



# Towards Fixed Mobile Convergence (FMC) Innovation

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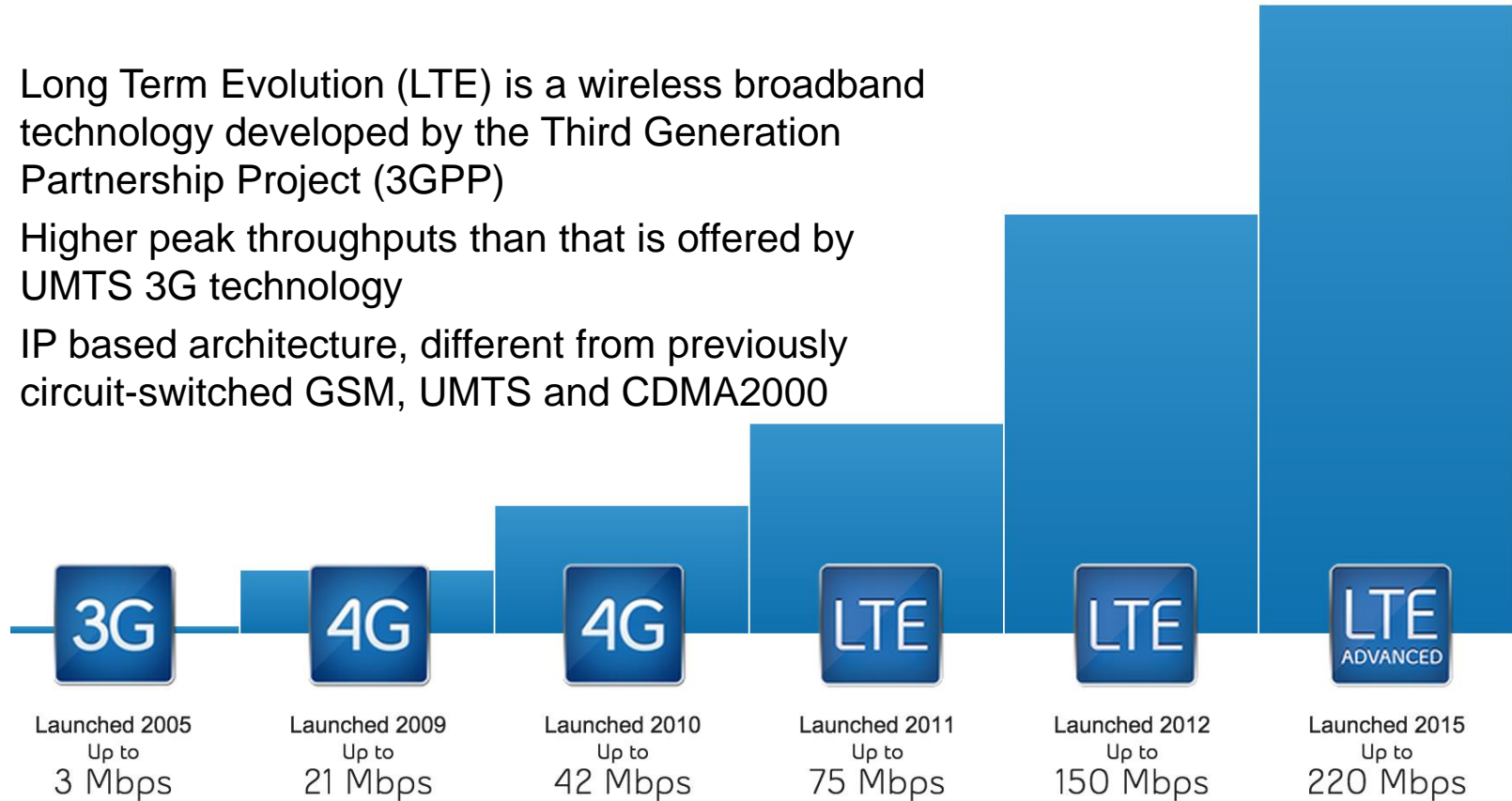
# Who is ITEC?

