Multiple Generations of Mobile Backhaul Technologies

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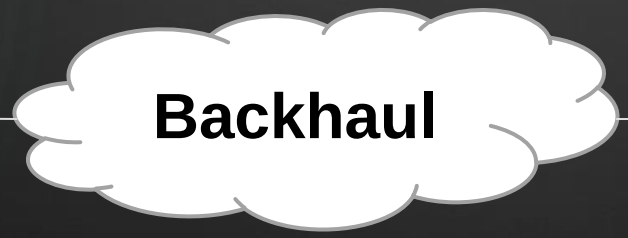
What is the Mobile Backhaul ?

portion of the network comprises the intermediate links between the Core Network , or backbone and the small subnetworks at the "edge" of the entire hierarchical network.

RAN BS



RAN NC
Core network

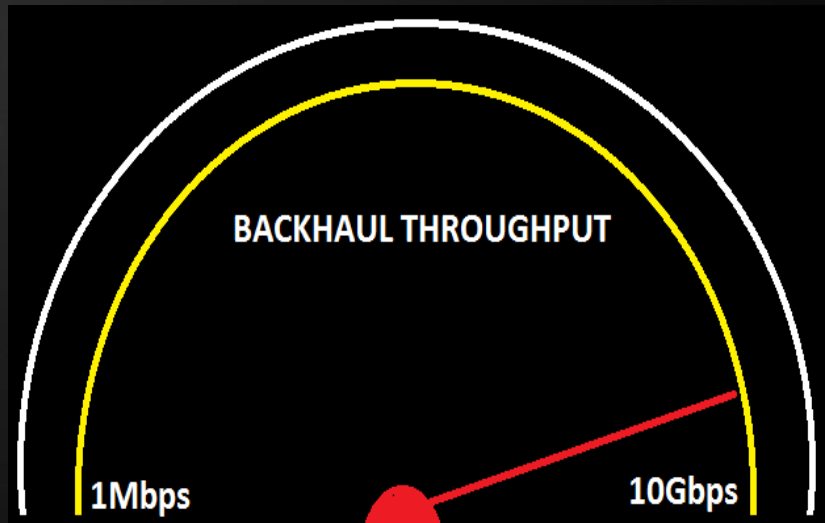
Introduction:

- Since the introduction of the new mobile generation with the new data networking capabilities, mobile networks & mobile usage has undergone a tremendous change. Once voice was the dominating service at the mobile networks,

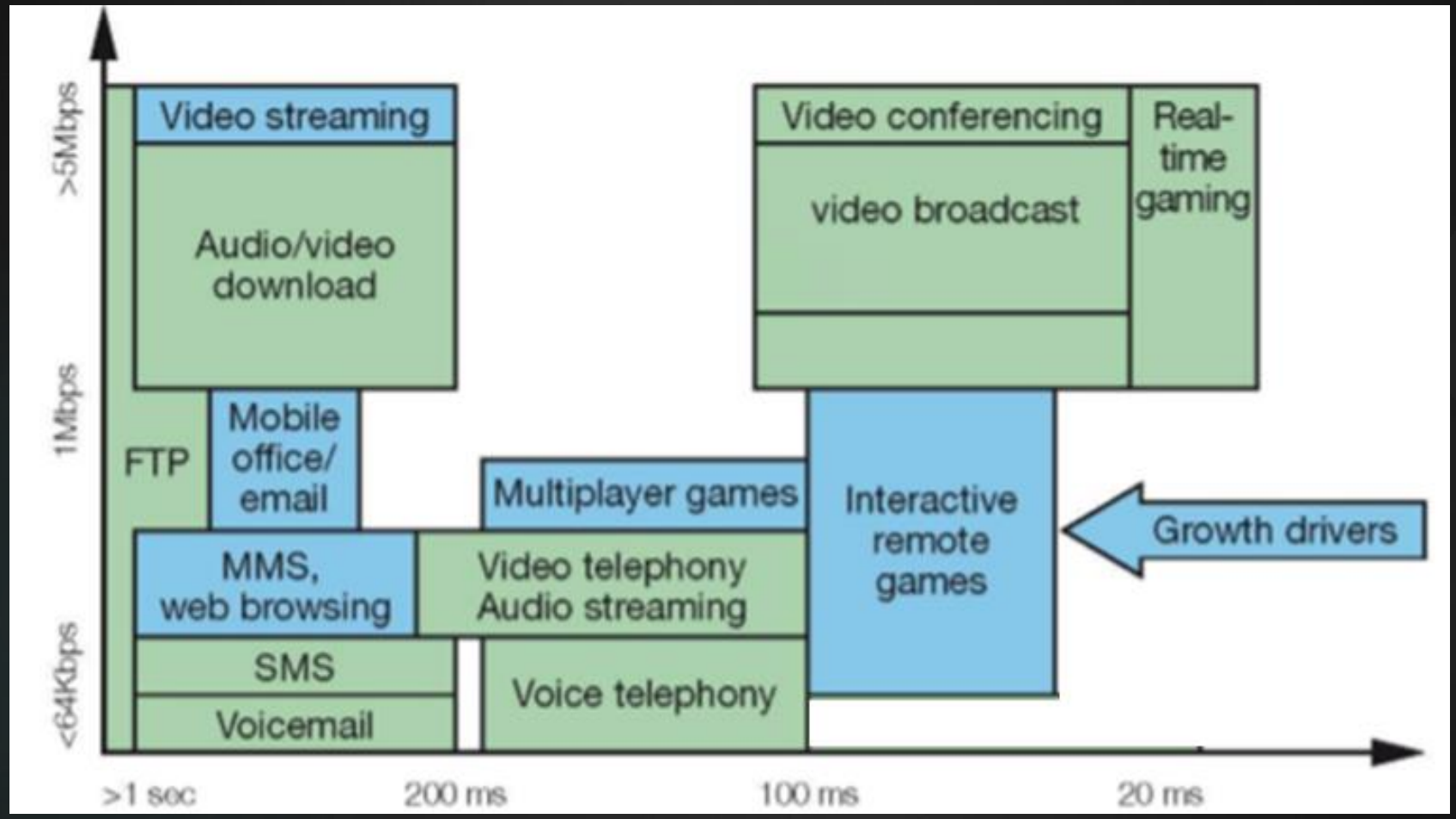
Nowadays data traffic volume exceeds voice traffic everywhere, where the service is available

- Backhaul network operators are being required to significantly reduce operational costs in order to compensate for declining Average Revenue Per User (ARPU) and to compete with a host of new competitors and technologies.

Operators are required to protect (or sufficiently emulate) core legacy services such as voice, which still account for a substantial share of revenue.

