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The Emerging Technology- LI FI Using Femtocells

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ABSTRACT

Nowadays internet is the basic requirement of many people to fulfill their task through wired or wireless network. As no of users increases in wireless network, their requirement increases that leads to decreases in speed proportionally. Although Wi-Fi has a speed of up to 150mbps as per IEEE 802.11n, it is still in shortage for accommodating huge requirements of users. To rectify this limitation of Wi-Fi, the concept of Li-Fi is introduced. This Technology is an alternative, cost effective and more robust and useful and uses The Visible light communication and LED which may be the future of Internet.

Femtocells are specific as a cost-effective solution for wireless industry to improve indoor service providing, and also to unload traffic from already overburdened macro networks. Due to spectrum availability and network infrastructure , a macro network may have to share spectrum with overlaid femtocells. In spectrum-sharing macro and femto networks, inter-cell interference caused by different transmission powers of macrocell base stations (MBS) and femtocell access points (FAP), in conjunction with densely deployed femtocells, may create dead spots where reliable services cannot be guaranteed to either macro or femto users. In this paper we analyze the working of Li-Fi using Femtocells.

KEYWORDS:

Li-Fi(Light Fidelity), VLC(Visible light communication), AP(Access Point),MBPS, VLC transmitter, photo detector, amplification and processing, , lamp driver, LED based headlights, LED based backlights, DSL (digital subscriber line), UMTS(UniversalMobile Telecommunications System), Femtocell (In 3G system-Home Node B).

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1. INTRODUCTION

In the past years, wireless cellular communications has significantly used due to their benefits of reducing the inter-site distance of cellular base stations. By reducing the cell size, the network spectral efficiency has been increased by two orders of magnitude. More recently, heterogeneous networks Are used which comprises of different cell layers composed of microcells, picocells and femtocells.

2. THE LI FI:

The concept of Li-Fi is suggested by germen physicist "Harald Haas." It is the technique to taking the fibber out of fiber optic by sending data through an LED light bulb that is used to flickers the intensity of light faster than the human eye[1].

In this technique a concept of LED and visible light is used for data transmission. The li fi uses VLC for data communications. An LED with Li-Fi technology can be used as a wireless network access point (AP). The Multiple APs each covering a particular area creates cellular network, allowing users to move from one AP to the other without any disturbance in their high-speed data stream[2]. The frequencies of these APs, are defined by lighting infrastructure requirements.

3. FEMTOCELLS (Home Node B):

Femtocells are used for short range, low transmission power, low operating cost, plug-and-play base stations (BSs) that are used in indoor deployment to enhance coverage. They use either cable Internet or broadband digital subscriber line (DSL) to backhaul to the core network of the operator. The deployment of femtocells increases the frequency reuse, and hence increases throughput per unit area within the system as they usually share the same bandwidth with the macrocellular network[3]. However, random deployment and the uncoordinated mechanism causes additional inter- and intra-cell interference between small cells which imposes a limit on how dense these small RF can be deployed before interference starts offsetting all frequency reuse gains .The small cell concept, however, can easily be extended to VLC in order to overcome the high interference generated by the close reuse of radio frequency spectrum in heterogeneous networks[4].

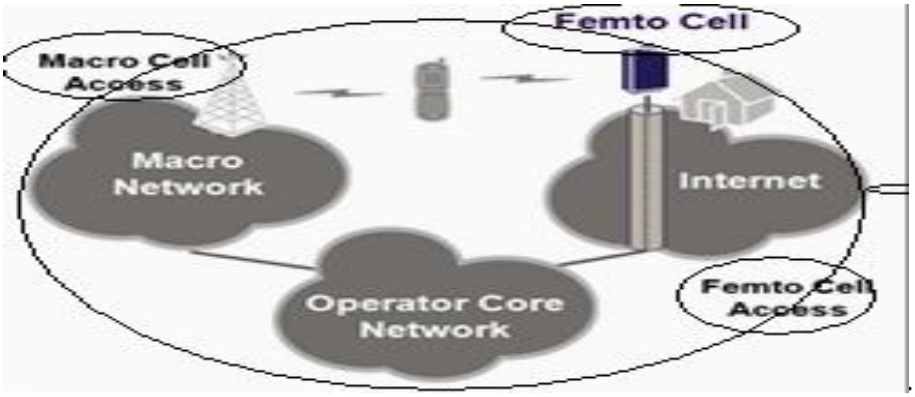

Figure-1. "Architecture of Femtocells"

3.1. Working:

The optical Access Point(AP) in Li-Fi is referred to as an attocell. The Li-Flame ceiling unit connects to an LED light to form an atto-cell, which provides communication in the Led Light illuminated area. The Li-Flame system is a combination of various ceiling unit access points and covers a wide area with multiple ceiling unit access points. The system operates in conjunction with the Li-Flame mobile transceiver unit, which features an infrared uplink and connects via a standard USB to the host device to allow full mobility[5].

If we equip a room with multiple light and that each light function as a very small radio base station, the result is a network of very small cells that is known as'optical attocells.

