UMTS FEMTO ACCESS POINT FOR HIGHER DATA RATE AND BETTER QUALITY OF SERVICE TO THE USERS INSIDE THE CUSTOMER PREMISE

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Abstract

Femto access point is a HomeNodeB solution which consists of NodeB and RNC Functionality which is located at the end User premise in order to provide better quality of service to the User by using less transmission power with minimal interference it is based on the UMTS WCDMA (Wideband Code Division Multiple Access) system .In this work we implemented the combined NodeB and RNC protocol stack which support HSDPA and HSPA for Rel8 By Using MIMO, higher modulation scheme like 16QAM, 64 QAM on dynamic based on radio condition and interfaces on radio links It is small cell solution that is micro–cell, it has capable of providing the service at all time to open and closed subscriber group subscribers (CSG) with higher quality of service(QoS) for 64 UE's for both Voice and packet call . By comparing the throughput with Macro network it shows Femto cell solution gives better throughput transmission rate, and signal to noise with low bit error rate for transmission of packets from Home NodeB in AWGN noise channel to end users to achieve the improved downlink data rate for quality of service for multimedia application and triple play service.

Keywords-*RRC HNBAP, RUA, RANAP, CSG, MIMO, HSDPA, HSUPA*

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1. INTRODUCTION

In the evolution of WCDMA a new concept denoted Femto-access point is currently being developed within the 3GPP framework [1] .Two important design targets for the Femto-access point concept are to provide downlink peak data rates in the order of 30-40Mbit/s for best effort packet based services and to significantly reduce the downlink transmission delays and error rate. Some important features that are introduced in Femto-cell solution are fast link adaptation, fast scheduling, by using the high speed downlink shared channel (HS-DSCH) that is shared in the time domain among the active users, similar to the DSCH in WCDMA of today. It is impleted with new Protocal called HNBAP same as NBAP in UMTS which take care of all functionalities of IuB interface and Femto-cell network architecture consists of Home NodeB Gateway to reduce the multiple physical connection load from all HNB's on core network which concentrate all Home NodeB to Core network with single physical and multiple logical connection). The paper is categorised as, **section (1)** is Network architecture of Femto-access point and interfaces implementation **section(2)** gives the implementation of Protocols stack of Femto-cell **section(3)** gives the Implemented Techniques MIMO,CSG ,Application and Feature supported for end users **section (4)** Comparing Femto-acess point with UMTS .

2. FEMTO-ACCESS NETWORK ARCHITECTURE

Point network architecture consists of three parts 1) User equipment 2) Radio access network 3) Core network.

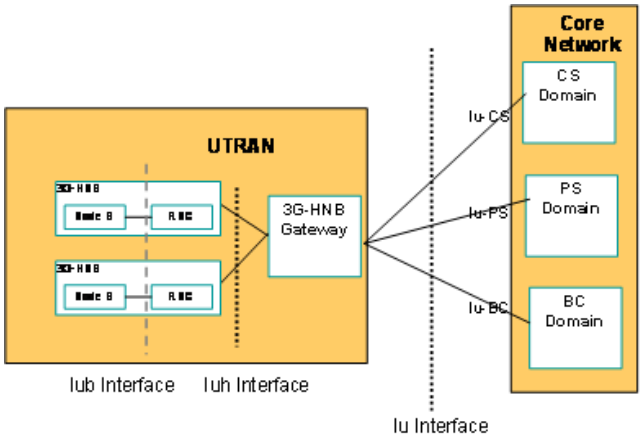

Fig.1 Femto-cell network

2.1 Interfaces and Function

Uu interface is also called as radio interface is between the User equipment and radio access network i.e our femtocell the main function of this is to provide the radio access to multiple Users and allocate the radio resources and control depending

upon the radio condition changes. The Protocol works on Uu interface is Radio Resource control (RRC).The main functions of femto-cell are Radio resources management, admission control, uplink and downlink power control to achieve better Qos ,taking handover decision based on measurement reports and providing the higher throughput for femto-cell subscriber using higher modulation with low power transmission from different users.

Iuh interface: The Iu-h is the interface between the HNB's and HNB-GW. Iu-h provides transport for the control and user plane messages RANAP user adaptation (RUA) is used over Iu-h to provide transparent transfer for the RANAP messages and another control plane protocol Called the Home NodeB Application Protocol (HNBAP) is as well introduced HNBAP is used to carry the HNB specific control information between the HNB and HNB-GW for HNB registration and UE registration for authorization.

