MINIATURE ANTENNAS DESIGN FOR IOT APPLICATIONS

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Abstract—In modern communication systems Internet of Things (IoT) plays an important role. A plethora of digital services including everything from smart homes, smart health, smart retails, smart wearables etc will incorporate Internet of Things (IoT). The first choice of communication for Internet of Things is wireless communication, Besides other things the power consumption and the size of the device are critical. Thus an improvement of the antenna radiation efficiency and a strong miniaturization is required. This paper presents a novel method for miniaturization of antenna for IOT based applications. The proposed antenna can be easily handled within compact communication devices. The simulation results are validated through measurements of the fabricated antenna prototype.

Keywords—Miniaturization,IOT..

I.INTRODUCTION

The way of gathering and processing information has been revolutionized by IOT. Owing to their compact size and cost effectiveness number of communication devices are connected to the internet has been increasing. Hence, the concept of Internet of Things (IoT) has been introduced. A widespread use of wireless networks also promotes shift towards modern communication devices rather than traditional ones such as desktop computers, tablets, etc. According to the recent survey, over 50 million such devices will be interconnected with each other via internet by the end of this decade [1–3]. The required hardware structure for IoT devices is different from that for traditional communication networks. Therefore, design and manufacturing processes of these devices should account for their role in the future communication systems and their specific applications. In particular, the advent of IoT calls for new wireless microwave systems which are cost-effective and compact by design, offer high data transmission rates, a low power consumption, so that they could be used in wearable devices [4].

A recent survey report [5] tells that the by the end of this decade there will be 50 billion such devices around us will be connected.

A completely new network dedicated to IoT applications is being developed in San Francisco area by a French startup Sigfox [6], Bouygues Telecom, a French mobile operator has recently announced LoRa technology based national deployment of an IoT network , along with Semtech [7]. In this paper, some aspects related to the design of miniature antennas for IoT applications are discussed. Miniaturization is in fact a key point in dealing with IoT devices.

The rest of the paper is organized as follows. In Sect. II, a brief overview of LoRa Technology is discussed, while Sect. III throws a light on antenna miniaturization. In Sec. IV Geometry of the proposed antenna is explained. Finally, some conclusions are drawn in Sect. V.

II.LoRa Technology

LoRa Technology is the DNA of IoT, connecting sensors to the Cloud and enabling real-time communication of data and analytics that can be utilized to enhance efficiency and productivity. LoRa Technology offers an efficient, flexible and economical solution to real-world problems in rural and indoor use cases, where cellular and Wi-Fi/BLE based networks are ineffective.

LoRa (short for long range) is a spread spectrum modulation technique derived from chirp spread spectrum (CSS) technology. Semtech's LoRa devices and wireless radio frequency technology (LoRa Technology) is a long range, low power wireless platform that has become the de facto technology for Internet of Things (IoT) networks worldwide.

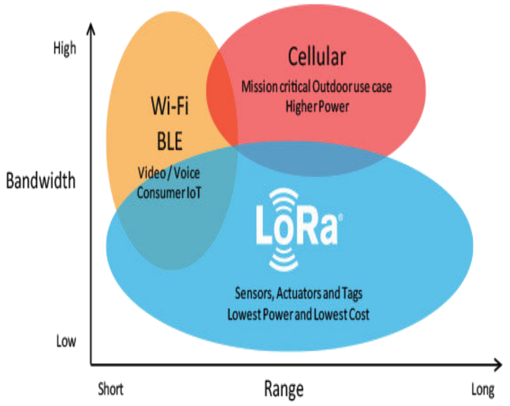

Fig:1 : LoRa Technology

LoRa Technology enables smart IoT applications that solve some of the biggest challenges facing our planet: energy management, natural resource reduction, pollution control, infrastructure efficiency, disaster prevention, and more. Semtech's LoRa Technology has amassed over 600 known uses cases for smart cities, smart homes and buildings, smart agriculture, smart metering, smart supply chain and logistics, and more. With 97 million devices connected to networks in 100 countries and growing, LoRa Technology is the DNA of IoT, creating a Smarter Planet.

