

Mobile Backhaul Evolution

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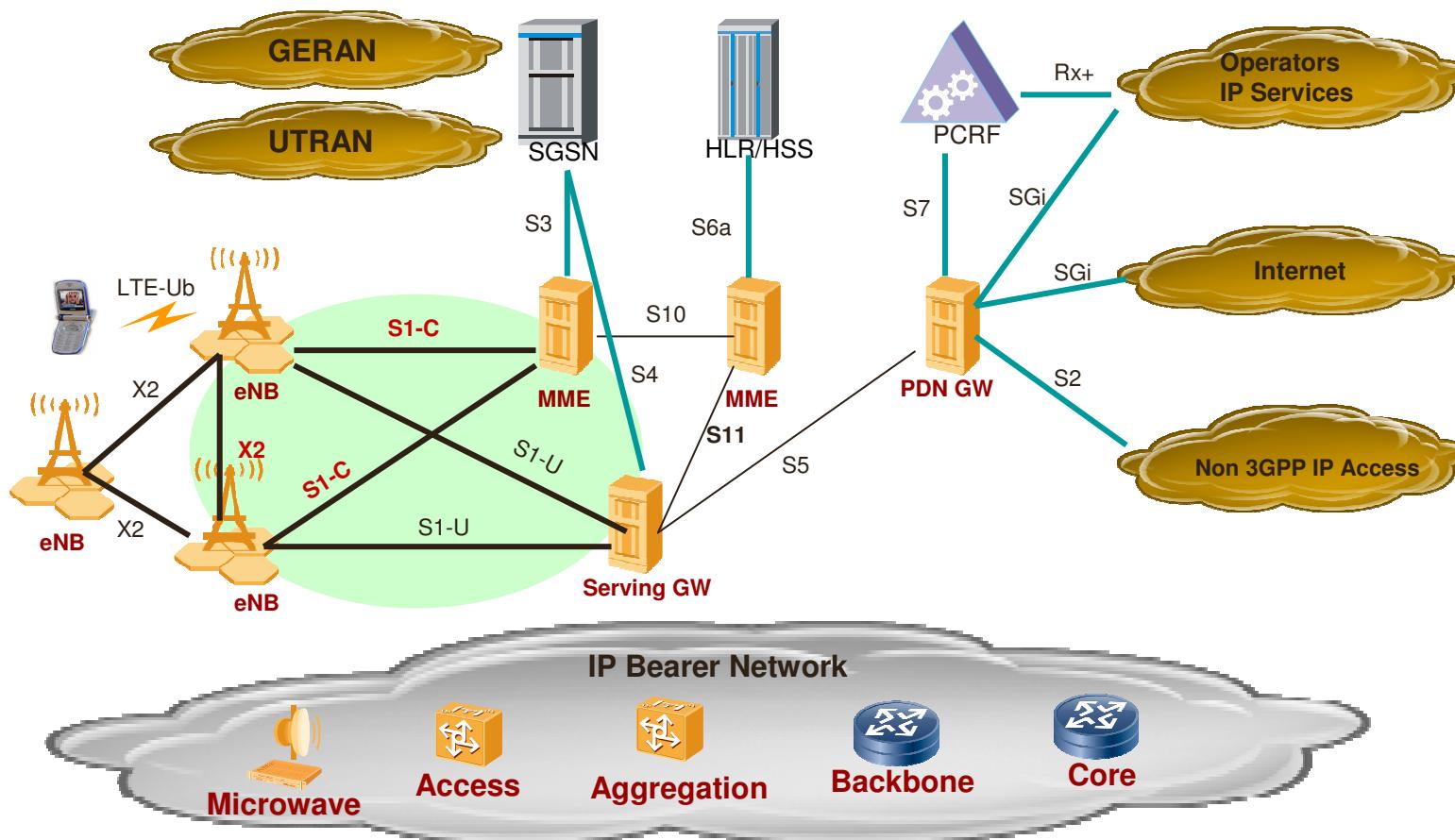
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Agenda

- LTE Architecture Evolution
- Service Deployment
- Open Discussion

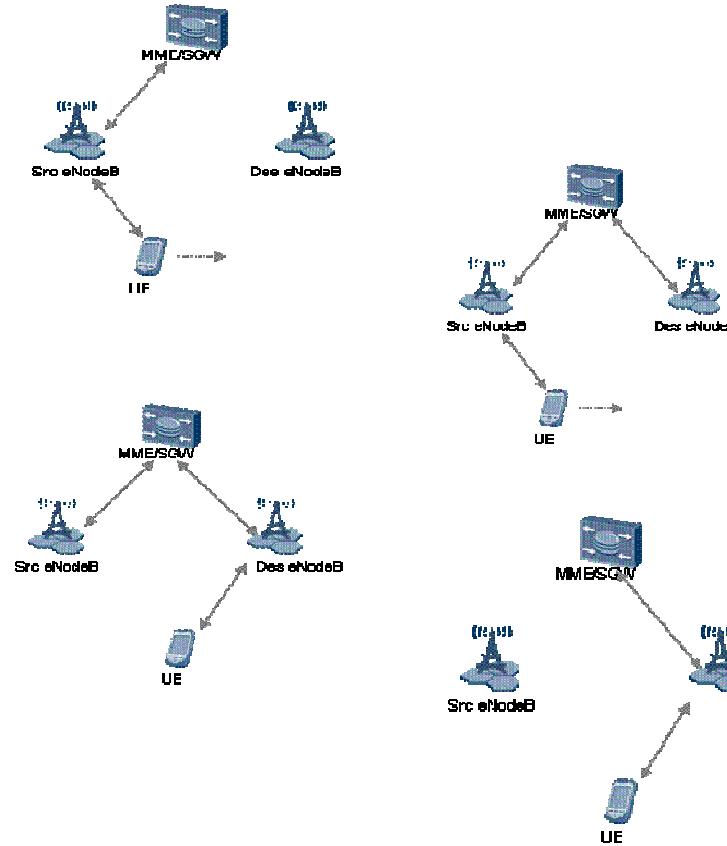
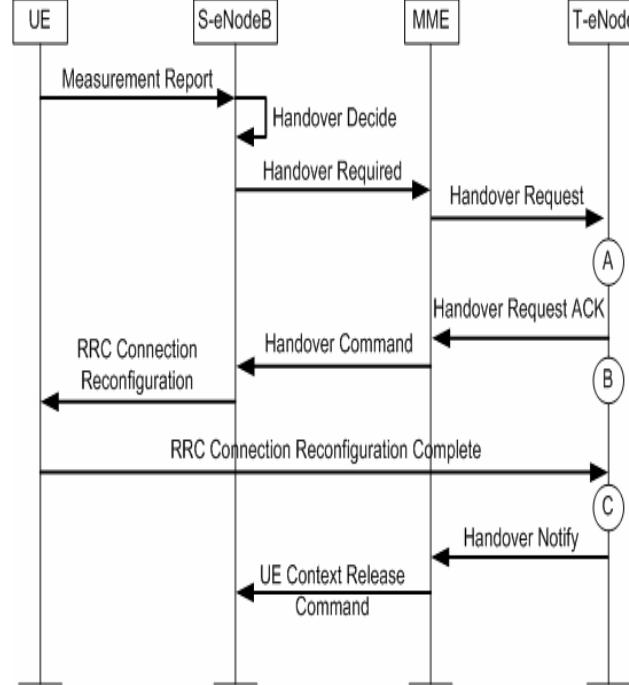
LTE Network Architecture



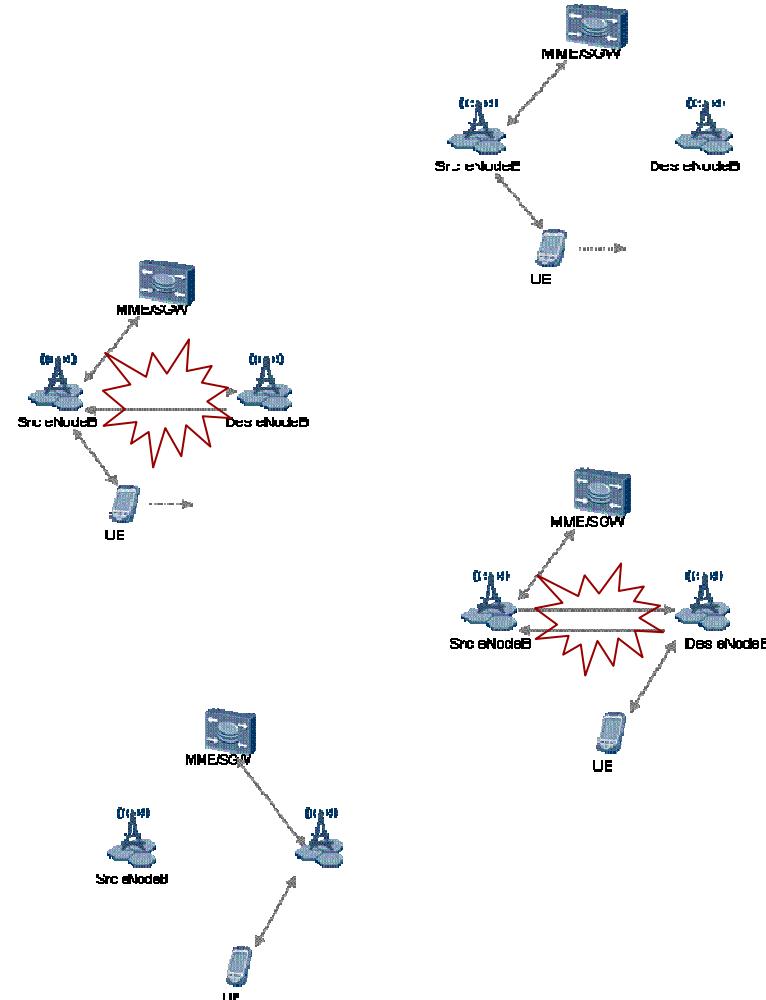
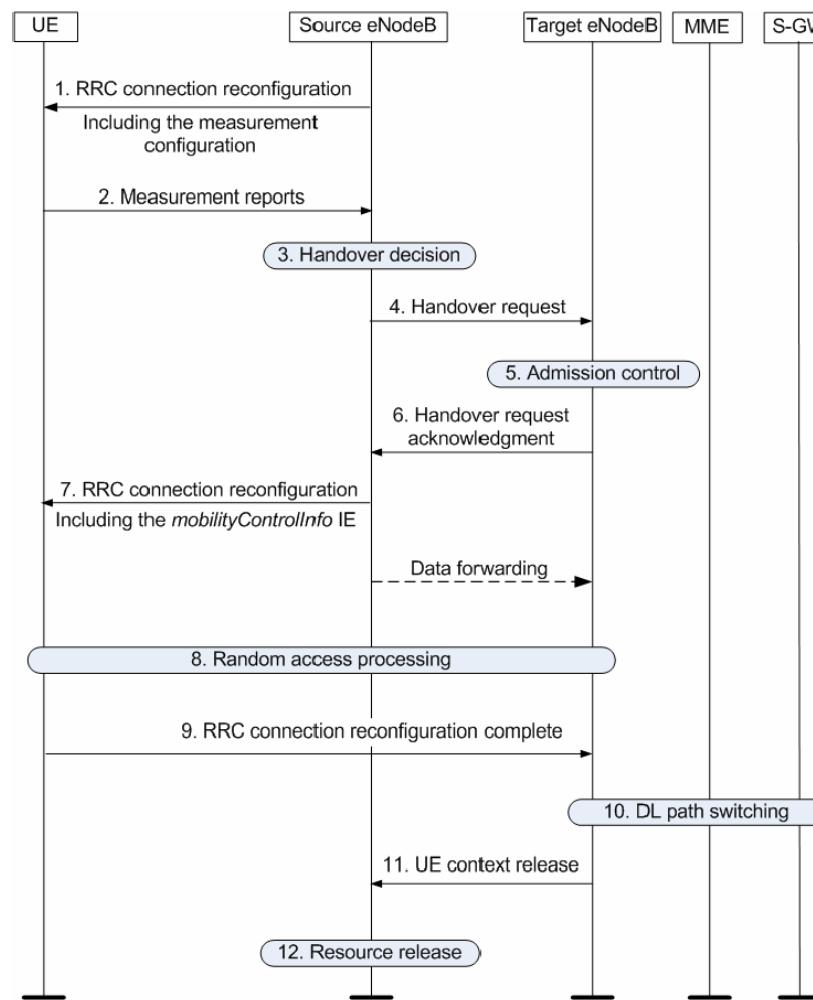
- MME (Mobility Management Entity)
- S-GW (Serving gateway)

