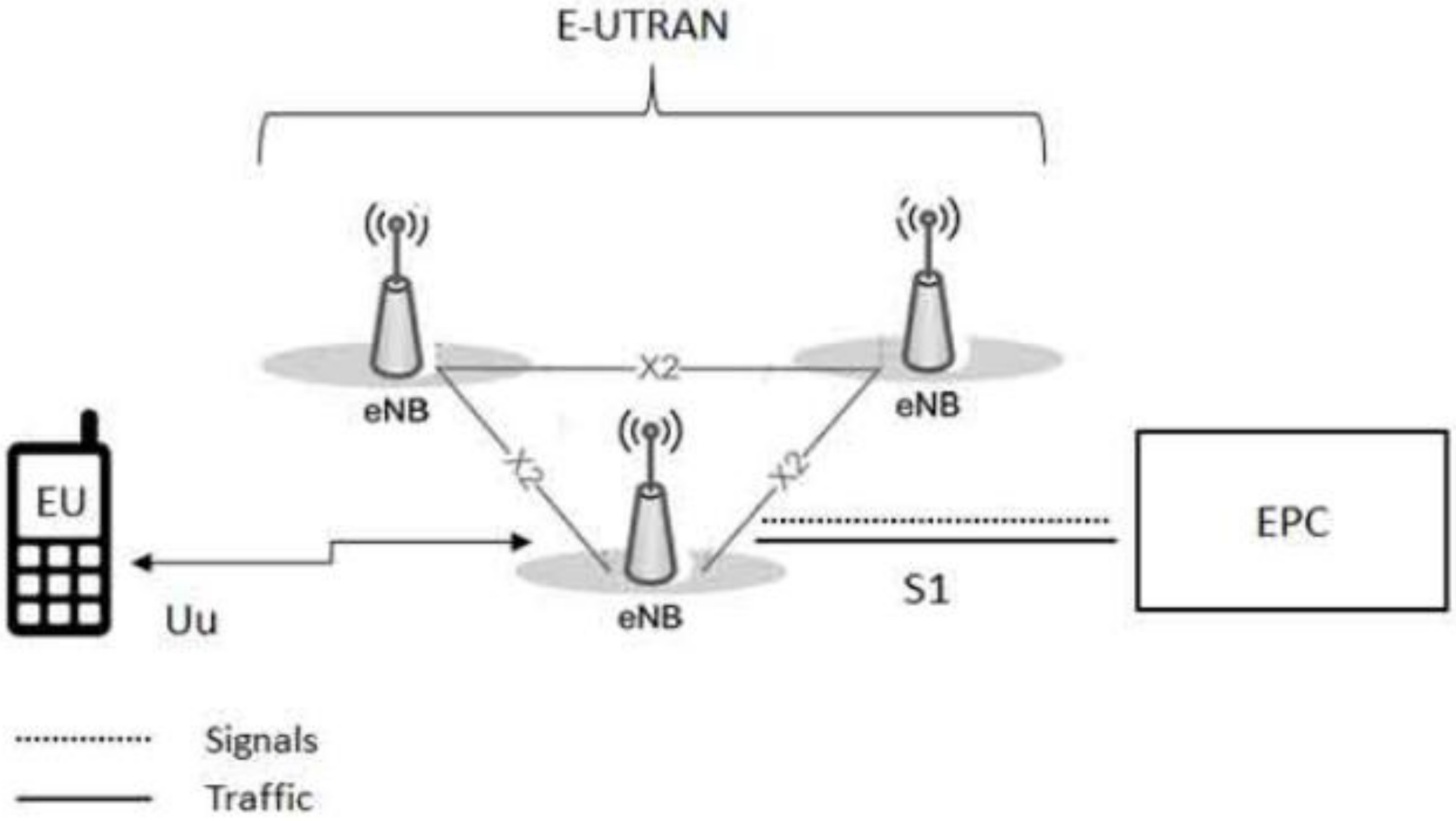
VOLGA, CSFB, SINGLE RADIO VOICE CALL CONTINUITY (SRVCC) & VOLTE

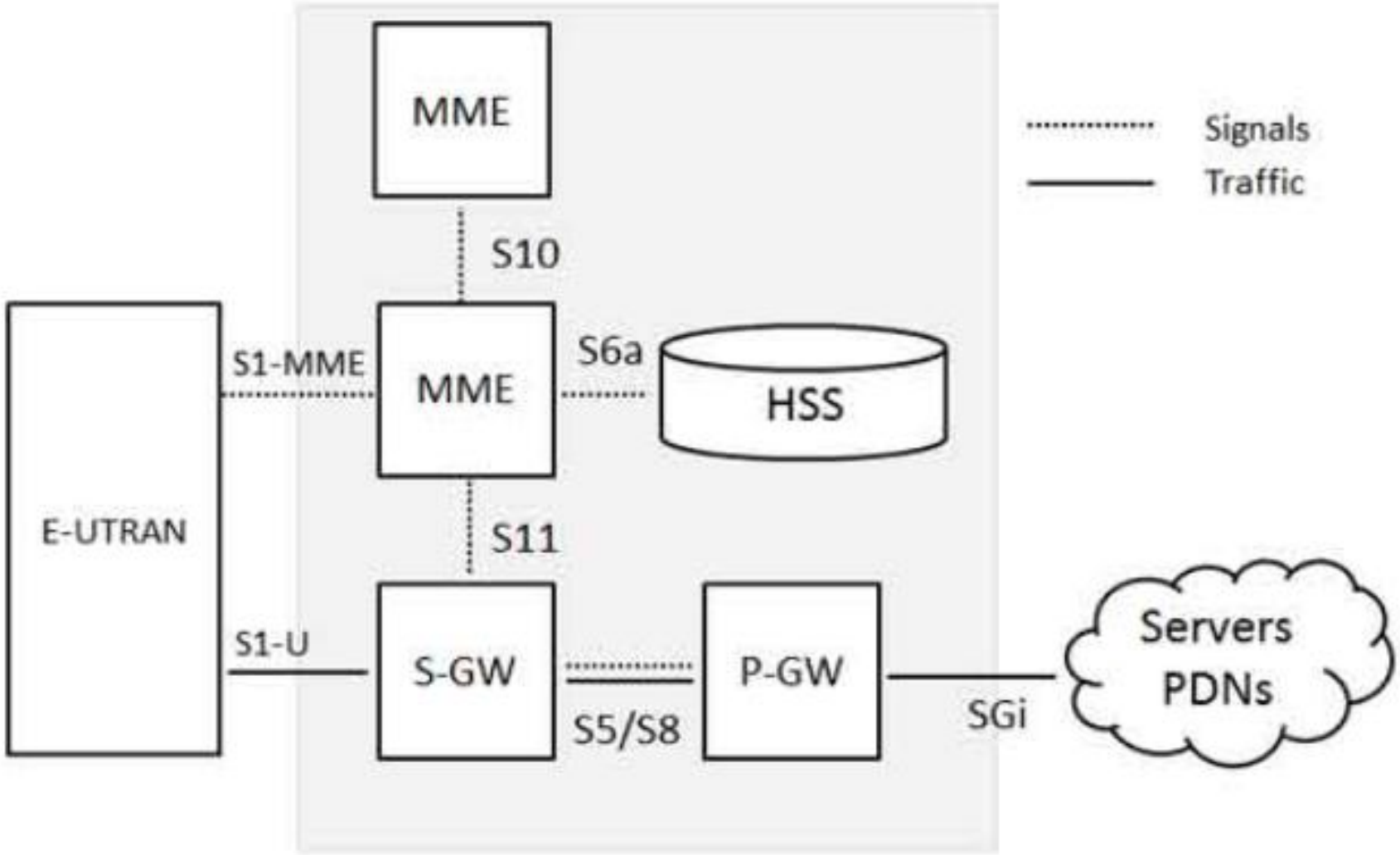
ECE 525E – WIRELESS & MOBILE COMMUNICATION

