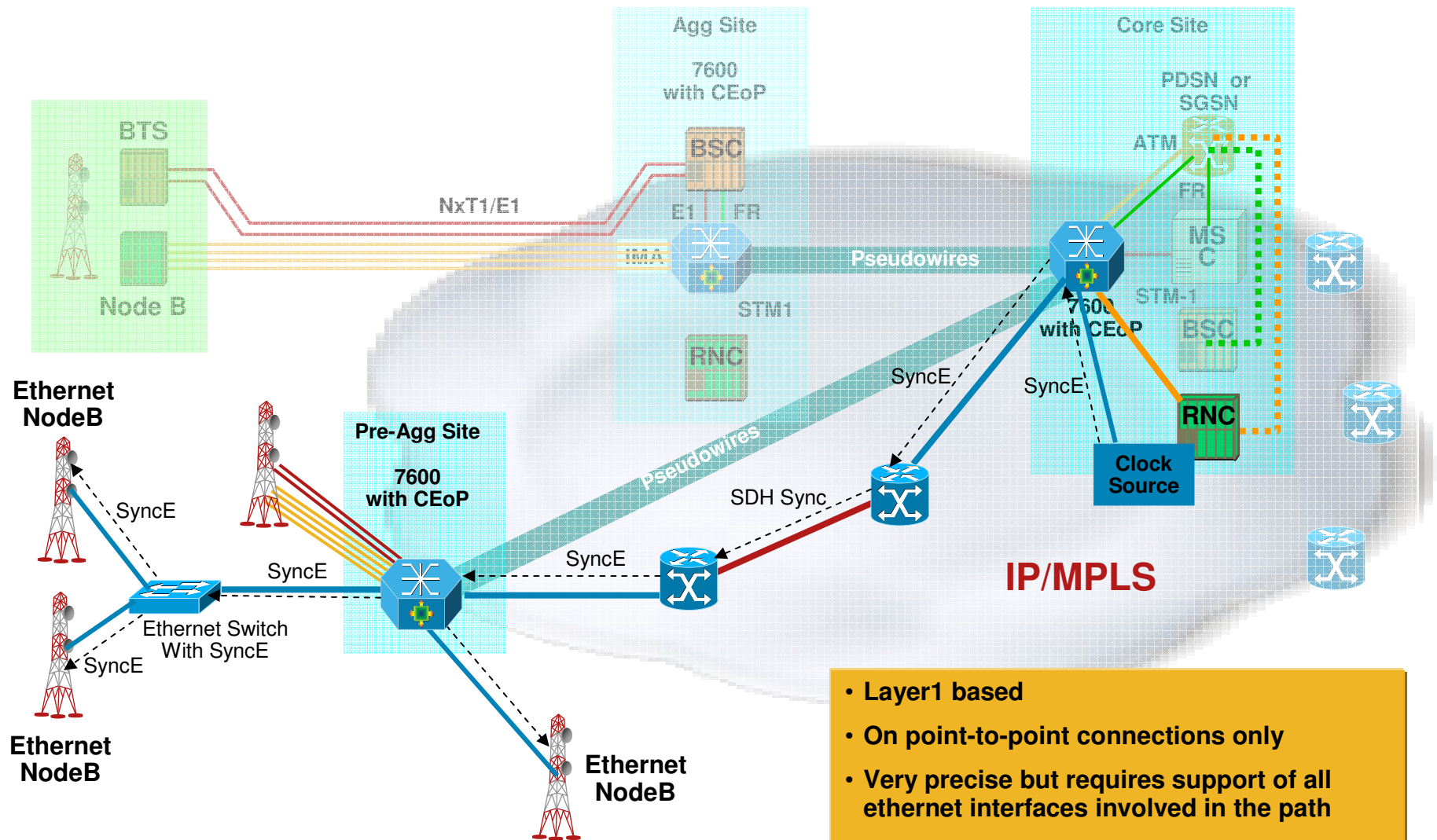
Synchronization

	Advantages	Disadvantages
GPS	Reliable PRC Relatively cheap Frequency and phase	Antenna required US Govt owned
PRC/BITS	Reliable PRC Generally Available	No Phase Need to maintain TDM in all Ethernet deployment
1588-2008	Packet Based (Frequency and Phase)	Requires Master w/ PRC Performance influenced by network Undefined Profiles in SP environments
SyncE/ESMC	Physical layer (Frequency)	No Phase Every node in chain needs to support
NTPv4	Packet Based (Frequency and Phase)	Not as robust as 1588-2008 Open standard Some proprietary implementations