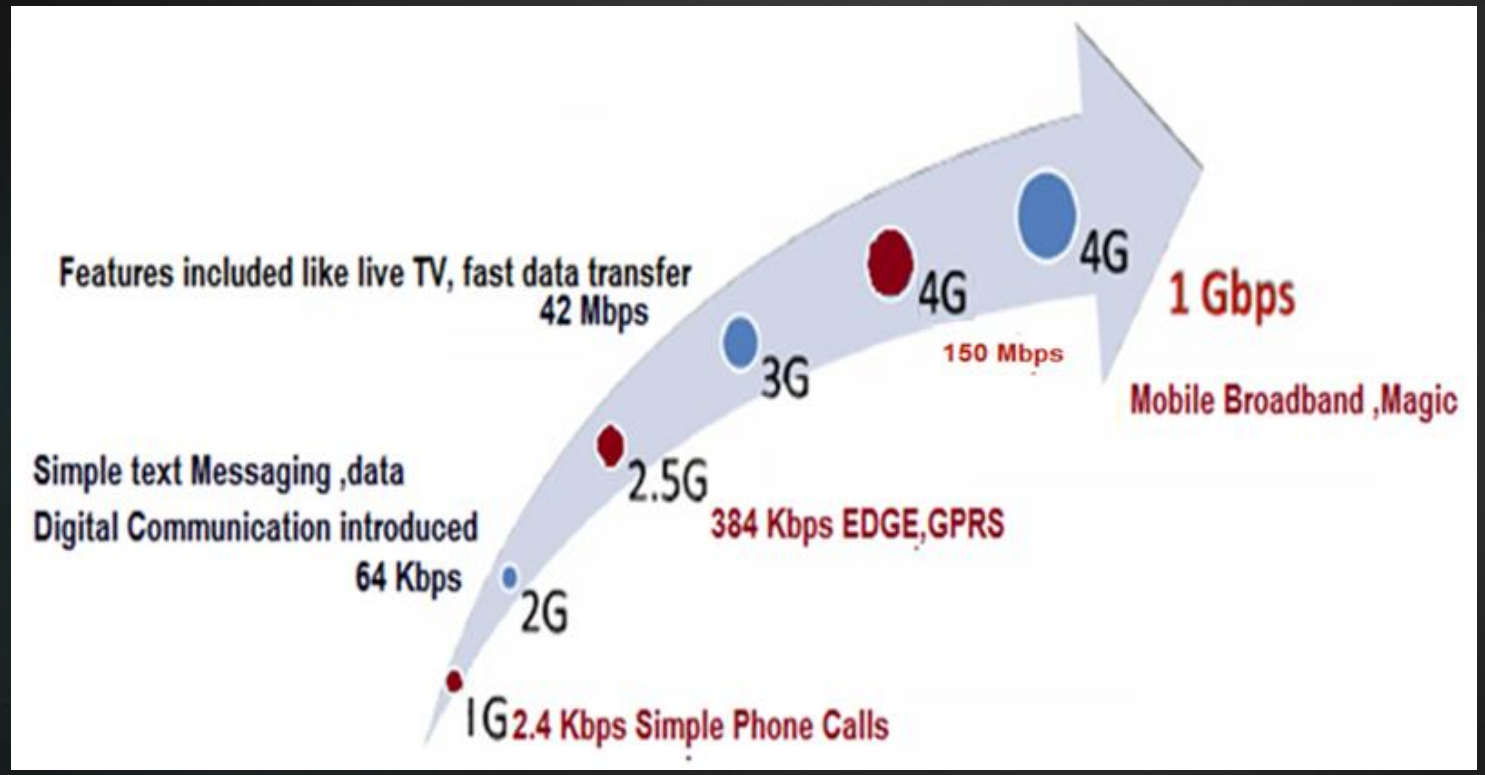


Typical Services and Network Requirements



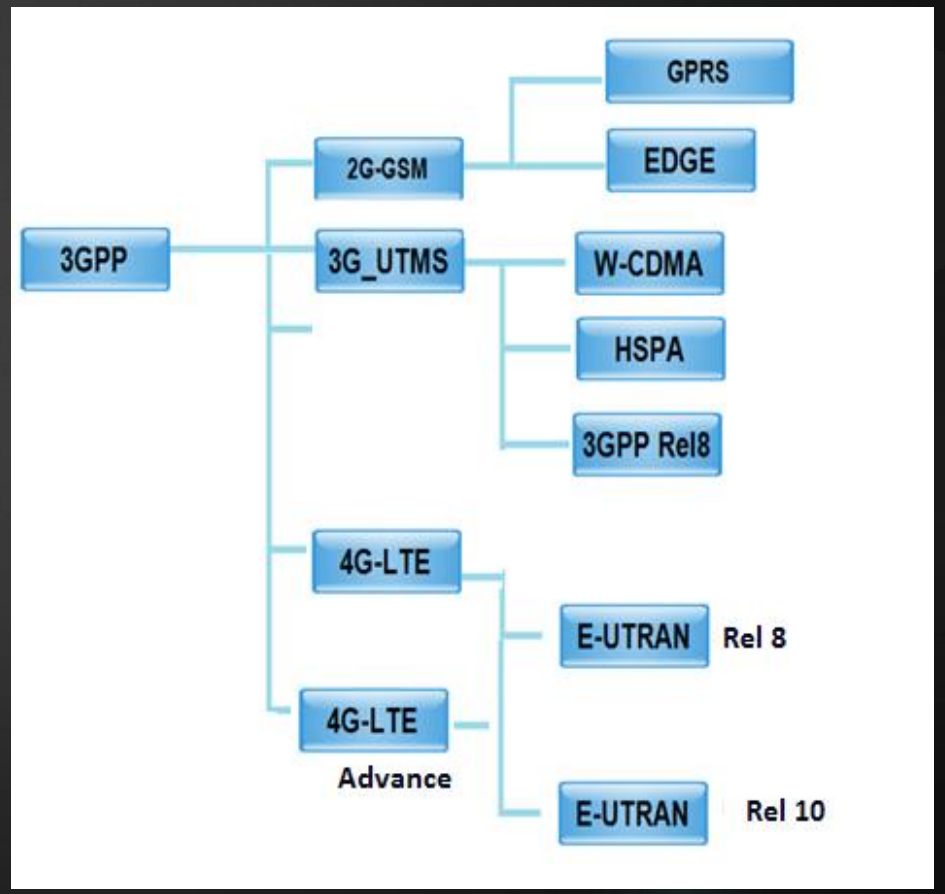
Evolution of the G

Mobile technologies are classified into different generations referred to as 1G,2G/2.5G/3G/4G . Each new generation of Mobile technologies provides users with enhanced services , higher speeds and better network capacity

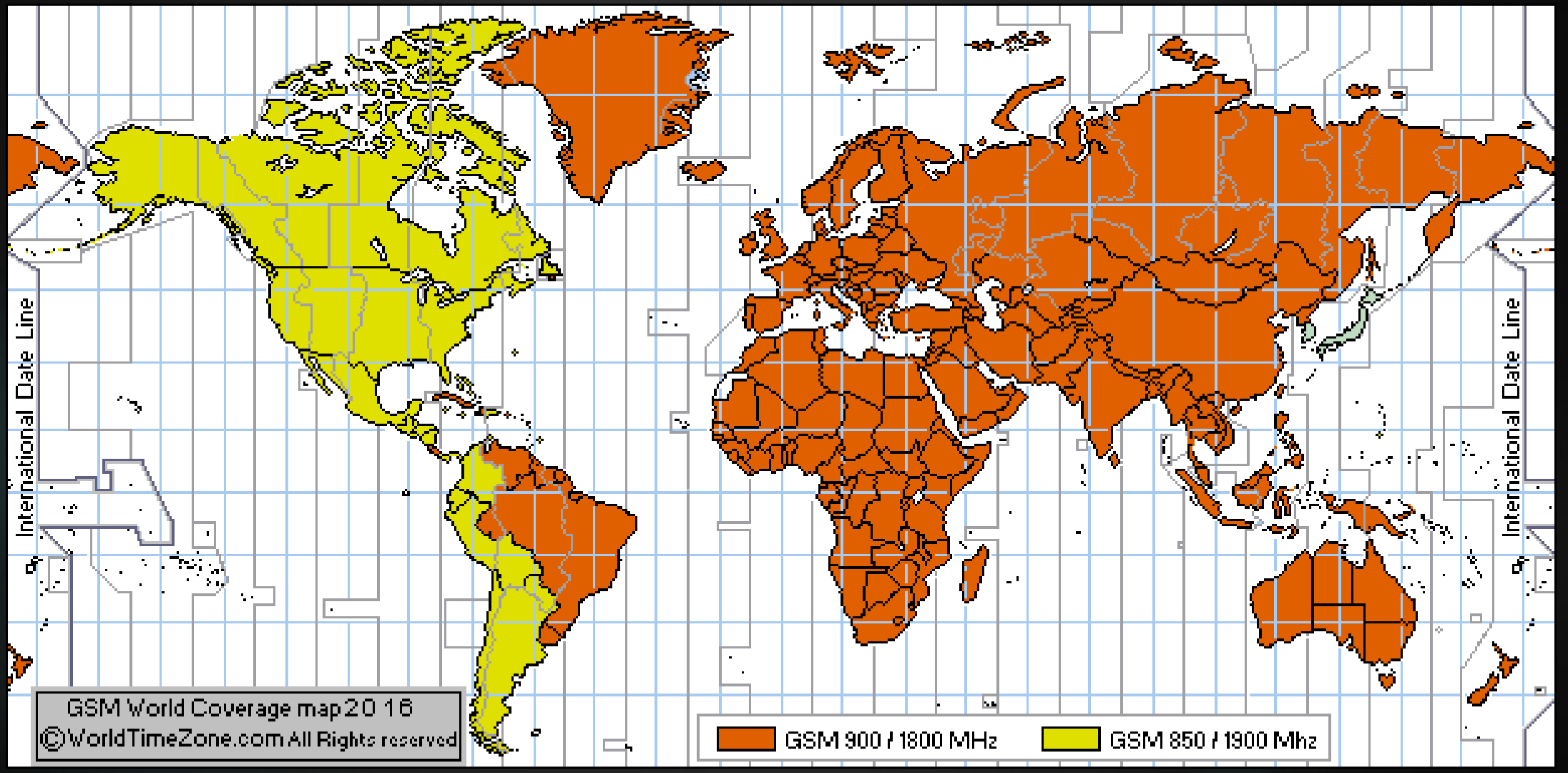


High-Level Overview of Mobile Technologies

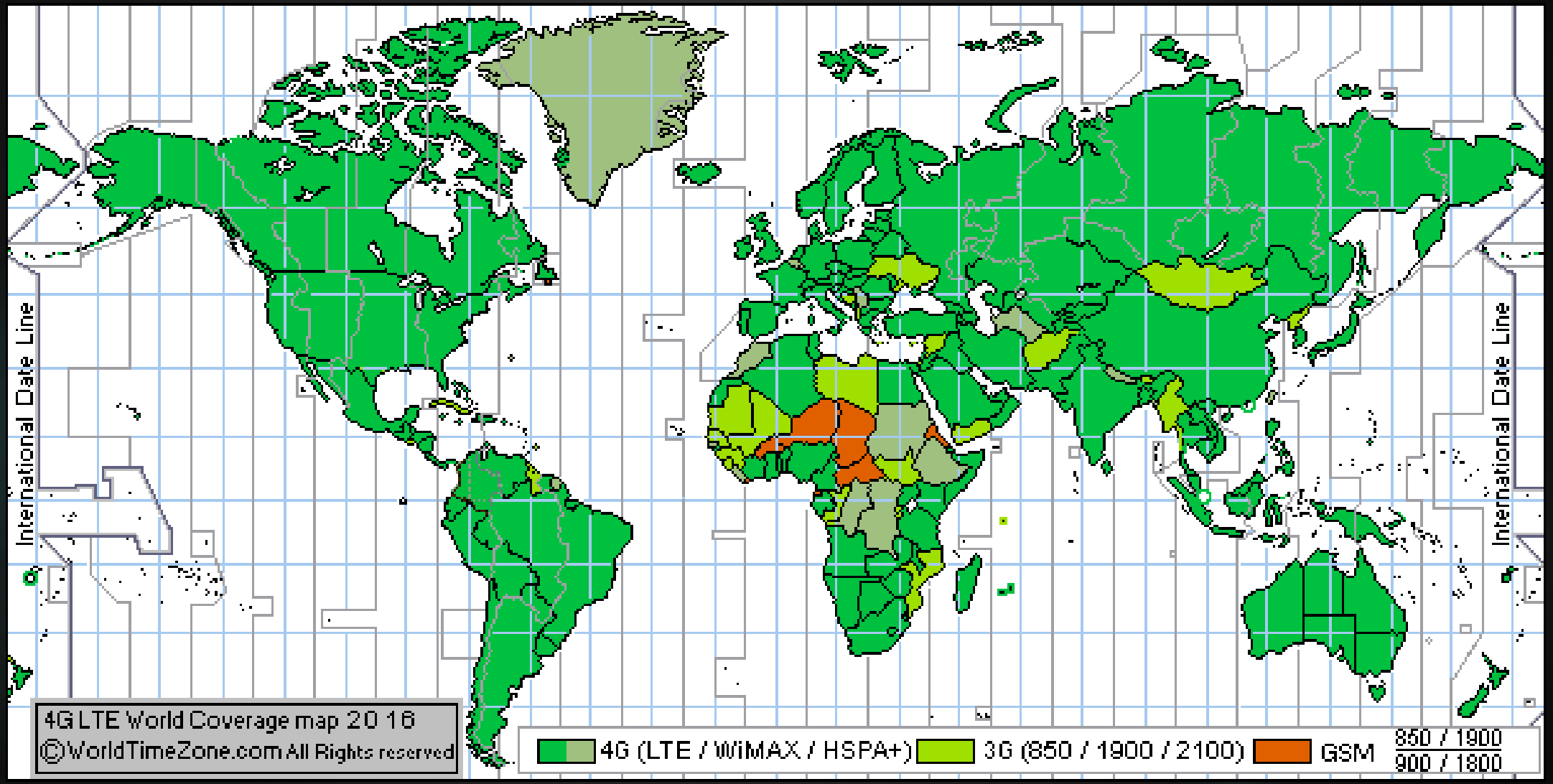
Different bodies and Forums such as 3GPP/#GPP2/ETSI/ITU ; recommend & approve standards and advance the various technologies under each generation