- PDN GW(3GPP anchor)
- ePDN GW(SAE anchor)

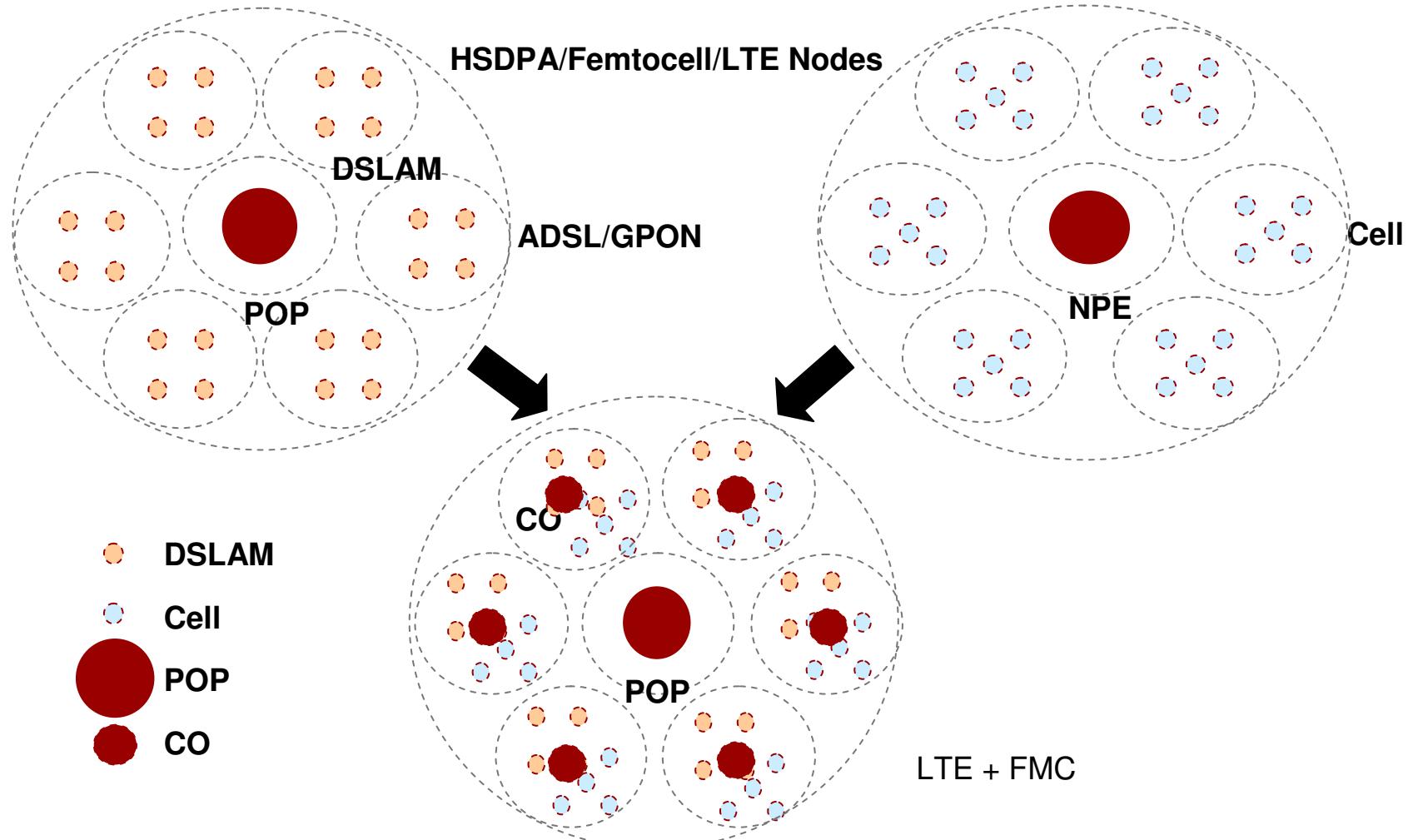
Procedure of S1 handover



Procedure of X2 handover



10X More Link Bandwidth, 10X More Nodes



UMTS to LTE- High Capacity and QoS

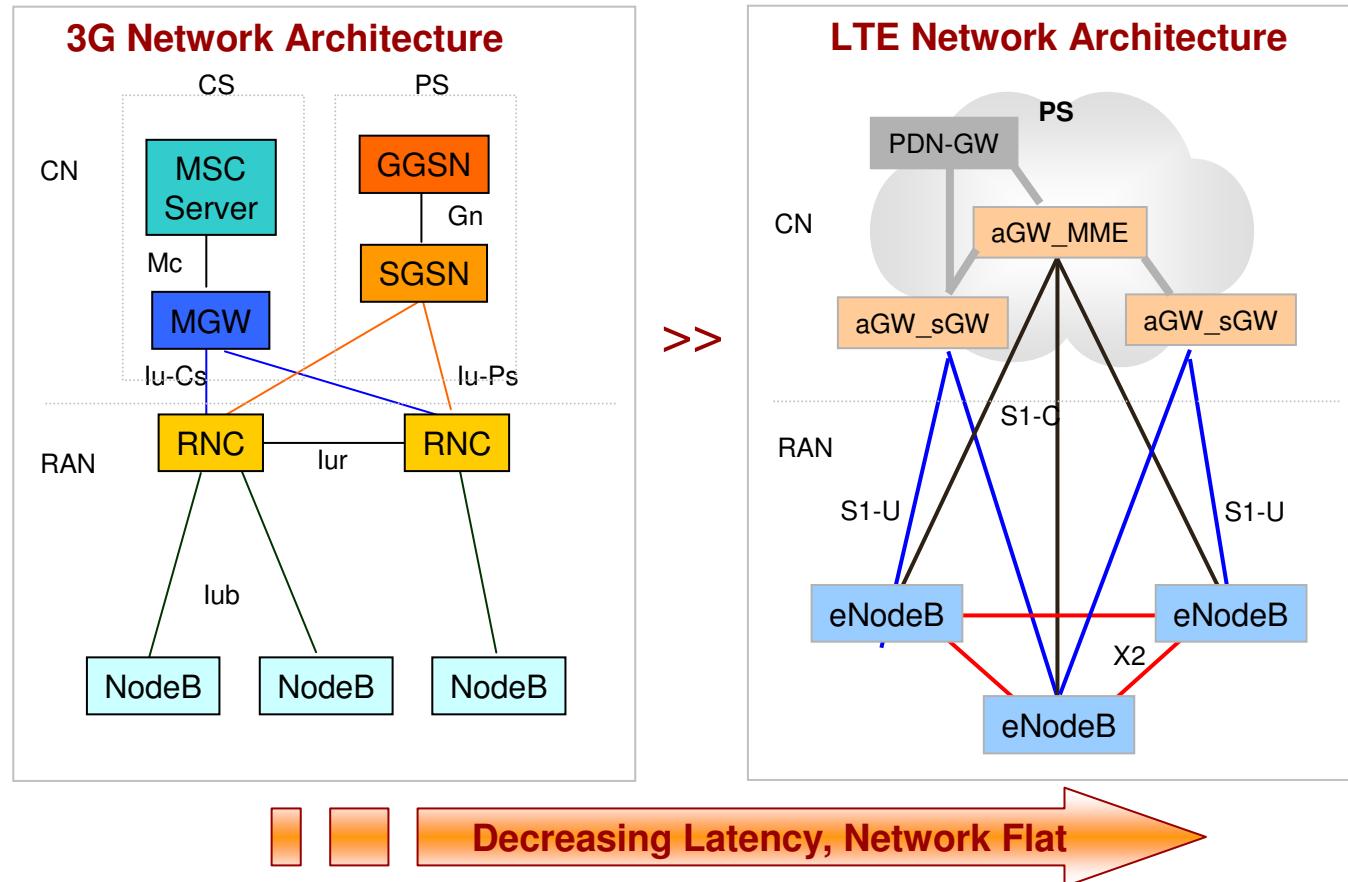
✓Capacity and QoS;

- ✓ **Capacity:** Comparing to UMTS, LTE provides ten times higher data rate speed than UMTS, i.e. the capacity specification of eNodeB now is 450M(downlink)/300M(uplink) bps. So traditional transport methods such as E1, PDH MW etc, have not flowed the trend. The Ethernet interface is recommended.
- ✓ **QoS:** It is recommended that the backhaul's QoS requirement of LTE is more than UMTS as following

Type		Delay	Jitter	Packet Error Loss Rate
S1 interface	Recommended	10ms	4ms	0.001%
	Tolerable	20ms	8ms	0.5%
X2 interface	Recommended	20ms	7ms	0.001%
	Tolerable	40ms	10ms	0.5%
Iub interface	Recommended	20ms	8 ms	0.05%

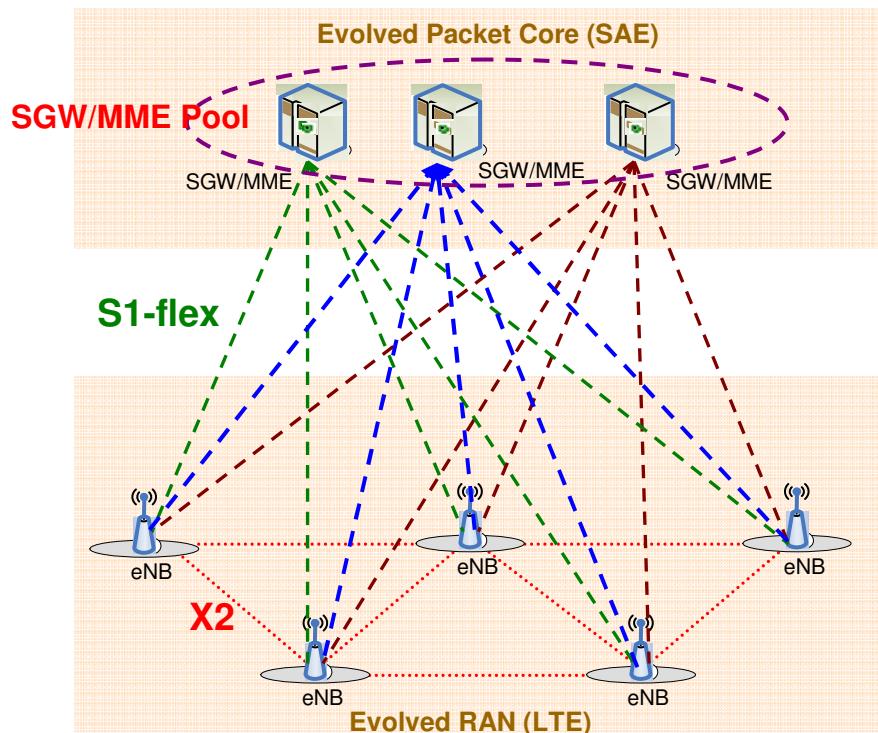
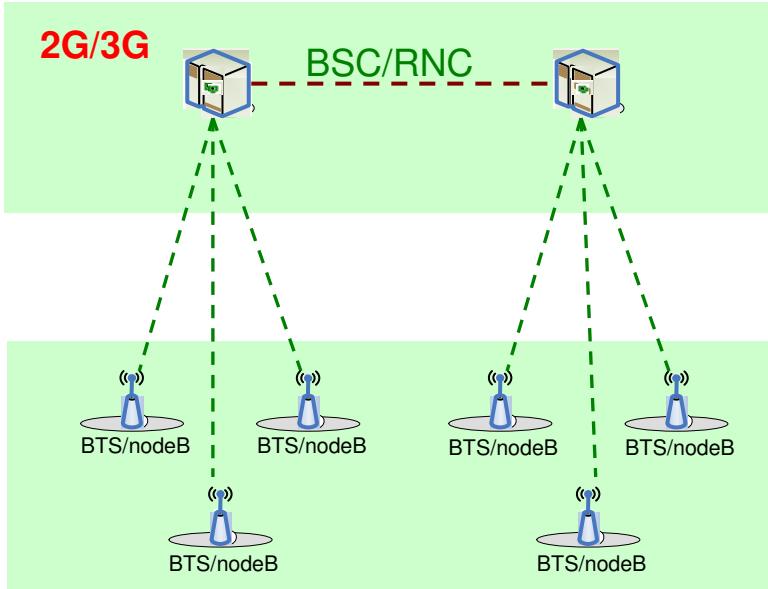
Note: The more stringent reason is that LTE provides higher throughput than UMTS. The most of Apps is based on TCP, and TCP is easy to be affected by quality of network. The TCP throughput is inverse ratio to QoS.h

