# LTE (Long Term Evolution) Project in Kurdistan

2015/2016

Amanj Abdulrahman Hama Amin

## LTE definition;

LTE (Long Term Evolution) is known as the evolution of radio access technology conducted by 3GPP.
The radio access network will evolve to **E-UTRAN** (Evolved UMTS Terrestrial Radio Access Network), and the correlated core network will evolve to **SAE** (System Architecture Evolution).

### LTE Long Term Evolution

This paper is described about the real project for the LTE or 4G network that we done in Kurdistan, LTE is a latest technology that deployed in overall world, even in Iraq only deployed in Kurdistan.

### Description of LTE:

LTE has been designed to support only packet-switched services; it aims to provide seamless Internet Protocol (IP) connectivity between user equipment (UE) and the packet data network (PDN), without any disruption to the end users' applications during mobility.

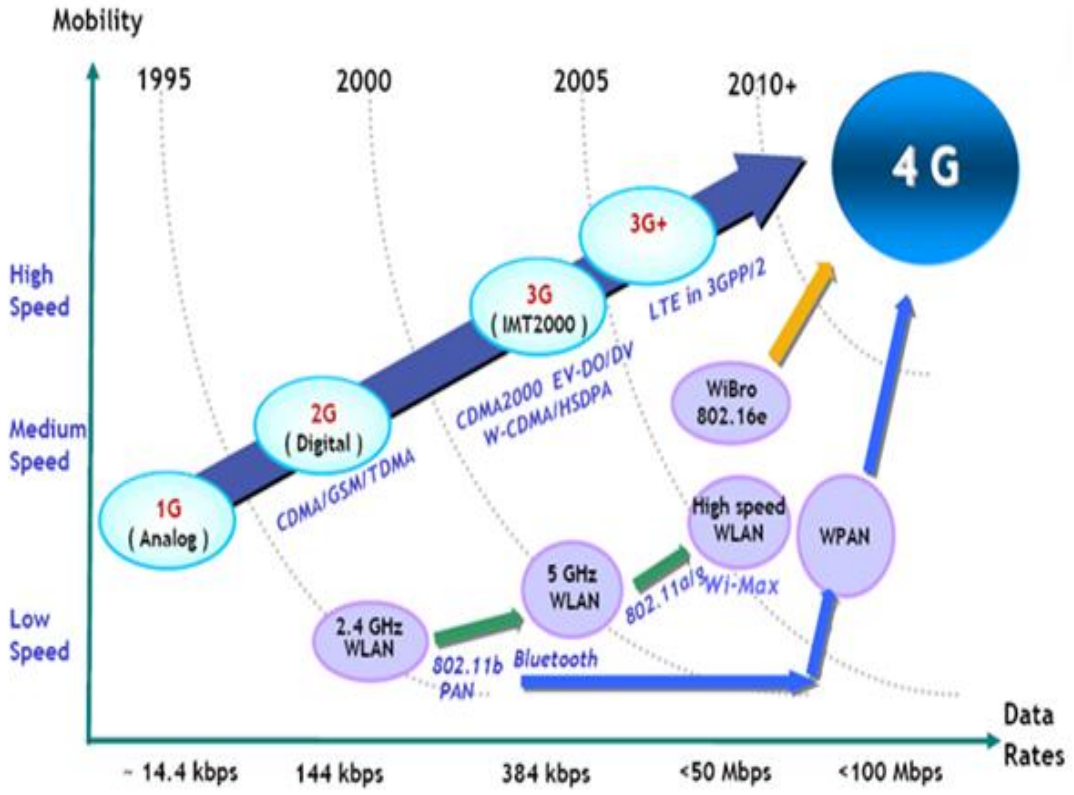
### LTE capacity and compare with 3G:

Usually LTE service can provide the high bandwidth which is per one site can provide 100~200 Mbps capacity, while in 3G network can provide max. 45Mbps, by another meaning for 3G network in one kilo meter square required 10 sites but in LTE/4G network required 100 sites which is mean more distance to be covered.

For the LTE network some principle need to be considered like what kind of frequency need to choose and what type of network architecture should be consider.