As attocells operates in the visible light spectrum, the optical attocell does not interfere with the macro cellular network. The optical attocell improves indoor coverage, and does not generate any additional interference, it is able to enhance the capacity of the RF wireless networks[6]. Li-Fi attocells allow for extremely dense bandwidth reuse due to the inherent properties of light waves. . The coverage of each single attocell is very limited, and walls prevent the system from suffering from co-channel interference between rooms. This originates the need to deploy multiple access points to cover a given space[7].

Each attocellular AP results in co-channel interference reduction. This technique allows the cellular coverage area to be broken down further into areas of low interference and areas of high interference – typically at the cell edges. The frequency allocation can then be performed in a more optimal way which allows the overall throughput distribution over the coverage area to increase significantly. A similar concept realized at the receiver side where multiple receiver elements provide a means for enhanced interference mitigation capabilities. This causes each photo detector to scan

only a fraction of the available space. The overall combination of all photo detectors provides a result. This discretization of the receiver eyesight allows interference to be avoided by careful recombination of the output signals from each receiver element.

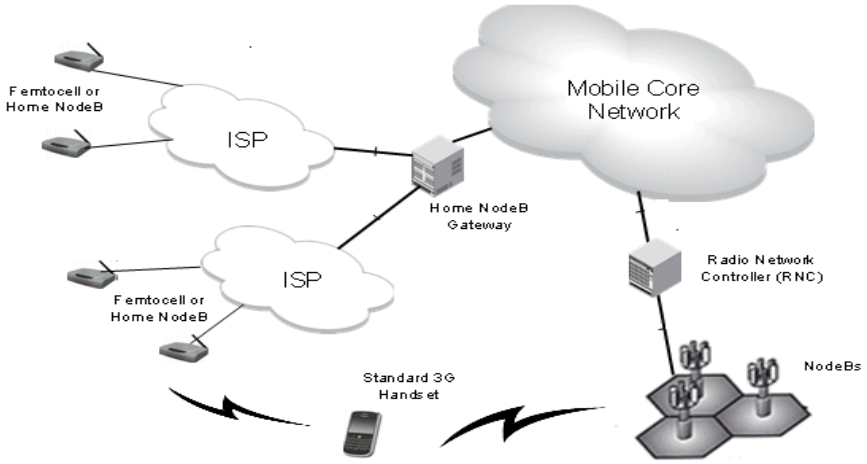

Figure-1. "Architecture of Femtocells used in Mobile Network"

However, due to the requirement for illumination indoors, the infrastructure already exists, and this type of cell deployment results in the very high, practically interference-free bandwidth reuse. The user data rate in attocell networks can be improved by up to three orders of magnitude. Moreover, Li-Fi attocells can be deployed as part of a heterogeneous VLC-RF network. They do not cause any additional interference to RF macro- and picocells, and can, hence, be deployed within RF macro-, pico- and even femtocell environments. This allows the system to vertically hand-off users between the RF and Li-Fi sub-networks, which enables both free user mobility and high data throughput. Such network structure is capable of providing truly ubiquitous wireless network access.

3.1.1 Advantages of using Femtocell with Li-Fi

- low transmission power,
- low operating cost,
- plug-and-play base stations (BSs)
- Easy to install
- Compatible with every UMTS (i.e. A 3G networking standard) mobile phone
- Better coverage

- Higher capacity
- Lower transmit power
- Prolong handset battery life
- Higher signal-to-interference-plus-noise ratio (SINR)
- Improved Macrocell BSs reliability
- Offload data traffic from the Macrocell BSs
- Increasing the area spectral efficiency (total number of active users per Hertz per unit area)

3.1.2 Disadvantages of using Femtocell with Li-Fi

- used for shortrange
- Equipment location
- Spectrum accuracy
- Quality of service
- Cannot used in rural areas where are many obstacles.
- If the receiver is blocked the signals cutt off.
- Reliability and network coverage
- Interference from external light sources
- High installation cost of VLC
- Emits harmful electromagnetic radiation and
- Limited data rate
- Can't be used in hospital and at the places where the equipments are based on electromagnetic principles.

4. CONCLUSION:

There are several practical matters that has to be overcome in order to make the attocell a reality. The first one is interference. Though a femtocell can be installed anywhere, it can only use the airwaves owned by the operator that sold it. That's why a femtocell owner can't take it overseas and make calls over it just like he was at home. Overseas, that operator's PCS or cellular frequencies are licensed to someone else who wouldn't take kindly to a femtocell blasting out interfering RF on its home turf.

The second one is placement; a femtocell needs to know where it is on an operator's network so it doesn't interfere with neighboring femtocells or the operator's macro network. Femtocell makers

usually get around this problem with GPS. The femtocells transmits its location back to the operator, which then makes an adjustment to the cell and its neighbors to mitigate those interference problems.

These problems are solved by using the weakest of radios. Regulators controls a transmission interference if it exceeds a certain power threshold. These regulations differ from country to country and band to band, but the solution is making use of an intelligent radio that adjust the attocell's radio power to just below licensed levels. In most cases it is a small cell and in some countries it would be a cell edge just 5 mm away from the dongle (In such situations it suggests you place the phone on top of the attocell and use a Bluetooth headset for the conversation.) In other countries the cell's range can extend to an entire room.

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