Wednesday, 15 April 2026

RECAP: LTE ARCHITECTURE – E-UTRAN



RECAP: LTE ARCHITECTURE – EVOLVED CORE

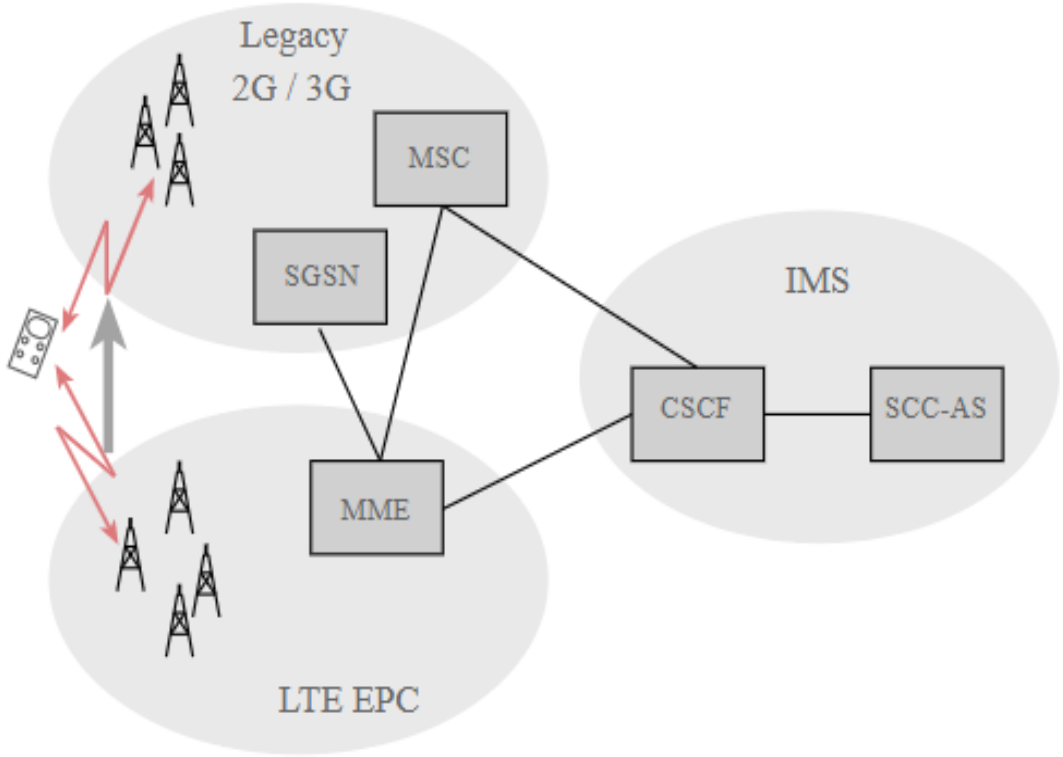


What is Single radio Voice Call Continuity (SRVCC)?

1. **Single radio Voice Call Continuity (SRVCC**) is an LTE feature that allows a VoIP/IMS call in the LTE packet-switched domain to be transferred to a legacy circuit-switched domain (GSM/UMTS or CDMA2000).
2. The SRVCC implementation controls the transfer of calls in both directions including:

   (a) LTE to legacy network handover

   (b) Legacy network to LTE



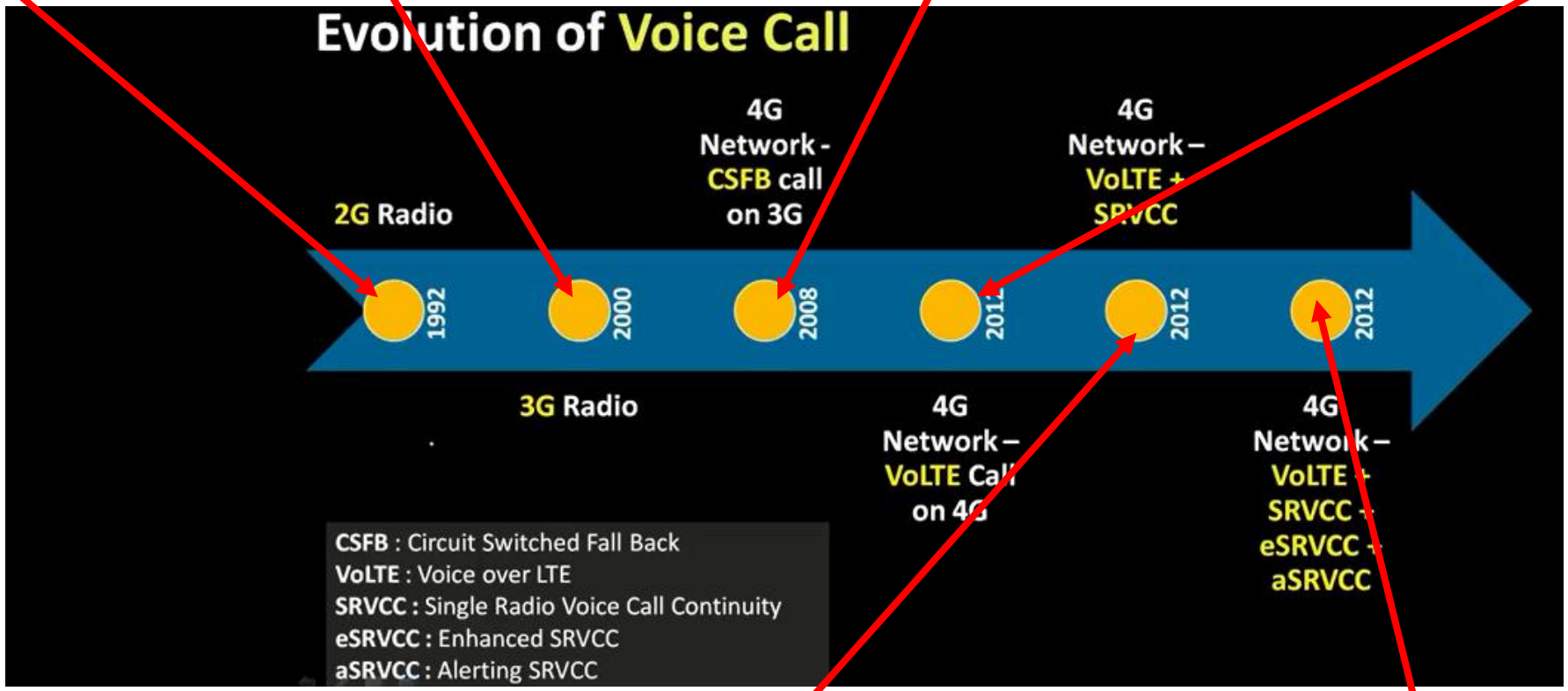
RECAP: Evolution Of Voice Services On Mobile Networks

Circuit-switched Voice communication

Spread spectrum voice channels and higher speed packet-switched data and video services