IEEE1588v2 in the RAN

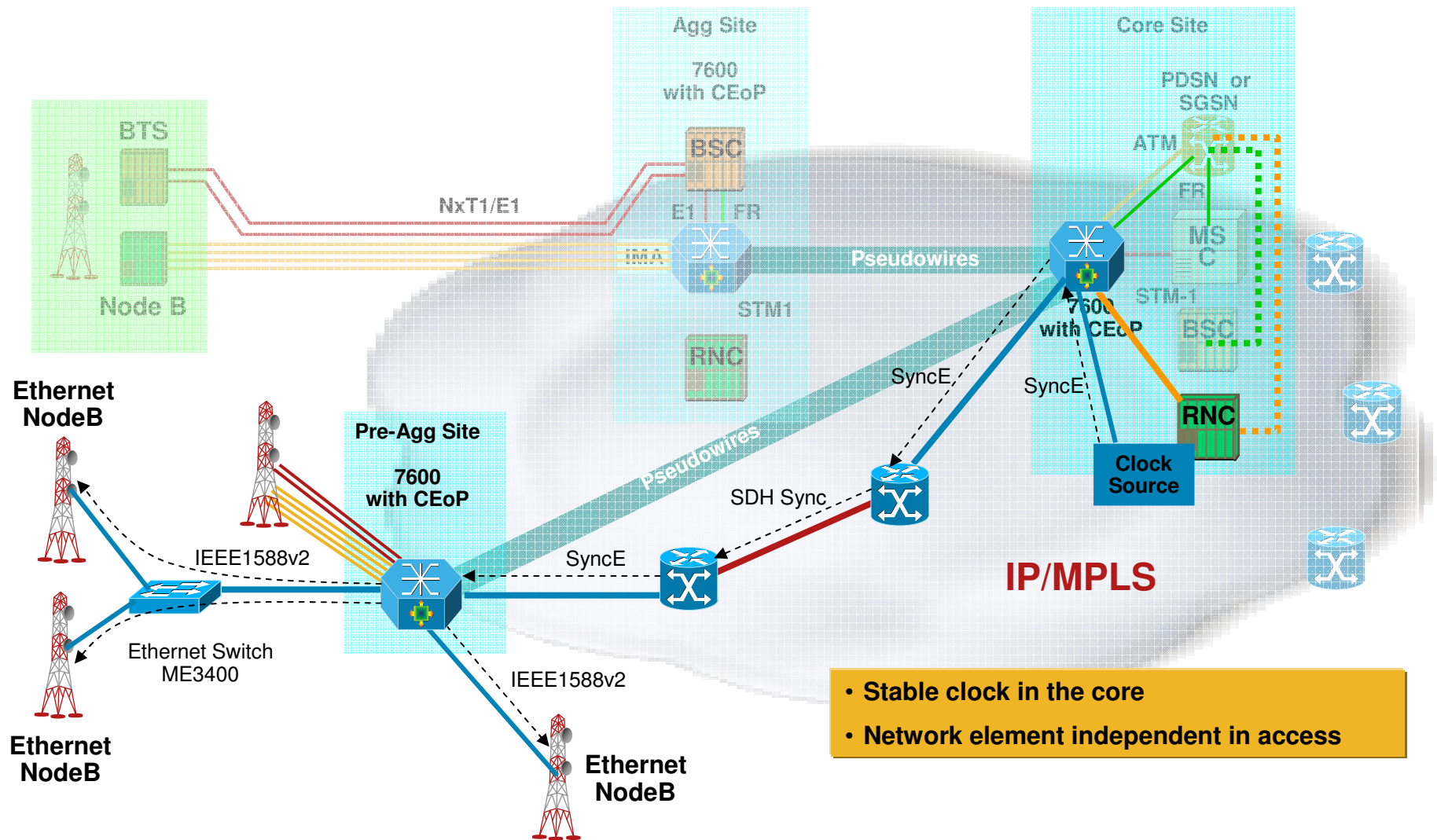


ITU SyncE in the RAN



- Layer1 based
- On point-to-point connections only
- Very precise but requires support of all ethernet interfaces involved in the path
- Does not support time synchronization

