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LTE-Advanced communication using in Femtocells Perspective.

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ABSTRACT: LTE means Long term Evolution and LTE-Advanced is the better than LTE communication for better mobile coverage. Femtocells are small mobile telecommunications base stations that can be installed in residential or business environments for better mobile or wireless devices coverage. Information and communications technology ecosystem now represents around 10% of the world's electricity generation and increasing continuously day to day due to increasing the base stations of 4G and LTE-Advanced wireless communications network and it may create a power management problem in near future. According to the Cisco Visual Networking Index: Global Mobile Data Traffic Forecast Update, for 2012-2017, "the overall mobile data traffic is expected to grow to 11.2 Exabyte's(EB) per year by 2017. To minimize the challenge A femtocell is possible solution, It results in a significantly improved signal quality and substantial cost savings also. The aim of this paper is to examine in a top-down approach the femtocells as an important component of the developing LTE-Advanced Technology, with essential projection into the future of the femto-cellular technology and what the future holds for its deployment for operators and also th benefits of Femtocells

Keyword:- LTE, LTE-Advanced, CA, Femtocell, HeNB, eNodeB, HNB.

1. INTRODUCTION

LTE-advanced also known as 4G wireless networks and it is an evolution of LTE Rel-8. IMT-Advanced (International Mobile Telecommunication-Advanced) refer to a family of mobile wireless technologies, which is also known as 4G. In 2010, LTE-Advanced/4G is ratified as IMT-Advanced technology. It will allow the cellular provider to complement their 3G services by offering higher data rates, lower latency and packet –based network. The standard for LTE was first published in 2005 as Rel-6 by 3GPP (third generation partnership project) since then LTE-Advanced standard been in development and finally in March 2009 it was finalized by 3GPP. To improve the user experience 3GPP is considering various aspects which include higher order MIMO, carrier aggregation, and a deployment strategy called heterogeneous network. Het Net combines macro-cell, microcell, relays, Pico-cell, and Femto-cell deployment in a single cell to increase spectral efficiency per unit area. It will also provide better broadband experience in a cost effective manner to users . The 4G technology can also significantly increase the spectral efficiency by adapting carrier aggregation that supports the bandwidth from 1.4MHz to 20MHz. In carrier aggregation multiple component carriers can be jointly used for transmission to/from user equipment. It is done such a way that it will be compatible with the previous releases of LTE. The fourth generation (4G) of wireless cellular systems has been a topic of interest for quite a long time, probably since the formal definition of third generation (3G) systems was officially completed by the International Telecommunications Union Radio communication Sector (ITU-R) in 1997. A set of requirements was specified by the ITU-R regarding minimum peak user data rates in different environments through what is known as the International Mobile Telecommunications 2000 project (IMT-2000). The requirements included 2048 kbps for an indoor office, 384 kbps for outdoor to indoor pedestrian environments, 144 kbps for vehicular connections, and 9.6 kbps for satellite connections.

Femtocells are small cellular telecommunications base stations that can be installed in residential or business environments to provide improved cellular coverage within a building. The technology also means operators can deliver better service to enterprises and high-

value customers. While a macro cell delivers coverage to a wide area, a femtocell delivers a lot of capacity in a locale – just delivering power to where the users are. Because they are closer to the users so it takes less RF power to provide a
High-bandwidth connection-a typical femtocell may have a 20mW RF section and consume a total of 2W. Using lower RF power also localises signals, so that scarce spectrum can be re-used more often than is possible in a macro cell network. The lower power means more efficient RF
technology too, so less energy is wasted there. The objective of this paper is to examine in a top-down approach the femtocells as an important component of the developing LTE-Advanced Technology, with essential projection into the future of the femto-cellular technology and what the future holds for its deployment for operators, the benefits of femtocell and advantage over macro cell and challenges to implement it.