Packet-switched LTE system with fall-back to 3G for voice

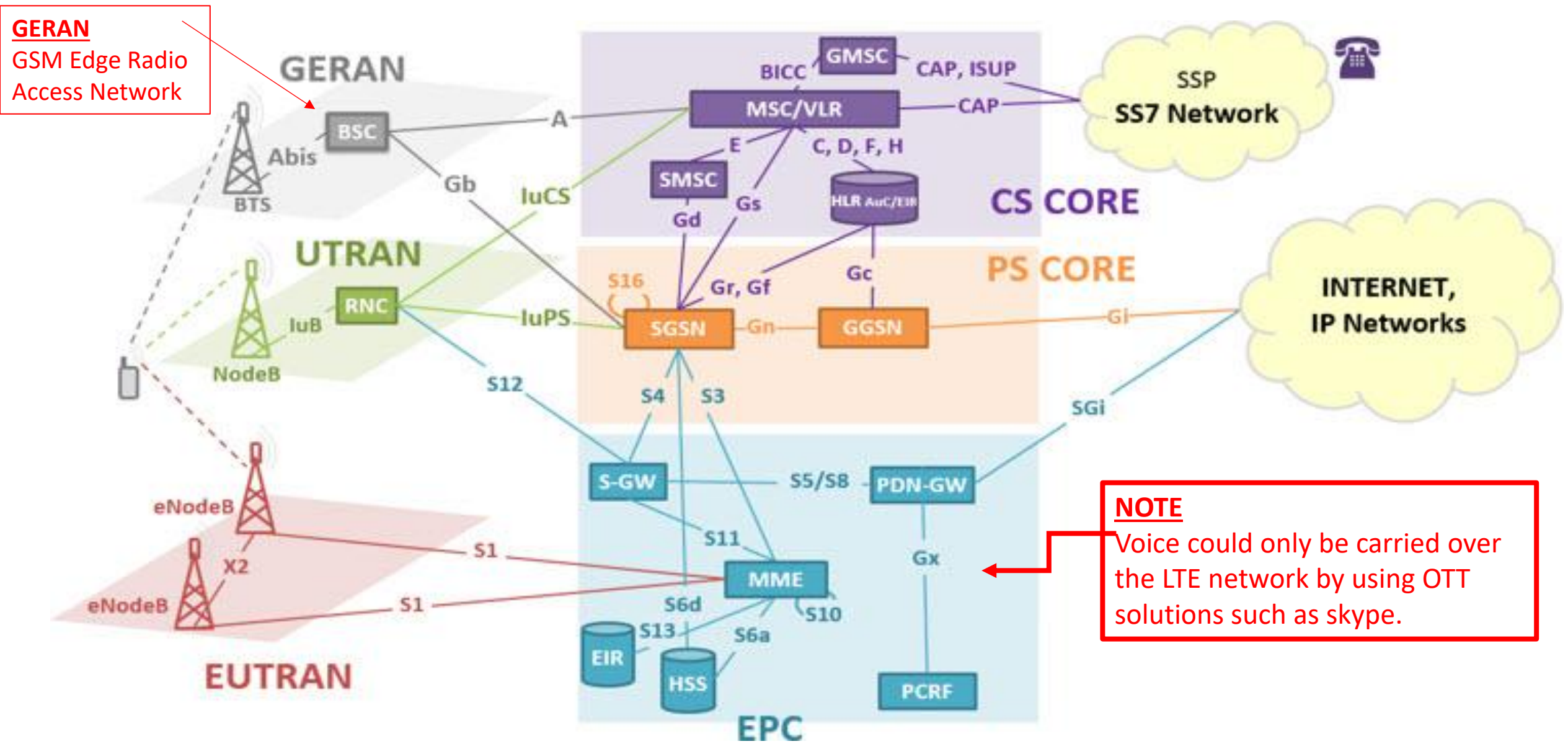
Packet-switched LTE system with Voice over LTE (VoLTE)



Packet-switched VoLTE networks with handover to 2G/3G networks in areas with poor 4G coverage using SRVCC

Packet-switched VoLTE networks with enhance SRVCC and alerting SRVCC which have shorter handoff times between 4G, 3G and 2G.

2G/3G/LTE NETWORK ARCHITECTURE



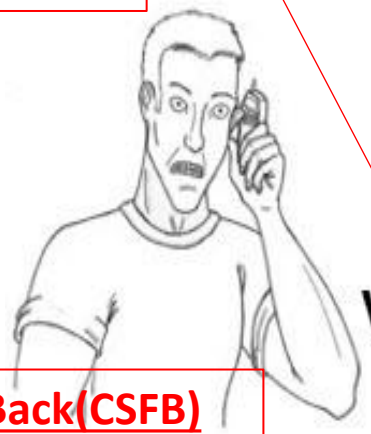
NOTE

Voice could only be carried over the LTE network by using OTT solutions such as skype.

DESIGN CHOICES FOR CARYING VOICE ON LTE NETWORKS

Legacy systems
LTE is being implemented in a phased manner with 2G and 3G networks still enjoying national coverage. Any LTE phone sold must support legacy systems.

Over the Top (OTT) systems
OTT systems can work on all generations of mobile devices but have poor quality service.



VOICE

2G only coverage

VoIP OTT (2G, 3G, 4G, WiFi...)

VoLTE (IMS)

VoLTE >> SRVCC

CSFB 2G/3G

3G only coverage

Voice over LTE (VOLTE)
VOLTE systems carry voice in the LTE networks using IP protocols.

Circuit-Switched Fall Back(CSFB)
Supports both LTE and legacy systems. But all voice calls are made on legacy systems (2G/3G).

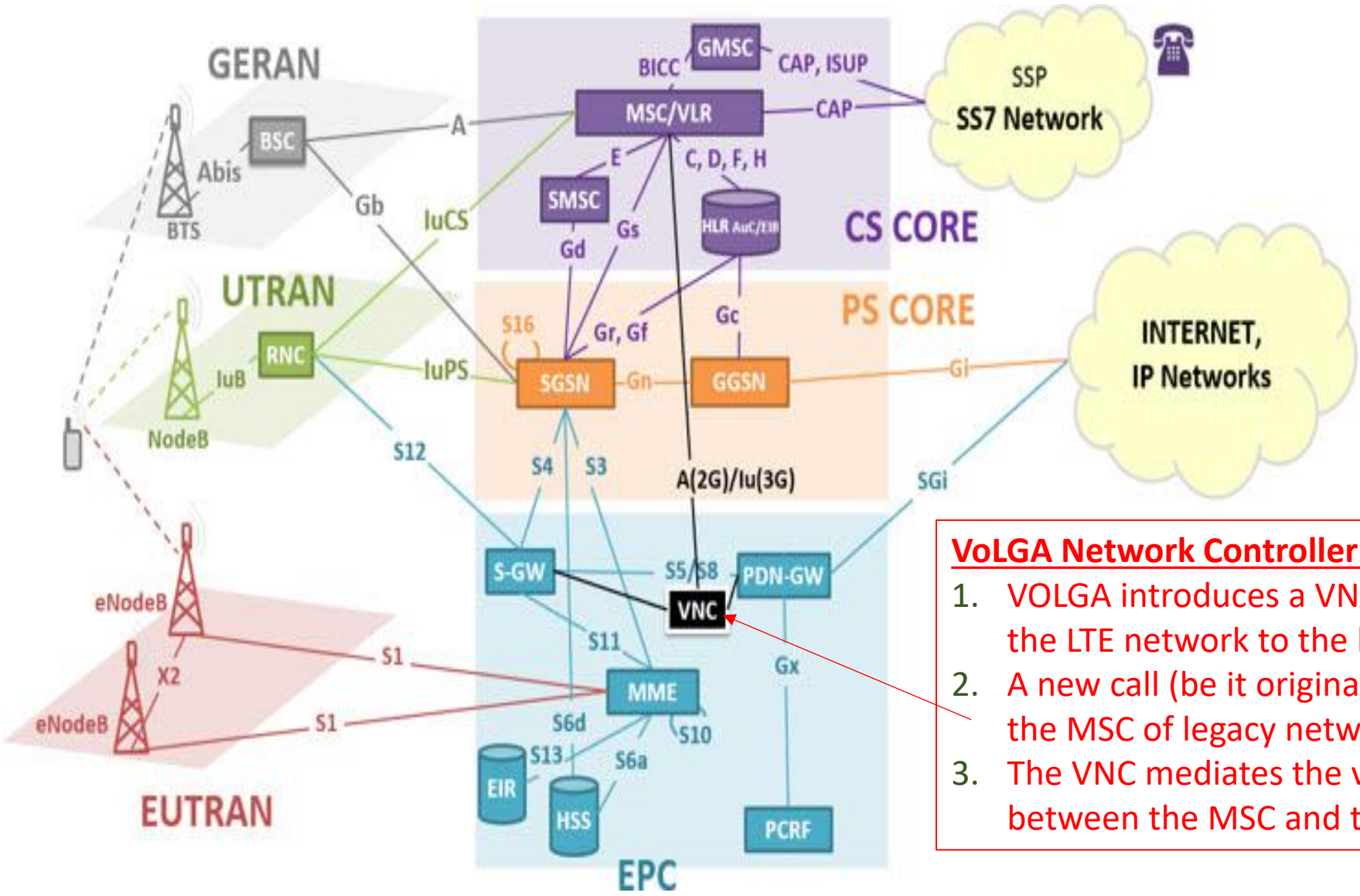
Single Radio Voice Call Continuity(SRVCC)
Supports handovers from LTE networks to legacy 2G and 3G systems.