Combination

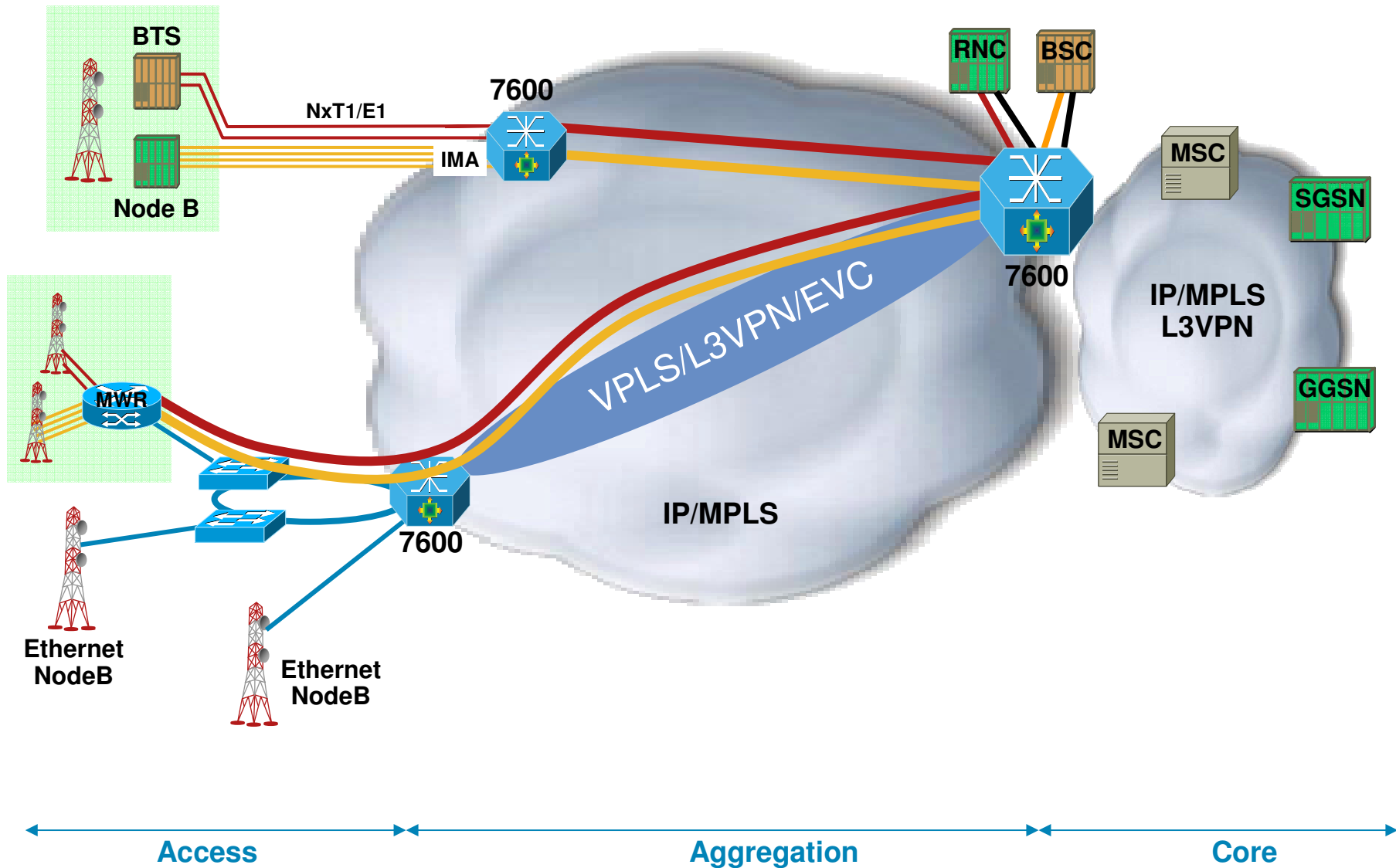




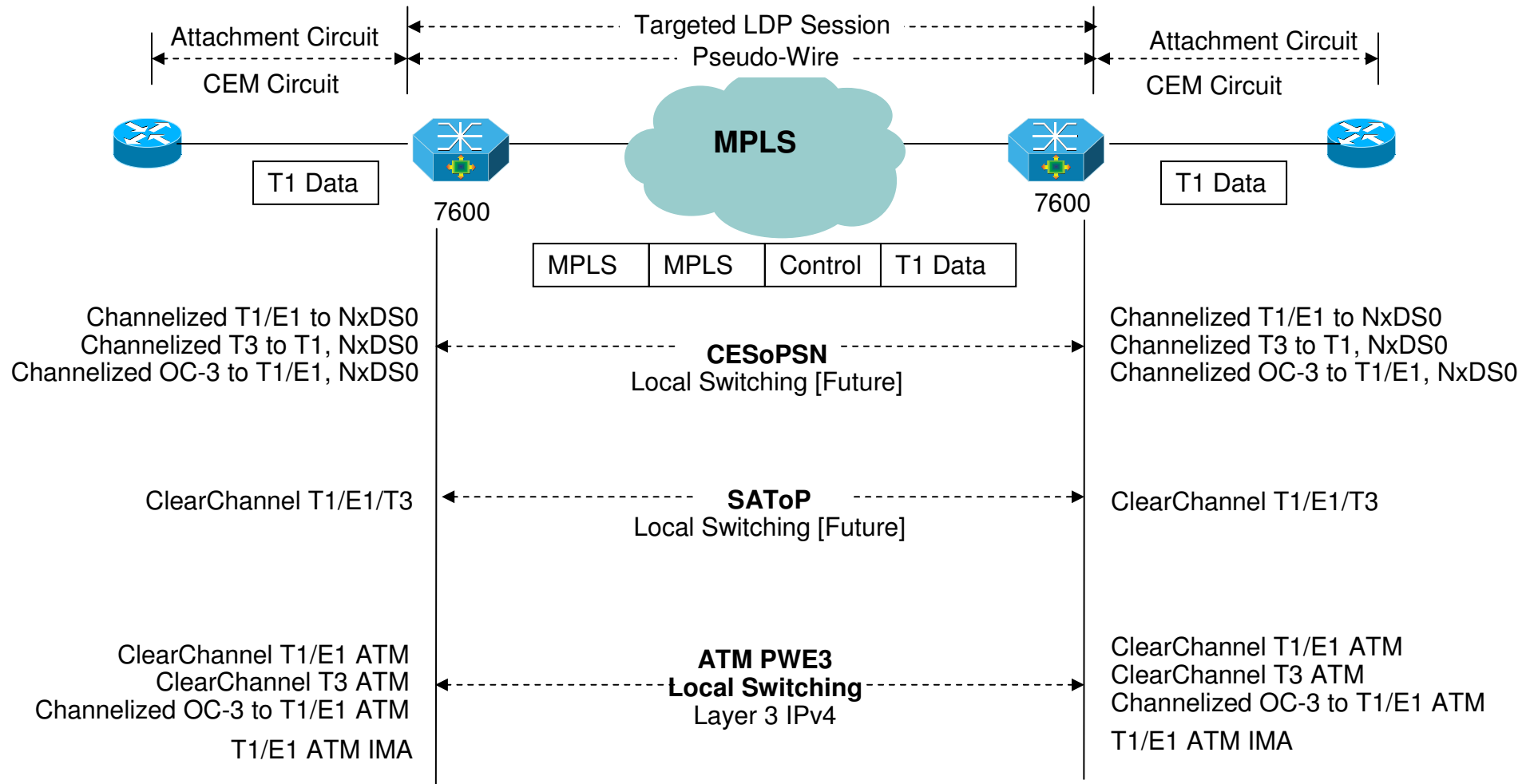
Legacy RAN Over IP



Legacy and All-IP RAN



Network Elements



SAToP : Structured Agnostic TDM over Packet : RFC-4553

CESoP : Circuit Emulation Service over Packet : RFC-4842

IMA : Inverse Multiplex over ATM

Pseudowire in the RAN

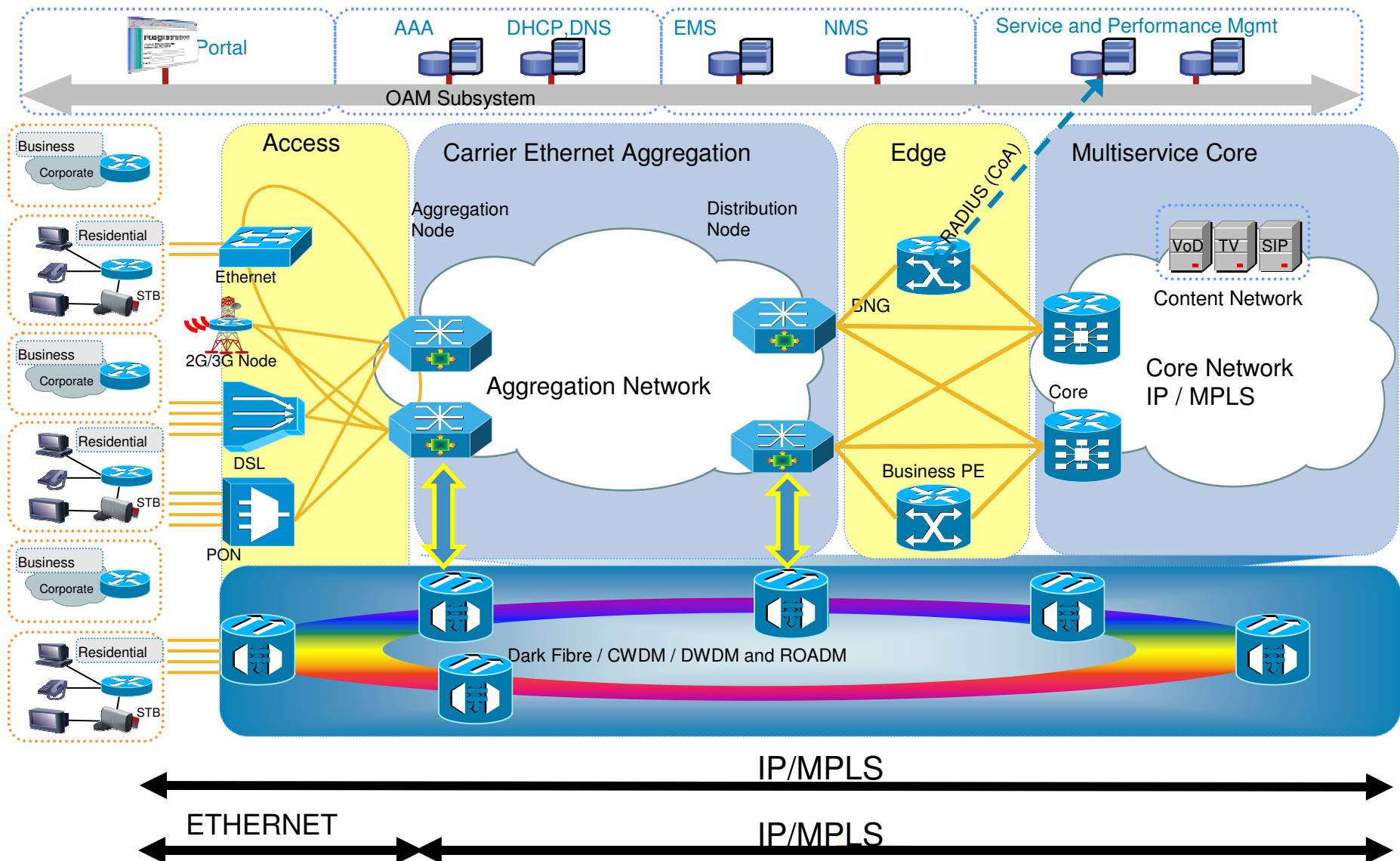
- RAN traffic groomed over MPLS Pseudowires for backhaul
- MPLS needed in Aggregation
- Reduced OPEX – Bandwidth Flexibility
- Eliminates need for ADM and ATM switches
 - “Flatten the network”, Simplify, Reduce costs
- Pseudowire enables greater flexibility for traffic handling
 - Proactive scalability -- Self-Adjusting Backhaul Transport
 - Pre-provision new and future services
- Provides Clock Recovery per 3GPP CESOPN Standards
- Longevity
 - Compliance with 3GPP/3GPP2 Reference Architectures up to R8