Network Flatten



Flat architecture reduces latency & simplifies deployment and maintenance

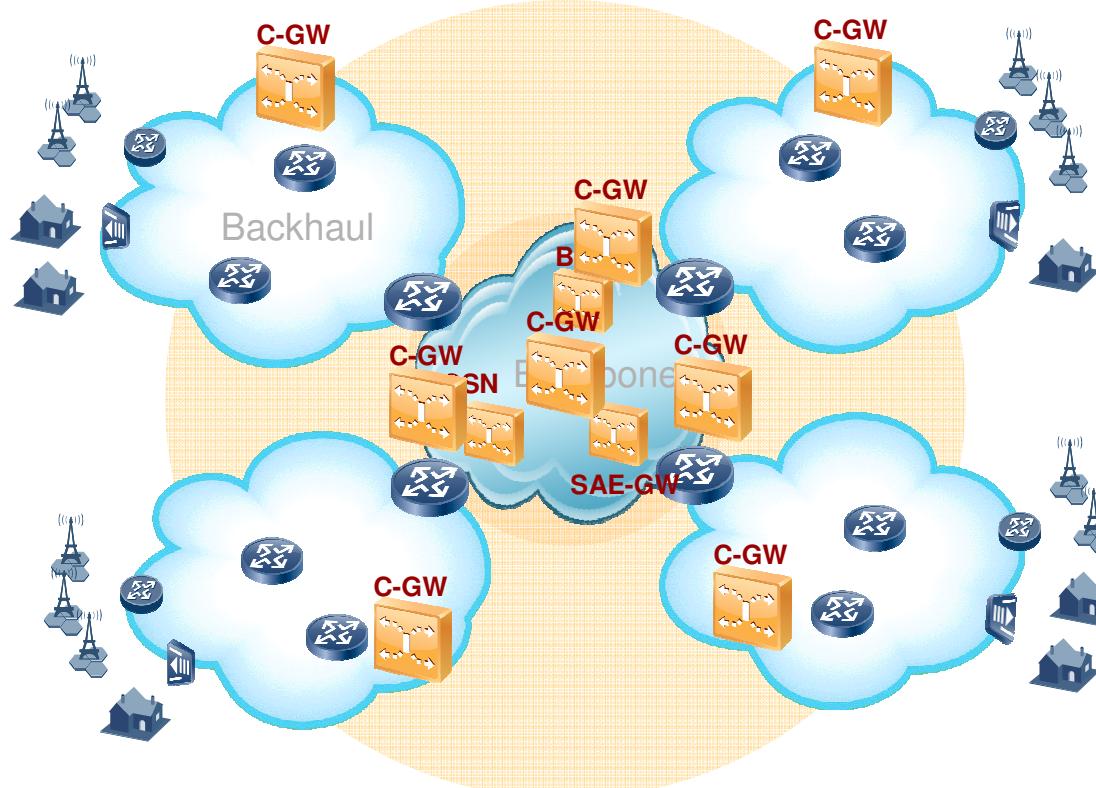
LTE S1-Flex Scenario



- The biggest value of S1-flex is for site disaster & Load balance.
- In 2G, BSC only need local protection, MSC need Flex. In 3G, RNC is higher than BSC, it need site 1+1 redundancy
- Comparing with 2G/3G, S-GW may be deployed in the same position with RNC, 1+1 redundancy may be considered. Higher position of SGW, Flex mode should be considered.
- MME would be deployed in the same position of GGSN/PDN GW, Flex mode should be considered.

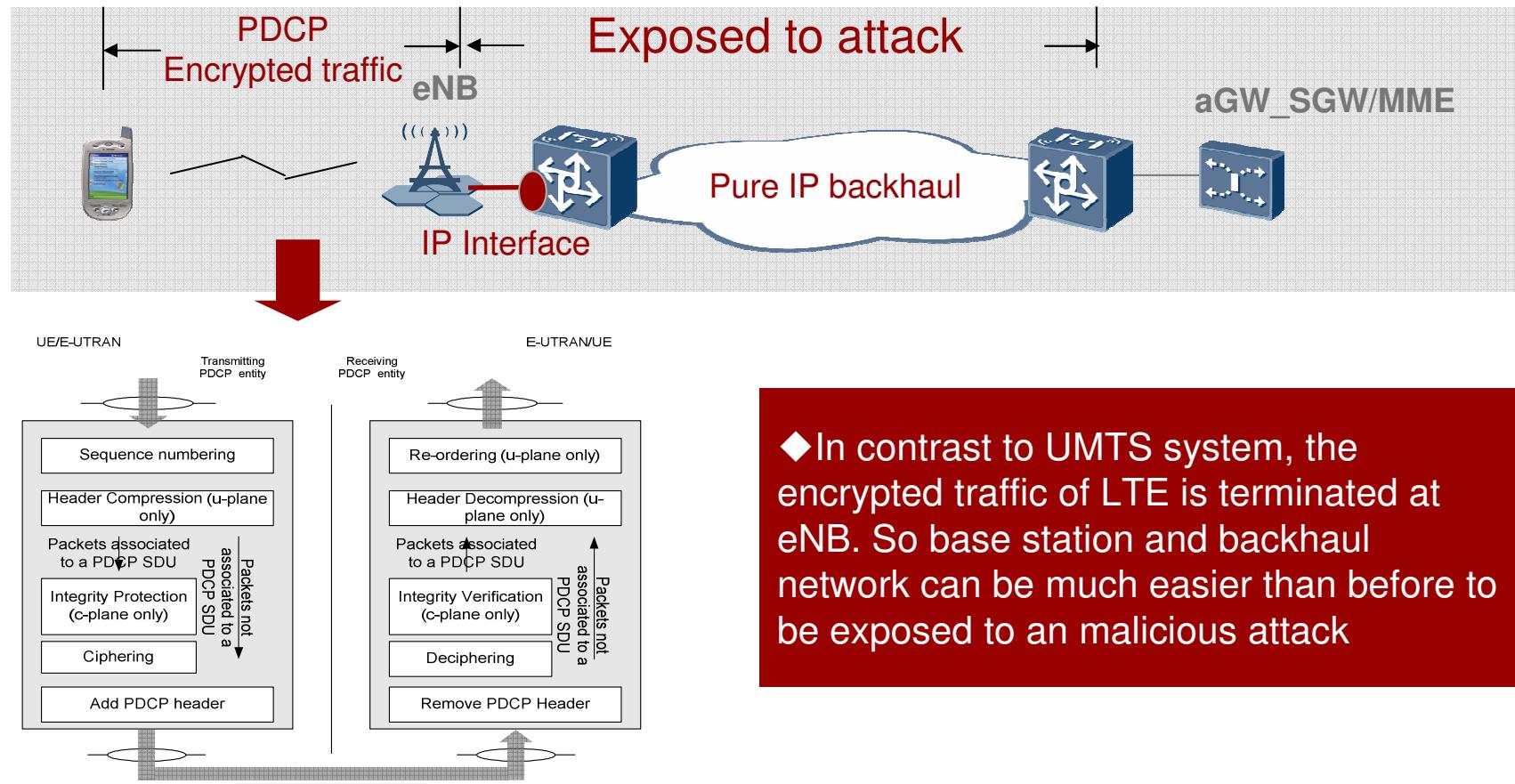
Evolution of EPC Network

› Hierarchical, distributed gateway further downside in backhaul



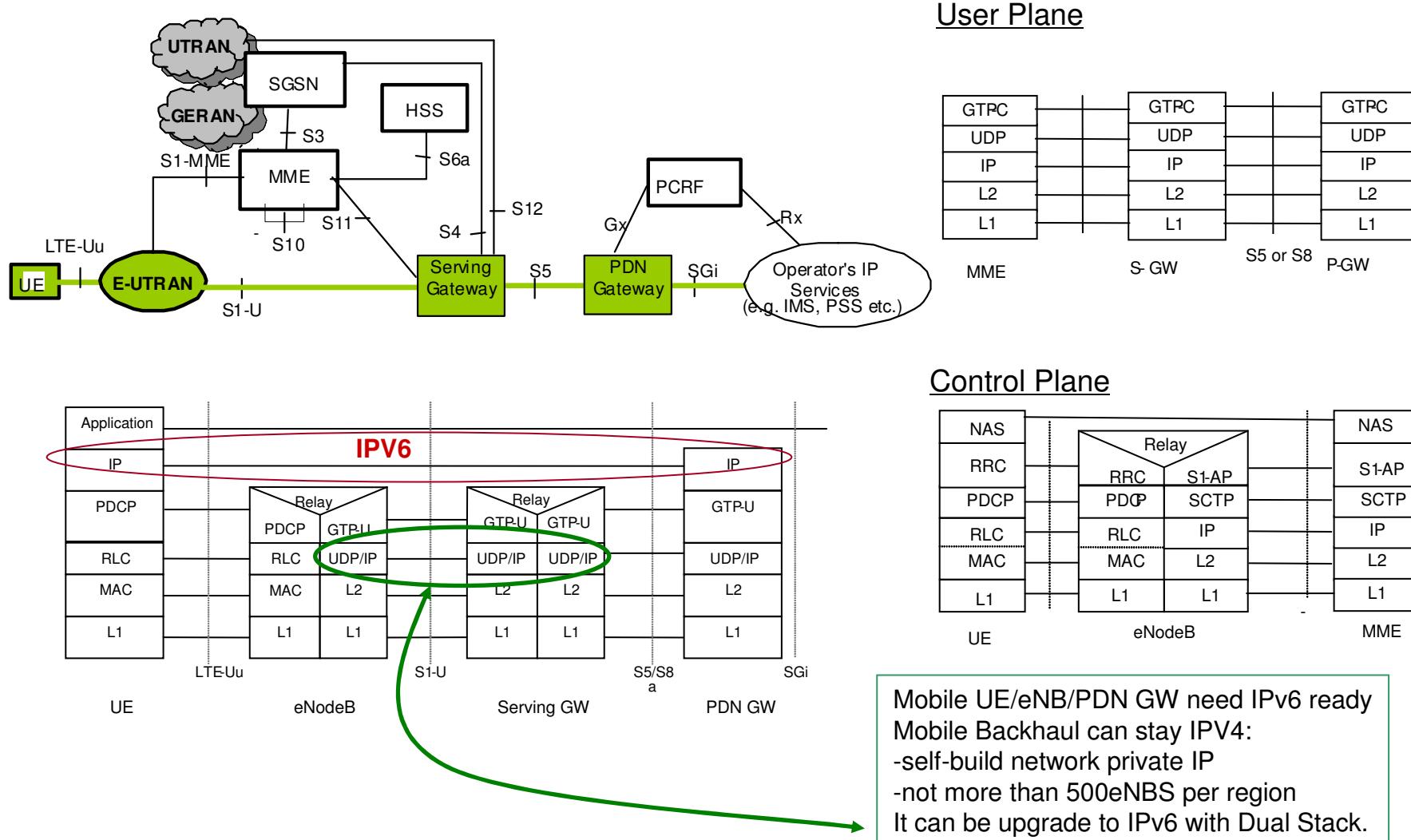
- State of the art. Service specific, centralized gateway
- Convergence gateway(CGW) reduce OPEX and CAPEX
- Distributed gateway achieve scalability and flexibility