LoRa technology is now being widely deployed. It is being incorporated into many systems, and even the small maker-style computers like Arduino have LoRa options. Accordingly it is very easy to develop applications for LoRa for both large scale manufacture or the more specialist applications based on IOT.

III. ANTENNA MINIATURIZATION

Many new investigations have been conducted to reduce the form factor (or the overall size) of different types of antennas while trying to maintain acceptable matching properties and operating bandwidth. These miniaturization techniques are generally related to changing the electrical and physical properties of an antenna. The most prominent antenna miniaturization techniques can be divided into two main categories: topology- and material-based methods.

From a macroscopic point of view, engineers are familiar with antenna properties and characteristics that can be modified by altering its geometry, current density distribution (electric or magnetic), and electrical dimensions. These characteristics are usually defined in terms of the matching/input impedance, radiation pattern/gain, efficiency, polarization, Q factor, and bandwidth. An excited antenna consists of the aggregation of moving charges. Hence, it can be an efficient radiator if the radiation from its accelerated charges (derivable from the Larmor result [8] is well managed to constructively add at selected desired frequencies and angular directions. To this end, proper engineering of the geometry, the current distribution, and the electrical dimensions of the antenna is needed. Founded on this concept, design methods have been developed that efficiently modify and optimize the shape and the overall geometry of an antenna to achieve the desired radiation characteristics while constraining the overall dimensions to be as small as possible. Some of these methods are reviewed next. Note that the works we cite here do not constitute an exhaustive list but provide the foundation for various techniques and related examples.

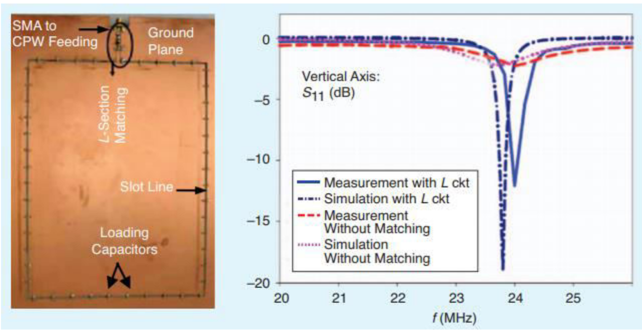

Fig: 2: A loaded HF slot-loop antenna: a fabricated antenna on Arlon fr = 4 substrate and the measurement and simulation results [9].

III. Geometry Of The Proposed Antenna.

The devices is intended to obtain the geolocation information through a GPS system and send it by using a LoRa transceiver. Consequently, the antenna is required to simultaneously cover both the GPS band at 1.57 GHz and the US LoRa band at 915 MHz.

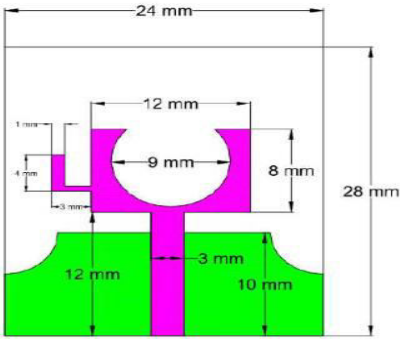

Fig:3: Geometry of the proposed antenna.

The proposed antenna is printed on an inexpensive FR4 substrate with a dielectric permittivity of 4.4. The thickness of the substrate is 1.5 mm and the overall dimension of the designed antenna is 18.7 mm × 17.6 mm which is one of the smallest UWB antennas with band-notched characteristics. The compact small size with a metallic layer on one side of the substrate makes the antenna easily integrate with system circuits. The antenna consists of a bevel radiating patch and a modified ground plane, which are responsible for a large impedance bandwidth. The angle of the bevel is controlled by the dimension L 1. Hence, the entire The length L 1 is optimized using HFSS and a change in this value leads to poor impedance matching.