Cisco Carrier Ethernet Architecture



Cisco's Carrier Ethernet Approach



Cisco 7600

Bridging the Solution

Mobile Transformation

- ✓ TDM to Packet Migration
- ✓ T1, T3, OCn, Channelized
- ✓ ATM Interworking
- ✓ MLPPP, IMA
- ✓ ATM Cell Packing/Relay
- ✓ SAToP
- ✓ CESoP
- ✓ AToM, MPLSoGRE
- ✓ SyncE, 1588v2, Adaptive
- ✓ BITS Clocking
- ✓ Y.1731, CFM 8.1
- ✓ Multicast & HA
- ✓ Multisegment Pseudowire
- ✓ Integrated Routing + Bridging

Management

- ✓ ANA
- ✓ ISC (Provisioning)
- ✓ Customer Network Management (CNM)
- ✓ MIBs



Modular, Scalable

- ✓ 40Gbps / Slot
- ✓ 720Gbps Total Bandwidth
- ✓ 5 Chassis Sizes
- ✓ PW3, BFD, Queues scale
- ✓ VLAN, MAC scale

Integrated Services

- ✓ L2 and L3 Services
- ✓ Business and Residential
- ✓ Session Border Controller
- ✓ Integrated Security
- ✓ Mobile Services

Carrier Class Resiliency

- ✓ APS, 802.3ad LACP, REP, BFD
- ✓ Access Circuit Redundancy
- ✓ Hot-standby PW Redundancy
- ✓ End-to-End OAM
- ✓ NSF/SSO, EFSU, ISSU

Cisco ASR 9000 “At a Glance”

- Optimized for Aggregation of Dense 10GE & 100GE
- Designed for Longevity & TCO: Scalable up to 400 Gbps of Bandwidth per Slot
- Based on IOS-XR for Nonstop Availability & Manageability
- Enables Network Convergence of Business & Residential Services for Fixed & Mobile Access
- Advanced Video DNA



Cisco MWR 2941-DC



***Most Compact, Affordable
High Performance
Cell Site Router with
Features Enabled***

1. **Cisco's Latest MWR Series Product**
2. **Six Built-In GE Ports (4 RJ-45, 2 SFP)**
3. **16 Built-In T1/E1 Ports, expandable to 24**
4. **Multiple Industry Standard Clocking Options**
IEEE 1588v2, Sync-E, Adaptive, Stratum 3
5. **Expanded Capacity**
Support for 2800/3800 HWICs
6. **Key Applications**
 - IP RAN:** Activate flexible and efficient all-IP RANs for new revenue-generating services with intelligent IP network features
 - RAN Optimization:** Optimize and reduce backhaul costs for 2G (GSM) and 3G (UMTS/HSxPA) wireless networks
 - Standards Based Pseudowire:** Use IETF PWE3 to transport 2G, 3G and 4G wireless networks over low-cost alternative networks such as xDSL, Carrier Ethernet, MPLS, etc.

Positioning for Key Solution Segments

Legacy 2G

- T1/E1/ATM L2 Backhaul
- PWE3 Circuit Emulation
- No Ethernet nodeBs
- ACR, APS and TDM HA mechanisms
- IP Gateways for Mobile Edge
- Up to 10G Scale

Portfolio:

- MWR2941, 7600



Hybrid 2G/3G/4G

- TDM/ATM hybrid with Ethernet/IP
- New Ethernet / IP centric nodeBs/RNC deployment
- Investment protection
- IP Gateways for Mobile Edge
- Up to 40G Scale

Portfolio:

- MWR2941, 7600



4G Ethernet Centric

- New Ethernet/IP centric overlays/greenfield
- High scale & density
- Cost Leadership
- Key Infrastructure platform going forward
- **IP Gateways: 7600**

Portfolio:

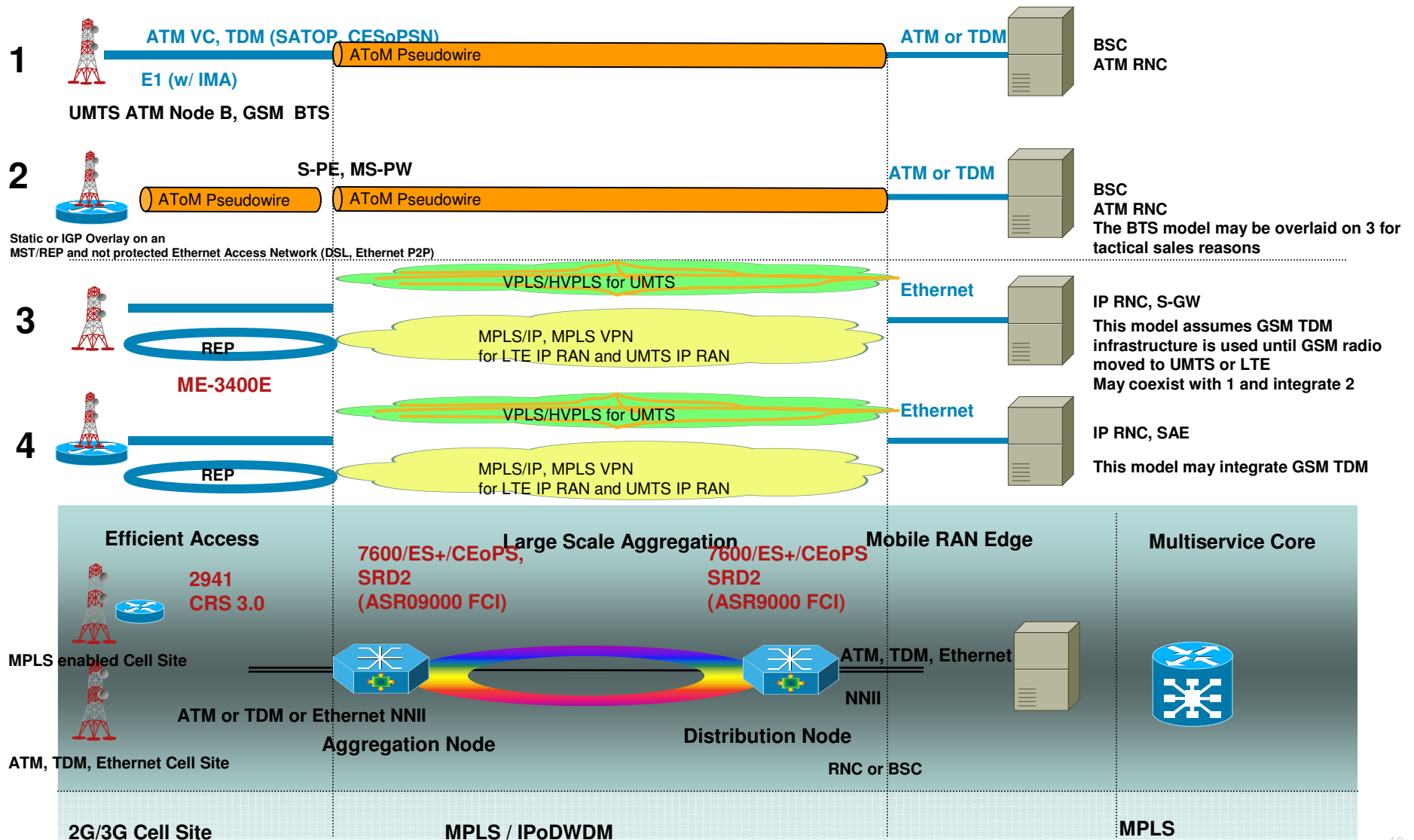
- ASR9000, MWR2941



Network is the Platform

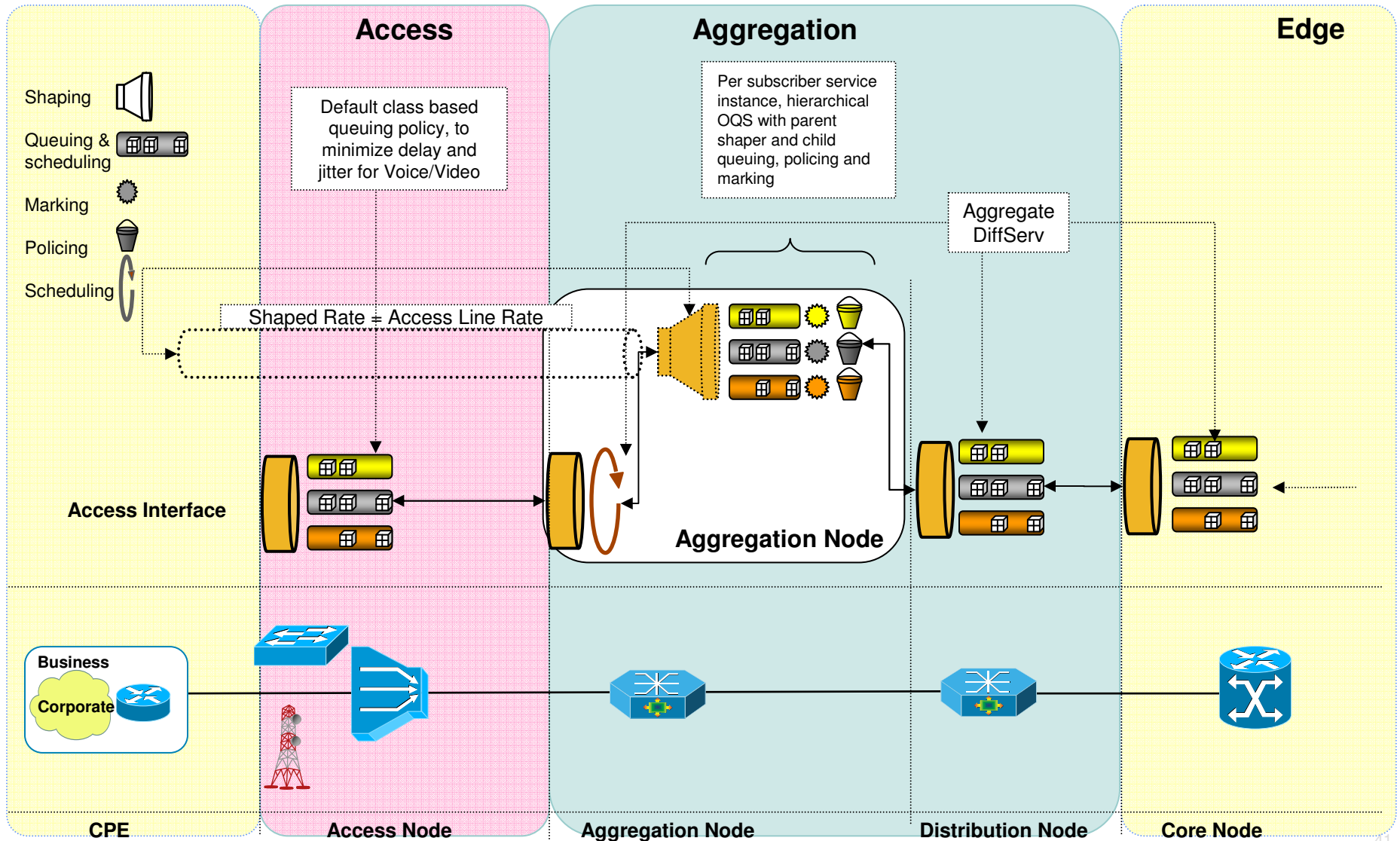
Cisco Carrier Ethernet - Mobile RAN Services