- TAMU ITEC established in 2004
- Premier Public Safety Communications Center in U.S.
- Developed, deployed and tested first NG 9-1-1 system in the world with U.S. DoT funding; FirstNet public safety broadband LTE project
- Would leverage over \$6 million in real time communications assets donated to the lab by industry leaders



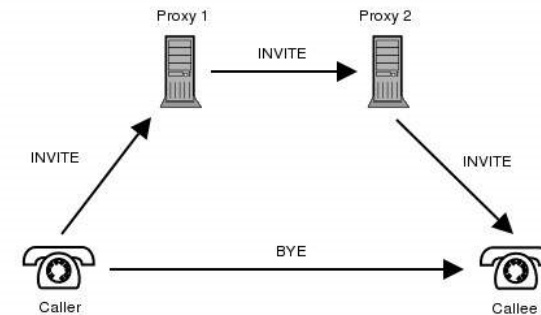
# Long Term Evolution (LTE)

- Long Term Evolution (LTE) is a wireless broadband technology developed by the Third Generation Partnership Project (3GPP)
- Higher peak throughputs than that is offered by UMTS 3G technology
- IP based architecture, different from previously circuit-switched GSM, UMTS and CDMA2000



# IP Multimedia Subsystem (IMS)

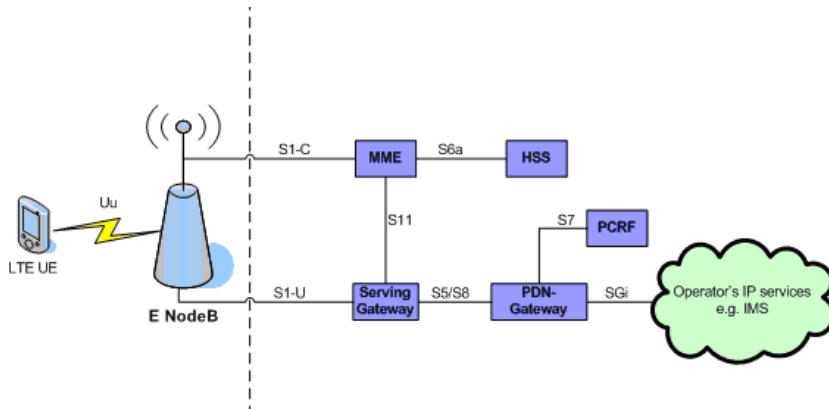
- **IMS**, as a standardized architecture, enables convergence on multiple fronts, including access types (fixed, mobile), service types, application control functions and convergence between telephony and traditional data delivery
- **IMS** uses IETF protocols wherever possible, e.g., **SIP** (Session Initiation Protocol), RTP and Diameter
- **LTE** is actually a wireless broadband technology developed to support roaming Internet access using mobile phones with the benefit of spectral efficiency as well as spectrum re-farming.
- While, **IMS** is more of an architectural framework designed to support IP multimedia services and has been around for some time.
- **SIP** is a communications protocol for signaling and controlling multimedia communication sessions. The most common applications of **SIP** are in Internet telephony for voice and video calls, as well as instant messaging, over Internet Protocol (IP) networks.



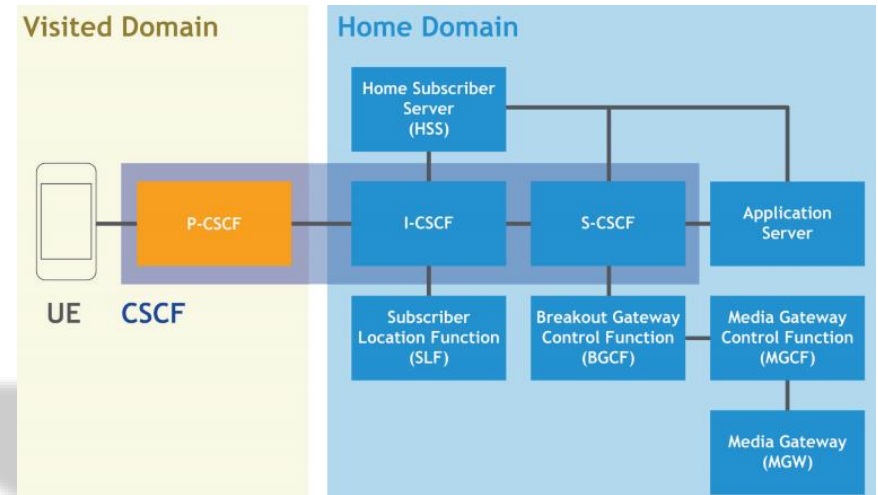
SIP Basic Call Flow

# LTE and IMS

- Both IMS and LTE have similar key components such as Home Subscriber Server (HSS) and Policy and Charging Rule Function (PCRF).