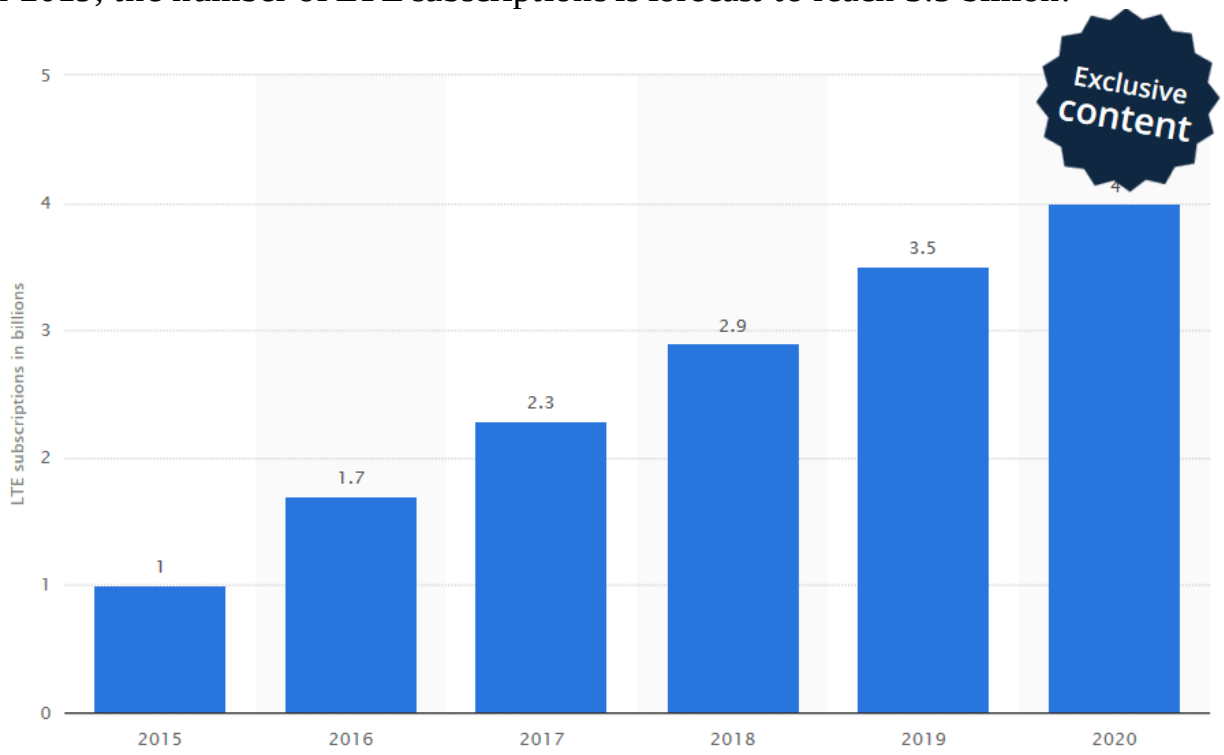
**What is LTE Encompassing?**

While the term "LTE" encompasses the evolution of the Universal Mobile Telecommunications system (UMTS) radio access through the Evolved UTRAN (E-UTRAN), it is accompanied by an evolution of the non-radio aspects under the term "System Architecture Evolution" (SAE), which includes the Evolved Packet Core (EPC) network, together LTE and SAE comprise the Evolved Packet System (EPS),
EPS uses the concept of EPS bearers to route IP traffic from a gateway in the PDN to the UE.
A bearer is an IP packet flow with a defined quality of service (QoS) between the gateway and the UE, the E-UTRAN and EPC together set up and release bearers as required by applications.



LTE has been developing since 2008 with tremendous promises or expectations not only for extended speed, bandwidth and capacity, but also for features that 2.5G and 3G/HSPA networks failed to crystallize, with the first LTE networks launched in 2009 in North Europe, today LTE is the fastest developing mobile system technology ever with 105 networks in 48 countries worldwide –expecting 159 by end 2012 – serving nearly 30 million subscribers.

Number of LTE subscriptions worldwide from 2015 to 2020 (in billions).
The statistic shows a forecast for the number of 4G/LTE subscriptions worldwide from 2015 to 2020.
In 2019, the number of LTE subscriptions is forecast to reach 3.5 billion.