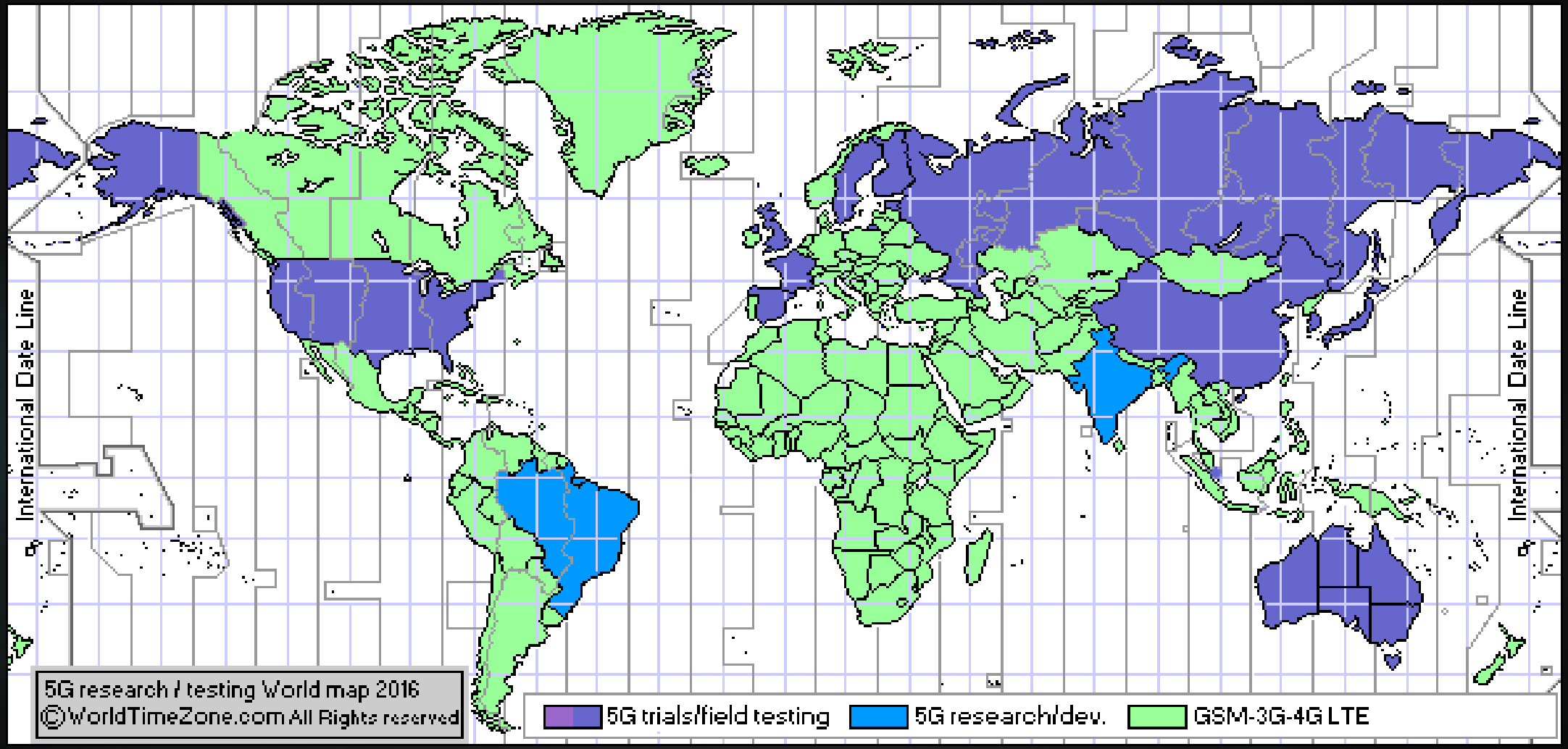
GSM World Coverage



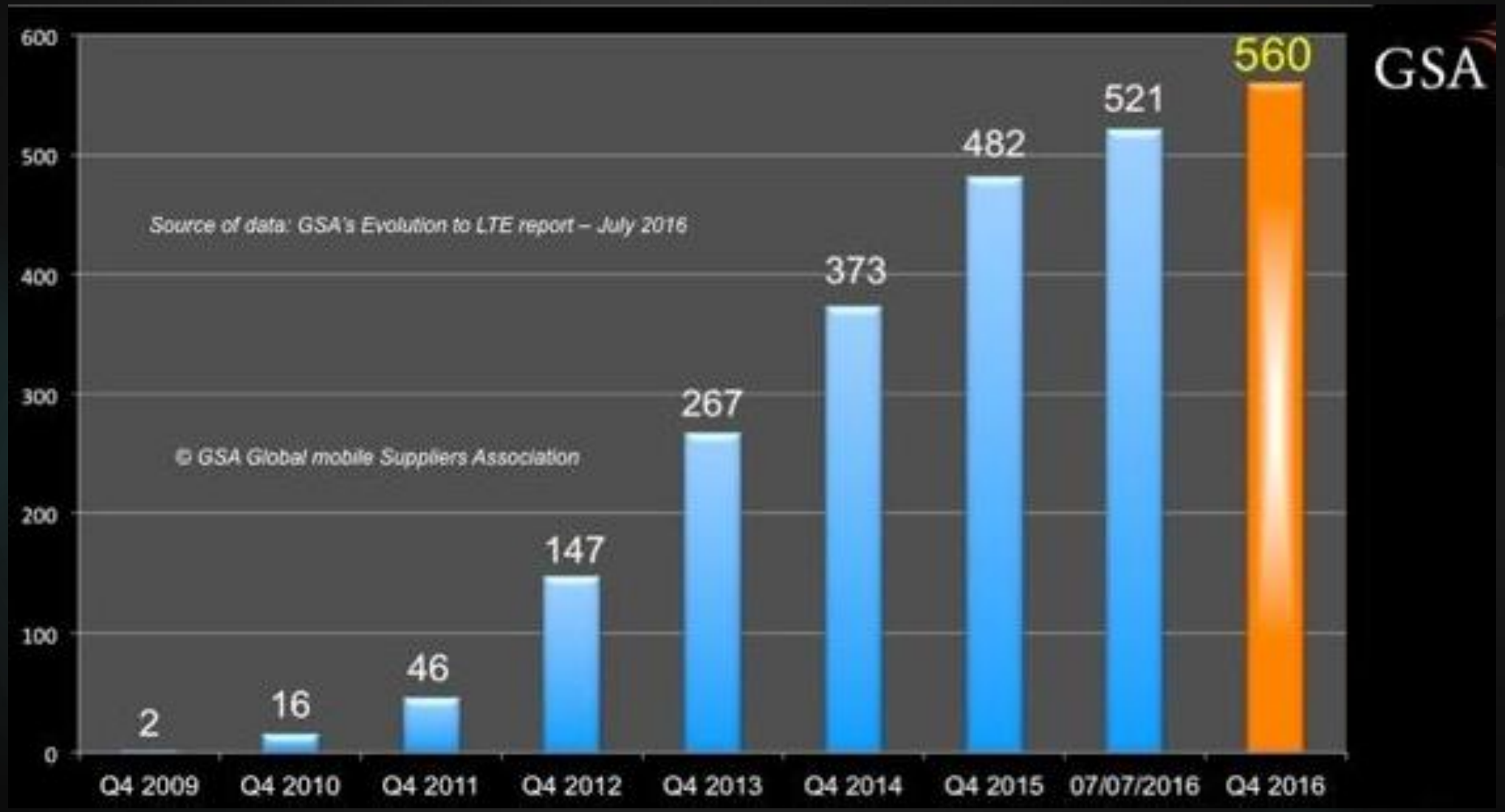
4G LTE World Coverage



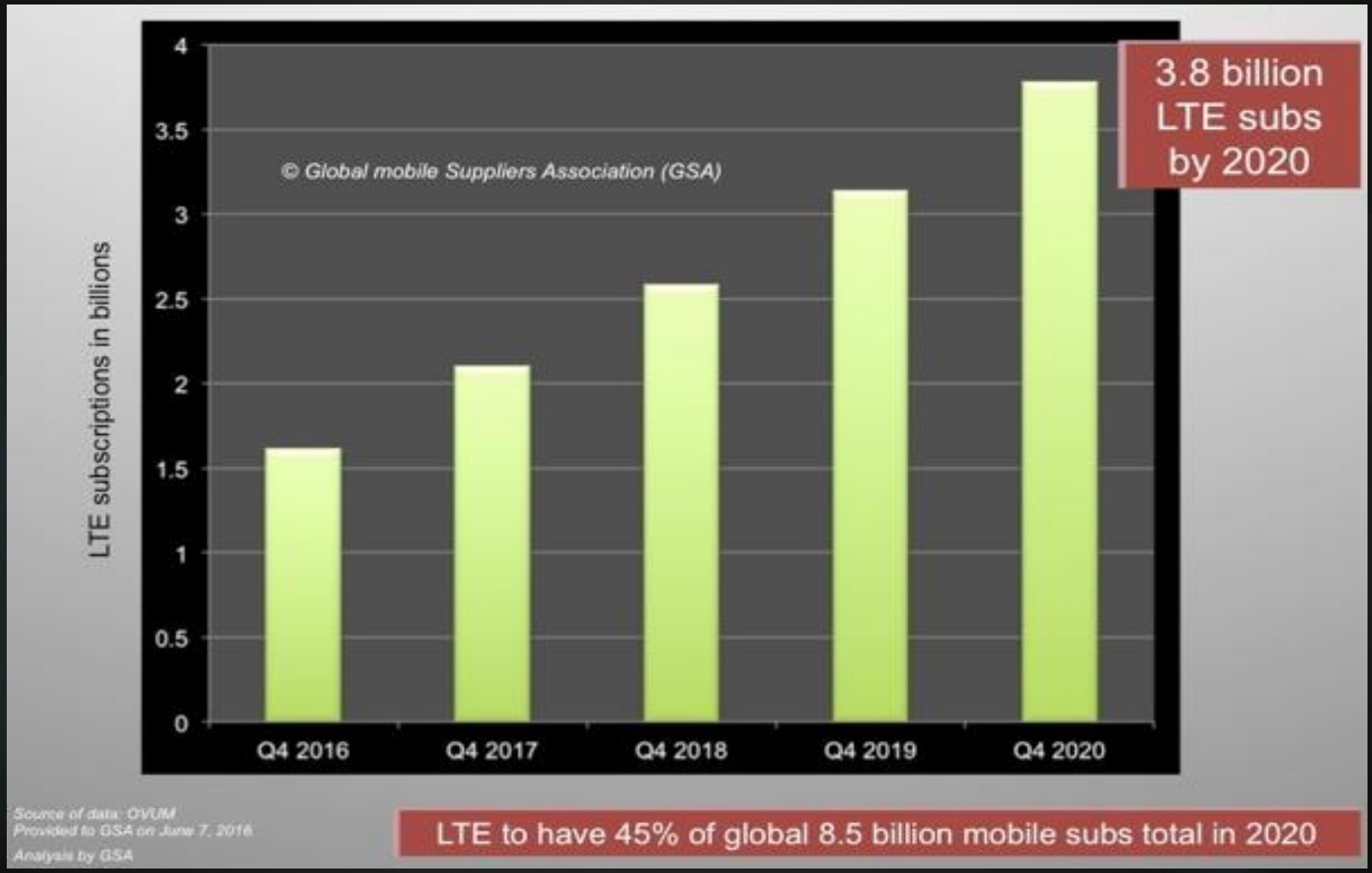
5G field testing and trials World Coverage



Commercially Launched LTE Network "Cumulative Totals - **Q4 2016**"



LTE subscriptions forecast 2016-2020



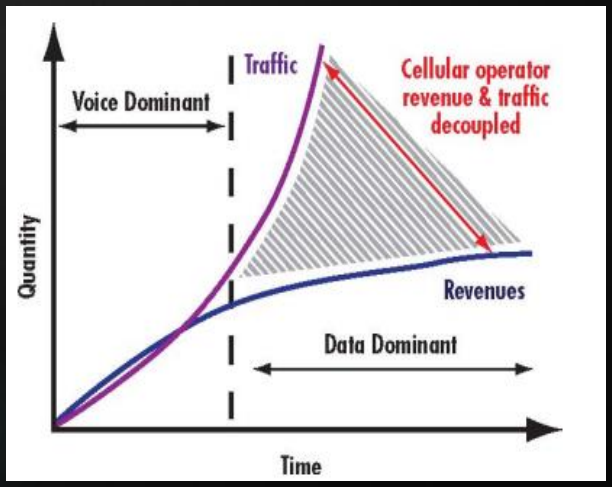
- Traditionally operators have built multiple networks for different purposes.
- The lowest layer has been the physical network including fiber, copper and radio connections. On top of those technologies like xWDM, SDH/Sonet, ATM, Frame Relay, IP, MPLS and Ethernet have been deployed.
- Since the fixed operator networks are running a combination of Ethernet and IP/MPLS at the moment, it is feasible to use the same networks for mobile backhaul purposes as well.
- This brings dramatic cost savings both on the OPEX and CAPEX side.

IP Backhaul is driven by the requirements imposed by 3G/ 4G technologies

- Migrating from existing separate, legacy ATM and TDM backhauling networks to a more cost-effective, converged, MPLS-enabled, and multipurpose infrastructure.