- UE: User Equipment
- E-UTRAN: The Evolved UMTS Terrestrial Radio Access Network
- EPC: The Evolved Packet Core
- MME: Mobility Management Entity
- PCRF: Policy and charging rules function
- CSCF: Call Session Control Function
  - P- : Proxy
  - I- : Interrogating
  - S- : Serving



# Fixed-mobile convergence (FMC)

- FMC is the trend towards seamless connectivity between fixed and wireless telecommunications networks. It also describes any physical network that allows cellular telephone sets to function smoothly with the fixed network infrastructure
- The ultimate goal of FMC is to optimize transmission of all data, voice and video communications to and among end users, no matter what their locations or devices. In the more immediate future, FMC means that a single device can connect through and be switched between wired and wireless networks.



# Why FMC?

FMC user benefits include:

- Dual-Mode Mobile solution (cellular & local wireless network)
  - Native mobile dialer integration for communication features, e.g. call handover
- Mobility with seamless communication across communications platforms
  - PC, tablet, phone, etc.
  - One or more identity available for a single device
- Consistent policy enforcement across diverse fixed-line assets & mobile services
  - Better user experience
  - Pavement to secured policy design

Moreover, in the operators' view:

- Unifying common resources (SBC, subscriber management, call control)
- Centralized routing
- Use of the mobile cloud to deliver an evolved business continuity approach
- Blending of existing business PBX services with new mobile features

# Goal

- To research and develop a new Fixed Mobile Convergence (FMC) architecture that will revolutionize the way that universities manage mobile communications in their community
- This project involves an donated IMS core and FMC applications
- Timeline:
  - Initial setup → Aug 2016
  - IMS – LTE → Oct 2016
  - IMS – Wi-Fi → Nov 2016
  - FMC applications → Feb 2016