ALTERNATIVES TO CARRYING VOICE OVER LTE NETWORKS

The alternatives for carrying voice over LTE networks are:

1. **Voice over LTE via Generic Access(VoLGA):** Use legacy 2G/3G as a generic access, 'packaging' voice services, and delivering via LTE.
2. **CS Fall Back(CSFB):** whenever the UE have the need to place a call, make it revert (fallback) for legacy networks.
3. **Voice over LTE (VoLTE):** make voice over LTE itself. In this case, the voice is pure IP - VoIP LTE.
4. **Single Radio Voice Call Continuity(SRVCC):** LTE (VoLTE) calls are transferred (via handover) to the legacy networks in a transparent manner wherever there is no LTE coverage.

VOICE OVER LTE VIA GENERIC ACCESS(VOLGA)



VoLGA Network Controller (VNC)

1. VOLGA introduces a VNC in the LTE network which links the LTE network to the legacy networks.
2. A new call (be it originated or terminated) is managed by the MSC of legacy network.
3. The VNC mediates the voice signal and its relays messages between the MSC and the LTE network.

ADVANTAGES OF VOLGA

Advantages of Voice Over LTE Generic Access (VoLGA) are :

1. Allows UE to access voice using CS domain and data service using LTE simultaneously.
2. Unlike CS fall-back, the data call is not dropped on handover to CS network.
3. The VoLGA solution caters to other CS services like SMS
4. It doesn't impact existing core network nodes like the MME, the SGSNs or the MSCs.
5. Supports emergency and other regulatory mandatory services.

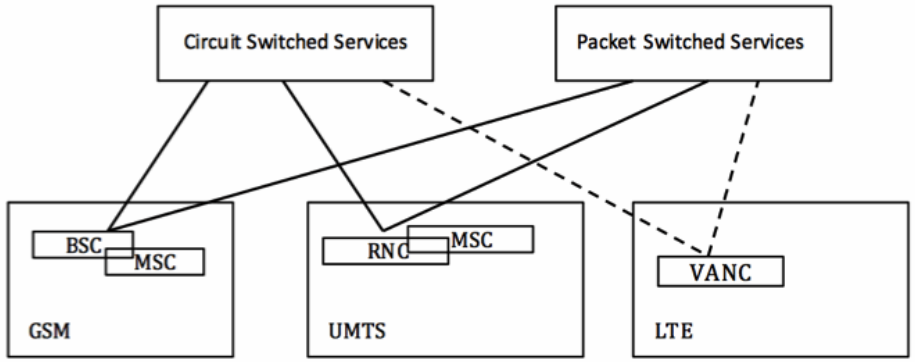


Figure 5 VoLGA Architecture

DISADVANTAGES OF VOLGA

The disadvantages of VoLGA are:

1. It has not been standardized by 3GPP.

2. It requires dual mode terminals with SRVCC capability.

3. To support roaming, the visited network also needs to deploy VNCs

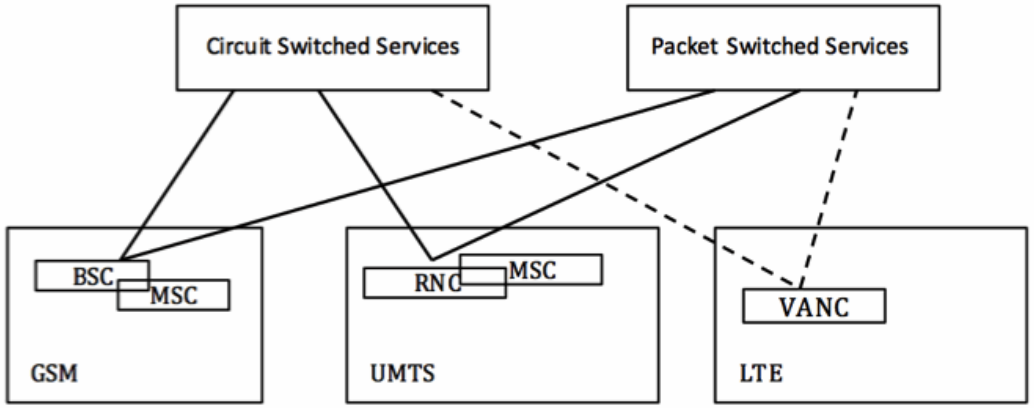
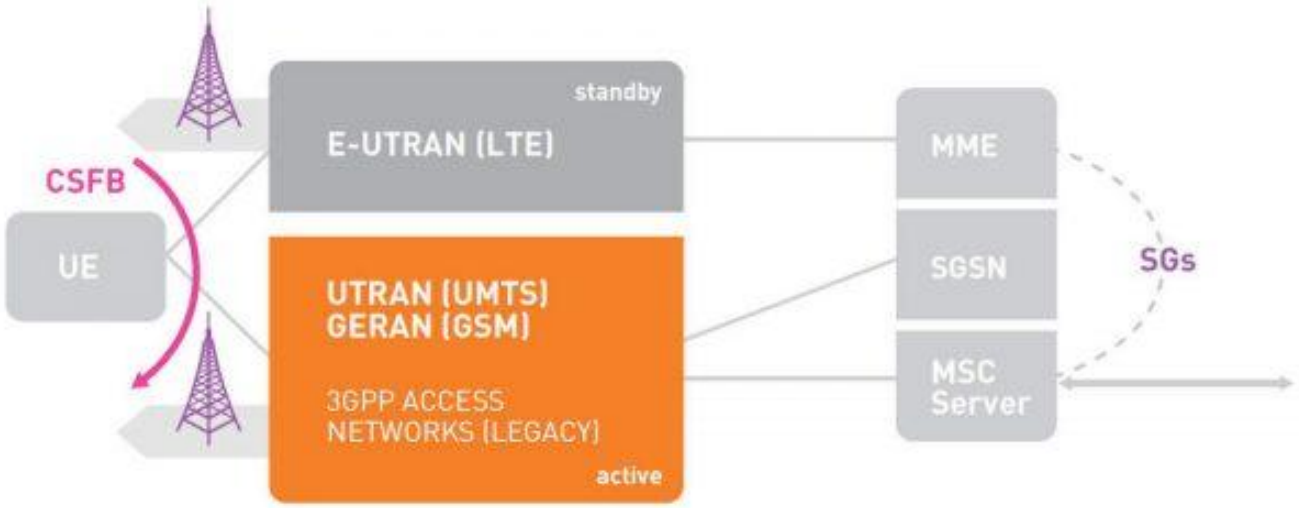


Figure 5 VoLGA Architecture

CIRCUIT-SWITCHED FALL-BACK (CSFB)