**What can LTE do?**

- Flexible bandwidth configuration: supporting 1.4MHz, 3MHz, 5MHz, 10 MHz, 15 MHz and 20MHz.
- Peak date rate (within 20MHz bandwidth): 100Mbps for downlink and 50Mbps for uplink.
- Time delay: <100ms (control plane), <5ms (user plane).

- Provide 100kbps data rate for mobile user (up to 350kmph).
- Support eMBMS.
- Circuit services are implemented in PS domain: VoIP.
- Lower cost due to simple system structure.

**Frequency Band of LTE;**

- Duplex mode: FDD and TDD
- Support frequency band form 700MHz to 2.6GHz
- Support various bandwidth: 1.4MHz, 3MHz, 5MHz, 10MHz, 15MHz, 20MHz

FDD Frequency Band

| **E-UTRA Band** | **Uplink (UL)** | **Downlink (DL)** | **Duplex Mode** |
|---|---|---|---|
| | **$F_{UL\_low}$ – $F_{UL\_high}$** | **$F_{DL\_low}$ – $F_{DL\_high}$** | |
| 1 | 1920 MHz – 1980 MHz | 2110Mhz – 2170 MHz | FDD |
| 2 | 1850 MHz – 1910 MHz | 1930 MHz – 1990 MHz | FDD |
| 3 | 1710 MHz – 1785 MHz | 1805 MHz – 1880 MHz | FDD |
| 4 | 1710 MHz – 1755 MHz | 2110 MHz – 2155 MHz | FDD |
| 5 | 824 MHz – 849 MHz | 869 MHz – 894MHz | FDD |
| 6 | 830 MHz – 840 MHz | 875 MHz – 885 MHz | FDD |
| 7 | 2500 MHz – 2570 MHz | 2620 MHz – 2690 MHz | FDD |
| 8 | 880 MHz – 915 MHz | 925 MHz – 960 MHz | FDD |
| 9 | 1749.9 MHz – 1784.9 MHz | 1844.9 MHz – 1879.9 MHz | FDD |
| 10 | 1710 MHz – 1770 MHz | 2110 MHz – 2170 MHz | FDD |
| 11 | 1427.9 MHz – 1452.9 MHz | 1475.9 – 1500.9 MHz | FDD |

| | | | |
|---|---|---|---|
| | | MHz | |
| 12 | 698 MHz – 716 MHz | 728 MHz – 746 MHz | FDD |
| 13 | 777 MHz – 787 MHz | 746 MHz – 756 MHz | FDD |
| 14 | 788 MHz – 798 MHz | 758 MHz – 768 MHz | FDD |
| … | … | … | … |
| 17 | 704 MHz – 716 MHz | 734 MHz – 746 MHz | FDD |

**TDD Frequency Band**

| **E-UTRA Band** | **Uplink (UL)** | **Downlink (DL)** | **Duplex Mode** |
|---|---|---|---|
| | **$F_{UL\_low}$ – $F_{UL\_high}$** | **$F_{DL\_low}$ – $F_{DL\_high}$** | |
| 33 | 1900 MHz – 1920 MHz | 1900 MHz – 1920 MHz | TDD |
| 34 | 2010 MHz – 2025 MHz | 2010 MHz – 2025 MHz | TDD |
| 35 | 1850 MHz – 1910 MHz | 1850 MHz – 1910 MHz | TDD |
| 36 | 1930 MHz – 1990 MHz | 1930 MHz – 1990 MHz | TDD |
| 37 | 1910 MHz – 1930 MHz | 1910 MHz – 1930 MHz | TDD |
| 38 | 2570 MHz – 2620 MHz | 2570 MHz – 2620 MHz | TDD |
| 39 | 1880 MHz – 1920 MHz | 1880 MHz – 1920 MHz | TDD |
| 40 | 2300 MHz – 2400 MHz | 2300 MHz – 2400 MHz | TDD |

**Why is LTE Essential for Operators?**

While LTE markets and technology has still to fully mature, LTE is entering now a new development phase where it is becoming a mainstream technology. Operators are investing massively in LTE networks, getting into a race for launching "first", urging regulatory bodies to release licenses, reframing spectrums where possible.
Because it can work on any frequency and any spectrum, and because it is an all IP network, LTE includes a set of features that help operators:

- Accommodate for the growing number of mobile broadband users and the exponential traffic development,
- Manage network costs efficiently,
- Leverage customers' value with differentiated value propositions.