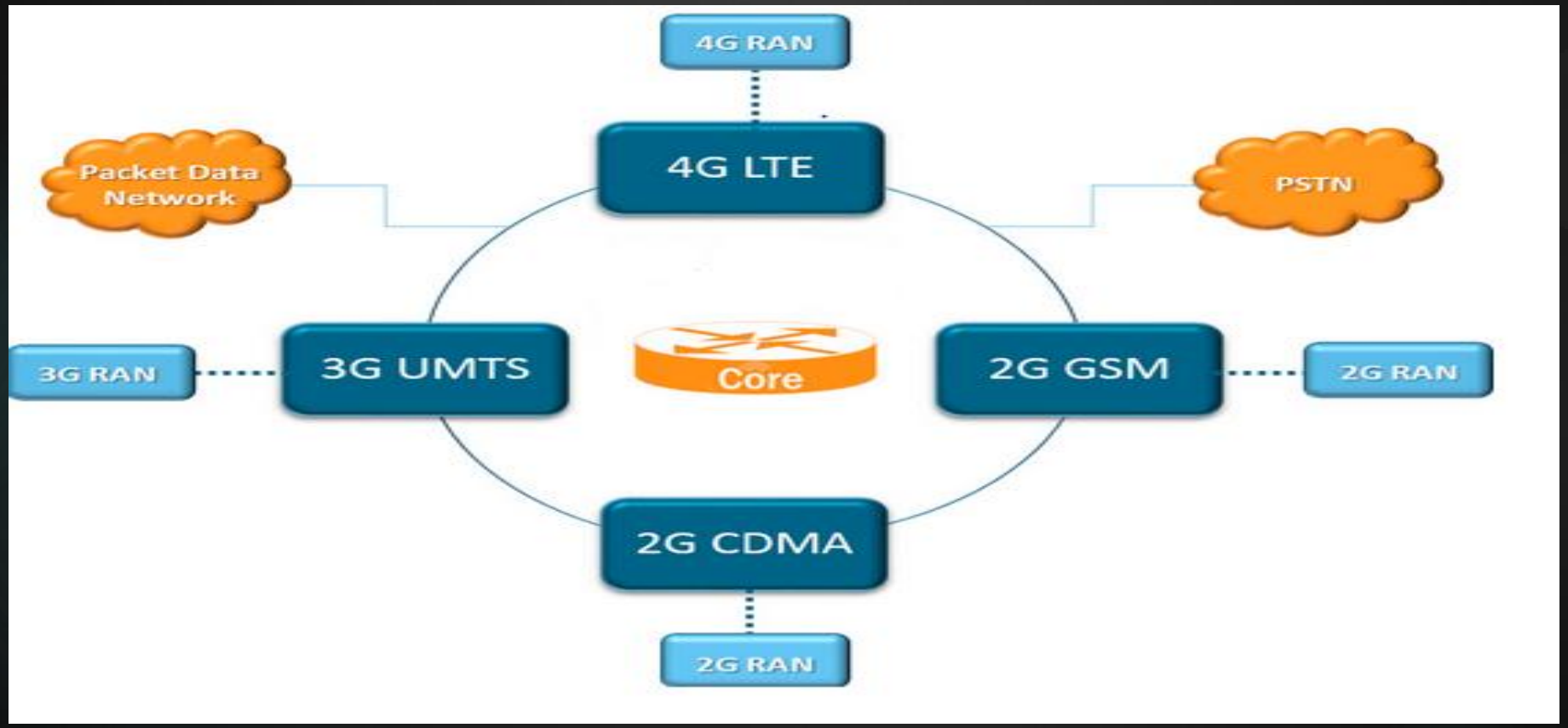
- In addition to reducing operational costs, MPLS-based networks will also lay the foundations for the delivery of next generation mobile services, such as location-based services, mobile gaming and mobile TV, and for the use of NEW technologies such as Long Term Evolution (LTE) and mobile WiMAX.

- Ultimately, this fully consolidated network will be able to handle many different types of traffic on a single cell site, enabling the operator to offer many different services to many different types of customer.



Mobile backhaul solutions can be either purely ip/Ethernet-MPLS or Hybrid of Ethernet and other layer 2 technologies such as ATM/T1-E1/Frame Relay .

Primary focus of New Mobile backhaul architecture based on Ethernet /MPLS solution



Main Mobile Backhaul keys :

- migration strategies from legacy technologies such as TDM ,ATM and IP /Ethernet-based and newer technologies such as WIMAX-LTE backhaul
- Flexibility of using a combined L2 and L 3 based network
- VPN based services across the network.
- Use traffic periodization and Class of service Cos
- More capacity with Scalable & Cost Effective setups.