Potential Security Risk for LTE-SAE

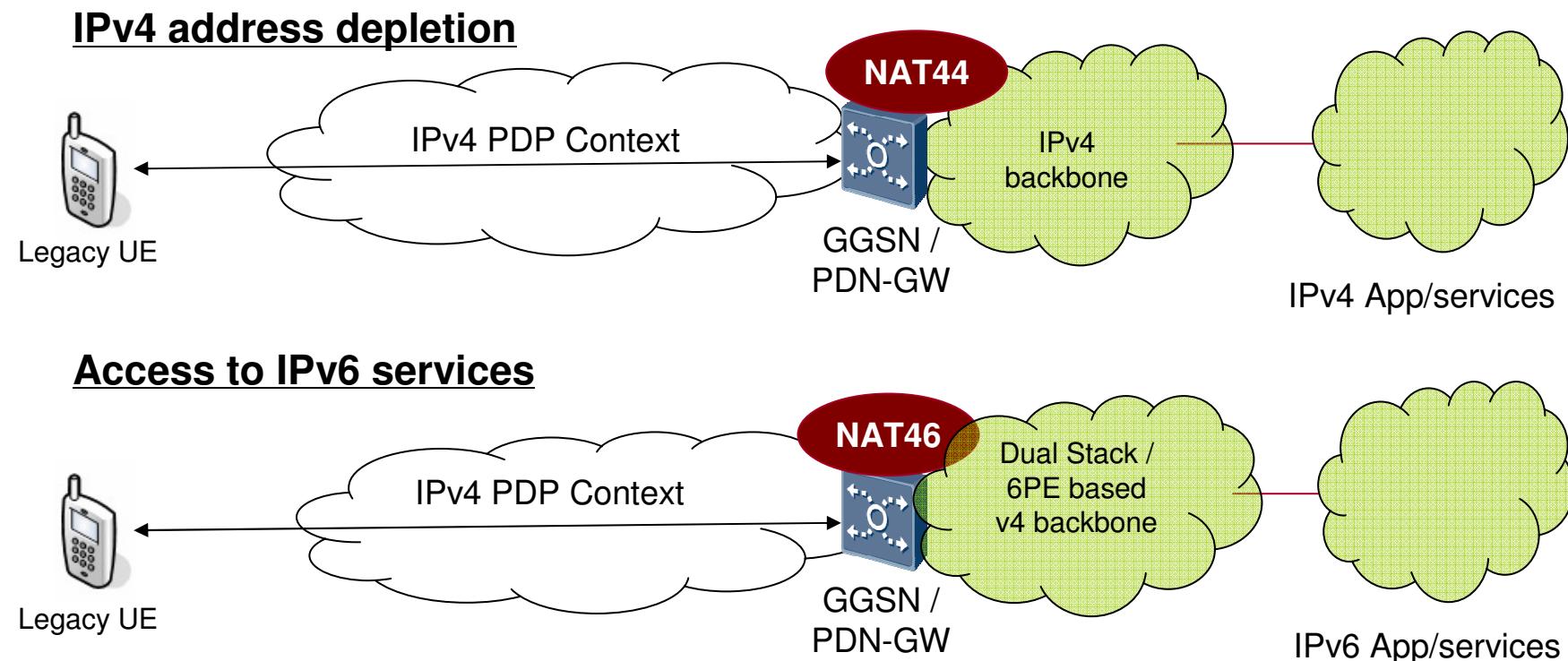


Source:3GPP TS36.323

Control & User Plane for LTE based on SCTP/GTP



IPv6 migration scenario 1 : UE IPv4 only

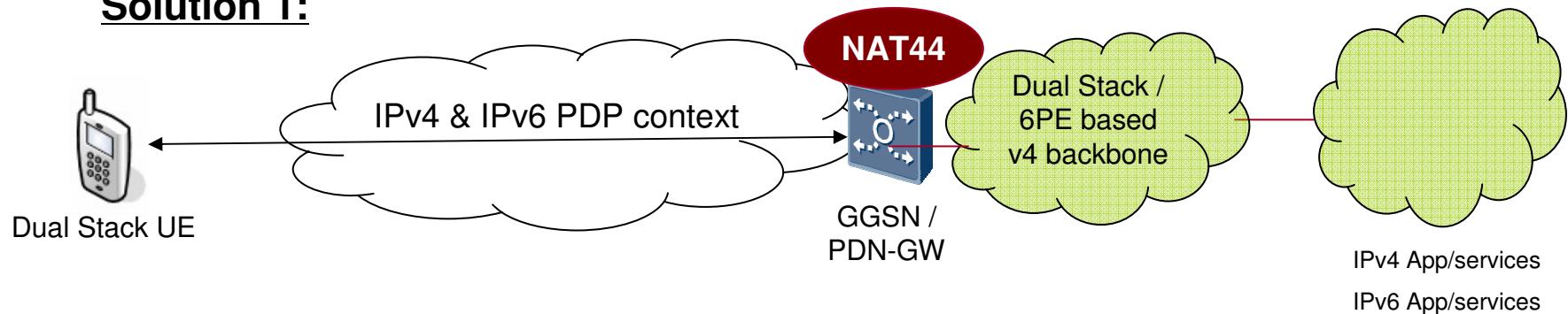


Scenario1 :

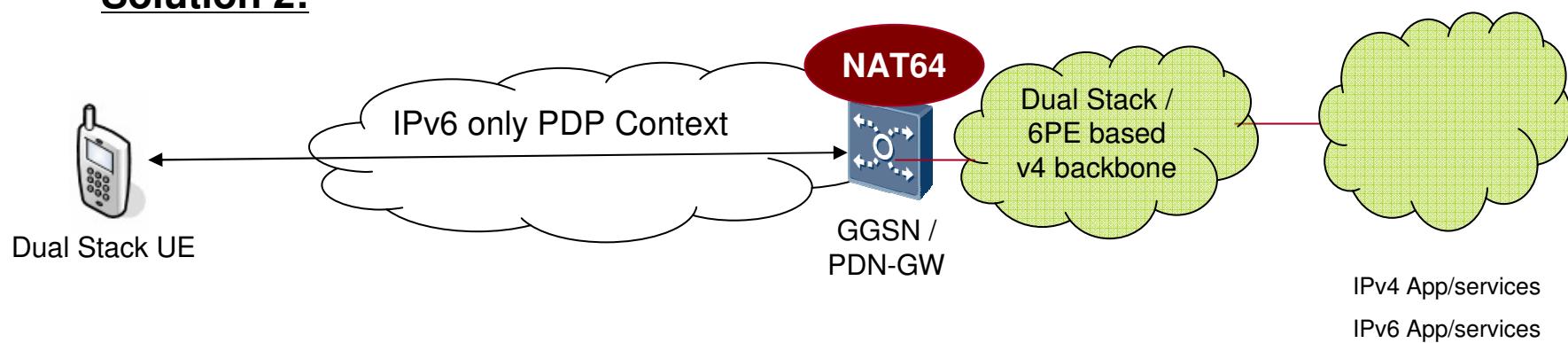
- UE is IPv4-only (i.e. IPv4 only connectivity to PDN)
 - IPv4 public or private Address
- UE MAY need to access IPv6-enabled services

IPv6 migration scenario 2: UE has IPv6 connectivity

Solution 1:



Solution 2:

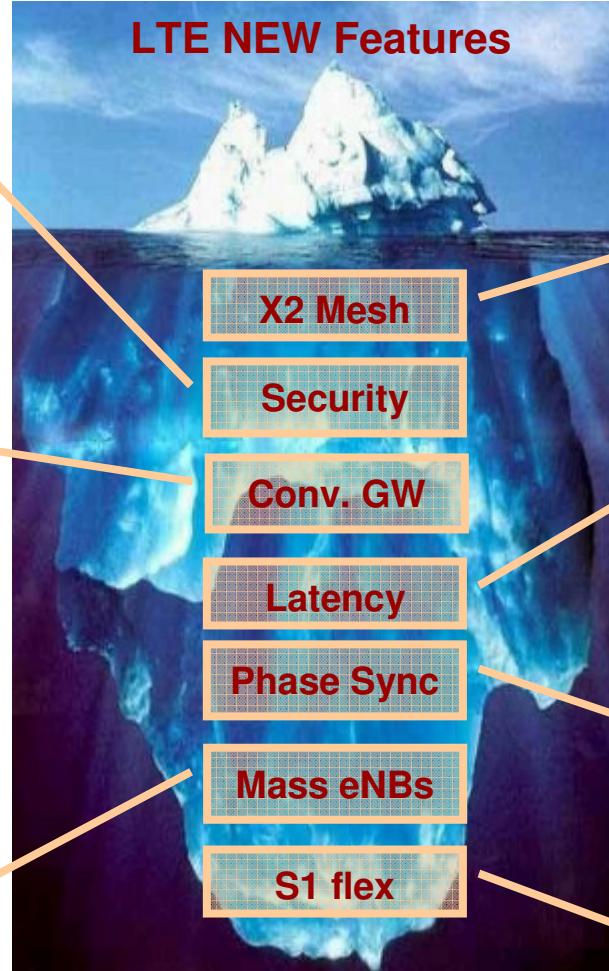


Summary of LTE new features

- Main security task for transport network : Anti-illegal access & Service Isolation

- Network flexibility and scalability for center and distributed CGW

- Mass eNBs results soaring OPEX
- To make LTE backhaul OPEX under control, Visualized, convergent and easy-to-use network management solutions is the way.