Market Transitions 1+2+3 or 1+2+4 or 3



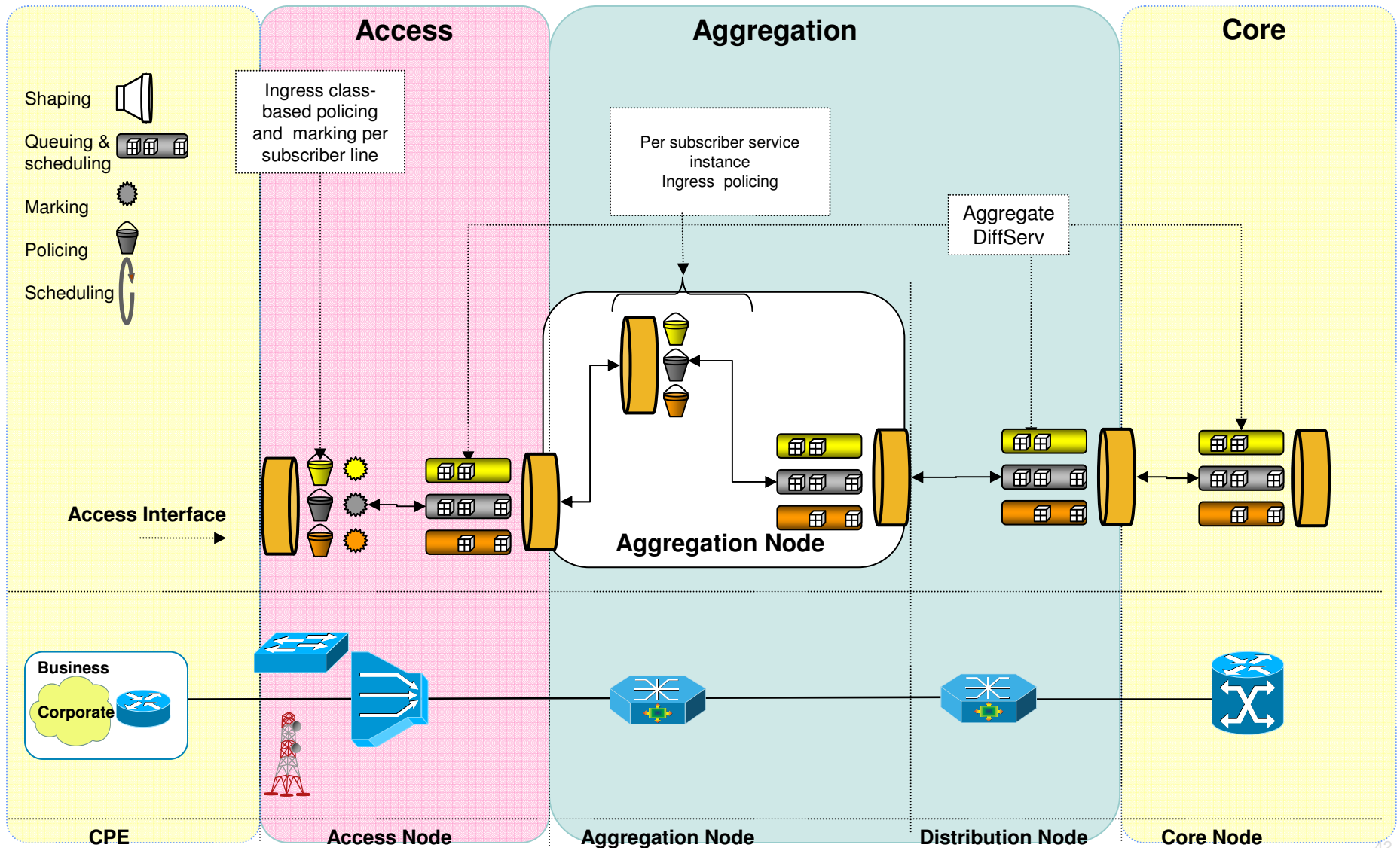
QOS Model - Downstream

Distributed Business L2/L3 VPN Services



QOS Model - Upstream

Distributed Business L2/L3 VPN Services



Baseline Network Availability Mechanism

IP Services:

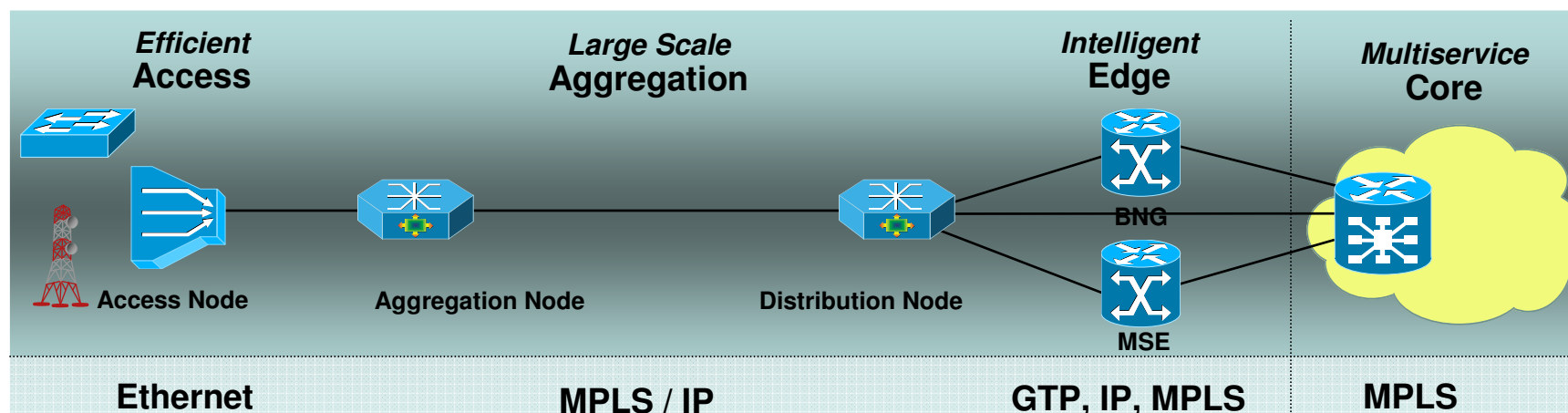
- Fast IGP/BFD convergence

MPLS Services:

- Pseudowire redundancy
- MPLS TE-FRR Link and Node protection with IP services, PW/VPLS PW tunnel selection

Access:

- Resilient Ethernet Protocol



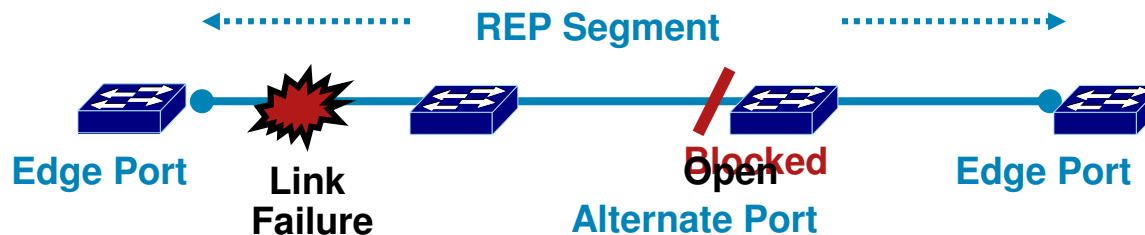
Carrier Ethernet Ring Topologies

Current Network Trends and Challenges

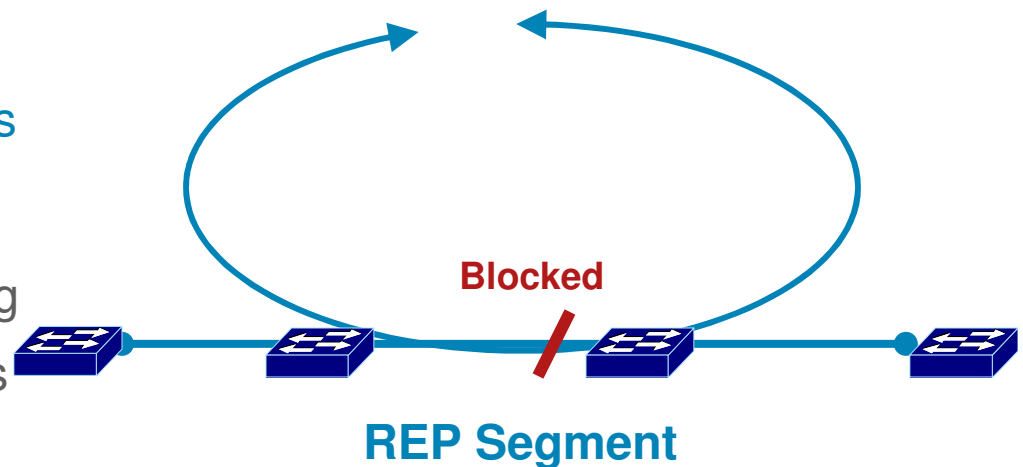
- **Large Spanning Tree domains**
Increasing number of nodes in the ring
- **Supporting higher number of subscribers**
Increasing number of VLANs, MAC addresses per L2 domain
- **Carrier Ethernet Trend**
Fast convergence requirement in the access and aggregation networks
Spanning Tree not perceived as Carrier Class
- **Complexity of management and troubleshooting as the network grows**