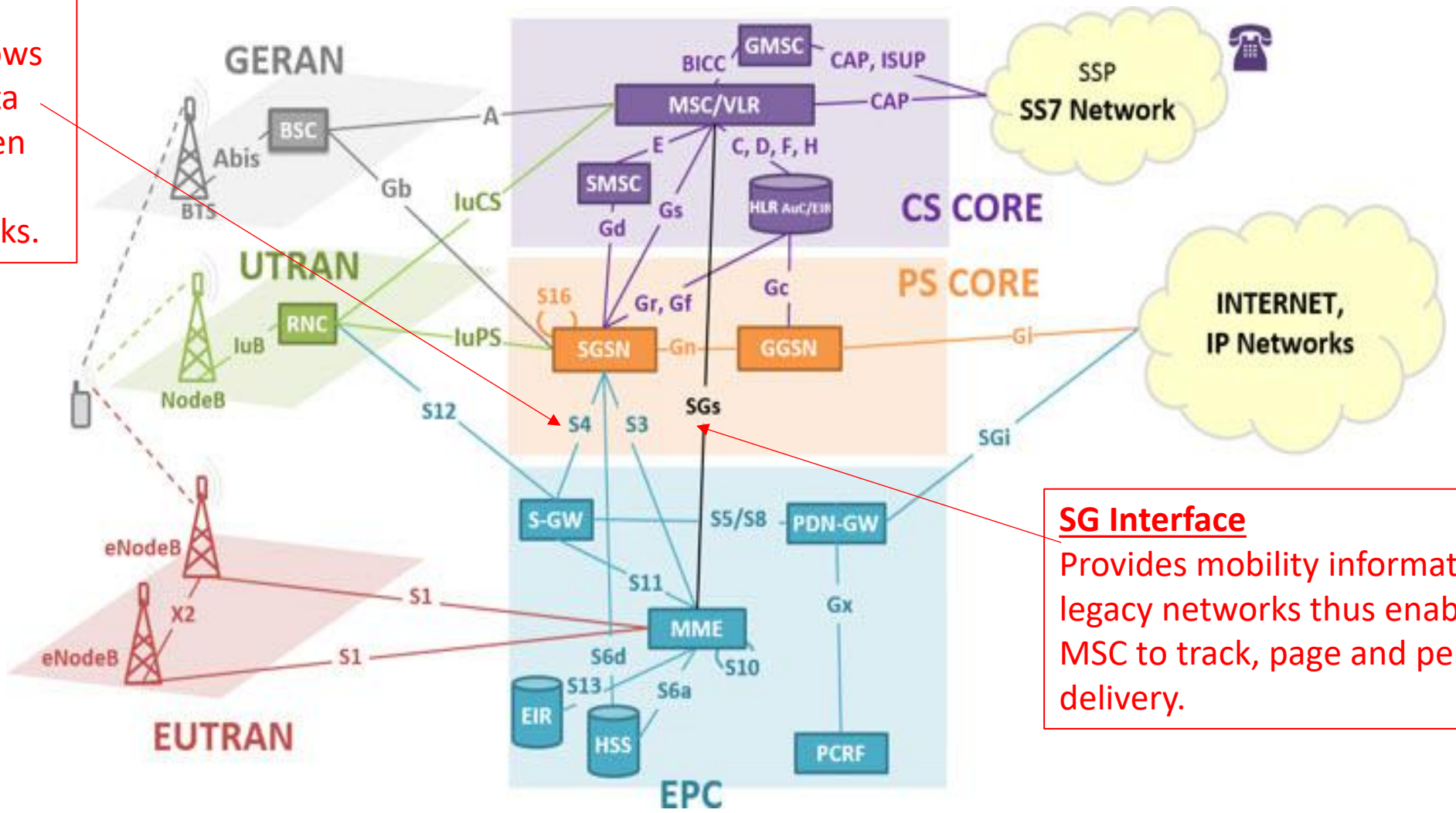
1. In Circuit-Switched Fall-back (CSFB), whenever there is a demand for a new voice call, the LTE user is 'backed' for a CS legacy network, assuming that this provides an overlapping coverage.
2. In other words, with CSFB, a voice call is never active in LTE, but in legacy networks (2G/3G).
3. At the end of the call in the legacy network, the UE can re-register the LTE network.
4. To support CSFB, a new interface is introduced called SG which connects the MME to the legacy MSC.



1. CSFB is currently the most widely used option for voice provision in LTE by operators.

CSFB ARCHITECTURE

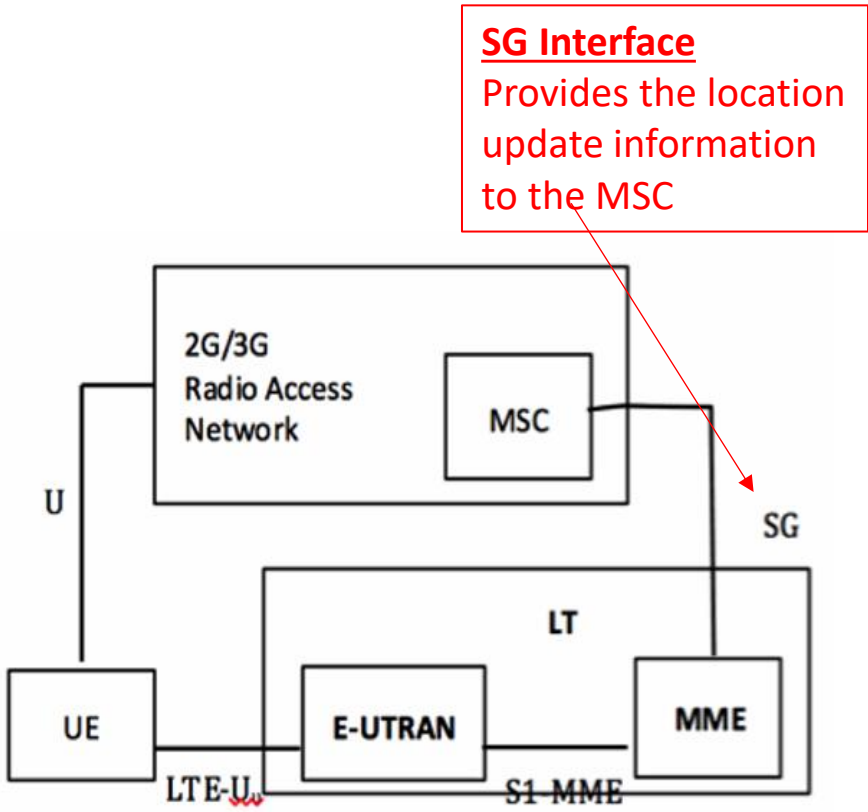
S4 Interface
S4 Interface allows handover of data sessions between LTE and legacy (2G/3G) networks.



SG Interface
Provides mobility information to the legacy networks thus enabling the MSC to track, page and perform SMS delivery.

CSFB - REGISTRATION AND LOCATION

1. In order to allow quick transfer to the legacy network (either 2G or 3G) when necessary, the LTE network needs to know the location of the UE. For this, the MME, which tracks the location of the UE in the LTE network, continuously provides location information to the legacy MSC, using the new SGs interface.
2. Messages through the SG interface supports management of mobility, paging and SMS delivery/forward.



CSFB - ORIGINATED CALL

1. When a UE is registered on the LTE network, and has an active IP connection, to originate a voice call, it sends an SRM (Service Request Message) to the MME (more specifically the ESR - Extended Service Request).
2. The MME checks whether the UE is CSFB capable, and notifies the eNodeB to transfer the UE to the legacy network (2G/3).
3. Before performing the UE transfer, the eNodeB can ask it to make RF measures on neighbouring 2G/3G network. The eNodeB then decides the best BTS for the UE and performs the transfer.
4. Once the UE camp in 2G/3G network, it starts the call procedure as usual.
5. The UE starts the authentication and call setup procedures in legacy network.

TRACKING AREAS Vs LOCATION AREAS

Tracking Area (TA)

TA is a geographical combination of several eNodeBs.