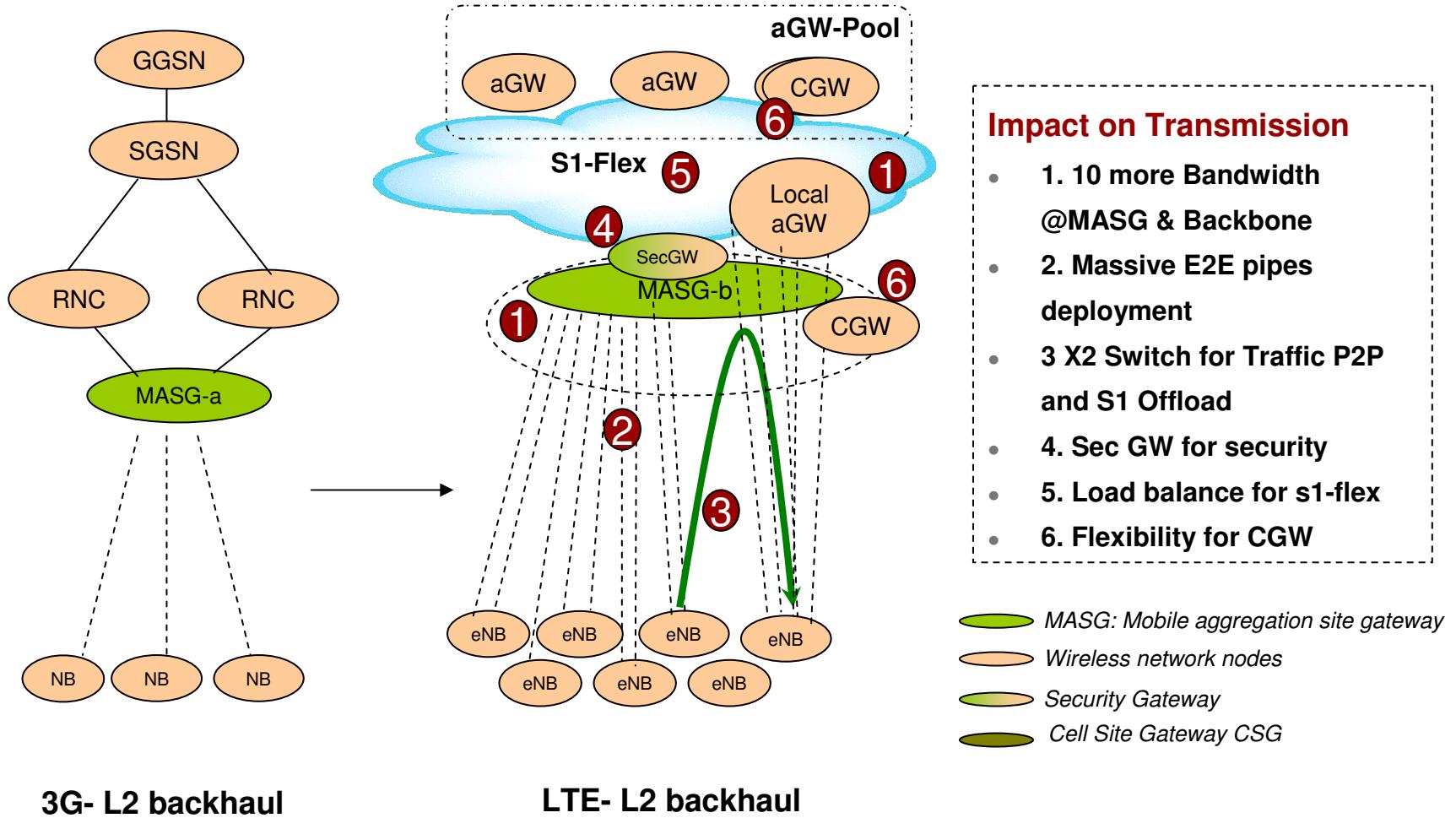
- LTE backhaul require S1 and X2 flexible switching point. Co-path or separate path to switch at the SGW site or lower position for X2

- Lower S1 and X2 switch point and Connection oriented backhaul facilitates low latency, the key competition strength of LTE.

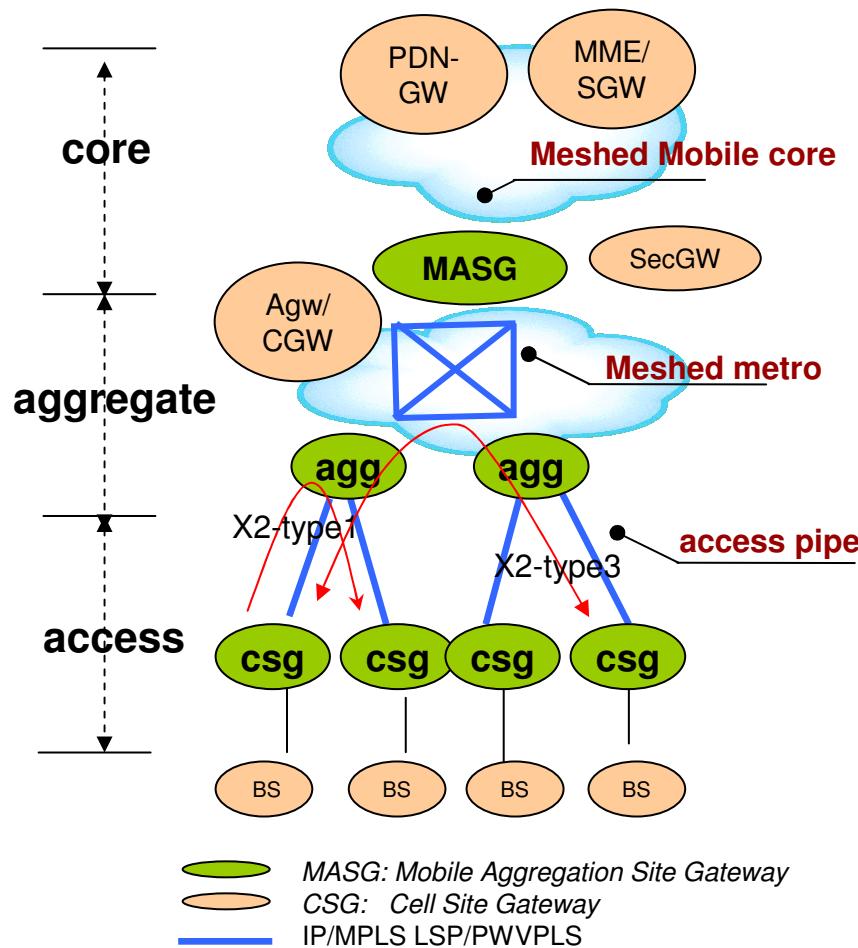
- IEEE1588v2 is the low cost phase Sync solution for LTE.

- Connectivity between Backhaul and backbone

Impact on legacy transmission



Partial mesh architecture for 2G/3G/LTE



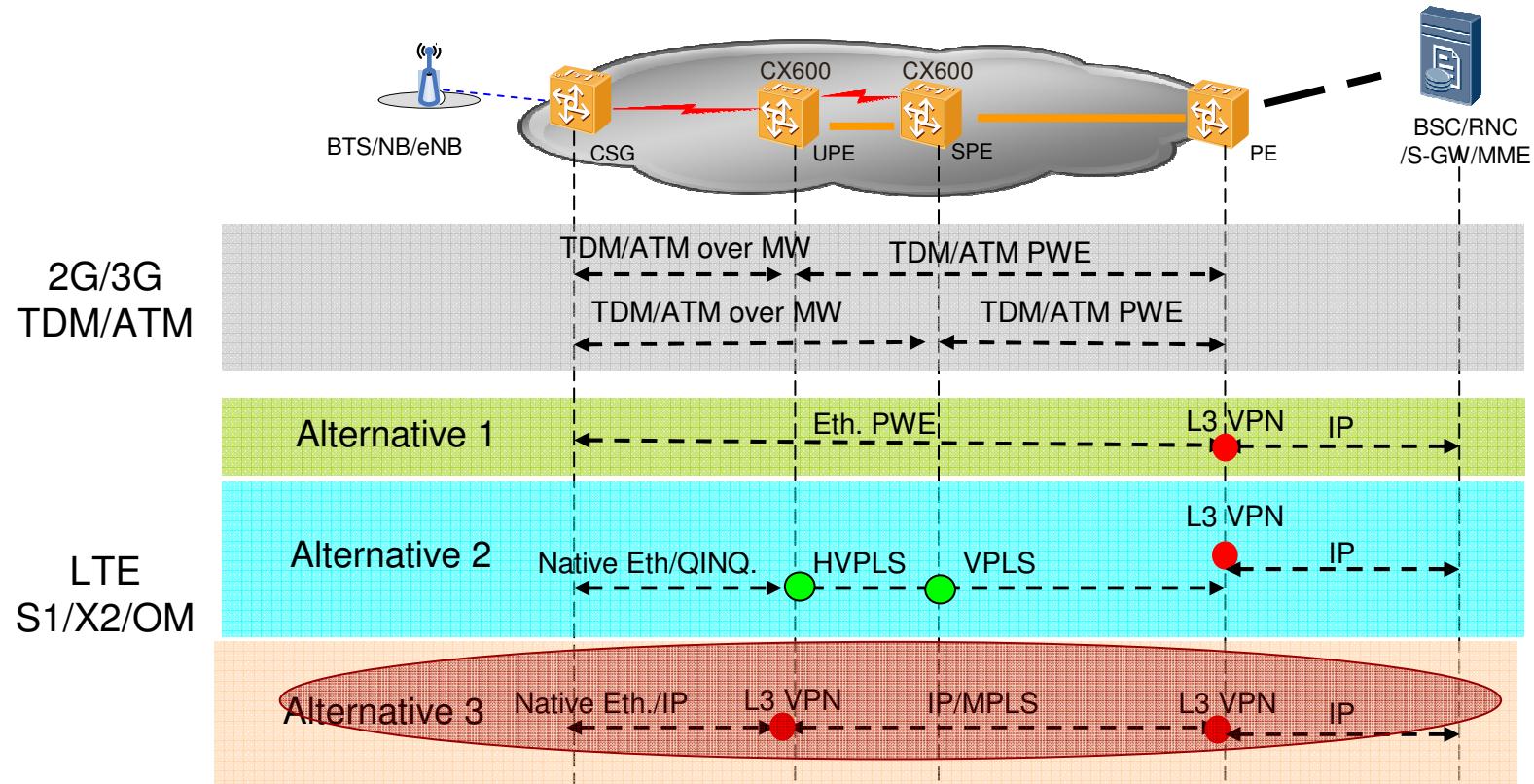
Change from E2E model

- Do not touch core network
- Change E2E pipe to access pipe
- Change metro to mesh mode using MPLS VPN technology
- Do not change CSG node and the csg-bs interface

Strength

- X2 traffic can be switched at agg
- Introduce IP technology at a rational degree and help to access multi-service and Converged GW
- When hybrid 2G/3G/LTE access, need mesh network run both pipe with L2VPN and L3VPN

Synergy transportation

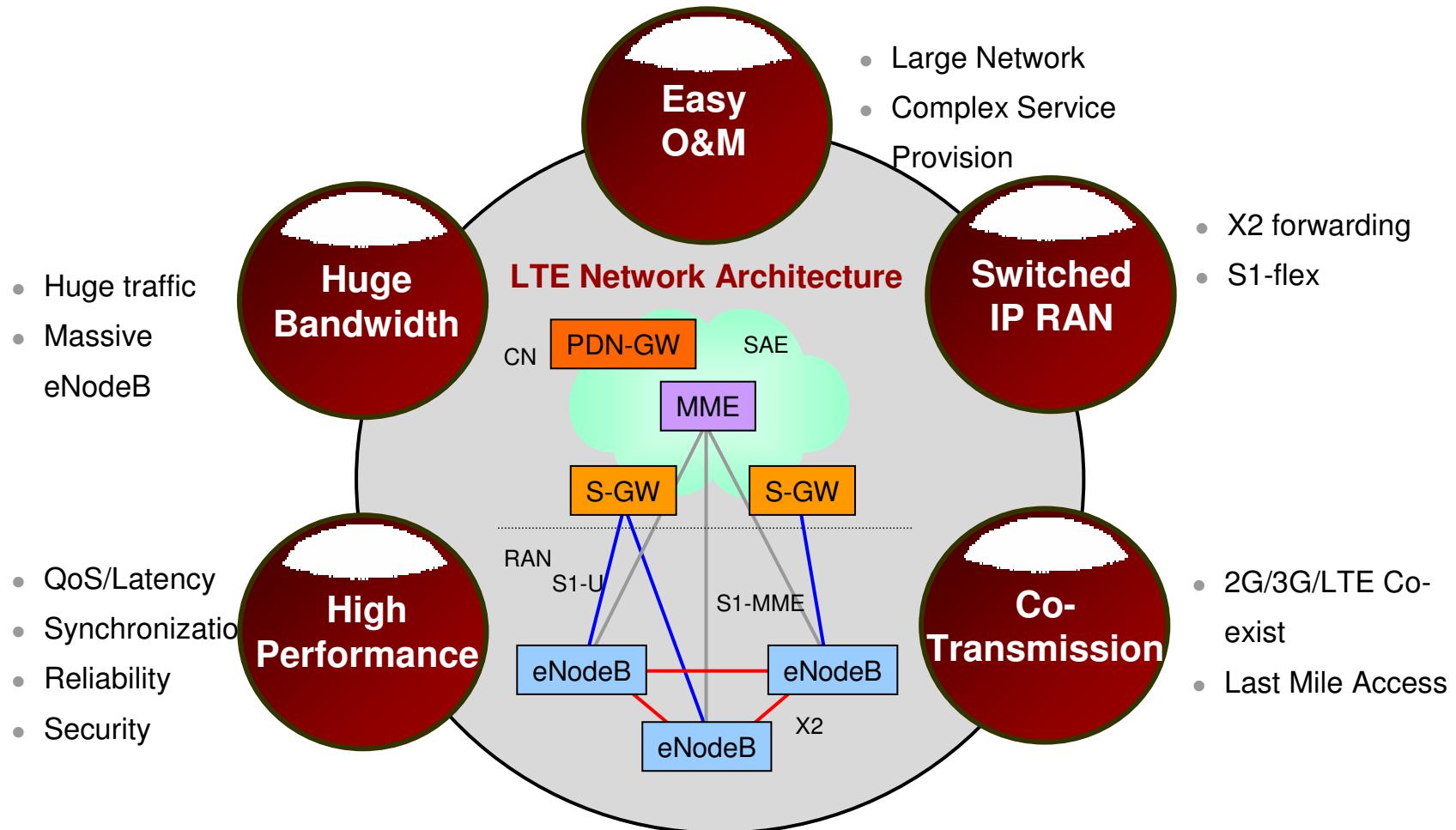


- Alternative 1 : PW goes into PoC1, L3 VPN starts from/between PoC1.
 - more pressure on PoC1 for the termination of TE-Tunnel & PW
- Alternative2& 3 (Vodafone global recommended): PoC3 equip. should support L3 VPN
- Networking solution relates to the Balance of the cost & technology

