

5G WIRELESS ARCHITECTURE

By Vadan Mehta

About Author

Vadan Mehta is having 12 years of experience in wireless telecommunication. He is PMI certified PMP and Cisco certified IPTD. Currently, he is working as telecom consultant for Tata consultancy services (TCS).

ABSTRACT

This document represents personal views on 5G network architecture, especially for wireless service providers. Document has 3 segments, Brief history of wireless telecommunication, 4G network architecture, Network Infrastructure sharing and 5G network architecture.

INTRODUCTION

“Before you create future, you must envision it “

: UNKNOWN

We are living in era of convergence. Convergence is merging of technologies, domain and discrete IT systems. Basic of convergence lies in Digitization. The digitization of everything is creating a more natural communications experience. Boundaries separating various technologies, engineering practices, functions etc. are dissolving. So tomorrow, our car, our mobile phone, our home security system, our office, all the systems that surround us, will communicate with each other automatically to fill our environment with our preferences and our need to feel connected anywhere, anytime and with anyone, across the world. This is called Ubiquitous Computing paradigm.

Wireless technologies are going to take taking new dimension in our lives. The wireless broadband will soon become readily available to everybody while, being at home, driving the car, sitting in the park, and even on a pleasure boat in the middle of a lake. And because of this, our need to have information at anytime and to be connected at all places, all the time, will be satisfied.

The world of universal, uninterrupted access to information, entertainment and communication will open new dimension to our lives and change our life style significantly.

This article is presenting vision of 5G network architecture, explaining concept of Ubiquitous computing, Super Core and Evolution of managed services.

Brief History of Telecom

Moore's law

The way that "Moore's Law" is usually cited is: *"the number of transistors that can be fit onto a square inch of silicon doubles every 12 months."* Moore's law describes a long-term trend in the history of computing

hardware but it also prove true for wireless technologies. From 1G (First Generation) to 4G (4th Generation), wireless bit rate has increased from 2.4 Kbps to 100 Mbps.

Brief description of Wireless Generations:

1G:

The first generation, 1G wireless mobile communication systems, was introduced in the early 1980s and completed in the early 1990s. 1G was analog and

supported the first generation of analog cell phones with the speeds up to **2.4kbps**. The prominent ones among 1G system were advanced mobile phone system (AMPS), Nordic mobile telephone (NMT), and total access communication system (TACS)

2G:

The second generation, 2G system, fielded in the late 1980s and finished in the late 1990s, was planned mainly for voice transmission with digital signal and the speeds up to **64kbps**. GSM and CDMA IS 95 were prominent technologies.

2.5G

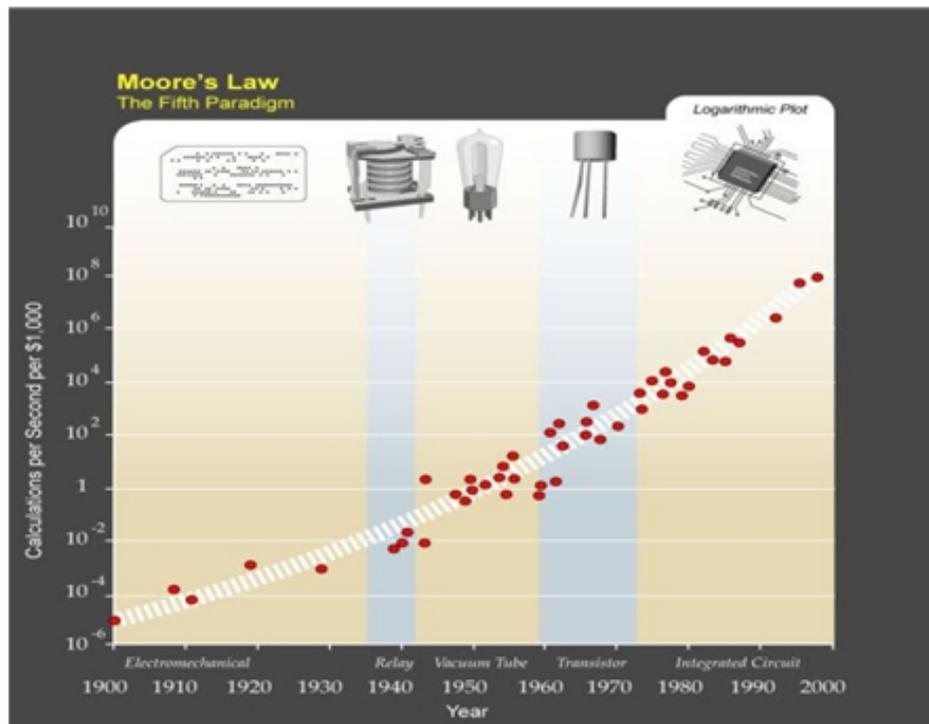
2.5G is used to describe 2G-systems that have implemented a packet switched domain in addition to the circuit switched domain. 2.5 G can provide data rate, up to **144 kbps**. GPRS, EDGE and CDMA 2000 were 2.5 technologies.