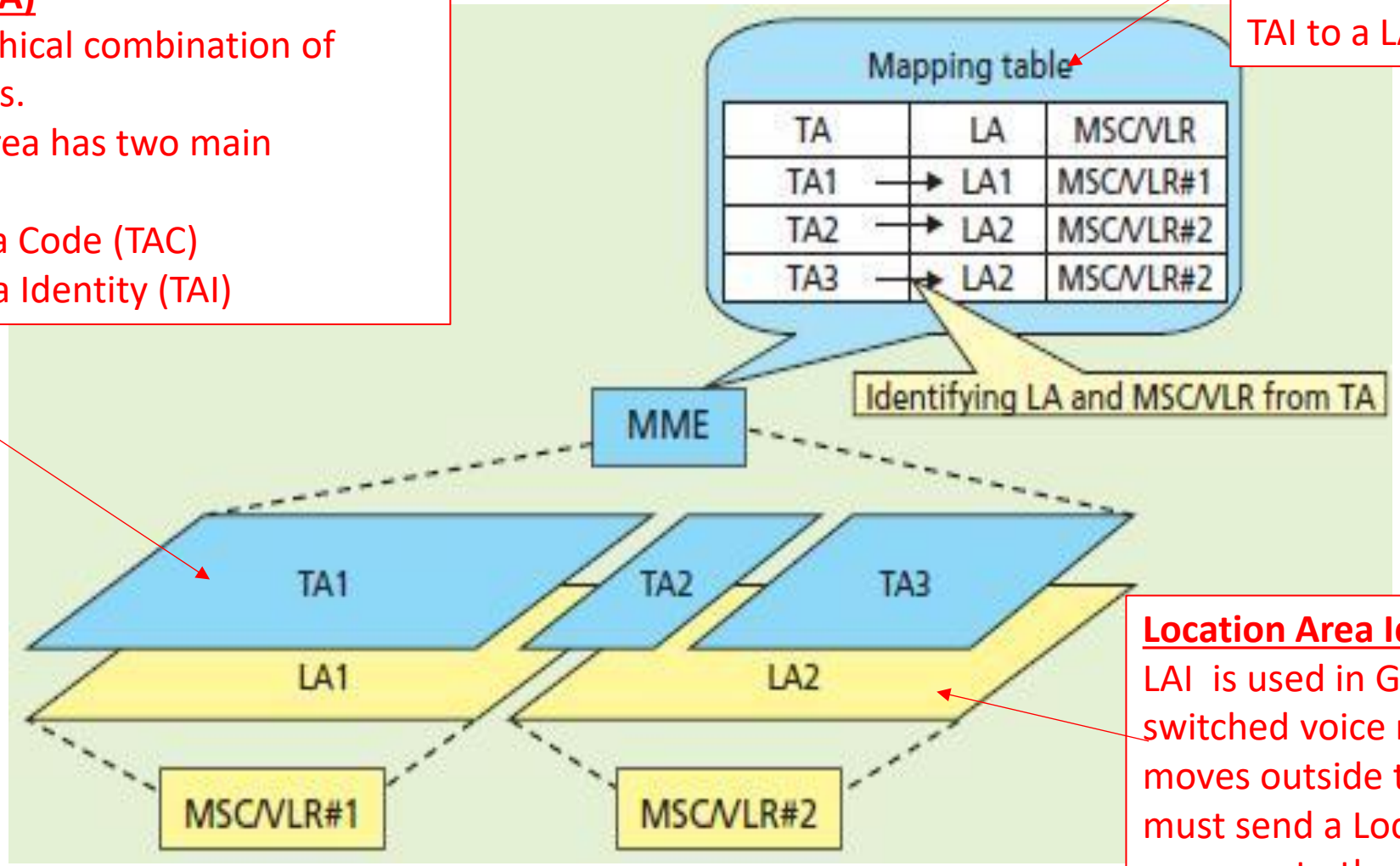
Each Tracking Area has two main identities:

(a) Tracking Area Code (TAC)

(b) Tracking Area Identity (TAI)

TA to LAI Mapping

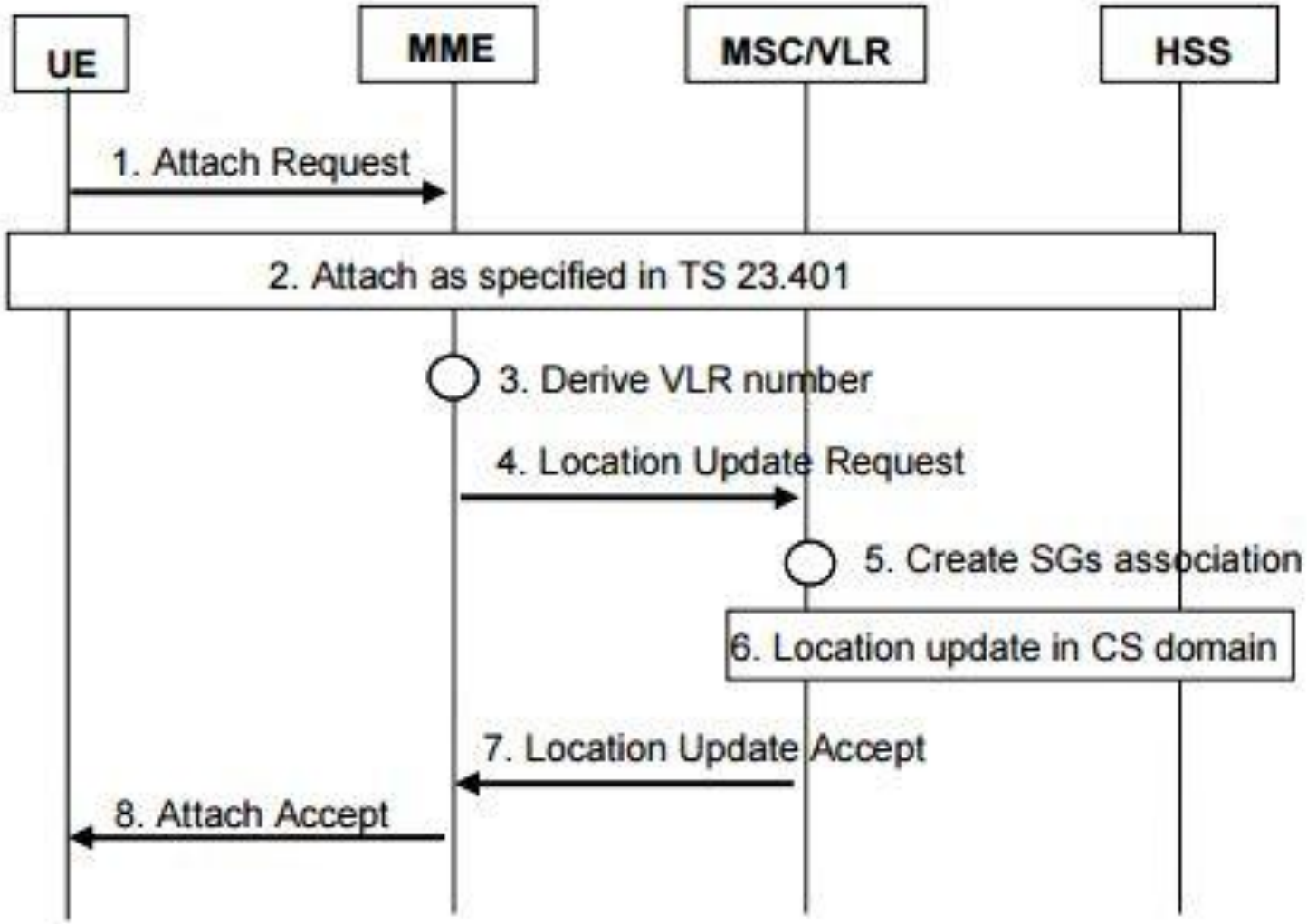
The MME needs to provide a LAI to the MSC, so it maps the TAI to a LAI.