V. ANALYSIS AND RESULTS

The optimized antenna has been realized for measurement and testing purposes. The Ansoft HFSS version 15 simulator is employed to simulate the proposed antenna.The performance was measured using Agilent N5225A PNA network analyzer. The measured data are in agreement with the simulated one, confirming the effectiveness of the numerical electromagnetic model composed by the antenna and the main components of the final device. The measured result shows that the operating frequency band of the proposed antenna ranges from 2.9 GHz to 13.7 GHz (VSWR < 2) which covers the entire UWB while rejecting the 5.1–5.9 GHz band. A slight deviation in results is mainly due to fabrication tolerance and the effect of SMA connector.

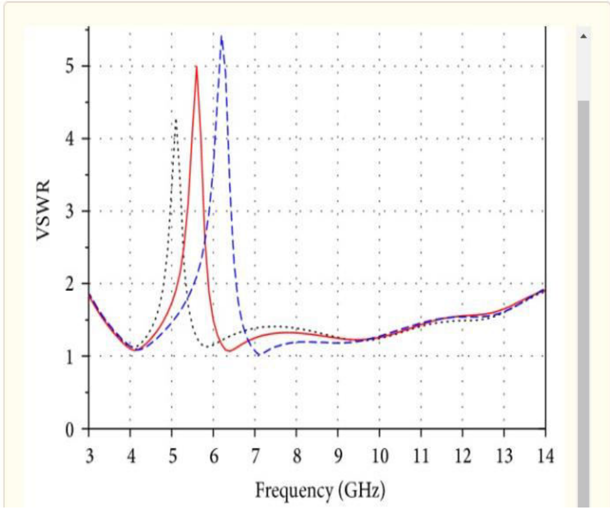

Fig:4: VSWR Vs Frequency for proposed Antenna

In this paper, the miniaturization of antennas for IoT applications have been discussed. IoT systems allows for strong miniaturization, antennas must be designed carefully considering the resulting antenna efficiency and sensitivity to the environment.

VI.REFERENCES

[1] Grau, A. (2016). How to Build a Safer Internet of Things: Todays IoT is full of security flaws. We must do better. IEEE Spectrum, http://spectrum.ieee.org/telecom/security/how-tobuild-a-safer-internet-of-things.
[2]Kamilaris, A., Pitsillides, A. (2016). Mobile Phone Computing and the Internet of Things: A Survey. IEEE Internet of Things Journal, 885−898.
[3] Jin, J., Gubbi, J., Marusic, S., Palaniswami, M. (2014). An Information framework for creating smart city through internet of things. IEEE Internet of Things Journal, 112−121.
[4] Moscato, S., Silvestri, L., Delmonte, N., Pasian, M., Bozzi, M., Perregrini, L. (2016). SIW components for the Internet of Things: Novel topologies, materials, and manufacturing techniques. IEEE Topical Conference on Wireless Sensors and Sensor Networks (WiSNet), 78−80.
[5]D. Evans, “The internet of things. How the next evolution of the internet is changing everything,” Cisco White Paper, 2011.

[6] Gigaom Research, "Sigfox brings its internet of things network to San Francisco," https:/gigaom.com/2014/05/20/sigfox-brings-its-internet-ofthings-network-to-san-francisco/, accessed August 2015. [7] Semtech Investor News, "Bouygues Telecom Announces June Launch of France's First "Internet-of-Things" Network Based on LoRa Technology," http://investors.semtech.com/releasedetail.cfm?ReleaseID=904103, accessed August 2015.
[8]J. D. Jackson, Classical Electrodynamics, 3rd ed. New York: Wiley, 1998.
[9]P. L. Chi, R. Waterhouse, and T. Itoh, "Antenna miniaturization using slow wave enhancement factor from loaded transmission line models," IEEE Trans. Antennas Propag., vol. 59, no. 1, pp. 48–57, Jan. 2011.