**LTE Features;**

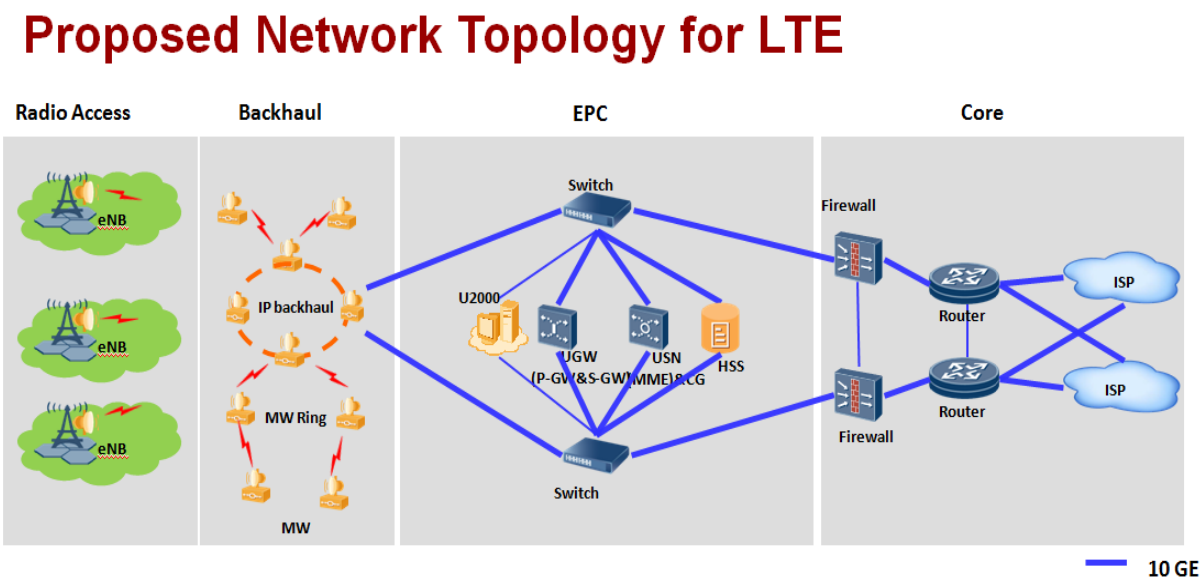
These features offer the following capabilities:

- Higher bandwidth,
- Higher coverage,
- Higher number of simultaneous customers (capacity),
- Better pooling of network parts,
- Flat and cost effective network architecture,
- Convergence of voice and data services for better network an spectrum efficiency,
- Customers, Applications and Services profiling to set a rich portfolio of differentiated value propositions for all customers' tastes and needs.

In short, LTE helps operators serve a demanding and growing mobile broadband mass market at the best cost, maximizing revenues and segments values with future proof investments.

**LTE Implementation in Kurdistan:**

In 2014 we start to implement two big projects in Kurdistan for LTE network, our responsibility to provide end to end solution include IP core, IP backhaul and access sites, the topology as shown below;