Main Mobile Backhaul keys :

Example :
IP RAN COS :

COS Traffic Class	COS Service Class	Typical Applications
Background	Low - Non Real Time Traffic	Wired/Mobile IP data/email
Interactive	Low - Non Real Time Traffic	TCP-based services -HTTP/Telnet
Streaming	Medium -Real Time Traffic	UDP/RTP-Streaming video
Conversational	High -Real Time Traffic	Voice- Voip /Video Conferencing

Main Radio access network RAN Components on different Mobile Networks

MOBILE TECHNOLOGY GENERATION	TYPE OF TECHNOLOGY	RAN COMPONENTS	EXAMPLE OF ROLE
Generation			
2G	GSM	BTS	• Communication between air interface and BSC
		BSC	• Controls multiple BS
		MSC	• Handles voice calls and SMS
2.5G	GPRS	BTS	• Communication between air interface and BSC
		SGSN	• Mobility management, data delivery to and from mobile user devices
		GGSN	• Gateway to external data network
		BSC + PCU	• Controls multiple BS and processes data packets
3G	UTRAN	NodeB	• Performs functions similar to BTS
		RNC	• Performs functions similar to BSC
		MSC	• Handles voice calls and SMS
4G	LTE	eNodeB	• Performs functions similar to BTS and radio resource management
		SGW (Serving Gateway)	• Routing and forwarding of user data, mobility anchoring
		MME (Mobility Management Entity)	• Tracking idle user devices, handoff management
		PDN Gateway	• Gateway to external data network
	WiMAX	BS	• DHCP, QoS policy enforcement, traffic classification
		ASN GW	• Layer 2 traffic aggregation point ASN
		CSN GW	• Connectivity to the Internet, external public or private networks

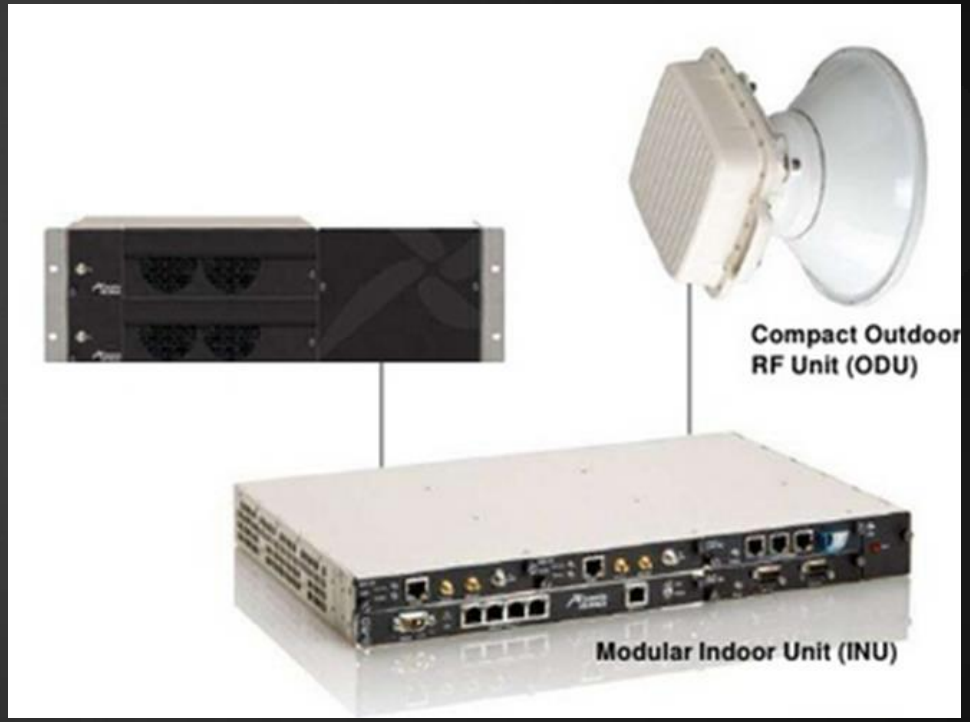
Mobile Technologies and Base station Support:

Network	Transport Network Layers
GSM/GPRS (2G/2.5G)	TDM
EDGE (2.5G)	TDM
UMTS (3G)	ATM
CDMA1 * EV-DO(3G)	IP/Ethernet
Mobile WiMax	IP/Ethernet
LTE (4G)	IP/Ethernet

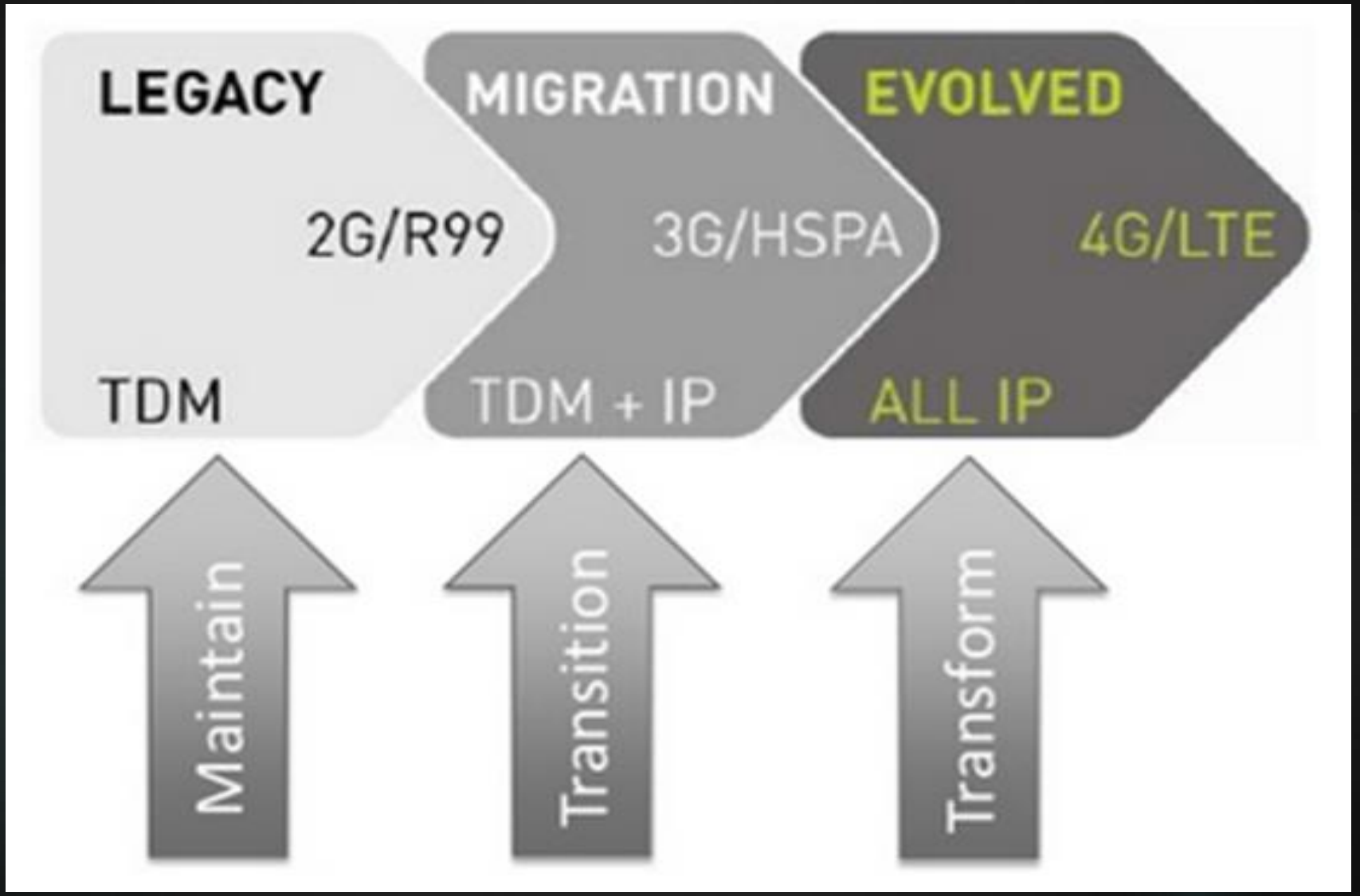
Multiservice Multi Structure platform

New enhanced platforms to cover the different mobile networks termination requirements

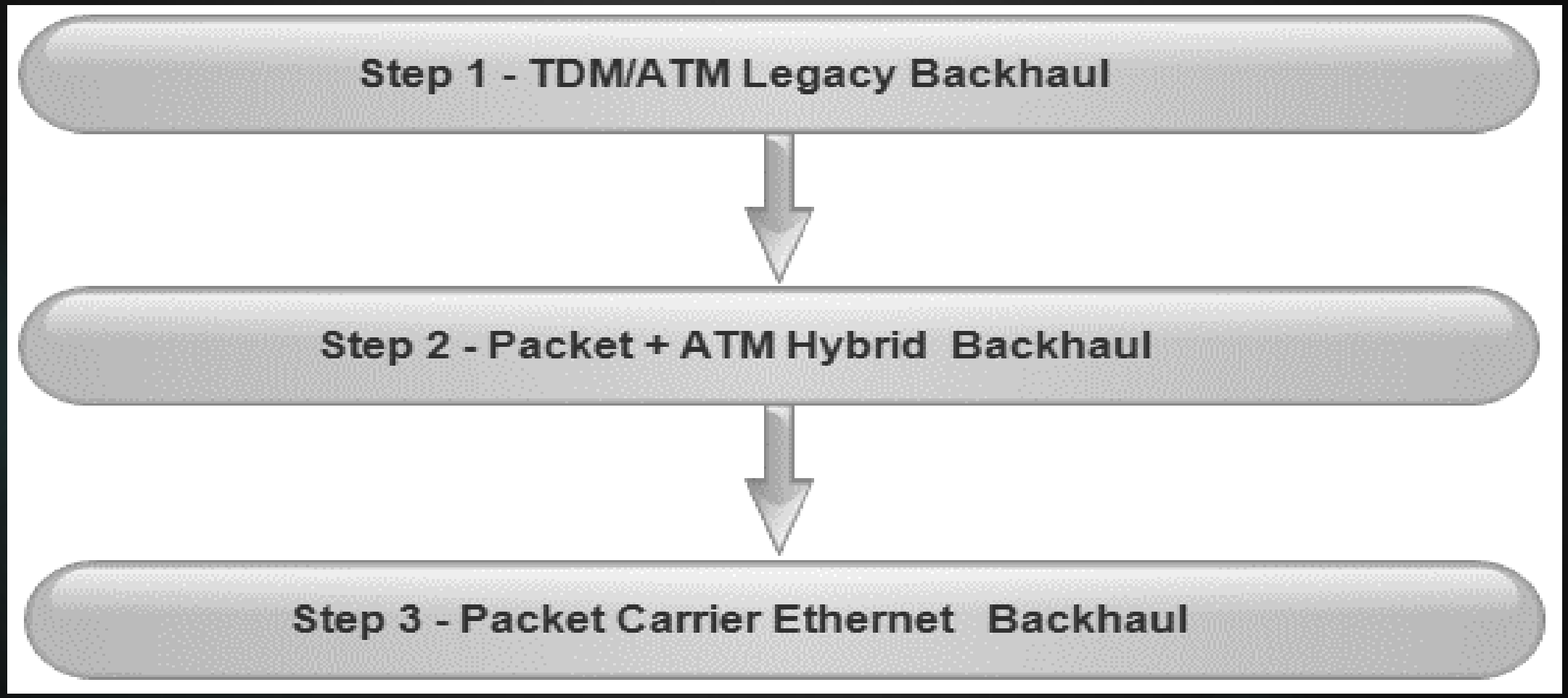
- ALL TDM
- ALL TDM+ IP
- All IP
- Full functionality & Capabilities