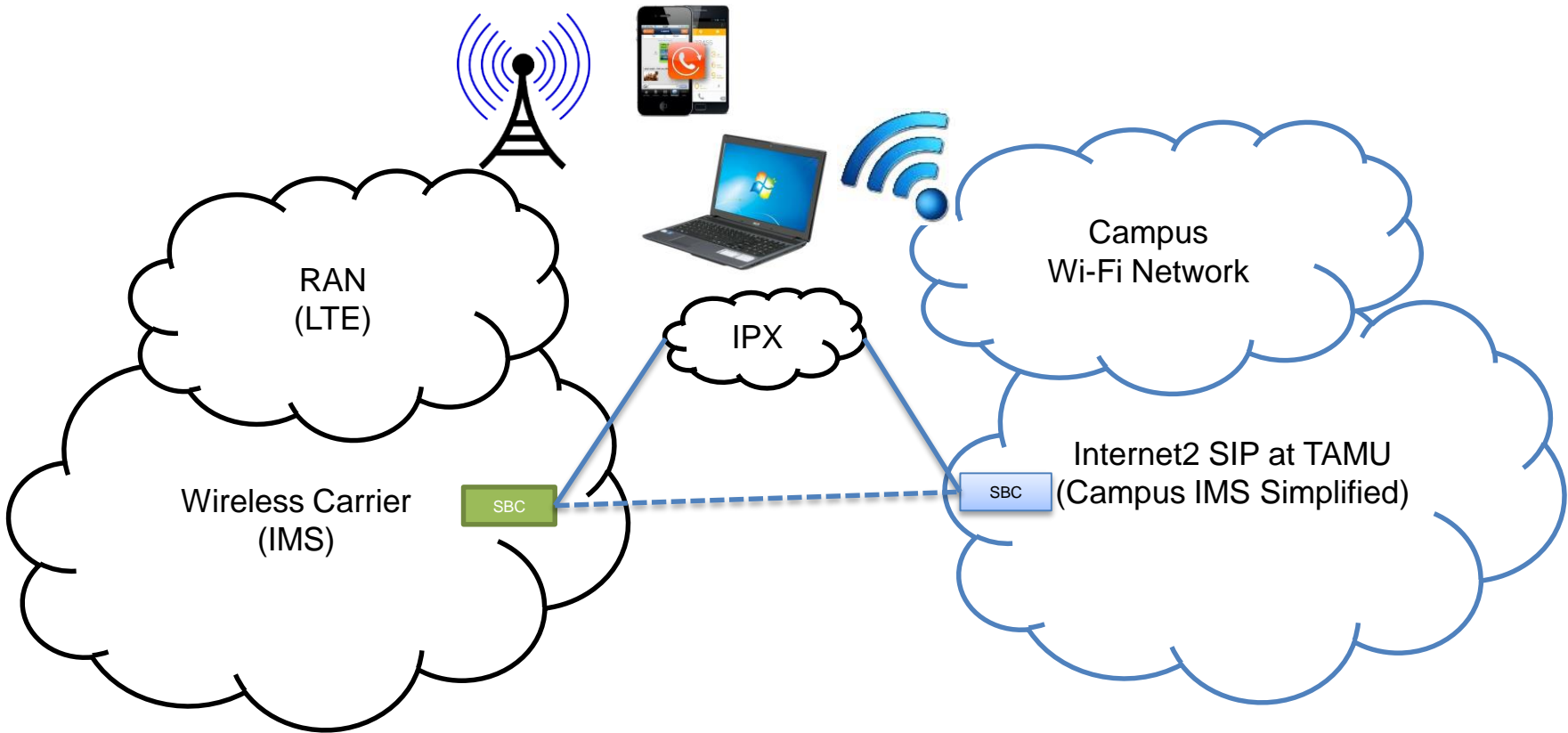


# Tasks

- Integrate IMS core with the Public Safety Broadband Network (PSBN), established in the ITEC labs for use as the Voice over LTE (VoLTE) solution for FirstNet
- Establish a recommended Higher Education Wi-Fi off load solution with collaboration with Wi-Fi equipment manufacturers and Wireless Service Providers
- Evaluate the feasibility of integrating a global MVNO higher education service
  - Mobile Virtual Network Operator: An MVNO is a company that sells mobile phone service by making use of another company's existing network infrastructure. An MVNO will have its own rates and calling plan features, its own billing system, and its own customer service
- Test and document applications that are running under the FMC architecture
  - Examples: Seamless call transfer between Wi-Fi and LTE, Voicemail accessibility for third party applications, etc.



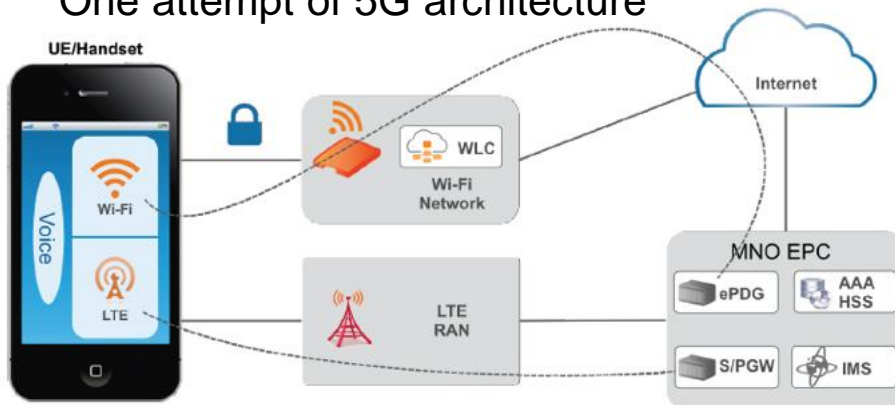
# Architecture



IPX: Internetwork Packet Exchange. A big advantage of IPX protocol is that it simplifies “Many to Many” peering.