Agenda

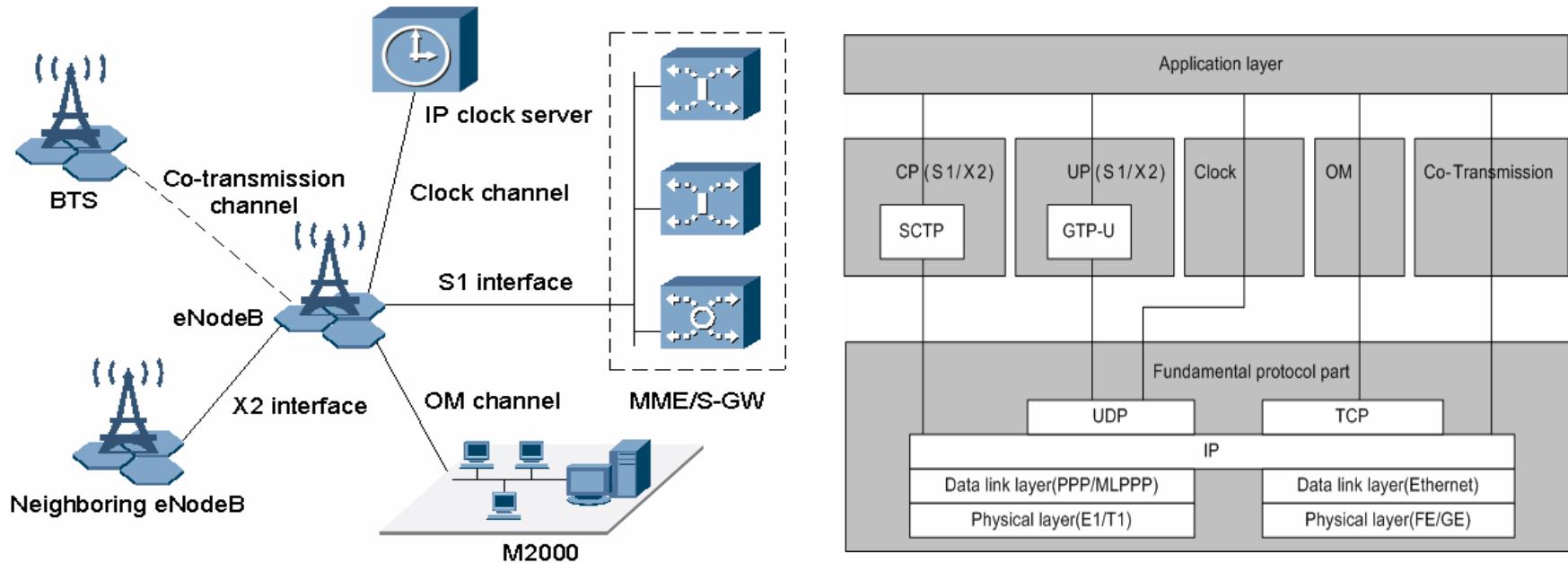
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LTE Backhaul Service Requirements



S1/X2	Latency	Sync.	Security	QOS	SON	Resiliency	Low cost	Scalability
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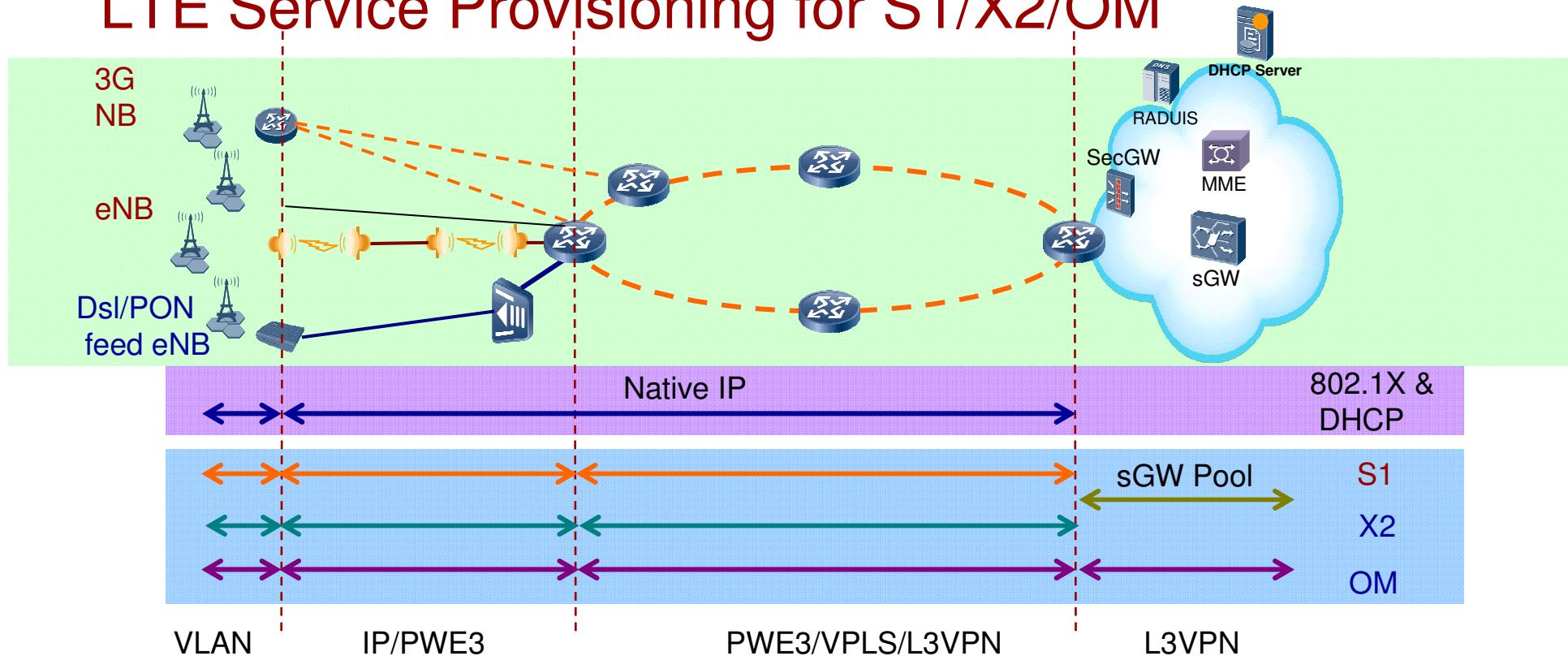
Overview of eNB's transport



The eNodeB communicates with other NEs (except UE) through the following five major interfaces:

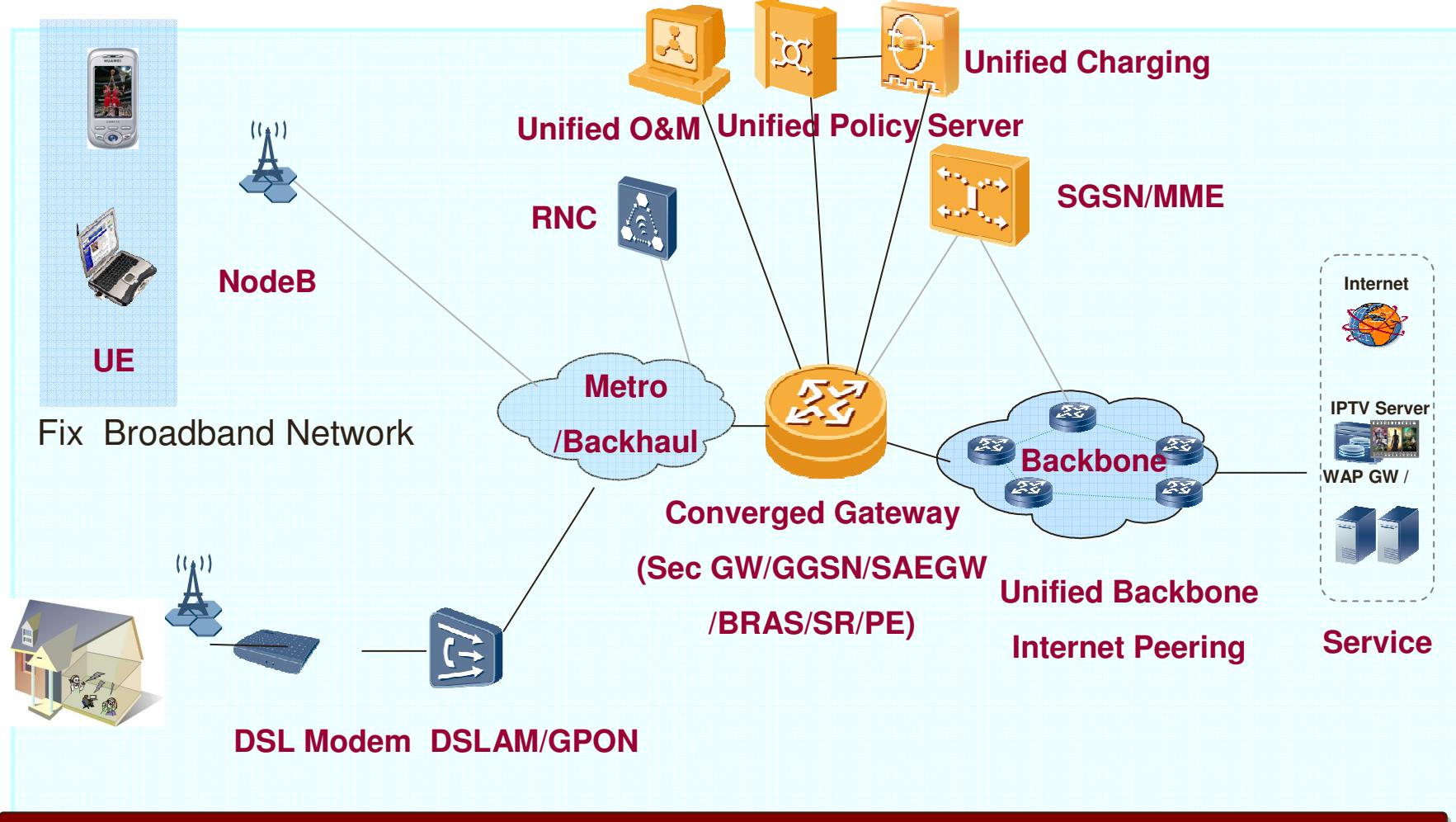
- ✓ The S1 interface exists between the eNodeB and the S-GW/MME. Bearing Protocol: SCTP and GTPU
- ✓ The X2 interface exists between the eNodeBs. Bearing Protocol: SCTP and GTPU
- ✓ The OM interface, also known as the OM channel, exists between the eNodeB and the network management system. Bearing Protocol: TCP and UDP
- ✓ The clock interface, also known as the clock channel, exists between the eNodeB and the IP clock server. Protocol: Bearing UDP
- ✓ The co-transmission interface, also called co-transmission channel, exists between the eNodeB and other devices. Bearing Protocol: IP

