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Problems of GNSS and 4G Wireless Networks

Dr. Atul M. Gonsai[1], Ravirajsinh S. Vaghela[2]

[1]Department of Computer Science, MCA department, Saurashtra University, Rajkot India

[2]Department of Computer Science, R. P. Bhalodia College, Saurashtra University, Rajkot, India

Abstract: ***This paper presents problem list of most buzzing two radio technology 1) GNSS (Global navigation satellite system) is nowadays essential integrated part of our life style and business. GNSS is now mature radio technology after long time span& evaluation but can easily victim of others. 2) Now days you are in the4th generation in mobile technology which provide QOS to end user. Yet both technologies have different utility and application they make great impact on radio technology usage and management. Here we focus on problems and challenges of the both radio technology.***

Keywords: GNSS, 4G, LTE, eNodeB, RFI

1. Introduction of GNSS

The GNSS is satellite based navigation system comprised of a network of orbiting satellites that provide location and time information, anywhere on or near earth. [1]

A. Importance& utility of GNSS

The tightest synchronization requirements lead to the need of highly accurate clock settings that can be accomplished by means of GPS satellites systems.[2]Preventing collisions involving surface mining equipment [3].GPS is utilized within the public safety services in a number of ways.

B. Why GNSS more likely to be a victim?

The main Reason behind the victim is that the signal received from satellite are very weak. First satellite is faraway at least 20000 km. Second Transmitter power is 27W. The signal power is low near ground level $10^{-16}$and 20db below background noise level. In radio signal applications, if the signal is not above the noise, it is not useful. [4]

C. Limitation & Problems of GNSS

GPS is designed for open-sky applications and its coverage is often limited in many indoors and urban canyon areas.[5]A GPS receiver must lock onto the signal from at least four satellites then track them accurately. Radio frequency Interference is a major source for potential degradation of GPS accuracy and reliability. Other sources of error which degrades GPS accuracy and make RFI mitigation harder include satellite and user motions which introduce Doppler effects, slow power fluctuations (due to changes in effective antenna gain and path loss) and fast power changes (due to multipath fading, blocking and shadowing). Doopler fluctuations make it difficult to distinguish between user motion and receiver clock drift, Power fluctuations make it difficult to determine the thresholds for acquisition and tracking whereas atmospheric errors introduces range and range-rate errors.[10]

Narrowband interference can severely degrade the performance of GPS receiver. It affects the operation of the automatic gain control (AGC) and low noise amplifier(LNA) in the RF front-end [8] and depending on how much of it passes through these primary modules. It can also effect the carrier and code tracking loops[9] which results in deterioration of all the GPS.

GPS signals can be severely affected by scintillations due to plasma irregularities, especially in the equatorial regions.[6]GPS can have significant effect of solar radio emission and GPS positioning was partially disrupted on the entire sunlit side of the earth.[7]GPS signals were initially designed with cross-correlation interference immunity of about 20 dB which is apparently not sufficient for ad-hoc networking in weak signals. [4]

i) Survey Reports of GPS Accident/Incidence

Figure 1: [**San Diego Harbour** In January 2007, GPS services were significantly disrupted throughout San Diego, California]

Many radio technology equipment stopped working near harbour like Naval Medical centre emergency pagers,traffic management system for guiding boats failed, and airport traffic control, cell phones users found they had no signal, and bank customer found Automated Teller Machines (ATMs) problems. They also blocked GPS signals across most area the city. It took three days to find an explanation for this mysterious event: two Navy ships in the SanDiego harbor had been conducting a training exercise when technicians jammed radio signals.

ii) NewYork Airport

In August 2013, the FCC fined a truck driver, after concluding he interfered with Newyork Liberty International Airport's satellite based tracking system by using an illegal GPS jamming device in his pickup truck to hide from his employer. The signals emanating from the vehicle blocked thereception of GPS signals used by the air traffic control system.

Same incident in late 2009, engineers notice that satellite positioning receiver lose signal during certain times of the day. The Federal Aviation administrator (FAA) inspected the problem and after two months found a local truck driver was using the jammer. When he passed the airport area in his daily routine, the airport's systems would temporarily fail.

