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Engineering

FREQUENCY SELECTIVE MEASUREMENT OF FDDLTE AND TDDLTE FOR BASE STATION COMPLIANCE

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ABSTRACT The rapid growth of wireless communication technology has caused the increase of several types of wireless transmitter infrastructures. Several concerns have grown regarding the effects of electromagnetic fields exposure on human health. The main objective of this paper was to analyze the implementation of FDDLTE & TDDLTE Technology exposure perspective, considering the presence of signals from other networks, such as GSM and UMTS. The exposure from both down- and uplinks in a typical urban scenario. The simulated results show that, for all the studied scenarios, the ICNIRP reference levels for exposure are satisfied. We also evaluate the power density (EIRP) by RF measurement methods like field probes measurements or frequency selective methods using SRM Narda and National EMF Portal. From the result it is observed that the maximum value of total exposure is obtained for FDDLTE & TDDLTE with base stations, being 88.718mW/m^2, & 78.818mW/m^2 which is as much as below the threshold value & base stations is compliance.

KEYWORDS : FDDLTE, TDDLTE, Narrowband Testing SRM Narda Tool, Mobile Tower Radiations

I. INTRODUCTION

Telecommunications constitute one of the most dynamic sectors of modern economies. The Fourth Generation (4G), corresponding to the Long Term Evolution (LTE), had its first release, Release 8, being deployed in commercial networks in 2010. This technology is only dedicated to data, having a flat and full-PS architecture, and high performance targets, such as low latency, high spectral efficiency and high peak user throughput, which can reach up to 300 Mbps in DL, and 75 Mbps in UL. These targets will overcome the increase of data traffic demand, supporting a wider variety of services (multiservice) and applications, and reduce costs, as mobile operators' revenue does not follow traffic evolution. In 2010, LTE Release 10 was approved, which includes new capabilities, such as Carrier Aggregation (CA), reaching up to 1 Gbps, the target value of the International Mobile Telecommunications (IMT) – Advanced. Figure 1.1 shows evolution of data traffic due to mobile phones and due to PCs, tablets and mobile routers, as well as the trend of voice traffic[3].

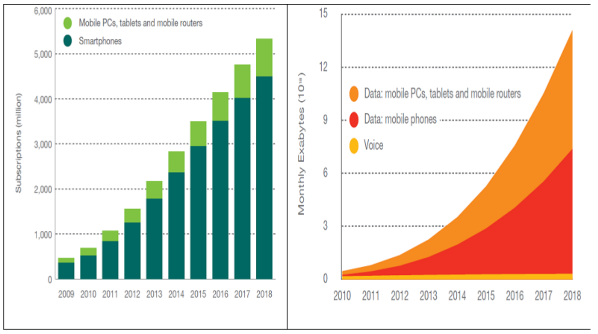


Figure 1.1. Mobile devices with cellular connection & data w.r.t voice Traffic

II. Fundamental Concept

In this section, the LTE and LTE-A network architecture is presented, based LTE and LTE-A have the same network architecture, as the improvements to the latter were not made in this domain. The network has an evolved architecture, in order to follow the evolution in the radio interface and taking some targets into account, such as system optimisation for PS services and performance improvement. So, as a result of the 3GPP System Architecture Evolution (SAE), one has a flat architecture, through the reduction of the network elements, being simpler than the existing ones for 3GPP and other cellular systems, and improving network scalability and end-to-end latency[8]. User Equipment (UE), Evolved-Universal Terrestrial Radio Access Network (E-UTRAN), Evolved Packet Core (EPC) and Services are the four high level domains of the LTE network architecture, where the E-UTRAN and EPC correspond to the radio access and core networks, respectively. These domains are represented in Figure 1.2, where the network architecture is shown considering only E-UTRAN as the radio access network[6].