LTE Service Provisioning for S1/X2/OM



- **Native IP forwarding for eNB 802.1X and DHCP traffic, ease of provisioning**
- **Separate L3VPN instance for S1, X2 and OM, guarantee specific QOS requirement**
 - S/C-VIDs tagged for service identification in eNB
 - P2P ETH/PW in access and L3VPN in Agg. to achieve scalability and multi-service provisioning

Unified Network for FMC Evolution

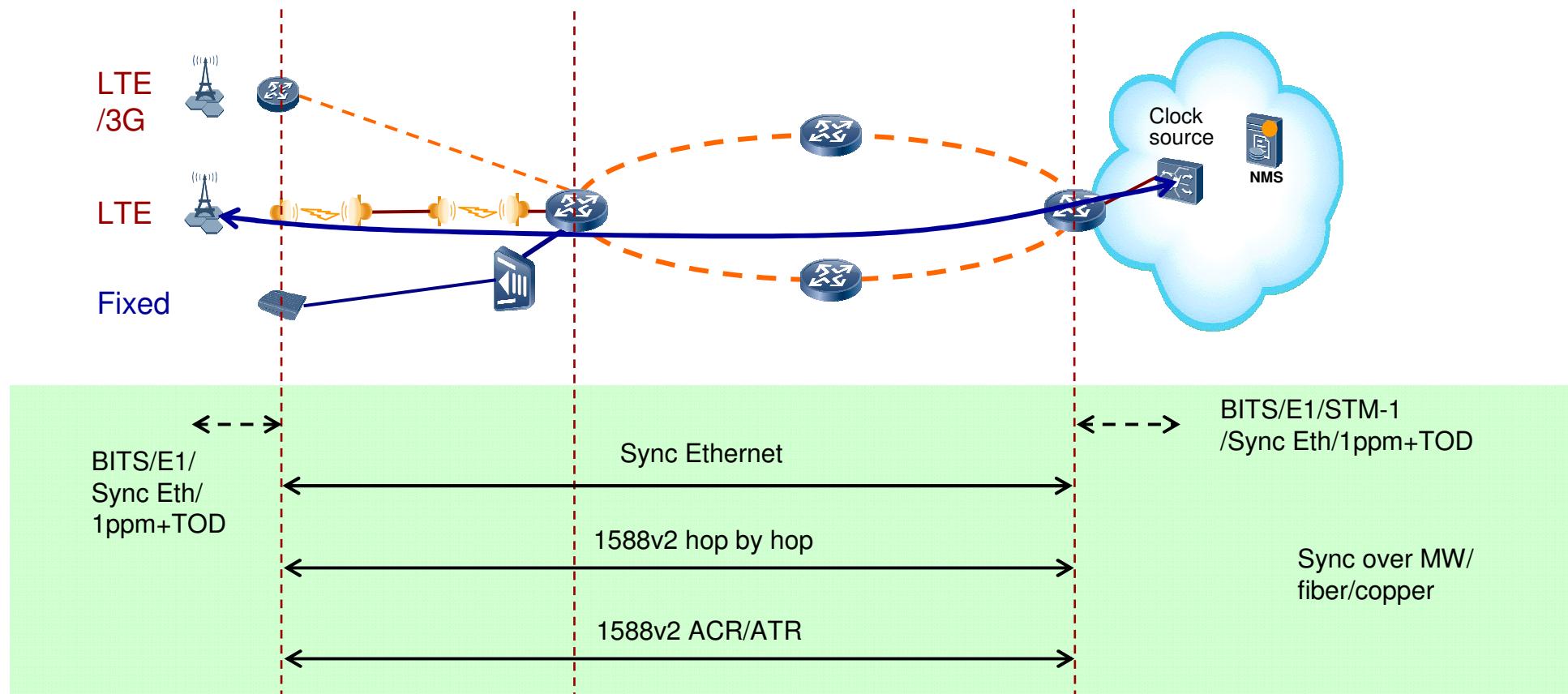


Mobile network - one backbone, for PS core and peering to internet

Fixed network - one backbone for peering or transit with much larger capacity for mobile one

Traffic could be converged to backbone for fixed or for Mobile peering one

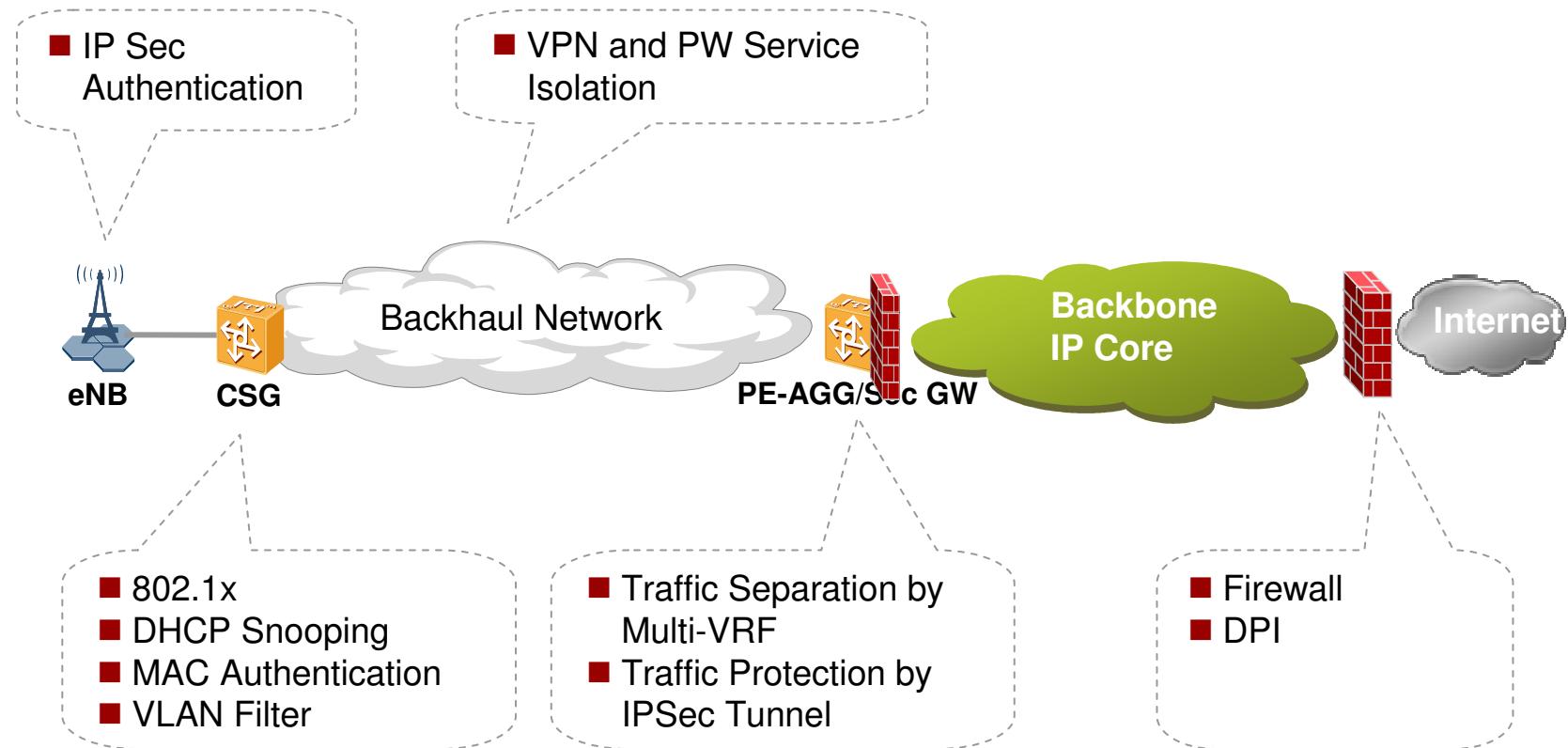
Synchronization



- **GPS grade timing synchronization**

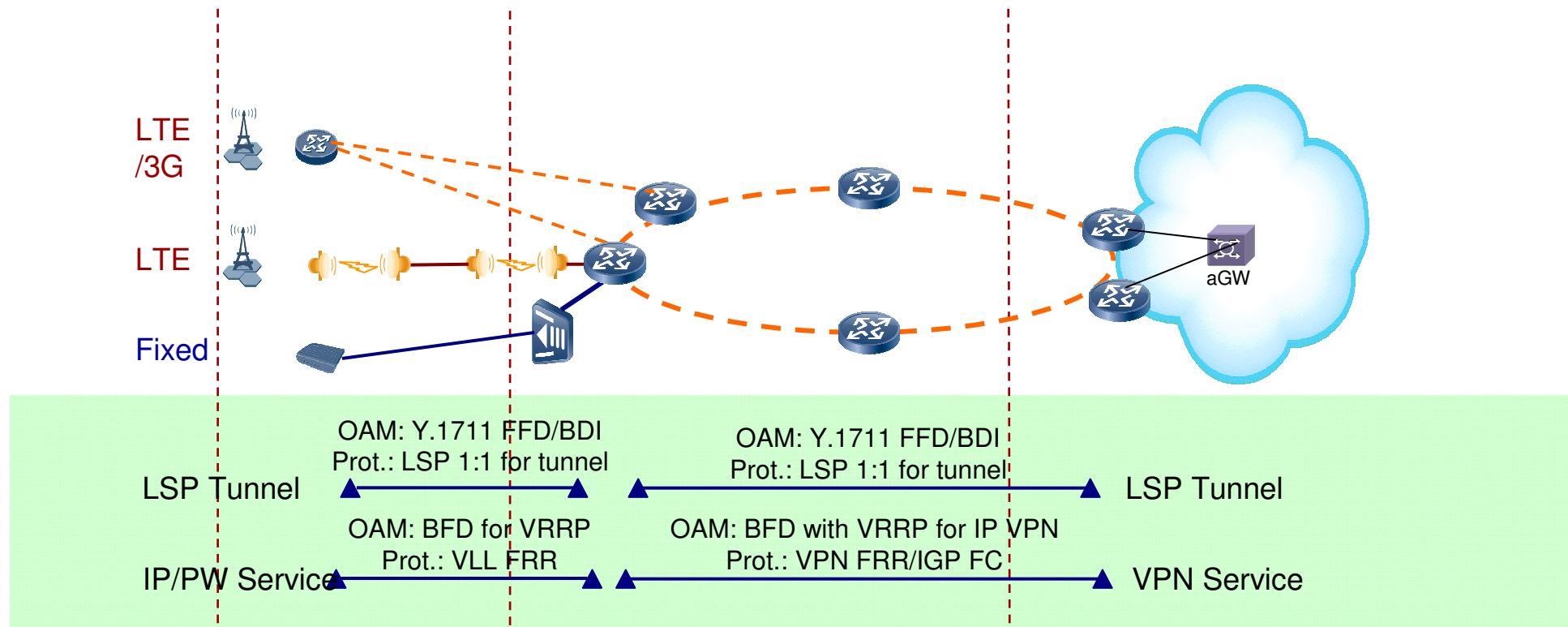
- Mature sync Ethernet, 1588v2 hop by hop solution
- 1588v2 ACR/ATR for transparent ME (ATR still under research in industry)
- Sync over MW/fiber/copper, facilitate versatile access

Make Network More Safe



- E2E security solution on different network elements and entities.