Iu_Cs and Iu_Ps interfaces are between HNB-GW and and Packet core network (Iu_Ps) ,Voice call core network (Iu_Cs) Transparent transport is also provided for the Iu user plane protocol layer, which is Terminated at the CN, not at the HNB-GW Iu_Bc is used for broadcast domain .

Iub interface is between NodeB and RNC in UMTS there is modification for Femto-cell solution as in Femto-cell NodeB and RNC are collocated as single device the Framing protocol is Used for User plane and Control plane for RRC Messages and for NBAP function it is a proprietary interface called FAPI for configuration of NodeB protocol stack dynamically depending upon the Radio resource management decisions.

3. PROTOCOL STACK OF FEMTO-ACCESS POINT

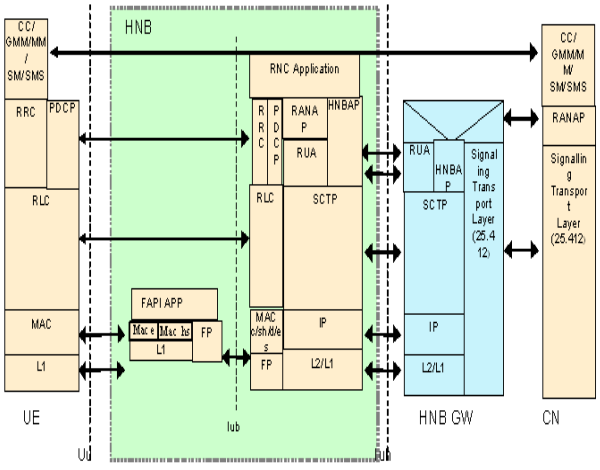

Fig.2 Femto-cell protocol architecture

Femto-cell Protocols stack consists:
RRC :RRC is the protocol exists in RNC and UE RRC it is the brain of radio access network which controls all lower layers RLC,MAC ,Physical ,for proper utilization of resource based on demand and multimedia service request from various user's[4]

Radio link control (RLC) and Medium access control (MAC) functionality are same as UMTS.

RLC: Segmentation, padding, error correction, sequence delivery etc [2]

MAC: Multiplexing, ciphering Prioritizes between different transport channels and Users,Ue identification etc[1].

The main protocol implemented for Home NodeB solution is **Home NodeB Application Part (HNBAP)**: for HNB authentication through HNB Registration and certification to allow only data to and from authorised HNBs and UE's using UE Registration request [8].

RANAP user adaptation (RUA) is used over Iu-h to provide transparent transfer for the RANAP messages to core network, as for Core network HNB-GW act as RNC[5].

RANAP Functions: RANAP provides the signalling service between the UTRAN and the CN, RAB Setup, modification, release, Relocation, Paging, Security mode control, Location reporting, Transport of NAS information between the UE and CN.

The Protocal Framing Protocol (FP) Used to communicate between NodeB and RNC inside the Femto-cell for User control and data plane and it ia a Layer-1 protocol. FP provides an important synchronization function between higher-layer radio access protocols and timing requirements of the radio transmission system. The FP also implemented for Iub interface in UMTS .Framing protocol is used for uplink and downlink data transfer. Framing protocol for the Dedicated Channel enables the RNC to exchange user data frames with UEs serviced by its own NodeB's.

For controlling and configuring the Femto-NodeB stack from RNC Application FAPI interface is implemented which is proprietary interface the function are same as of NBAP of UMTS i,e Cell configuration management, Common TrCh management, System Information management – CRNC schedules System broadcast info in BTS, Common measurements – NodeB can report cell common resource situation, Radio link management – create/modify/delete RL(s), Dedicated measurements – NodeB reports RL specific measurements – used for RRM purposes General error indications, Resource event management, DL power drifting correction.

4. FEMTO-ACCESS POINT SERVICES AND TECHNOLOGIES

The main motivation of Home NodeB solution is to provide the higher throughput and better quality of service to the end user with minimum capex this is achieved by reducing the delay ,co-channel interface as it coverage area is to small ,as their no much interference on radio link the RNC will provide the higher modulation scheme such as 64QAM,and Channelization codes with Spreading factor is low such SF=4,8,16 etc which is depends upon the service requested by the 64 users in order to provide these femto-acess point uses the standard techniques such as .