Location Area Identification (LAI)

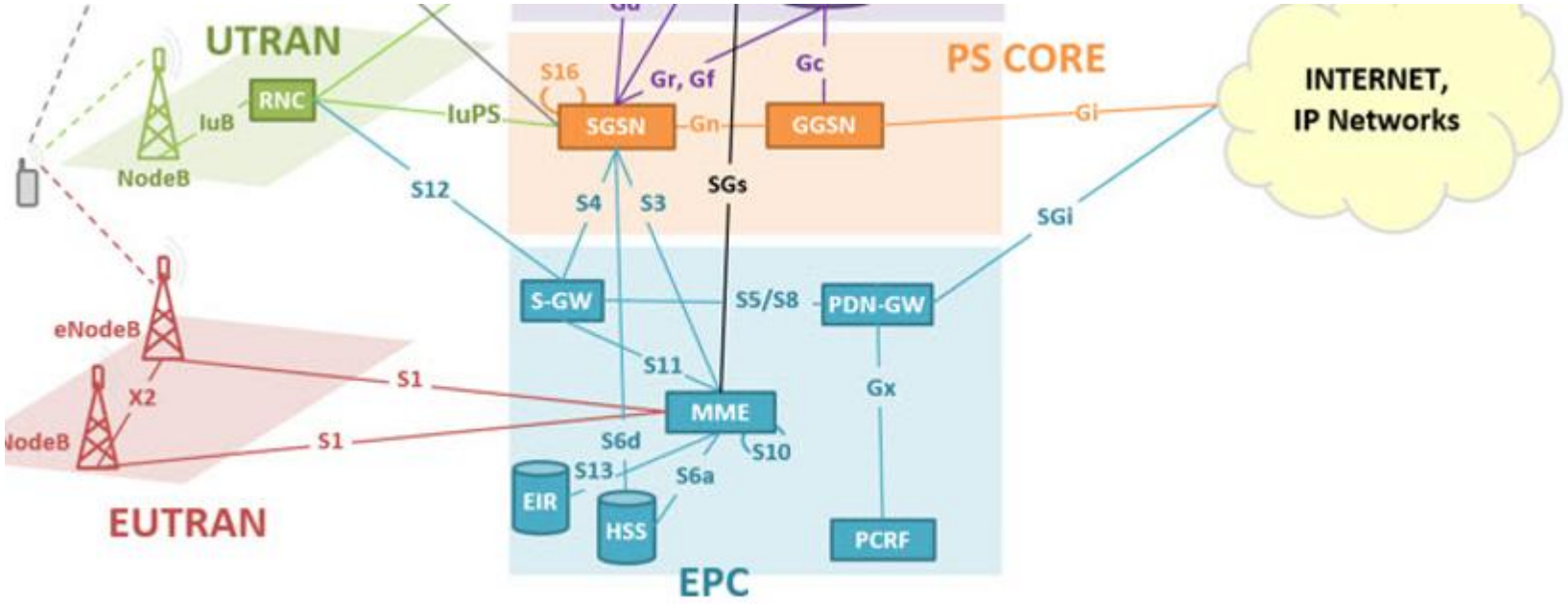
LAI is used in GSM and UMTS circuit-switched voice networks. If the MS moves outside the location area, it must send a Location Area Update message to the MSC.

FLOW-CHART OF CSFB - ORIGINATED CALL



CSFB – CALL + DATA CONNECTION IN LTE

1. When a UE with active data connection in the IP LTE network wants to make a call, it has two options, i.e
   (a) The data are also transferred to the legacy network, or
   (b) The data are temporarily suspended, until the return to the LTE network.
2. The S3 interface is used to carry out the Packet-Switched (PS) session handover for 3G (or 2G).



CSFB - INCOMING VOICE CALL

1. The incoming call request arrives first to the MSC where the UE was previously registered.
2. The MSC sends paging messages to the related MME via SGs interface. This message is forwarded to the UE, which is still connected to the LTE network.
3. If the user accepts the call, it sends an SRM (Service Request Message) to the MME. The then MME notifies the eNodeB to transfer the UE for the legacy network, and the eNodeB then decide the best network for the UE to make the call.

ADVANTAGES/DISADVANTAGES OF CSFB

Advantages of CSFB:

1. Ease of implementation
2. The sunk cost in the legacy 2G/3G infrastructure is utilized
3. CSFB sustains roaming services between legacy systems and LTE.

DISADVANTAGES OF CIRCUIT-SWITCHED FALL-BACK (CSFB)

Disadvantages of Circuit Switched Fall-Back (CSFB):

1. Due to delays associated with fall-back and recovery, **call set up latency is worse than the original 2G/3G networks**
2. **2G/3G network may not be available** in all macro/micro cells of the LTE leading to patchy service
3. **Operators who do not have legacy deployment** cannot implement CSFB
4. When switching over to CS voice connection, **all LTE data sessions get dropped**

VOICE OVER LTE

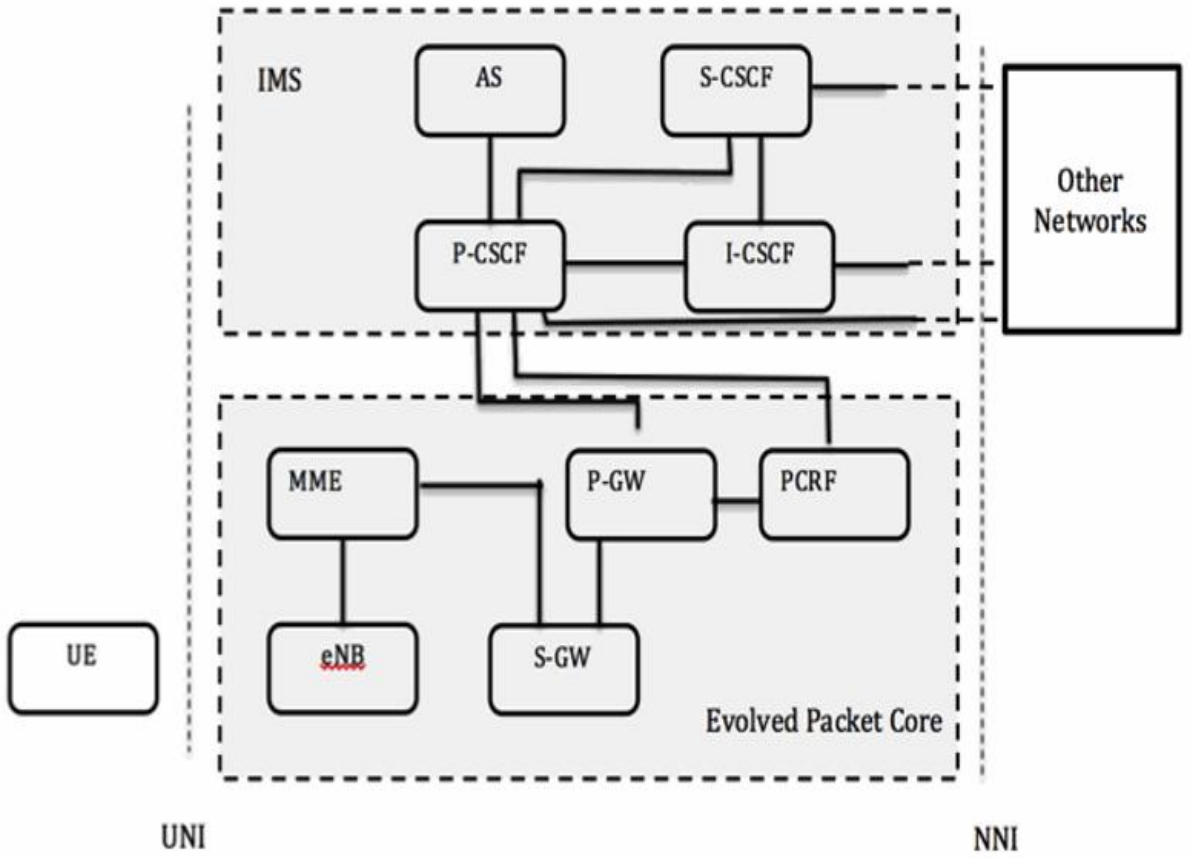
ECE 525E – MOBILE COMMUNICATION

Monday, 04 March 2024

COMPONENTS OF VOLTE

- To make voice calls, LTE networks need to have an IP Multimedia Services (IMS).

- When the first LTE networks appeared, they had no IMS, and without IMS, it was not possible to make any calls to any Public Switched Telephone Network (PSTN).