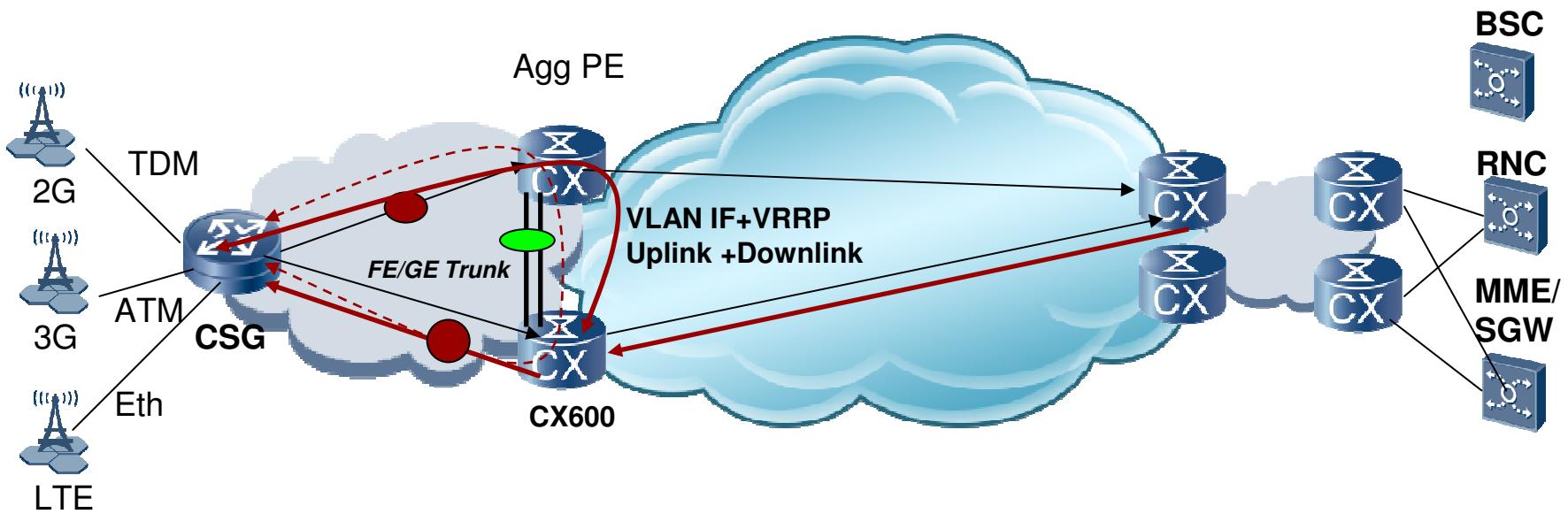
OAM and Protection



- **Carrier grade OAM and protection**

- LSP 1:1 for tunnel layer protection
- VLL FRR for PW service layer dual-home protection
- BFD with VRRP for IP Service dual-home protection
- VPN FRR for VPN service layer dual-home protection
- **IGP FC** will Convergence within 1s. iBGP route convergence
- Load balancing is also applicable for LSP 1:1, VLL FRR and VPN FRR

CSG with Agg PE Resiliency



- Cell Site Gateway (CSG) works on the Active/Standby mode where its two Eth interfaces will only have one IP & one MAC. Uplink/Downlink connection between CSG and PE, depends on the status of link and node by BFD.
- For the 2 Agg PEs, a FE/GE Trunk (at least 2 FE/GEs) for L2, VRRP with one VLAN IF in two eth port. L2 mode FE/GE links between 2 Agg PE for L2 traffic (with routable VLAN IF);L2 mode FE/GE links between Cell Site Gateway (CSG) and Agg PE (with routable VLAN IF);
- The switch-over depends on CSG with BFD.

S1/X2	Latency	Sync.	Security	QOS	SON	Resiliency	Low cost	Scalability
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Summary LTE Service

Simplicity

- ◆ VPLS/VPRN for LTE Signaling, User traffic and OM plane based on VLAN. QOS mapping based vlan 802.1p/dscp/exp
- ◆ S1-flex;X2 flexible switch point; IPsec blade integrated functions fits in CO
- ◆ 4G services to IP by making full use of existing ME, DSL2+/PON;

←→ Vlan1 for Signalling(s1+x2)

←→ Vlan2 for OM

←→ VLAN 3 for User traffic(s1+x2)

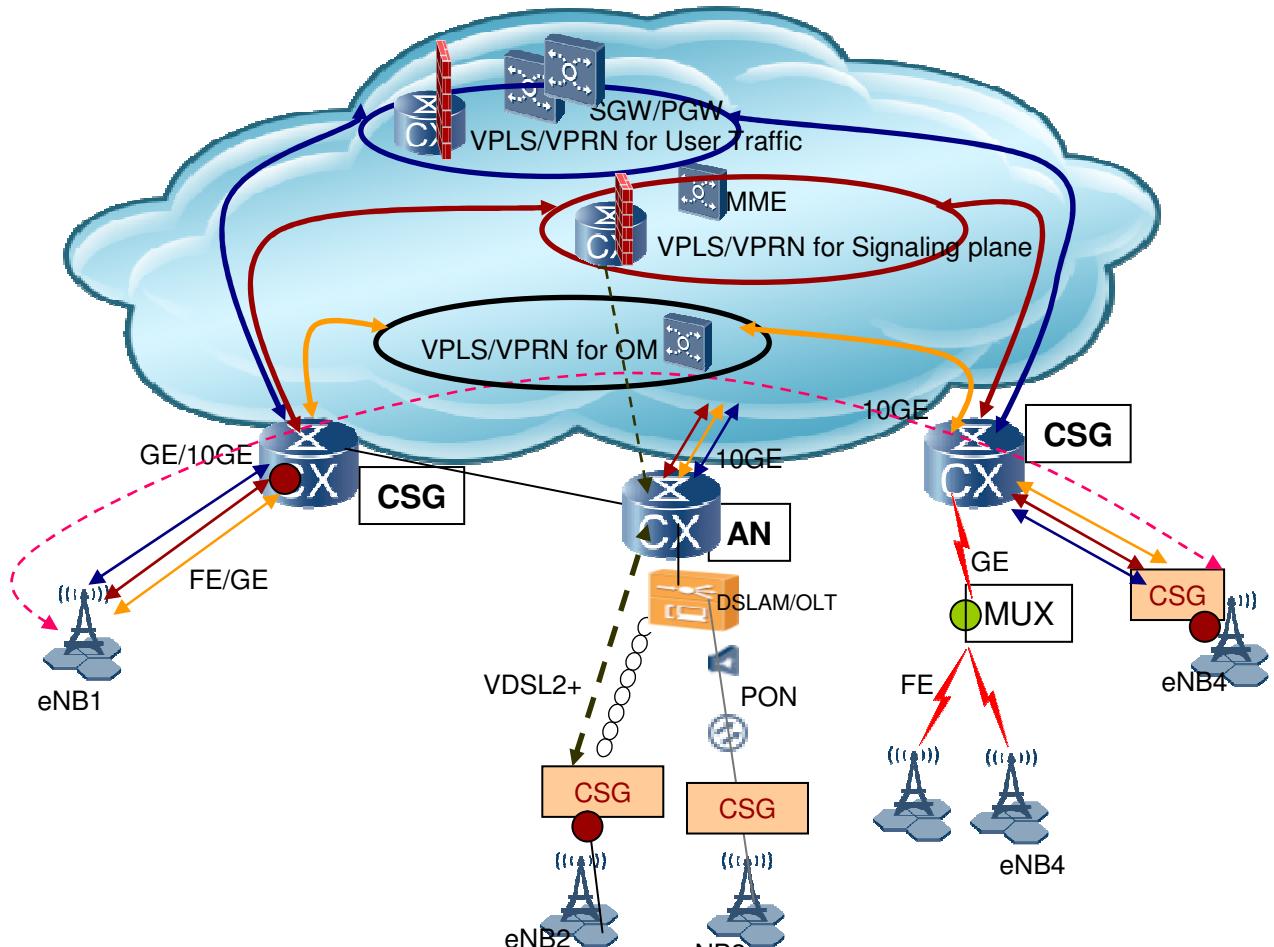
←→ 1588v2 ACR (Phase Sync.)

←→ X2 for inter-area eNBs

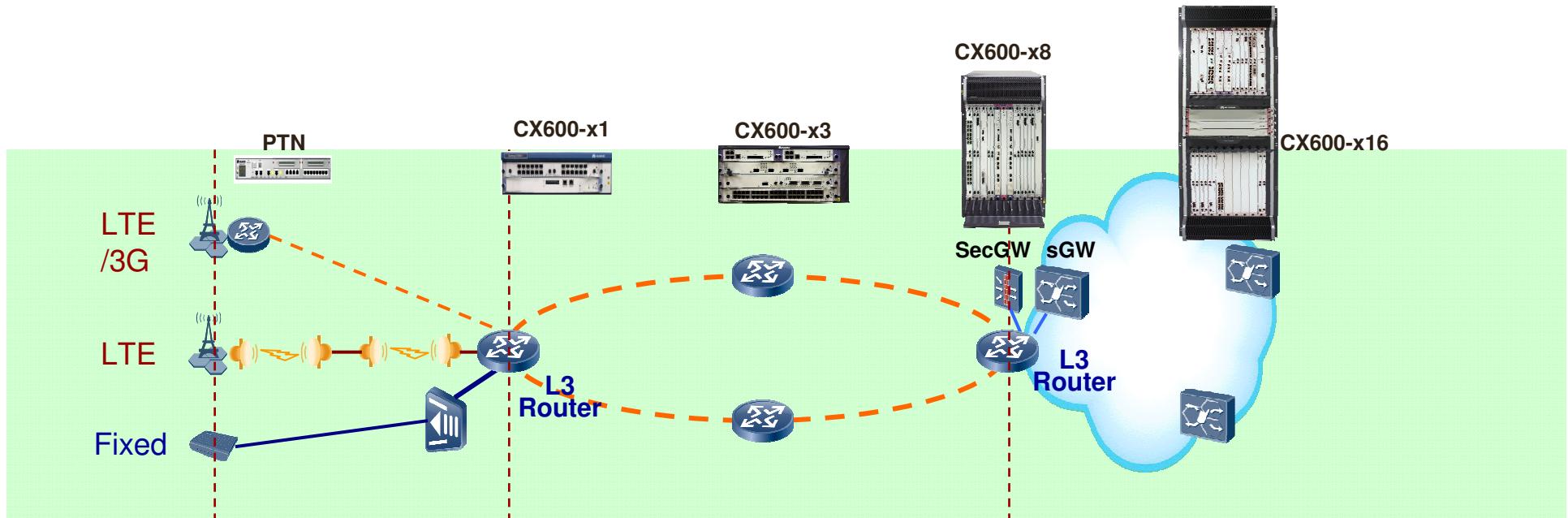
802.1x authentication



CX600 with IPsec blade for LTE IPSEC Tunnel



Huawei E2E IP RAN Solution



- **Comprehensive Interface**

- 10GE/GE/FE
- E1/T1/STM-1

- **L2&L3 Multi-Service**

- Native Eth, VLAN
- RIP, OSPF, ISIS, BGP
- MPLS, MPLS TE
- Eth/ATM/TDM PW, VLL, VPLS, L3VPN
- IGMP, PIM/PIM SSM, MVPN

- **High Availability**

- RRPP , RSTP, LACP, MC-Trunk, MC-APS
- LSP 1:1, TE FRR, VPN FRR, VLL FRR, PW Redundancy
- E-VRRP, BFD for Static Route, IGP Fast Convergence

- **Hybrid HQoS**

- 5-level HQoS
- 128k Duplex Queue

- **Synchronization**

- 1588v2, ACR, Sync Eth, E1/STM-1

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Thank You

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