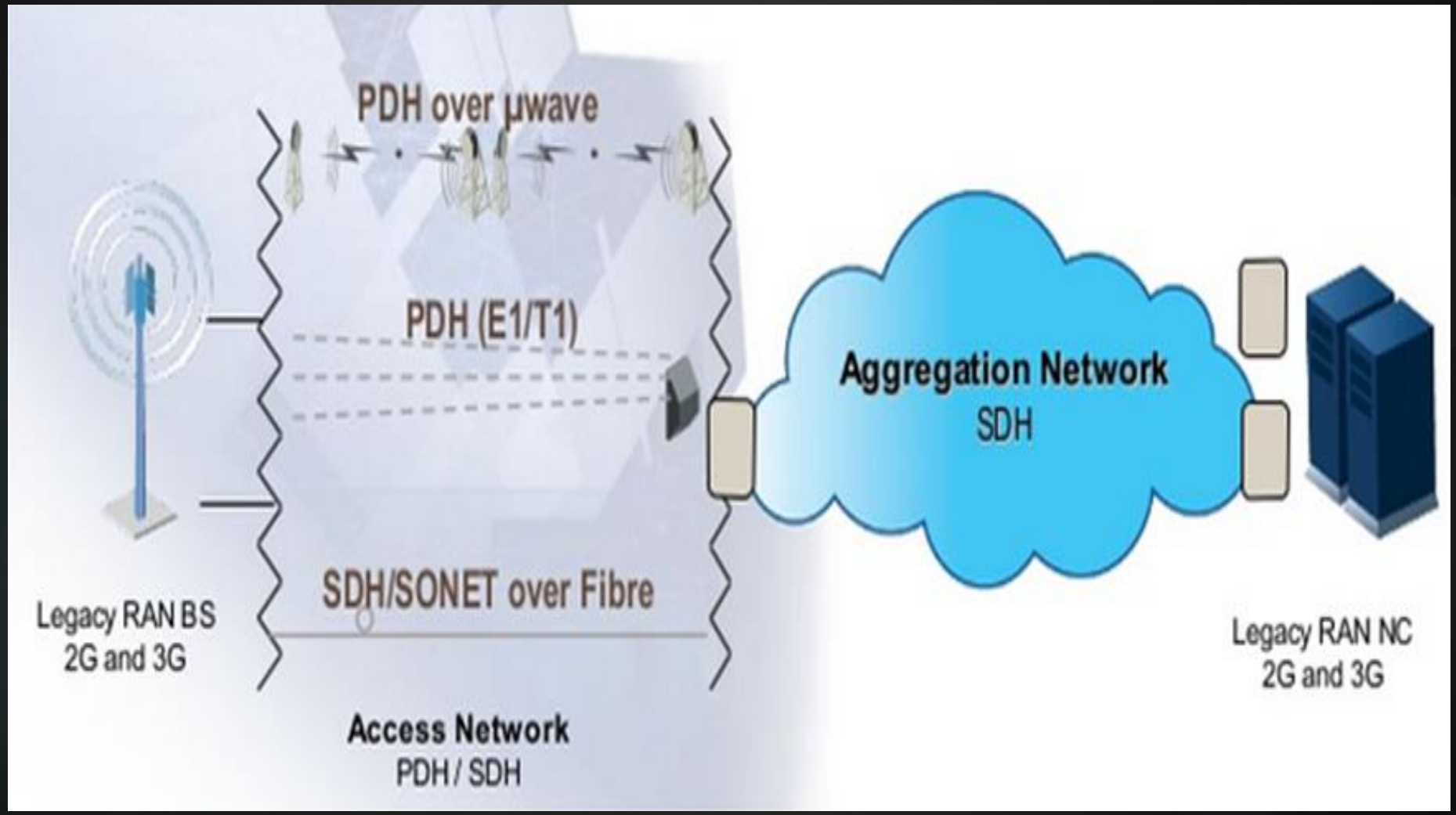
Mobile Backhaul Network must evolve



Legacy Backhaul Networks to carrier Ethernet Migration Strategy

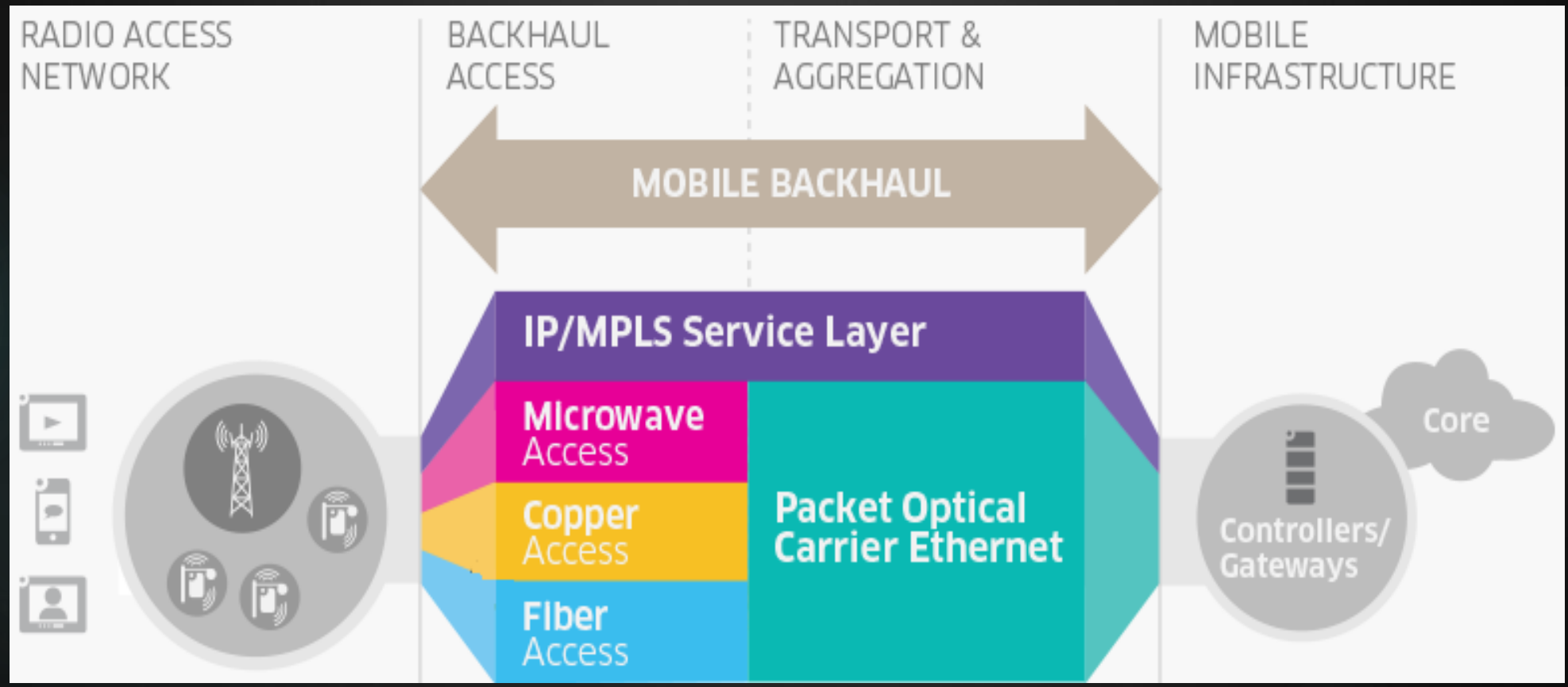


Legacy Mobile Backhaul Networks



NEW IP Mobile Backhaul Networks

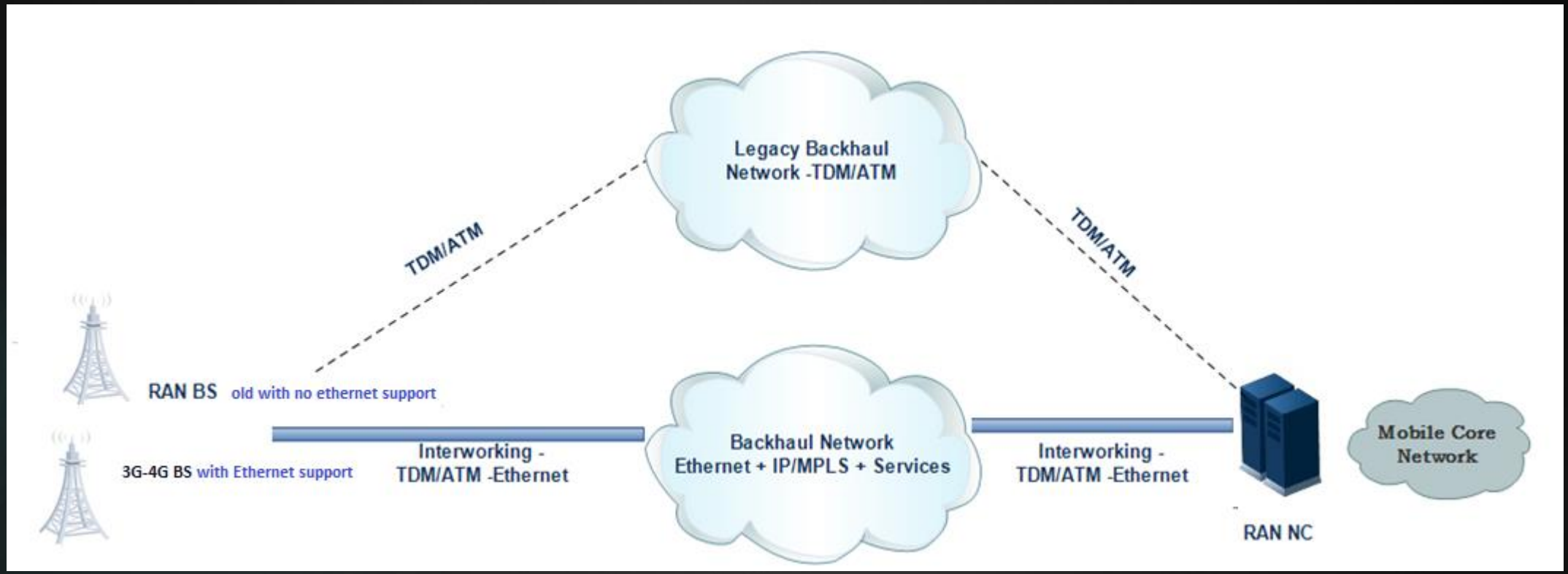
Flexible, scalable and simplified mobile backhaul Network enable delivery of increased mobile capacity and coverage with the right quality of service. Increasing in network and operational efficiency.