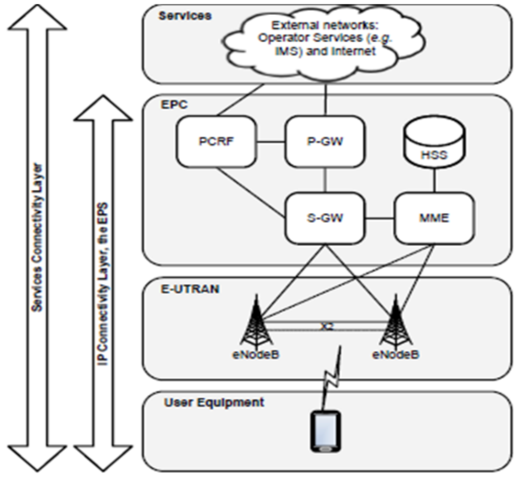


Figure 1.2. Network Architecture for an E-UTRAN only network

Concerning the LTE radio access network, E-UTRAN is composed of a mesh of evolved NodeBs (eNodeBs), connected through the X2 interface, and provides connectivity to the EPC. An eNodeB is a Base Station (BS), responsible for all radio functionalities:

- Ciphering/deciphering User Plane (UP) data, for security purposes when transmitting data through the radio interface;
- Header compression/decompression, which allows an efficient use of the radio interface, through the compression of IP packet headers, avoiding repeatedly sending the same data in IP headers;
- Radio Resource Management (RRM), which controls the radio interface usage, including resources allocation based on requests, prioritisation and schedule of traffic according to required Quality of Service (QoS), as well as constant monitoring of the resource usage situation;
- Mobility Management (MM), that controls and analyses the radio signal level measurements made by the UE, also doing similar measurements and taking decisions according to these to handover between cells, which includes exchanging handover signaling between other eNodeBs and the Mobility Management Entity (MME).

III. RELATED WORK

The related work for emf survey includes taking emf radiation readings at four corners of the upper roof and four corners at the ground along with its distance from antenna, identifying operator and rf cables used, including the sections, preparing the layout of the site, taking panoramic pictures of the site along with building, rooftop, signage, antennas and sector picture which are required for making standard emf report. SRM (as per requirement) meter pictures at four corner at the site roof and on the ground are taking along with safety evaluation time completed at each of the corner. All measurement taken as per DOT Guidelines.

IV. SYSTEM DESIGN AND DESCRIPTION

The two types of meters used during measurement of radiation are described as below:

1)Narrow Band Meter (NBM):It has Non-directional measurement using isotropic probes for applications in the frequency range 1 Hz to 60 GHz, Automatic storage of position data with GPS interface and plug-in GPS receiver, Memory for up to 5000 measurement results, Probe for spectral measurements and Weighted Peak from 1 Hz to 400 kHz. It makes extremely accurate measurements of nonionizing radiation. It is equipped with probes for measuring electric and magnetic field strengths, it covers all frequencies from just a few Hz as found in industrial applications through to long wave and on up to microwave radiation. A probe with built-in FFT analysis enables spectral measurements in the low frequency range. These probes are calibrated separately from the field meter, and include a non-volatile memory that contains the probe parameters and calibration data. It is mainly used for used to make precision measurements to establish human safety, particularly in workplace environments where high electric or magnetic field strengths are likely to occur [9].

Figure 1.3. Narrow Band Meter

2) Selective Radiation Meter (SRM): It is used for Selective Measurement of RF and Microwave Electromagnetic Fields. It has Isotropic and Single Axis Measurement from 9Khz to 16Ghz, Automatic Antenna and Cable Detection, Excellent immunity for Operation in High Field Strengths, Ultrawide Dynamic Range of 50 uV/m to 200 V/m. It also measures strength of single emitters in multiple emitter environments. It determines 5% boundaries for FCC Compliance. It has resolution bandwidths (RBWs) upto 20 Mhz for UMTS. The SRM has the ability to measure fields more accurately than broadband equipment and more importantly is able to give you more information that just the total-like exactly what emitter or emitters are generating most of the power. The meter is an optimized spectrum analyzer covering 9 Khz to 6 Ghz and modified to make accurate field strength reading with the help of the antenna. It is designed for outdoor use: rugged, splash proof ergonomic design and is also equipped with GPS and voice recorder to simplify survey reports. It gives results in V/m, A/m, Power Density, or Percentage of Permissible Limit [10].