Resilient Ethernet Protocol

A segment Protocol



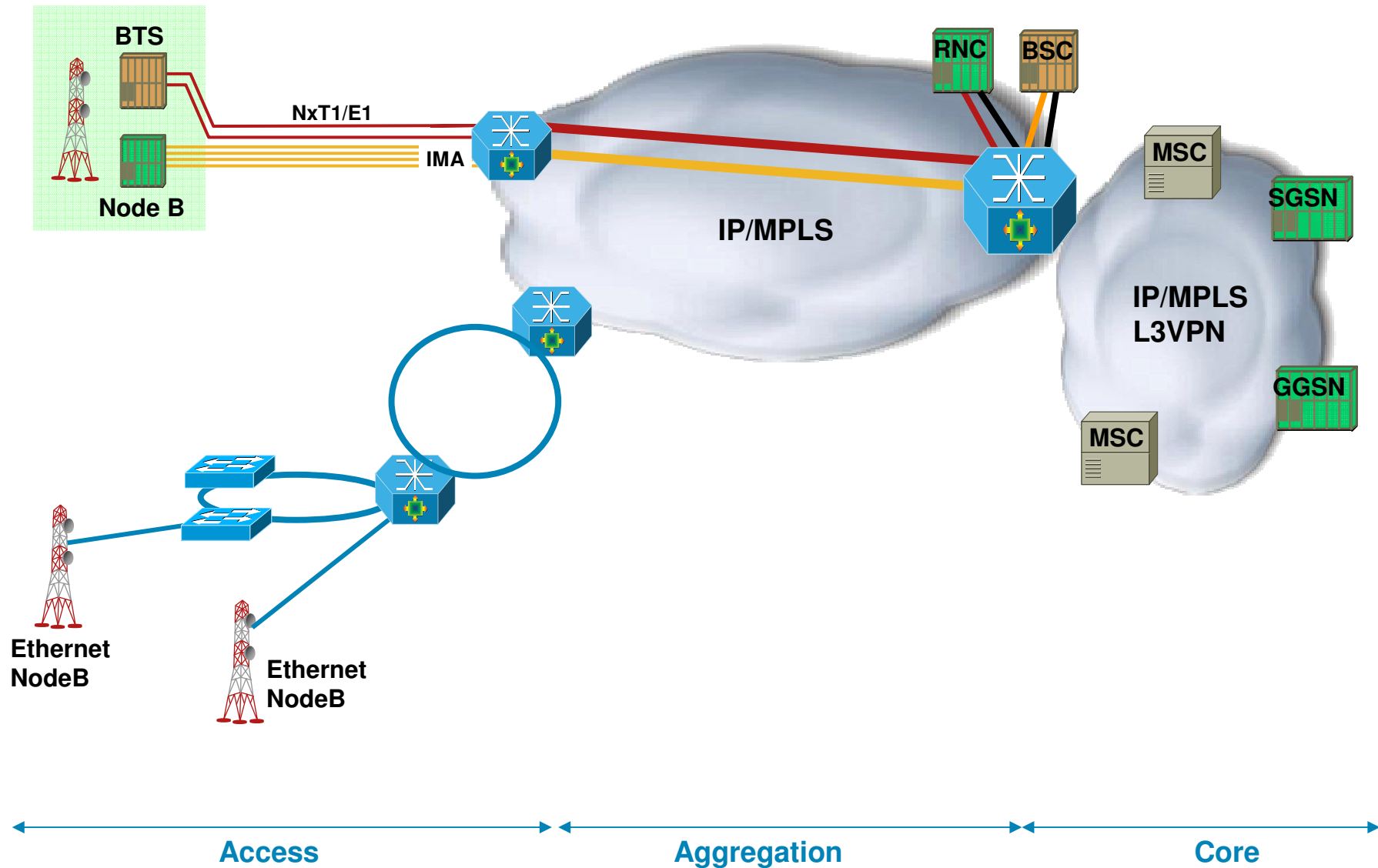
- A **REP segment** is a chain of ports connected to each other and configured with a **segment ID**.
- One switch can have **only two ports** belonging to the same segment.
- REP guarantees there is **no connectivity** between two edge ports on a **segment**.
- When all interfaces in the segment are UP, the **alternate port** is blocking
- When a link or switch failure occurs on the segment, then blocked port goes forwarding