# Wi-Fi calling

- Currently, direct Wi-Fi calling (and messaging) has been enabled by US Carriers such as AT&T, Sprint, & T-Mobile, as an IMS service.
  - Services are provided to users via the IMS telephony application server irrespective of access type (such as WiFi or 3G/4G RAN)
  - Operators are willing to deliver services across radio access they don't own or manage.
- Different from Skype, Hangout, which are mobile apps
- Lack of Quality of Service, or QoS, because Wi-Fi directly sends packets to internet which has no prioritization service
- With our FMC architecture design, campus/enterprise Wi-Fi users would be able to have an option of LTE-like calling
- One attempt of 5G architecture



# Discussion

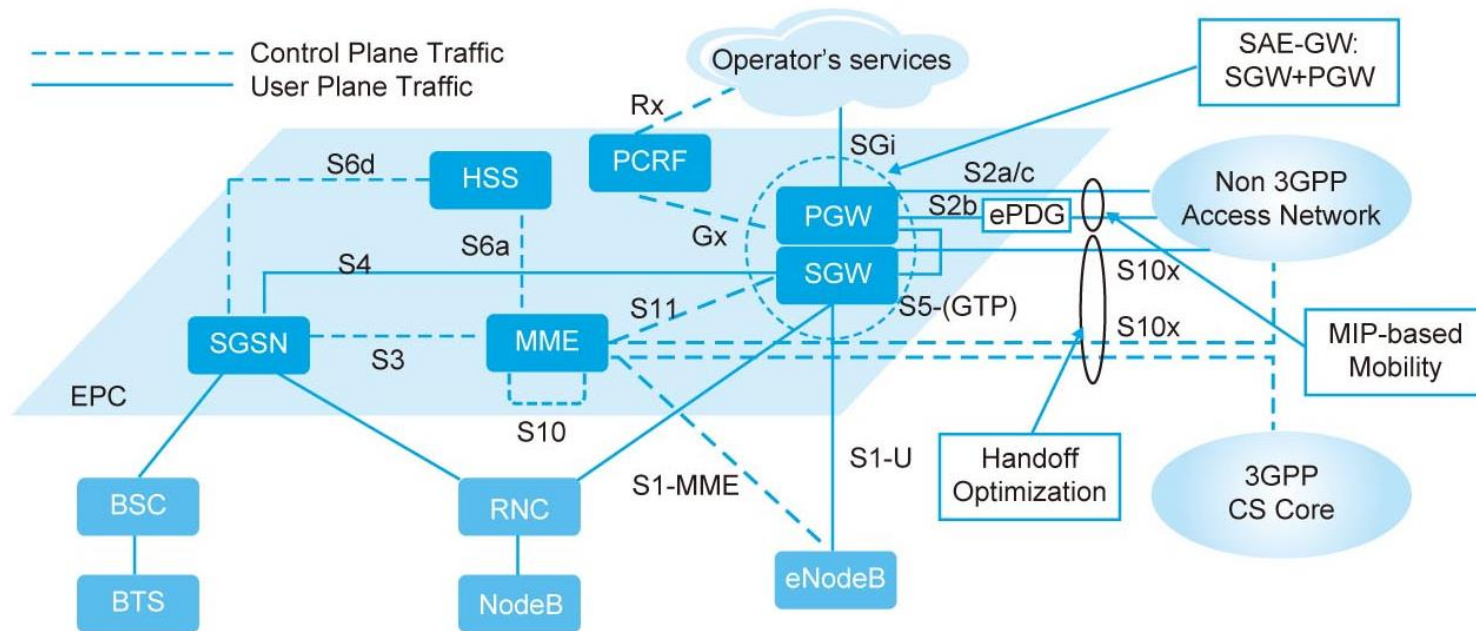
- Challenges:
  - Integration of IMS – LTE networks from different vendors, implementation details differs
  - Alignment of Wi-Fi QoS and IMS QoS, policy translation needed
  - Potential security issues may exposed due to the open nature of IP-based network, delegate design required for preventing free channels, DDoS attacks, etc.
  - Data management among different architectures and services
- State-of-the-art:
  - Software Defined Network (SDN) maybe used for easy management and network-wide monitoring
  - SDN architecture decouples the network control and forwarding functions enabling the network control to become directly programmable and the underlying infrastructure to be abstracted for applications and network services, e.g. QoS, firewalls, IDS, etc.

- Questions?