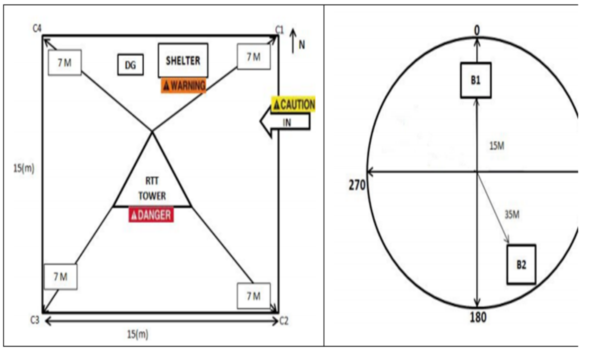
Figure 1.4. Test Setup for SRM-3006 Meter

The system can be implemented for workplace environments where high electric or magnetic field strengths are likely to occur. Some examples are Measuring field strengths to comply with general safety regulations, Establishing safe zones, Measuring field strengths of cell phone transmitters and satellite communications systems to demonstrate compliance with human safety standard limit values, Measuring field strengths in the industrial environment, such as plastics welding equipment, RF heating, tempering, and drying equipment[11]. It can also be implemented by using "NBM-TS" PC software provides the functions that are - Result transfer to a PC , Result database management , Result evaluations , Device configuration management , Firmware update control , Remote controlled measurements. SRM also has special capabilities when it comes to RF safety measurement, it also has special operational modes (UMTS P-CPICH) for common engineering measurements and it also makes it simple if you want to perform safety measurement only[9].

Figure 1.5. SRM Meter Setup in Work Place

V. Result

The site layout for frequency selective measurement is shown in the figure shown below:



The examples of the readings of frequency selective measurements will be seen as follows:-

APPENDIX-D

D-1 : SITE DATA & TECHNICAL PARAMETERS

Name of BTS : Dulit Garh

	Item	Unit	Idea-TDD LTE	Idea-UMTS	Idea-GSM	Idea-FDD LTE	Rem
SITE DATA	Site ID		51317	1317	AMB317B	41317	
	Name		Dulit Garh	Dulit Garh	Dulit Garh	Dulit Garh	
	Date of Commissioning		30-Aug-18	29-Jan-13	19-Nov-12	18-Dec-15	
	Address		# 650,Village New Dalip garhPO BabyalDistt AmbalaDistrict-Ambala.Pin Code-134003	# 650,Village New Dalip garhPO BabyalDistt AmbalaDistrict-Ambala.Pin Code-134003	# 650,Village New Dalip garhPO BabyalDistt AmbalaDistrict-Ambala.Pin Code-134003	# 650,Village New Dalip garhPO BabyalDistt AmbalaDistrict-Ambala.Pin Code-134003	
	Lat / Long		30.36144 / 76.86757	30.36144 / 76.86757	30.36144 / 76.86757	30.36144 / 76.86757	
	RTT/GBT		RTT	RTT	RTT	RTT	
	Building Height AGL	mts	4	4	4	4	
	Antenna Height AGL	mts	19	22	22	22	
	Make and Model of Antenna		S-Wave EW/EW-65-18DV10	ANDREW & LBX-6516DS-VTM ANT	ANDREW & LBX-6516DS-VTM ANT	ANDREW-HBXX-6517-DS-VTM	
	System Type (GSM/CDMA/UMTS)		TDD LTE	UMTS	GSM	FDD LTE	
	Base Channel Frequency	MHz	2550,2550,2550,	2151.4,2151.4,2151.4,	935,935,935,	1810.1,1810.1,1810.1,	
	Carriers/Sector		1,1,1,	1,1,1,	4,4,4,	1,1,1,	
	Tx Power	(dBm)	43	43	43	43	