2. MOTIVATION

Motivated by the increasing demand for mobile broadband services with higher data rates and Quality of Service (QoS), 3GPP started working on two parallel projects, Long Term Evolution (LTE) and System Architecture Evolution (SAE), which are intended to define both the radio access network (RAN) and the network core of the system, and are included in 3GPP release. LTE/SAE, also known as the Evolved Packet System (EPS), represents a radical step forward for the wireless industry that aims to provide a highly efficient, low-latency, packet-optimized, and more secure service. The main radio access design parameters of this new system include OFDM (Orthogonal Frequency Division Multiplexing) waveforms in order to avoid the inter-symbol interference (ISI) that typically limits the performance of high-speed systems, and MIMO (Multiple-Input Multiple-Output) techniques to boost the data rates. At the network layer, an all-IP flat architecture supporting QoS has been defined.

3.LTE-ADVANCED FEMTOCELL NEED

According to the Cisco Visual Networking Index: Global Mobile Data Traffic Forecast Update, for 2012-2017, "the overall mobile data traffic is expected to grow to 11.2 Exabyte (EB) per year by 2017 as shown in figure 1. Now a days majority of the traffic would be online video which requires more bandwidth possibly transmission bandwidth of about 100 MHz in DL and 40 MHz in UL. To full fill the massive bandwidth the possible solution is in the form of LTE-Advanced Femtocell which will gain more capacity in urban area hotspots like shopping centres and office building. Actually coverage has become the major problem in rural areas due to long distance between base stations and in indoor and underground locations due to wall abstractions. Hence factors like coverage, capacity, bandwidth, data rates and security etc.Demonstrates the need of device like femtocell which can provide a solution to such type of problems. From LTE-Advanced Femtocell, the peak data rate is 1 Gbps for DL and for UL, 500 Mbps can be achieved which is 40 times faster than 3G.

3.TECHNOLOGY WITH CONCEPT BEHIND LTE-ADVANCED FEMTOCELL

Femtocells are small cellular telecommunications base stations that can be installed in residential or business environments is a very small, low cost base station with low transmit power. These devices integrated to small plastic desktop & wall mount cases that are

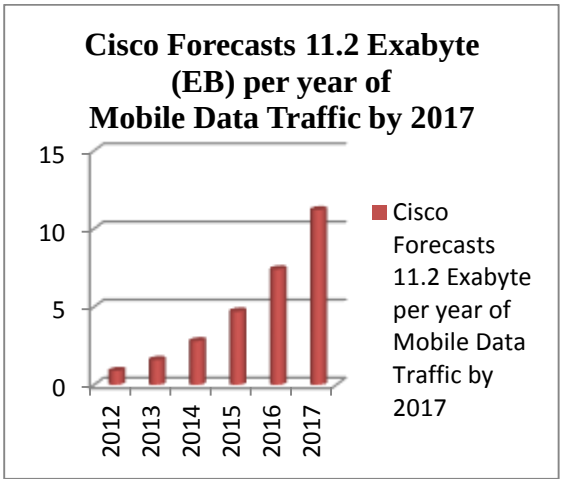

Figure1:- Cisco Forecasts 11.2 Exabyte per year of Mobile Data Traffic by 2017.

powered from the customer's electricity sockets. In order to link the femtocells with the main core network, the mobile backhaul scheme uses the user's DSL or other Internet link. This provides a cost effective and widely available data link for the femtocells that can be used as a standard for all applications. Figure No-2 shows the broad

level 3G and 4G network architecture using femtocell as a base station.

In the 3G, the femtocell is refers to as the Home Node B and in the LTE and LTE-Advanced, it has been named as the Home enhanced NodeB (HeNB).The development of the femtocell is a significant steps made to help network density in microcells. The femtocells help to reduce the cell size for increased quality of service. Of much emphasis is the reduction in the maximum transmits power in 40 femtocells as compared to the broader macrocells. As part of the small cell group. Figure 3 shows a significant comparison with respect to radius of coverage.

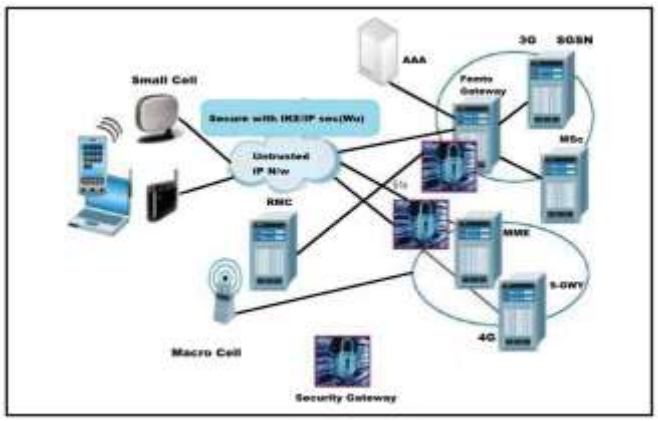

Figure 2:- Broad level N/w architecture of 3G and 4Gusing Femtocell.