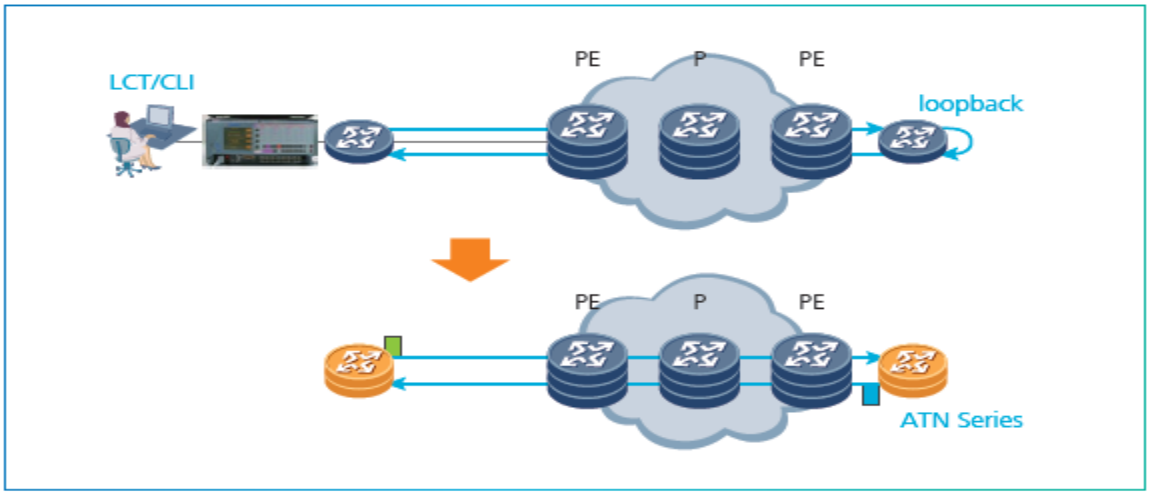



**LTE Network Architecture;**

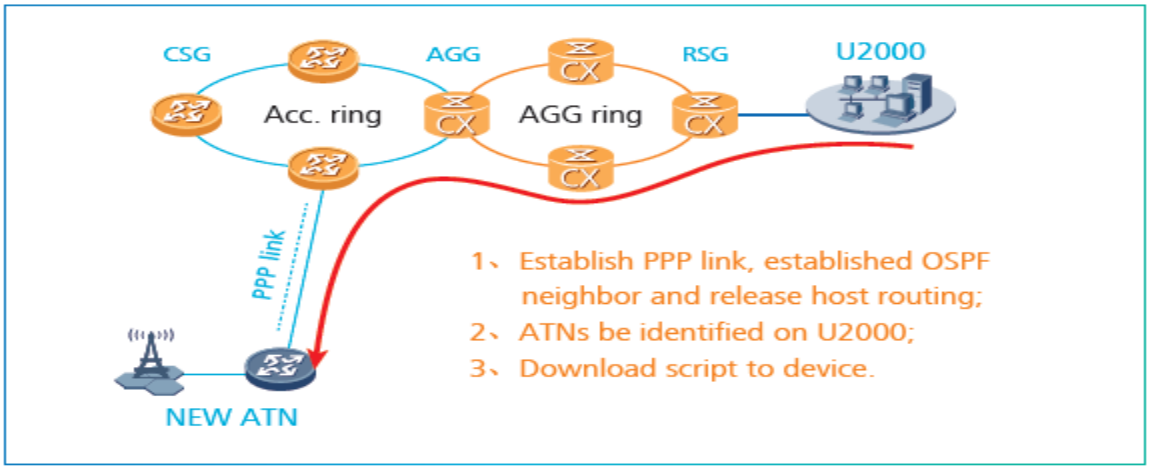
The LTE Network includes the following parts;

Core part; the core part include the following network elements;

- Router, the router is important to make the interconnection between inside and outside of the network, mainly used to import public IP to private IP and used for the BGP (Border Gateway Protocol).




- Firewall; mainly used to make a protection of the network and using the network full secure, the firewall used to prevent the attack from outside of the network that trying to hack the network.
- Switch: the switch is used to make the integration for all network elements inside of IP core, the interconnection between switch and other network elements must be GE and 10GE interface.
- HSS: its core network element and the main function for accounting the users.
- USN: it's a core network element and main function for signaling.
- UGW: it's a main network element used to define accounting, authentication and authorization for each users.
- NMS; stand for Network Management System, it's used to manage all Network elements remotely.



Backhaul or Transmission part;

In this part can carry all traffic from core part to the access part and used the following products;

- Fiber: fiber connection is more important to use as a transmission and aggregate all traffic, usually using dark fiber and distribute through some node of routers or DWDM.
- Router, this equipment is more important to make routing protocol and using IP/MPLS n the ring of fiber connection.

Access part;

It's a last part of LTE architecture, in this part use to connect the aggregation to access site, if the transmission use a fiber from aggregation to the site then there is no MW and usually in access site using switch or small router to make the IP integration.

- Wireless site; in this site directly users can connect to the wireless and access the internet.
- Wireless usually contain as two main part which is RRU (radio remote unit) and BBU (base band unit).