Hybrid Wireless Range Extender : LTE (3G/4G) Over Wi-Fi

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ABSTRACT – The increasing of modern devices and sensors everywhere and the Internet of things enter in many other things in our world, for that the increase of the internet demand has become everywhere with ideal coverage area. Combine Wi-Fi internet access with a mobile network and blanket coverage, is best way to provide the internet everywhere with fewer base-stations. The aim of this project is to solve out of coverage problem by using a broadband data source then transmits this data locally as Wi-Fi router using the 802.11ac protocol. The result is hotspot Wi-Fi can any devices connect internet through it.

1. INTRODUCTION

Information and communication technologies (ICT) have totally changed the world in a comparatively short period of time. Today the Internet has become an indispensable part of people's lives throughout the world and it's very important for many people. Instead of going to the post office to send a telegram they can generally reach nearly anyone by simply sending an email or use any application to send message from any location that has Internet connectivity. With the increasing serve of the Internet and mobile phones there has been a visceral market require for convergent evolution of these two technologies. The customers require more than comparatively reach the internet via a fixed desktop computer, but they need to surf and access the Internet wirelessly and in any place , from any location that has network connectivity. This request has fund the deployment of many kind of wireless networks. Two of the most prevalent types of wireless networks are the wireless local area network (WLAN) and high speed wide area cellular networks (often called "mobile broadband"). Today the most popular instance of the later type of network is the various types of third generation (3G) and more recently fourth generation (4G) cellular networks. 4G is constantly referred as the descendant of the 3G and 2G standards and (3GPP) is currently standardizing Long Term Evolution (LTE) Advanced as incoming 4G standard along mutually Mobile Worldwide Interoperability [1].

The Internet of Things (IoT), interconnection and communication between everyday objects and, IoT enables many applications in many domains. IoT is nothing but an advanced concept of ICT (Information Communication Technology) and, IoT allows people and things to be connected Anytime, anywhere , with Anything and anybody, ideally using Any path/network and Any service. IoT is the interconnecting of devices and services that reduces human intervention to live a better life [2]. The growth of the Internet of Things and the directions to deploy more sensors anywhere has led to search for cost effective ways to connect many devices to the Internet. In the most common network architecture for home IoT, the devices use low-power wireless or Wi-Fi to connect to an AP and access the Internet backend [3]. With the increasing prevalence of Smartphone and tablet computers, current mobile broadband networks can provide users with acceptable data rates together with mobility. The popularity of Smartphone and tablets, however, does not mean these devices have yet replace laptop computers, people still need wireless access to the Internet via their laptops, and the problem of installation of AP is only limited to area with building such as campus, office, home and some places need to access 3G/4G to access internet. However, signal strength received by an mobile station (MS) degrades when located far away from BS or AP [4] . one may think that placing another AP can be a solution, but it is not the best decision because it is expensive and static, and consumes high power. Our project highlights how to solve out of coverage area problem in IEEE/Wi-Fi standard by developing a prototype that can receive 3GPP/4G/LTE standard signal, and broadcast a new IEEE standard signal with a new coverage area. Our project also supports D2D communication between devices where IoT device is expected can communicate in various wireless standard.

2. METHODOLOGY

The purpose of this research is to build a hybrid wireless range extender (HWRE) using Raspberry Pi that can help to increase the wireless signal strength that broadcast from cellular network. The Raspberry Pi is a small sized computer like a credit card size and it's low cost device. Raspberry Pi running on Ubuntu operating system. The network interfaces are configured using USB Wi-Fi dongle and 3G/4G LTE modem to provide the internet. This project can be considered successful if the hybrid Wi-Fi repeater be able to meet the needs of users and establish new Wi-Fi access point at the location that out of coverage area of any type of internet wireless , or the signal strength are slow within the specific area. The testing will be passes in two scenario. The first scenario is to test and collect data when the device direct connected to the cell tower as show in figure 1. The second scenario, the same test are repeated with using hybrid Wi-Fi repeater to have a reliable data as show in figure 2.