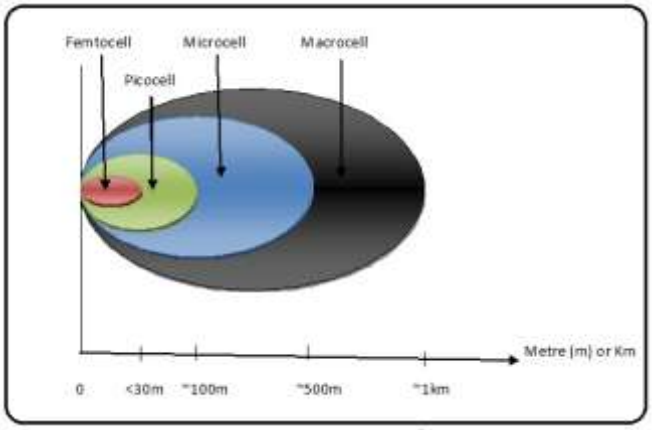

Figure 3:- Small cell comparison in terms of range

Overview of LTE-Advanced E-UTRAN: The core architecture of the LTE-Advanced is enhanced from the LTE E-UTRAN. The Figure 4 shows a typical LTE-Advanced E-UTRAN architecture. E-UTRAN architecture basically has the eNodeB and this creates the air interface for the U-Plane and C-Plane protocols termination to the UEs. The eNodeBs serve as the logical point used for serving the E-UTRAN cells. Also, there is the Home eNodeB (HeNB). The HeNBs are a type of eNodeBs with low cost and good indoor coverage. They are mainly connected to the EPC either directly or through a Gateway that can provide supports for a set of HeNBs. E-UTRAN network element and their interfaces can be seen from Figure 4.

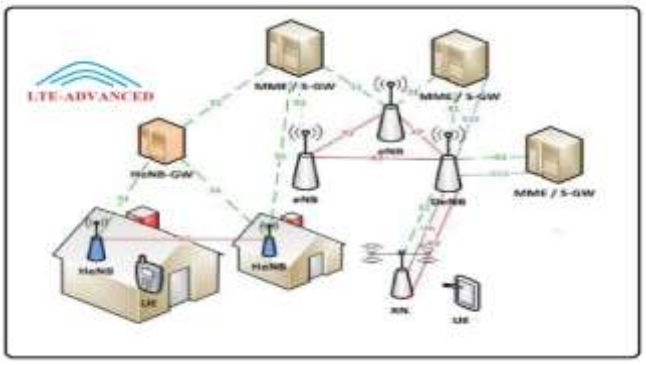

Figure 4:- Architecture of LTE Advanced E-UTRAN.

i.Packet Data Network Gateway: The PDN GW provides connectivity to the UE to external packet data networks by being the point of exit and entry of traffic for the UE. A UE may have simultaneous connectivity with more than one PDN GW for accessing multiple PDNs. The PDN GW performs policy enforcement, packet filtering for each user, charging support, lawful Interception and packet screening.

ii.Mobility Management Entity: manages and stores UE context (for idle state: UE/user identities, UE mobility state, user security parameters). It generates temporary identities and allocates them to UEs. It checks the authorization whether the UE may camp on the TA or on the PLMN. It also authenticates the user.

iii.eNB : eNB interfaces with the UE and hosts the Physical (PHY), Medium Access Control (MAC), Radio Link Control (RLC), and Packet Data Control Protocol (PDCP) layers. It also hosts Radio Resource Control (RRC) functionality corresponding to the control plane. It performs many functions including radio resource management, admission control, scheduling, enforcement of negotiated UL QoS, cell information broadcast, ciphering/deciphering of user and control plane data, and compression/ decompression of DL/UL user plane packet headers.

iv.Serving Gateway:-The SGW routes and forwards user data packets, while also acting as the mobility anchor for the user plane during

inter-eNB handovers and as the anchor for mobility between LTE and other 3GPP technologies (terminating S4 interface and relaying the traffic between 2G/3G systems and PDN GW).