Airports and the FAA have back-up plans, processes and redundant systems that keep passengers safe. The GPS interference threat is real, but airports are better equipped to handle GPS outages than other industries that also rely on accurate GPS time and/ or location data.

iii) Ships in the English Channel

The U.K. has deployed a back-up ship navigation system in the English Channel to tackle the ever increasing risk of disruption to vessel GPS navigation devices. Seagoing vessels employ GPS to efficiently navigate and without it dense traffic patterns (figure 2) would require additional shipboard crew. The General Lighthouse Authorities (GLA) of the U.K. and Ireland launched a radiobased back-up system called eLoran to counter threats of jamming and GPS signal loss.

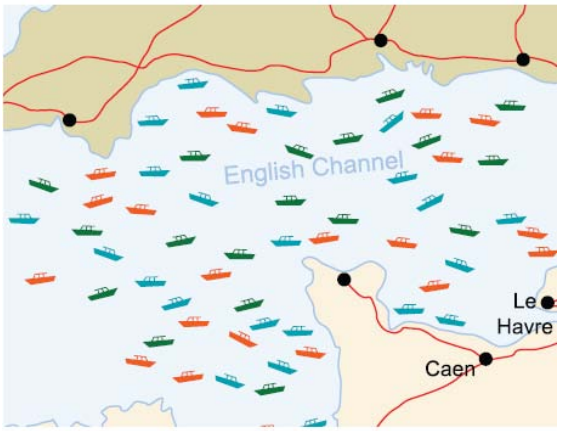


Figure 2: eLoran system for efficiently navigate and without it dense traffic patterns][11]

2. Introduction of 4G Wireless Network

The 4G networks are all-IP based heterogeneous networks that allow users to use any system at anytime and anywhere, and support a variety of personalized, multimedia applications such as multimedia conferencing, video phones, video/movie-on-demand, education-on-demand, streaming media, multimedia messaging, etc. As the technology matures, traffic congestion increases, and competitive pressures mount, QOS and policy management will become more and more important. 4th generation wireless network consist of Wimax and LTE (Long Term Evolution).Here, we are focus on LTEonly as 4g.

A. Overview of LTE Architecture

LTE architecture is designed for improving the performance, reducing the cost and delivering the services in more efficient way. Fig shows the Service Architecture Evolution (SAE) of LTE. It has two nodes, eNodeB (evolved Node B) as base station of LTE, and AGW (SAE Gateway). Fig shows the Service Architecture Evolution (SAE) of LTE. It has two nodes, eNodeB (evolved Node B) as base station of LTE, and AGW (SAE Gateway). LTE system standardizes the existing interfaces of HSPA for the interconnection of networks.

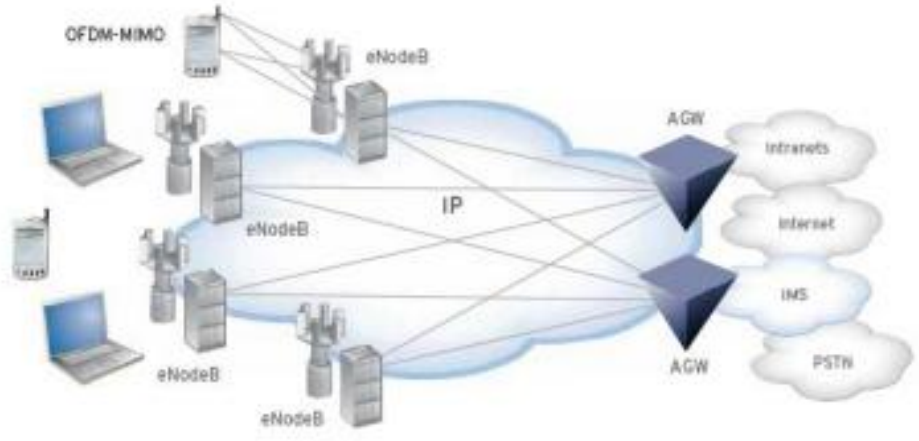


Figure 3: Architecture interconnection of networks

The existing architecture of WCDMA, CDMA2000, HSPA, and SGSN are integrated for developing the design of LTE. This helps the system to achieve the handovers in various networks. The architecture has several modules, each and

every module have specific functionalities. LTE uses retransmission technology for regulating the packets in eNodeB. For this base station have control plane and buffer for high speed data retransmission S1 interface is used to connect eNodeB and Evolved packet core, X2 is used to interconnect eNodeBs. eNodeBs is providing compression and encryption methodologies to the users. It is responsible for Routing.[12]