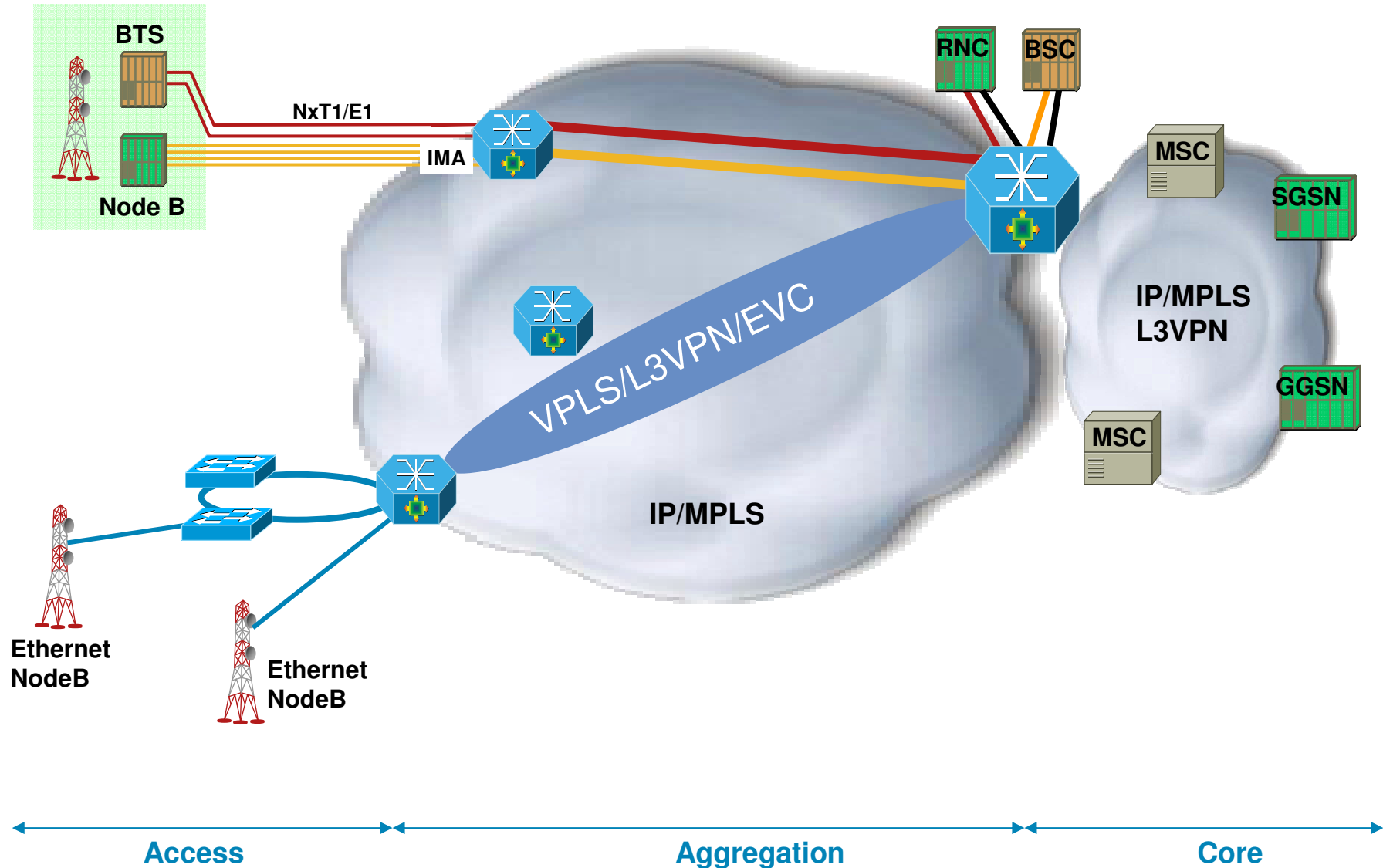
REP Benefits

- **Fast and predictable convergence**
 - Convergence time: 50 to 250ms
 - Fast failure notification even in large rings with high number of nodes
 - Manual configuration for predictable failover behavior
- **Co-existence with Spanning Tree**
 - STP is deactivated on REP interfaces
 - Limit the scope of Spanning tree
 - Topology Changes Notification from REP to STP
- **Optimal bandwidth utilization**
 - VLAN Load balancing
- **Easy to configure and troubleshoot**
 - Topology archiving for easy troubleshooting
 - Known fixed topology
 - Simple mechanism to setup the Alternate port (blocking)

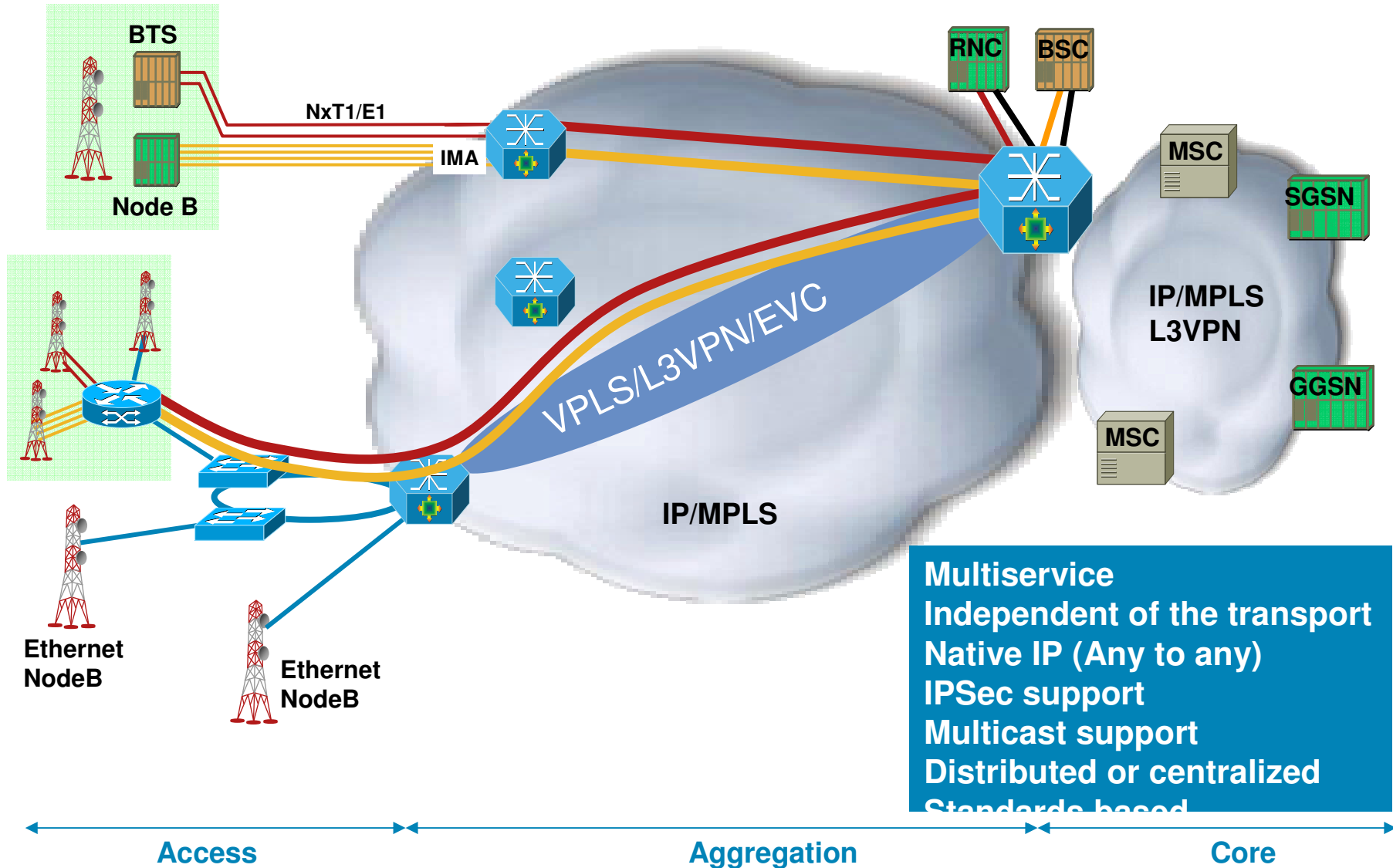
Expansion on Demand I



Expansion on Demand II



Expansion on Demand III



From Ethernet to MPLS/IP

- Access based on simple Ethernet
- Aggregation based on MPLS/IP
- Larger access sites based L2 only
 - Migrate to L3 by license when needed
 - Add TDM/ATM access ports when needed
 - ML-PPP for TDM microwave to Ethernet NodeB
- Add MWR if needed on cell-site
- Expansion of Aggregation towards Access on as needed basis



FOR IMMEDIATE RELEASE ON 10 FEB, 2009

***IP/MPLS Forum Announces Cisco is the First Vendor Certified
in its “MPLS in Mobile Backhaul Certification” Program***

Cisco successfully completes pilot phase of Forum’s certification program
focused on TDM Services over MPLS

PARIS, FRANCE – 10 February, 2009 — The IP/MPLS Forum announced today at the MPLS & Ethernet World Congress 2009 in Paris, France that Cisco Systems is the first vendor to have successfully completed the first phase of its MPLS in Mobile Backhaul certification program. Cisco submitted its 7600 series Edge router and 2941 Mobile Wireless router for testing, and both have passed the IP/MPLS Forum Abstract Test Suite for Time Division Multiplexing (TDM) Services over MPLS.



Summary



All IP RAN Summary

- Designs depend on operator's needs
- MPLS in Aggregation is more flexible than L2 Aggregation
- Line between Access and Aggregation can move depending on traffic and operator's structure
- Any-to-any connectivity may be required for LTE
- Circuit Emulation and ATMoMPLS for legacy RAN to reduce OPEX
- Cisco Carrier Ethernet architecture supports various models and can evolve with the network
- Cisco certified for TDM transport by IP MPLS Forum