There are the some key technology ingredients in the LTE Advanced:-

i.Cooperative Multi-Point Transmission and Reception:-The CoMP, as an advanced type of MIMO, provides the higher data rates, with cell edge throughput, coupled with excellent system throughput in high and load scenarios.

ii. Support for Heterogeneous Network Deployment: The issue of achieving a broader coverage with enhanced performance is of significant importance when it comes to the LTE-Advanced. Aside from the previously mentioned technological components of LTE-Advanced (CA, e-MIMO and CoMP), there is futuristic demand to have improved spectral efficiency per unit area. That is, every user within a particular cell must have a smooth and efficiently uniform service. This whole idea of spectral efficiency canters around the development of new deployment strategy called Heterogeneous Networks.

iii. Carrier Aggregation : Although there has been considerable flexibility in terms of bandwidth for previous releases, the LTE-Advanced (Release 10) gives more and desired flexibility in terms of transmission bandwidth of up to 100 MHz, while essentially allowing for backward compatibility with its predecessor. To actualize this, the idea of CA scheme is introduced. The CA is based on aggregating multi-component carriers and jointly makes use of them for transmission to and from mobile terminals (single). Up to 5 transmission components can be aggregated either when they are in the same frequency range or not. The fragmentation of the spectrum allows for the higher data rates by the combination of the all the small fragments to a big component.

iv.Enhanced Multi-Antenna Support: To meeting the LTEAdvanced goals, the multi-antenna solution is vital in driving the increased data rates and much system level performance. The enhanced Multi-Input and Multi-Output (MIMO) system is very important as this is a major enhancement technique that uses multiple antennas at both ends of the transmission system, that is transmit and receiving sides. The main components of the MIMO technologies used in the LTE are fundamentally important in the LTE-Advanced. the multi-antenna configuration in enhanced MIMO is extended for up to 8 x 8 in the DL and up to 4 x 4 in the UL. The transmission diversity and spatial multiplexing are most preferred to be used in actualizing the enhancements for an enhanced improve coverage and absolute peak data rate in the LTE-Advanced targets.

5.DIFFERENCE BETWEEN LTE-ADVANCED AND LTE

LTE-Advanced	LTE
LTE-A are 3 times the capacity of that in the LTE.	LTE has a capacity of 200 active users for every cell at 5 MHz.
In LTE-A, the peak data rate is 1 Gbps for DL and for UL, 500 Mbps.	For the peak data rate, the LTE has 100 Mbps for DL and 50 Mbps for UL.
LTE-Advanced	**LTE**
LTE-Advanced (4G) is backward compatible with LTE; and it is part of 3GPP Release 10.	LTEis not backward compatible with the previous 3G; it is part of the 3GPP Release 8.
LTE-A has quite the same as LTE requirements but there a need for optimization in the deployment for local areas and in micro cells.	LTE covers a range of up to 5 km for full performance.
LTE-Advanced offers greater speed of almost more than 40 times faster than 3G. The use of the antenna 8 x 8 in DL and 4x 4 in the UL also helps	LTE is meant to give a data rate of 326 Mbps using the 4 x 4 MIMO but 172 Mbps with the 2 x 2 MIMO in 20 MHz spectrum
It Allows for transmission bandwidth of about 100 MHz in DL and 40 MHz in UL.	It Deployed in scalable bandwidths of 1.25MHz to 20 MHz.

Advantages of Femtocell:-

i.Macrocell Reliability: The macrocell uses some of its resources for better reception to serve mobile users; this is because the femtocells will absorb some of the indoor traffic. The use of the femtocell helps to reduce the load on the macrocells.

ii.Coverage and Capacity: The femtocells operate within a small distance, which helps to have a comparative low transmit power, and help to have higher SINR. As a result, there is always excellent signal reception for coverage and higher capacity.

iii. Subscriber Turnover: It is quite popular that customers are not okay with indoors reception; and this has made customers to change their operators more often. So the use of the femtocell will help in creating a better customer's perspective in this regards.

iv. Cost: In terms of cost reduction, the deployment of femtocells has been studied to reduce the CAPEX and OPEX for the service providers. Cost of electricity and backhaul is reduced and the cost of deploying extra macrocells is avoided as a result of the femtocells deployment which has significant compensation on the broader macrocell network.