IP MULTIMEDIA SERVICE (IMS)

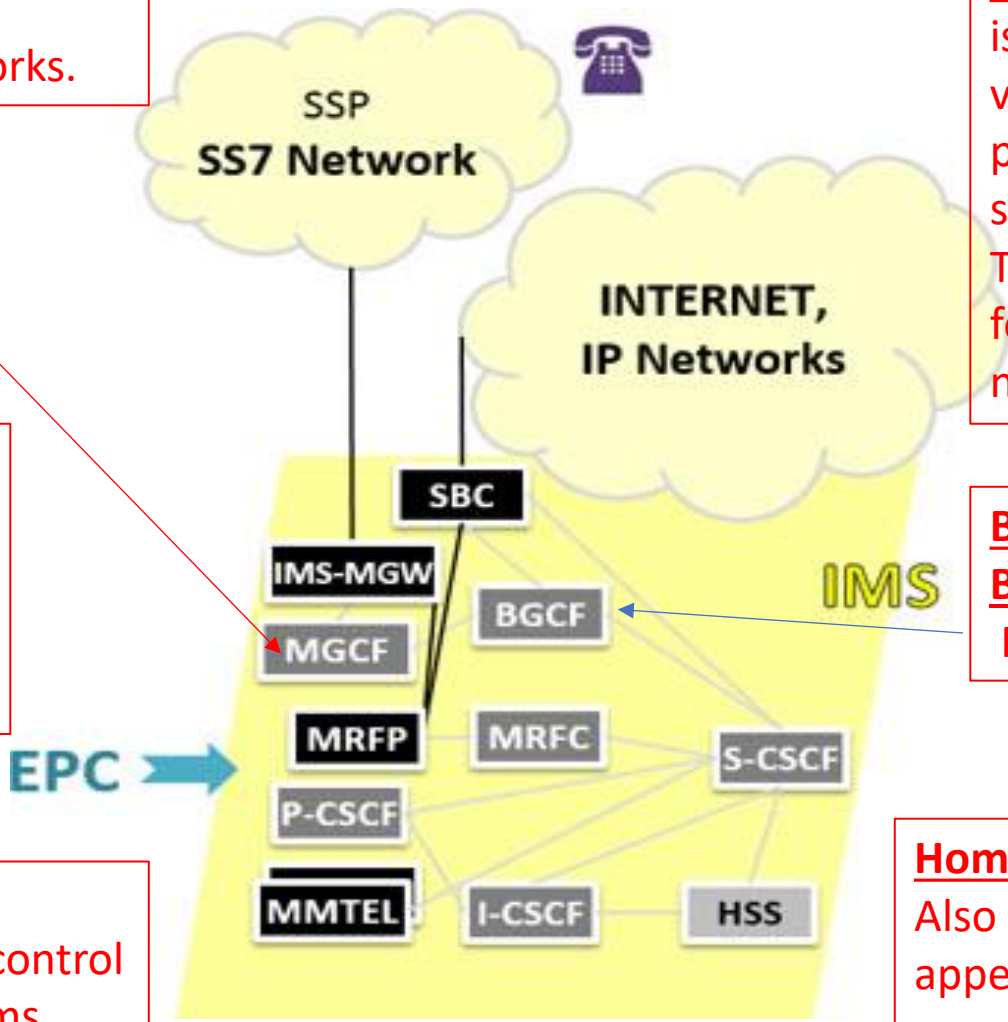
- IMS is a backbone (network) at the application level, which works on top of other wireless networks and not just the LTE (as 3G, 2G, WiFi and others).
- The IMS is not new: it already existed before the LTE.

ELEMENTS OF THE IMS

Media Gateway Controller Function (MGCF)
MGCF is the control element that communicates with other PSTN networks.

Media Resource Function(MRF)
provides services related to voice, such as conferences, announcements, voice recognition and so on.

Session Border Controller(SDC) is an element of the edges of the IMS to control signaling and often the media streams involved in calls.

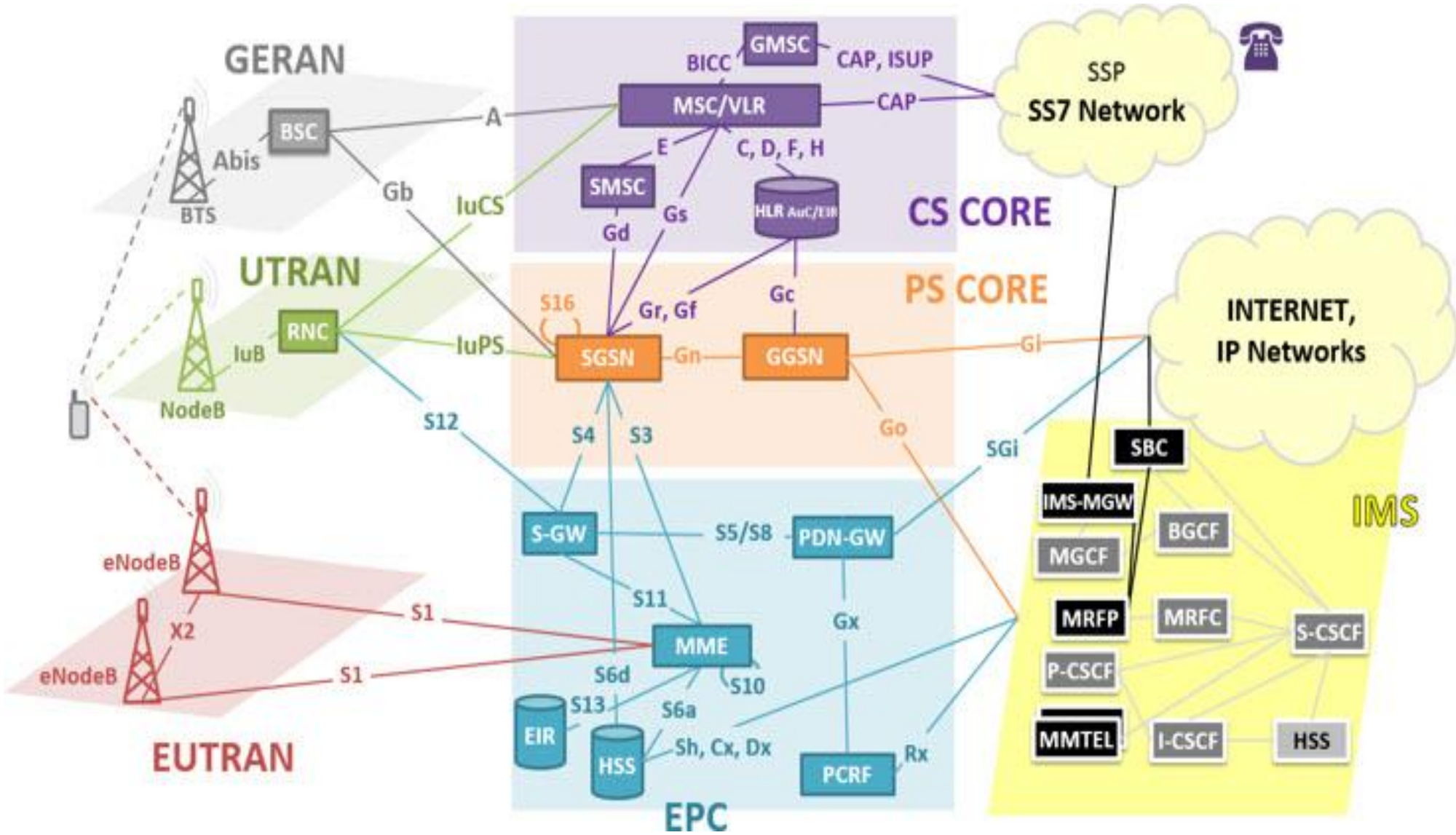


IMS Media Gateway(MGW)
is the element that takes care of voice functions for example making protocol translation required to support the call such as the Real Time Transport Protocol (RTP) to analog format or basic PCM in the CS network; and vice versa.

Border Gateway Control Function BGCF)
Provides routing functions.

Home Subscriber Server(HSS)
Also exists in the LTE EPC (although appeared first in IMS), and its functions are similar.

VOICE OVER LTE ARCHITECTURE



VOICE OVER WIFI (VoWiFi)

1. Some operators use VoWiFi to offload voice traffic over a WiFi network.
2. Though VoWiFis is the commercial name, the service is sometime referred as Evolved Packet Data Gateway (EPDG), WiFi Offload, etc.
3. Similar to VoLTE, VOWiFi uses the IMS to initiate, connect and control voice communications.