Network Migration options

Scenario A:- BS with No Ethernet Support

Option 1: Run IP/Carrier Ethernet in parallel to TDM/ATM Backhaul

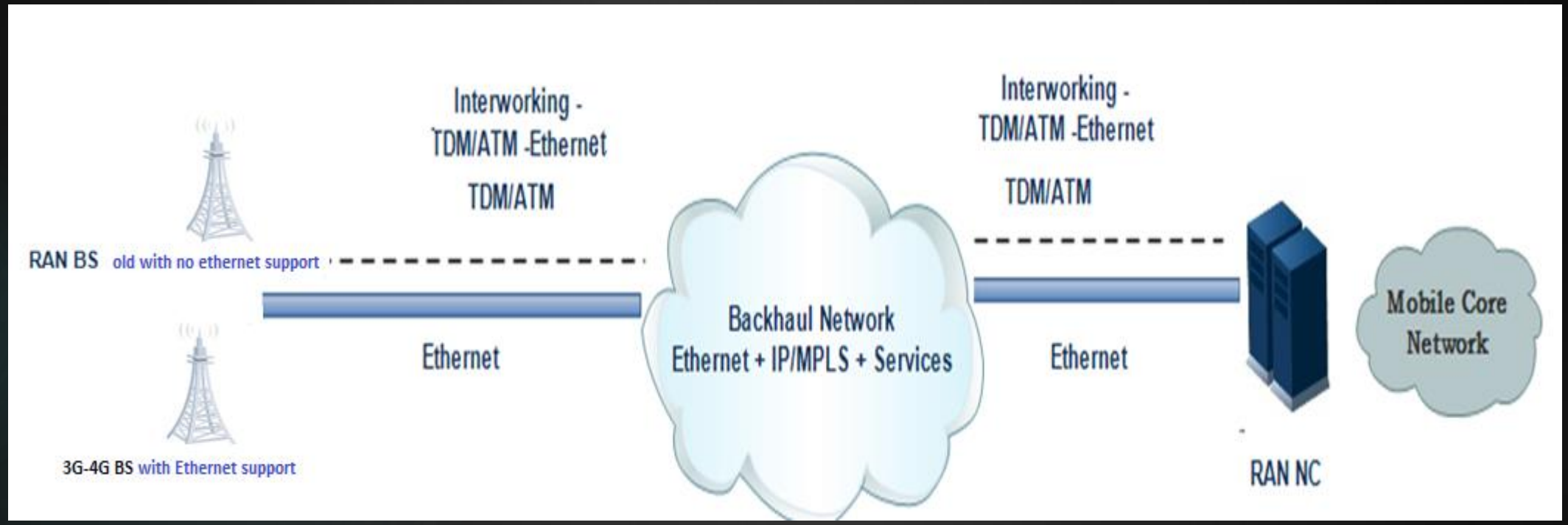


Co-existence of Legacy technologies and Ethernet

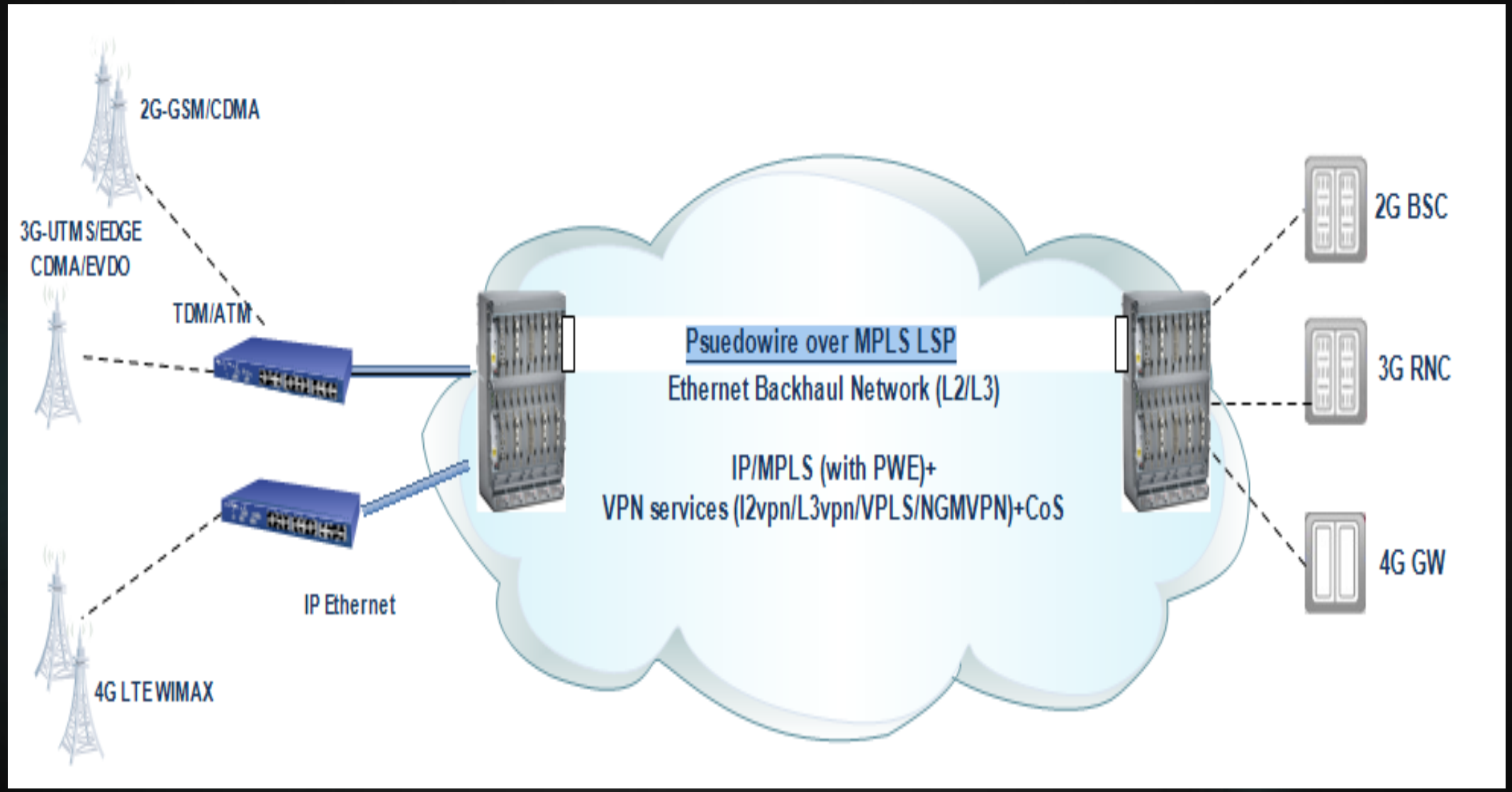
**Usually MPLS network carried over dark Fiber,OSN network, DWDM Network , MW or Hybrid of all of them