Actual Site Report

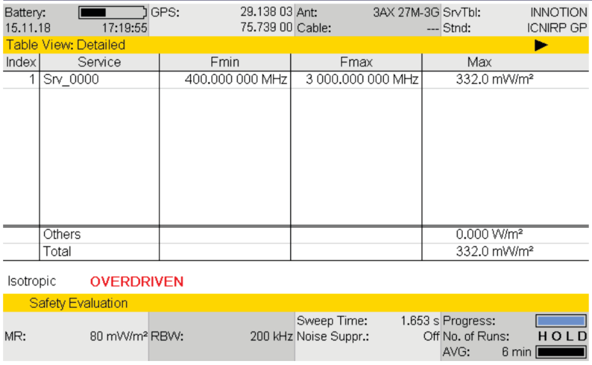


Figure 1.6. EIRP 332.0mW/m^2 at 400 to 3000 MHZ

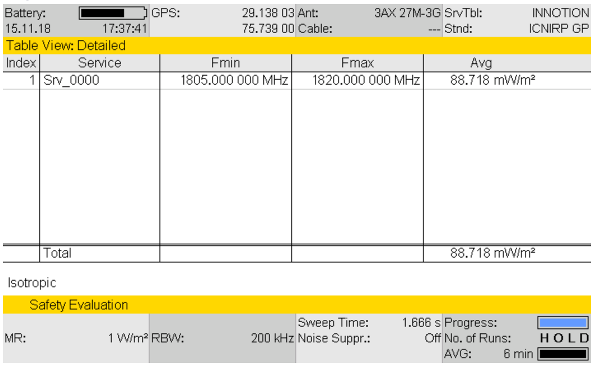


Figure 1.7. EIRP 88.718mW/m^2 at FDDLTE 1805-1820 MHZ

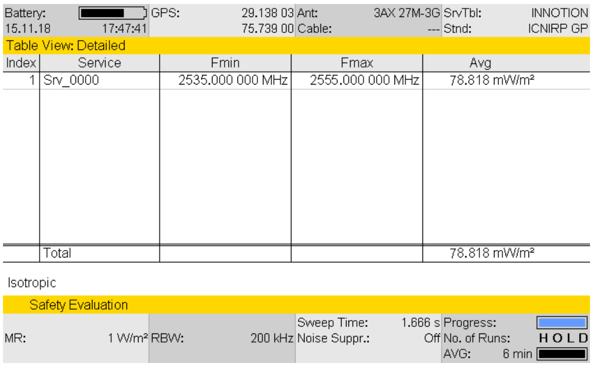


Figure 1.8. EIRP 78.818mW/m^2 at TDDLTE 2535-2555 MHz

V. LIMITATIONS

SRM Narda Tool have certain limitations. They consume high power, which means battery does not last longer. It usually last for maximum of 3hrs. So we must provide an additional battery in device itself in emergency cases and also it should have power saving mode which can be helpful when the device is not in use and saves the power. This can be implemented by same technology which is used in laptops and mobile phones. It is also difficult to take into account time variation of the EMF. In SRM Tool, noise level of shaped probe would distort the result and if significant field components in range of below 10Mhz are present so in case of doubt measurement should be done to determine field components below 10Mhz.For this purpose SRM should be used. Wi- Fi/WLAN (IEEE 802.11 a/h/j), HIPERLAN (High Performance Radio Local Area Network); U-NII (Unlicensed National Information Infrastructure) have very high frequencies (5150-5825 GHz) so they cannot be detected using an H-field/E-field antenna up to 9Khz which makes it hard observe the frequency. For this purpose we use an E-Field antenna of 6Ghz/9Ghz, three axis which makes it easy to detect such frequencies and the purpose is served.

Conclusion

EMF radiation levels in area accessible by the people may be controlled very efficiently by measurement. As you can see there are many factors which have an impact on measurement accuracy and the selection of a measurement zone should involve proper selection of adequate tools and measurement techniques. Public concern about potential health effects of human exposure to the electromagnetic fields from modern RF-communication should be taken into consideration. Especially since the number of base stations has grown up considerably within the recent years. The explosive demand for mobile communication and information transfer using personal devices such as mobile phone or notebook computer has caused the need for major advancements of antenna design and adequate measurement equipment. This concludes that the Exposer value under the threshold Value (DOT Guideline) and base stations is compliance.

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