6.CHALLENGES OF FEMTOCELL

Although, there has been a significant example shift in the use of femtocells, there have been few challenges that the femtocells deployment has to combat. To reduce the expense femtocell requires very little for installation and setup. The devices should also be auto configuring so that it is very easy for the customer to use it. The user only needs to plug in the cable for internet connections and electricity and every thing else should be automatically configured. Femtocell can even face a problem in adjusting with its surrounding environment as the environment changes continuously. Even opening and closing doors again and again can change the environment. If femtocells will be deployed in large scale, then network should also be strong enough to manage this. Even building walls and windows attenuate the signals. As 70-80% mobile traffic is generated indoors mostly in homes and offices, so it is quite challenging for a femtocell for to deliver excellent data experience indoors. Femtocells face challenges like: Femtocell interference issues, Femtocell spectrum issues and Femtocell regulatory issues Hence we can say that management is big issue as operators today manage tens of thousands of cell sites. Femtocells will number in millions. It will lead to interference problem. That interference can also be femtocell to femtocell interference in adjacent buildings. Even this, configurations of femtocell should be so simple that an average user can install it.

7.RESULT & CONCLUSION

This thesis has given a broader perspective top-down overview into the past, present and what the future holds for the femtocells. It is important to know that the development of femtocells as a part of the big small cell pictures has a place in the present and future of wireless networks. The femtocells benefits are considered with discussion on what they offer and will continue to offer in terms of improved coverage and better capacity; more system reliability; a boost to subscribers' confidence and cost reduction. In this thesis additional, presented accordingly also, are some of the major issues that might set in if the future of the femtocells is not given necessary attention in terms Femtocells will be successful to make the landlines away. More important for us, there are no health effects from radio waves below the limits applicable to wireless or cellular communication system.

8.REFERENCES

[1] The Impact of Femtocells on Next Generation Mobile Networks [online].

[2] The Femto forum ,"Wireless in Home and Office" ,[Online] Available www.femtoforum.org

[3] Journal and Conference Papers and http://www.femtoforum.org

[4] HeNB (LTE Femto) Network Architecture[Online]http://www.slideshare.net/zahidtg/henb-lte-femtonetwork architecture

[5] 3GPP, "ITU Library and archive services",URL,http://www.itu.int/en/history/overview/Pages/history.aspx.

[6] A. Larmo, M. Lindstrom, M. Meyer, G. Pelletier, J. Torsner and H. Wiemann, "The LTE link-layer design", IEEE communication magazine, April, 2009.

[7] D. Astely, E. Dahlman, A. Furuskar, Y. Jading, M. Lindstrom & S. Parkwvall, "LTE: the evolution of mobile broadband", IEEE Communication Magazine, April, 2009.

[8] T. Hong, "OFDM and its wireless applications: A survey", IEEE transactions on Vehicular Technology, Vol. 58, Issue 4, pp. 1673-1694, May 2009.
[9] 3rd Generation Partnership Project, "Technical Specification Group Radio Access Network; evolved Universal Terrestrial Radio Access (UTRA): Base Station (BS) radio transmission and reception", TS 36.104, V8.7.0, September 2009.
[10] Alamouti. S, "A simple transmit diversity technique for wireless communications ", IEEE Journal on Selected Areas in Communications, Vol. 16, pp. 1451 - 1458, 1998.
[11] J. Ketonen, M. Juntti and J. R. Cavallaro, " Performance Complexity Comparison of Receivers for a LTE MIMO–OFDM System ", IEEE Transaction on Signal Processing, Vol. 58, No. 6, pp. 3360 – 3372, June 2010.
[12] Z. Lin, P. Xiao, B. Vucetic and M. Sellathurai, "Analysis of receiver algorithms for lte LTE SC-FDMA based uplink MIMO systems ", IEEE Transaction on Wireless Communications, Vol.9, No. 1, pp. 60 – 65, January 2010.

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