B. Importance

LTE is a 4G wireless technology standardized by the 3GPP (3G Partnership Project) that is being deployed today by leading operators around the world to provide high-speed data and multimedia services. The LTE market is growing rapidly. According to telecom research firm IDATE, there were more than 10 million LTE subscribers and 50 deployed LTE networks at the end of 2011, growing to an estimated 118 million subscribers and 200 networks in 2013. All leading operators are moving to LTE**.**

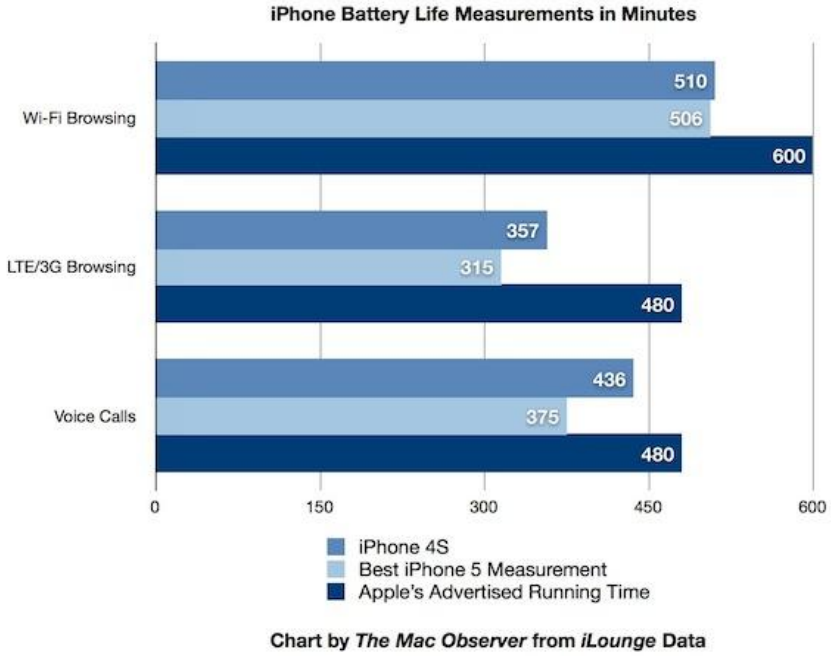
C. Different types of problems in 4G

As LTE networks proliferate and network traffic increases, interference is becoming an issue for LTE operators. Due to limited spectrum resources, most operators are deploying their LTE networks in a frequency reuse =1 configuration, which means that a single carrier frequency is reused in all cells of the network. This deployment scheme is also referred to as a single-frequency network, and it is different from schemes used in predecessor cellular networks, where predefined planning ensured limited inter-cell interference. Single frequency networks are the most efficient in terms of overall spectral efficiency, but by nature they are limited by inter-cell interference.

Figure 4: Intercell interference in 4g Lte][13]

Radio devices operation on Broadband wireless Access (BWA) 4G wireless technologies like IEEE 802.16 (Wimax) and LTE-A require very low noise floor. So sometime wifi could be interfere if radio spectrum adjacent to 4g. [14]

The iPhone 5's battery life is greatly reduced depending on the strength of the cellular signal received by the phone, according to extensive testing performed by iLounge Monday.[15]



Your first 4G phone is likely to be heavier than it should be. This is going to be a function of adding a larger battery to the device.

However, the all-IP architecture of LTE networks introduces more security risks. Attackers could potentially access unencrypted user traffic, or network control signalling.

An additional security risk for both 3G and 4G networks comes from the increasing deployment of public-access microcell base stations, aimed at providing additional local capacity in public areas such as shopping centres, shared offices and more. These small devices placed in areas accessible to the public cannot be physically secured in the same way as a conventional base station, giving attackers a potentially easier entry point from which to attack the network [16].

4g lte could cause the coexistence problem of interference with other radio service like S-band Radar, such as

degradation of performance due to lower throughput indicated by and increasing block error rate (BELR) and Digital TV Technology if band overlap is there.

The in-device co-existence interference a matter of concerns due to the extreme closeness of multiple transceivers within the same device which can potentially interfere with each other.[17]

FCC found potential interference at GPS low power receiver if 4g lte is adjacent and cancel a deal of Lightsquare Company of USA.[18]

3. Conclusions

Any new technology come with advantage and with some disadvantages but we have radio spectrum limited by nature so we have to use it wisely and use it optimum by checking its limitations and resolve it at low cost.

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