3G:

The third generation, 3G wireless system, was developed in the late 1990s and might be well-done in the late 2000s. 3G is not only provided the transmission speeds from **125kbps to 2Mbps**, but also included many services, such as global roaming, superior voice quality and data always add-on. UMTS, CDMA Evdo, HSPA are 3G technologies.

4G:

The fourth generation (4G) is a conceptual framework and a discussion point to address future needs of a high speed wireless network that can transmit multimedia and data to and interface with wire-line backbone network perfectly just raised in 2002. The speeds of 4G can theoretically be promised up to **1Gbps**. LTE is considered as 4G technology.

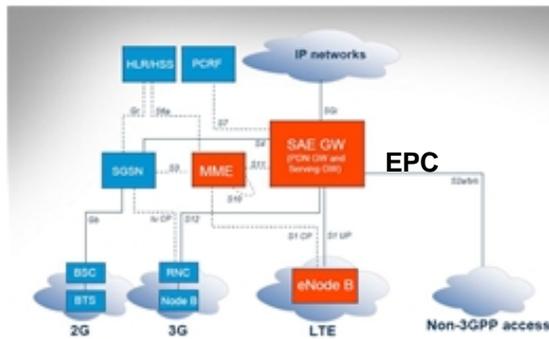


4G Architecture

4G is being developed to accommodate the QoS and rate requirements set by forthcoming applications like wireless broadband access, Multimedia Messaging Service (MMS), video chat, mobile TV, HDTV content, Digital Video Broadcasting (DVB), minimal services like voice and data, and other services that utilize bandwidth. The definition of 4G is to provide adequate RF coverage, more bits/Hz and to interconnect all wireless heterogenous networks to provide seamless, consistent telecom experience to user.

Evolved Packet Core (EPC)

Evolved Packet Core is the IP-based core network defined by 3GPP (Telecom standard) for use by LTE and other access technologies. The goal of EPC is to provide simplified all-IP core network architecture to efficiently give access to various services such as the ones provided in IMS (IP Multimedia Subsystem). EPC consists essentially of a Mobility Management Entity (MME) and access agnostic Gateways for routing of user datagram. EPC will be a completely new architecture for wireless operators, one that emulates the IP world of data communications rather than the voice-centric world of wireless. EPC is based on flat IP

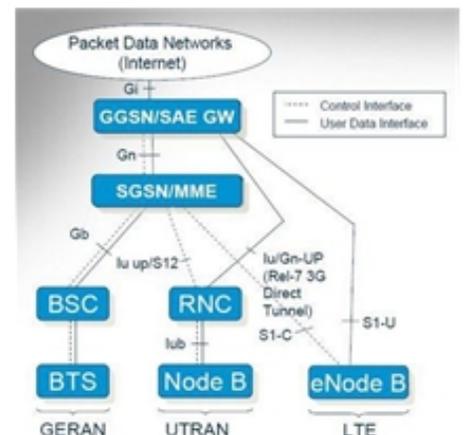


network theory.

FLAT IP ARCHITECTURE

Premise of 4G, is resting on All IP architecture.

Mobile networks have been designed up to this point — for circuit-switched voice. Wireless networks were designed in a hierarchal fashion to aggregate, authenticate, manage and direct calls. A BSC aggregates calls from multiple base stations, allocates radio channels, enables handoffs between base stations and passes on calls to an even more centralized mobile switching center. As packet data networks emerged, they were overlaid on the existing voice-centric architecture, using the BSC for the same mobility management functions and adding the SGSN and GGSN in the case of GSM/UMTS and a PDSN in the case of CDMA to route and manage data sessions, as well as to connect to the Internet or appropriate IP network. As data traffic is increasing rapidly, this voice centric architecture has become cumbersome and harder to manage with too many network entities.



Flat network architecture removes that voice-centric hierarchy from the network. Instead of overlaying a packet data core on the voice network, separate and much-simplified data architecture can be implemented that removes the multiple elements from the network chain. BSC functions are divided between Base station and media gateway router. Base station will communicate directly via 3GDT (3G direct tunnel) with media gateway over WAN (Carrier Ethernet, MW, DWDM etc). Some of the functions of BSC/RNC such as Radio resource management, Radio Bearer Control, and Dynamic allocations of resources will be handled by base stations, while functions such as Distribution of paging messages, Security will be function by mobility manager, located in Gateway router.

This approach has clearly visible advantages. It will save significant amount of Capex and Opex as, service provider will have fewer hops and fewer network entities. By reducing the number of hops on the network, data travels faster between end points, greatly reducing the network latency to help support real-time applications such as voice over IP (VoIP), gaming and videoconferencing.

The flat IP architectures have emerged with WiMAX, and future LTE networks will be flat by definition.

This article is written by Vadan Mehta (vadanmehta@rediffmail.com)