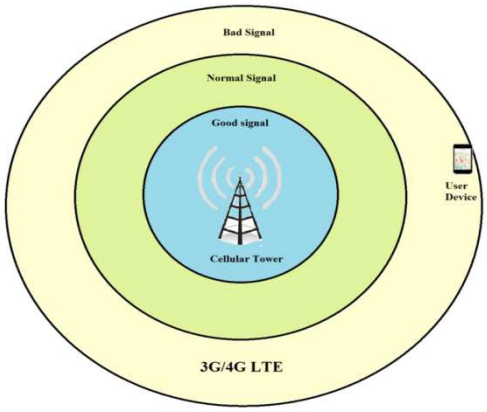

Figure 1 The first scenario the testing without using hybrid wireless range extender

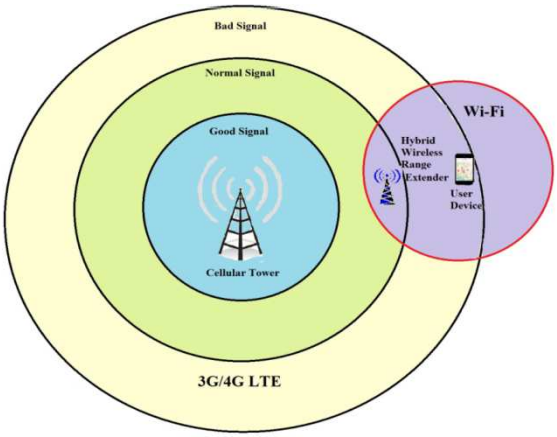

Figure 2 The first scenario the testing with using hybrid wireless range extender.

3. RESULTS AND DISCUSSION

The results collected by tested our project in two scenarios. The first scenario was to test and collect data which is signal strength when Smartphone direct connected to cellular network. Then, the same test will be done with using Hybrid Wireless Range Extender at the same point for the second scenario. The tests are repeated to have a reliable data. The results is measured in megabits per second (Mbps), to measured how quickly amount of data can be sent from phone to the internet and back again by using nperf application for Smartphone to measure the speed of download and upload for this data when using HWRE and without using HWRE as show the result in figure 2 and figure 3.

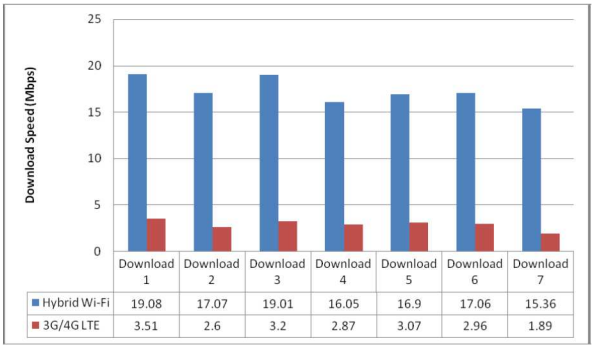

Figure 2 The graph for download speed of the hybrid wireless range extender and cellular network.

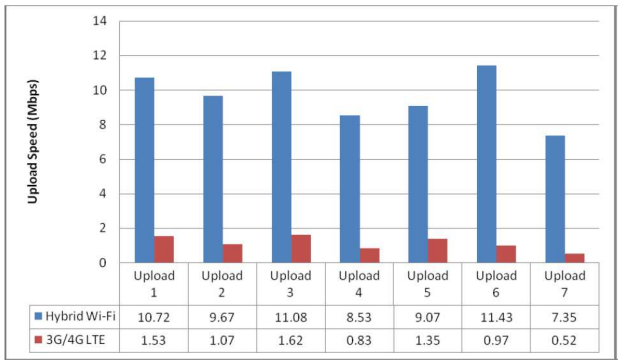

Figure 3 The graph for upload speed of the hybrid wireless range extender and cellular network.

4. CONCLUSIONS

We proposed a hybrid wireless access method to overcome out/weak of coverage area. Each project has its own interests and objectives as the project Energy Efficient hybrid Wi-Fi Repeater. Although there is some weakness and limitations but the objectives of this project was achieved. Based on the test result and analysis in the creation and completion of this project, it prove that this project is designed to benefit the users when it comes to wireless signal problems. With the lower cost development and some improvements, everybody can freely using this product. Besides that, the main tool used which is Raspberry Pi has its own ability to works for any project development.

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