Scenario A:- BS with No Ethernet Support :-

Option 2: Emulate Native Service Over Ethernet Using PWE

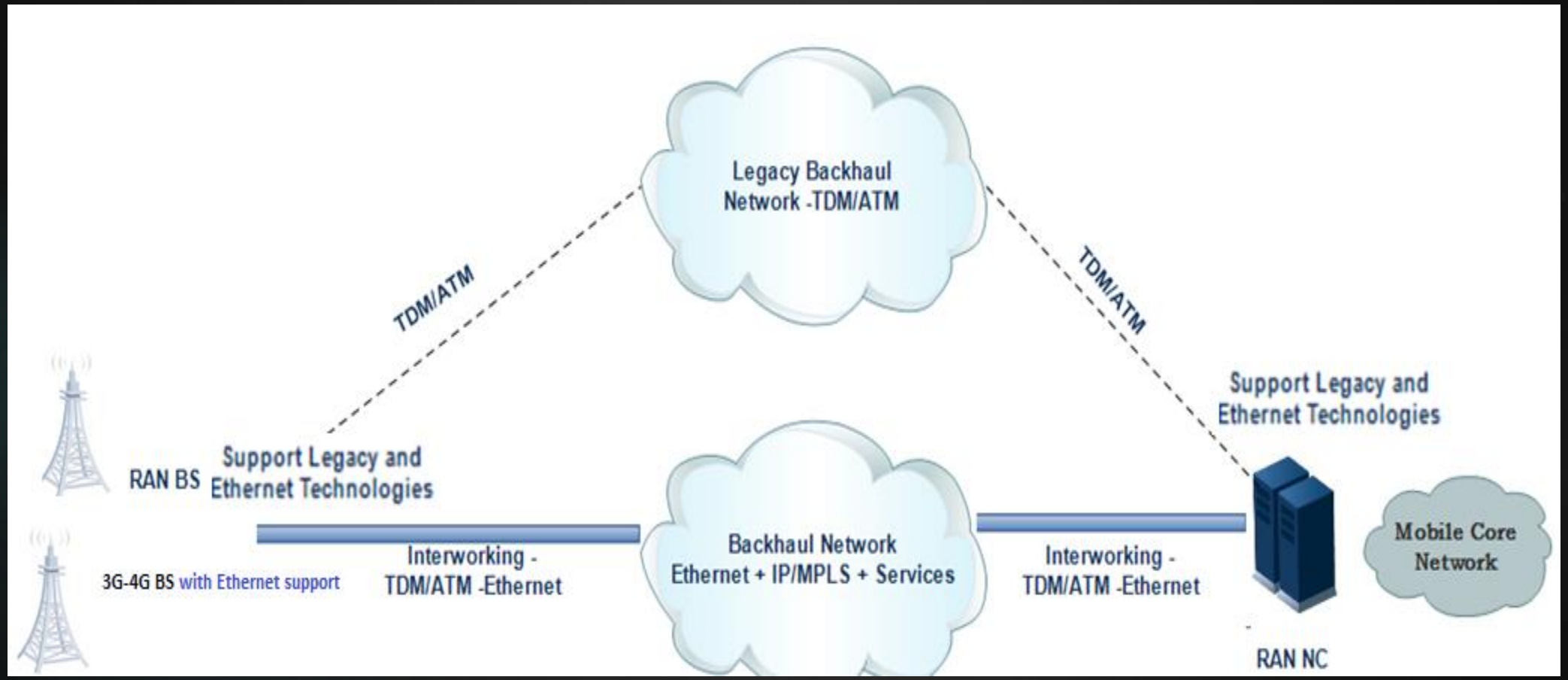


Legacy Technologies Carried over Ethernet network


2G-GSM/CDMA
3G-UTMS/EDGE
CDMA/EVDO
TDM/ATM
IP Ethernet
4G LTE WIMAX
Psuedowire over MPLS LSP
Ethernet Backhaul Network (L2/L3)
IP/MPLS (with PWE)+
VPN services (l2vpn/L3vpn/VPLS/NGMVPN)+CoS
2G BSC
3G RNC
4G GW

Scenario B:- BS Support Ethernet in Addition to Legacy Technology :-

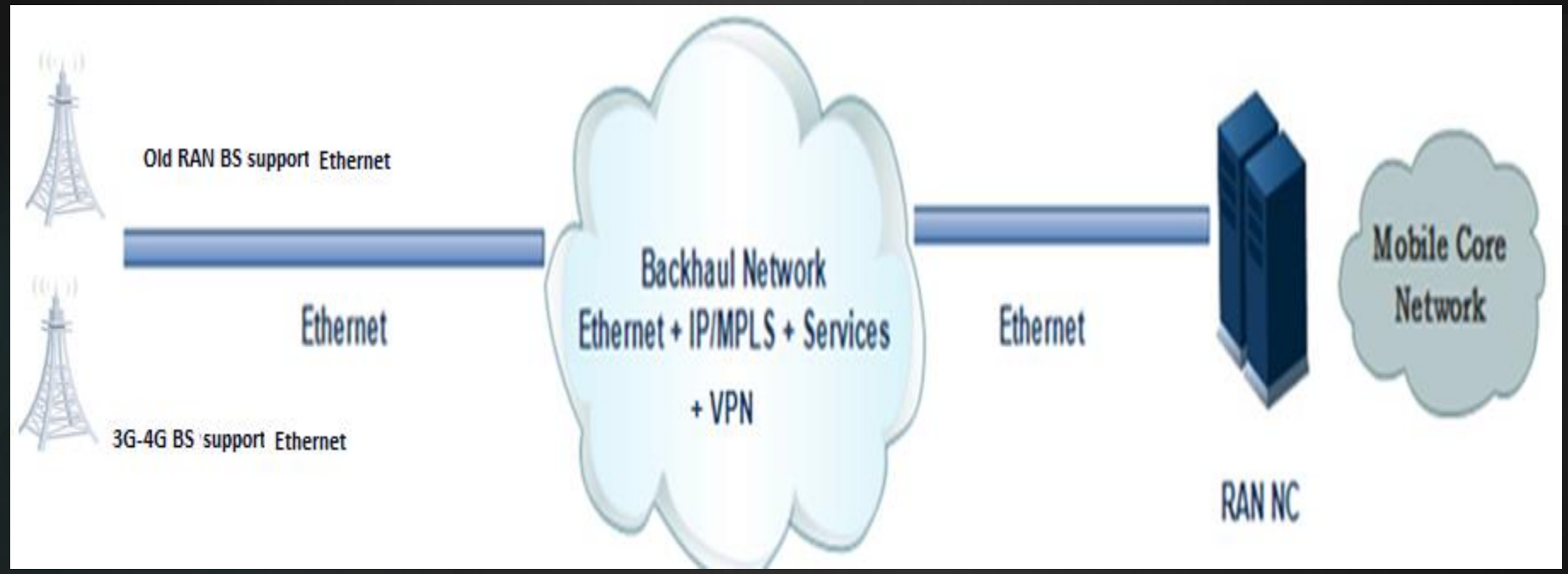
Option 1: Using both packet/Ethernet and Legacy Technologies



Dual Support for Ethernet and Legacy Technology

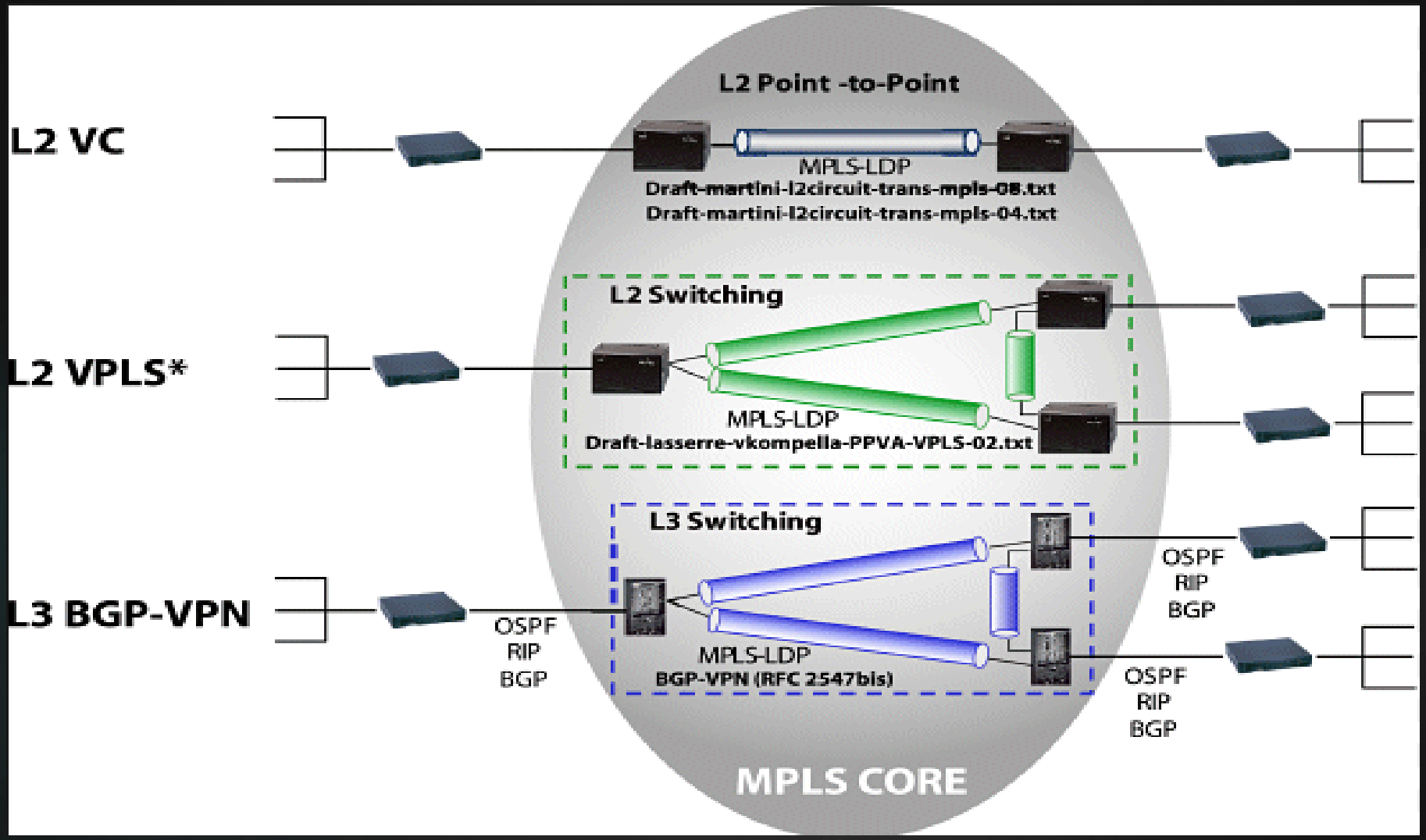
Scenario B:- BS Support Ethernet in Addition to Legacy Technology :-

Option 2: Use Packet/Ethernet All Through Backhaul



All IP-Ethernet –based Backhaul

VPN services



Other Design Considerations:

- VLAN Models
- MPLS LSPs
- Failure Recovery and reliability

Vlans :

2 scenario whether the frames from cell are tagged :

Tagged Frames

Location and service tagged comes from the site

Untagged Frames

BS not capable to tag

MPLS LSPs

- Single LSP or multiple LSPs assigned to carry the traffic within the backhaul network, same MPLS LSP can be used to carry different traffic streams originating and destined to same VPN instance.

Failure recovery reliability

OAM on physical and link level

LSP link and node protection.

Routing Metrics

Dual Homing

Conclusion

MPLS technology in backhaul is the solution to the bottleneck in today's new mobile network.

Offers benefits and cost efficiencies in both legacy mobile backhaul and for future environments based on new technologies such as LTE.

Protects existing technology investments

Ensures that the technology will remain sufficiently “future proof "and scalable.

New services can be successfully rolled out, while mobile operators are able to leverage further cost benefits by using an MPLS-based backhaul network to deliver many non-backhaul services.

Thank You