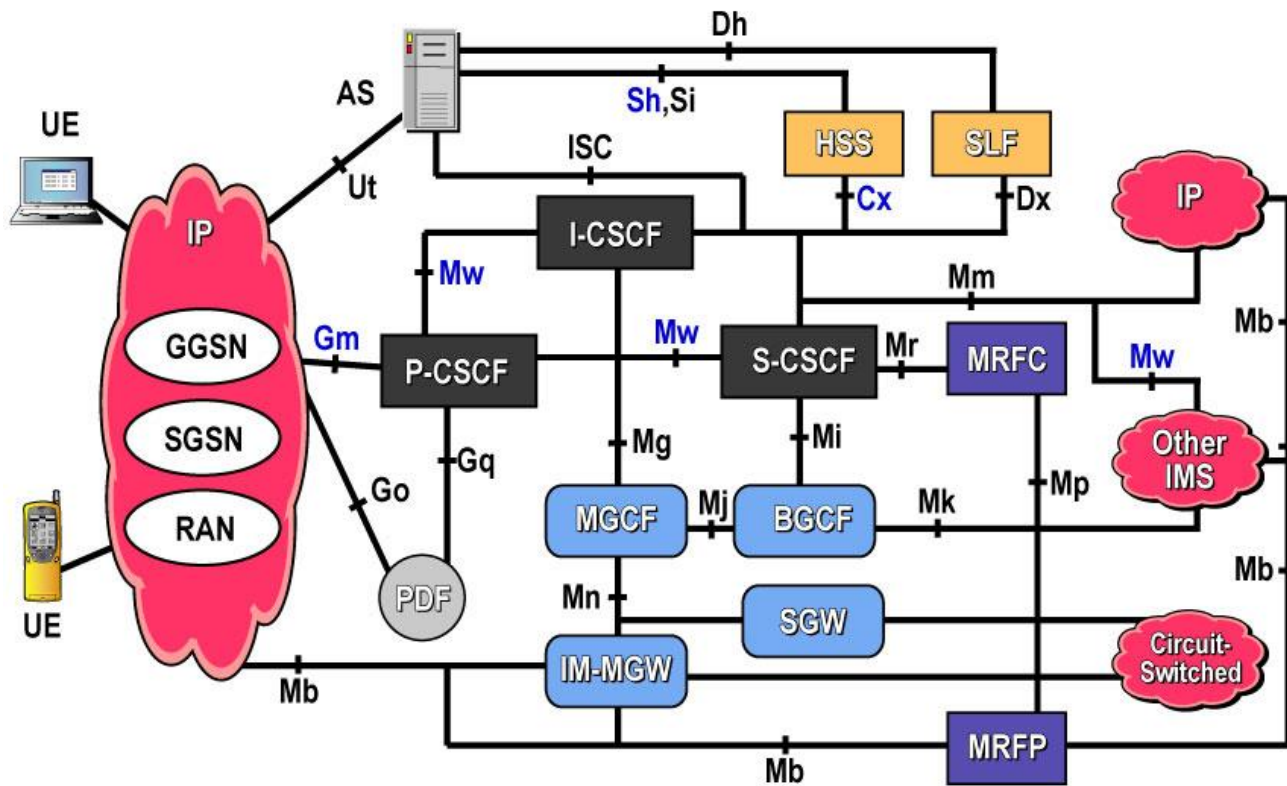
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# LTE Architecture



# IMS Architecture



# CSCF

- The Serving-CSCF (S-CSCF) performs the session control services for the UE. It maintains a session state as needed by the network operator for support of the services
- Interrogating-CSCF (I-CSCF) is the contact point within an operator's network for all connections destined to a subscriber of that network operator, or a roaming subscriber currently located within that network operator's service area.
- The Proxy-CSCF (P-CSCF) is the entry point to the IMS domain and serves as the outbound proxy server for the UE. The UE attaches to the P-CSCF prior to performing IMS registrations and initiating SIP sessions. The P-CSCF may be in the home domain of the IMS operator, or it may be in the visiting domain, where the UE is currently roaming. For attachment to a given P-CSCF, the UE performs the P-CSCF discovery procedures. Attachment to the P-CSCF is necessary for the UE for initiating IMS registrations and sessions.