Multiple-Input-Multiple-output (MIMO): By using this it providing several advantages over transmit diversity techniques with multiple antennas only at the transmitter and over conventional single antenna systems [2]. If multiple antennas are available at the transmitter and receiver, the peak throughput can be increased a technique known as code reuse. With code reuse, each channelization/scrambling code pair allocated for data transmission can modulate up to *M* distinct data streams, where *M* is the number of transmit antennas. Data streams which share the same channelization/scrambling code must be distinguished based on their spatial characteristics, requiring a receiver with at least *M* antennas. In principle, the peak throughput with code reuse is *M* times the rate achievable with a single transmit antenna. For MIMO systems using code reuse principle all transmit antennas operate at the same data rate. In controlling the data of antenna separately, more granularities in the rate set is achievable, resulting in higher overall throughput. With *M* transmit antennas. The high-speed data stream for a given user is first demultiplexed into *M* sub streams. Following demultiplexing, the individual sub streams for each antenna are turbo encoded, interleaved, and mapped to modulation symbols. Each of the *M* sub streams is then demultiplexed into *N* sets of symbols. The *N* symbols for each antenna are each modulated by one of *N OVSF* codes. The sub streams may have different information rates, but the coded symbols have the same symbol periods the MIMO plays a major role in data rate enhancement in downlink packet access [11].

Closed subscriber Group (CSG): Home NodeB may provide restricted access to only UEs belonging to a Closed Subscriber Group (CSG). One or more of such cells, known as CSG cells, are identified by a unique numeric identifier called CSG Identity. To facilitate access control, a UE with CSG subscription would have an Allowed CSG List, which contains one or more CSG Identities associated with the CSG cells on which the UE is allowed access. The UE uses the

Allowed CSG List along with the CSG Identity broadcast by the CSG Cells in CSG cell selection and reselection The Femto-access point can be configured in three diffent CSG modes based on operator requirement **open access**: Open access is the simple case If a user is under a HNB coverage area, services are provided whether or not also macro cell service is available for all Users , **Closed access** : is the configuration option where the HNB provides services only for a preconfigured set of users called a Closed Subscriber Group (CSG), Hybrid access: is the configuration option where the radio resources are allocated to CSG users with high priority and for other users it looks with low priority resource allocation.

The Femto-acess points provides all the services provided by the macro network with improved Quos such as
Conversational call – Voice and video-conferencing
Streaming call - Video on demand
Interactive call - Web browsing and internet based email
Background call - SMS, FAX email.
Multirab - One Voice call with multiple Packet calls at a time for multiple UE's,High speed downlink packet access(HSDPA), High speed uplink packet access(HSUPA), emergency service[11].

Femto-access point features: Cell selection and reselection ,Radio Resource management (RRM) ,Radio bearer management, Hand in from macro ,HNB to HNB handover ,hybrid CSG, power control, measurement reports, Congestion control, Multiple primary PDP (packet data protocol) context, Multiple secondary context, release 8MIMO +64QAM modulation scheme, RRC states (Cell_Fach,Cell_Dch,Cell_PCH,Cell_UraPch) ,security mechanisms. Paging etc.

5. FEMTO-CELL COMPARISON WITH MACRO-CELL

The main advantages of Femto-cell is frequency reuse as the cell coverage area is to small we can use the same frequency channels in wide range for higher spectral efficiency with minimal co-channel inference.

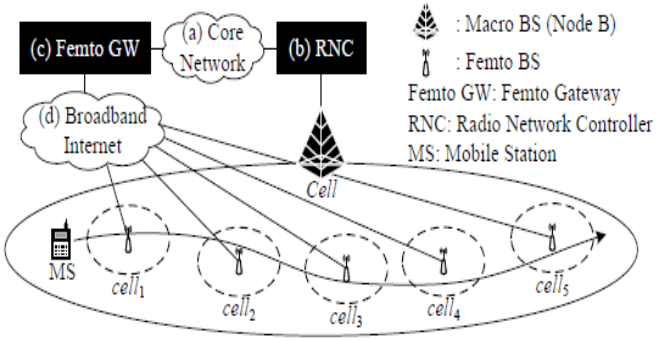

Fig 3 Network architecture comparison between Macro and Femto-cell

With the above architecture its shows that multiple femto-cells which connects to the core network via Home NodeB Gateway (HNB-GW) can be deployed in macro coverage area for data rate enhancement with better coverage to the end users .femto-

cell Self-optimization tied to backend network intelligence for easily managing millions of devices so they do not cause interference with neighbouring femtocells, picocells, and macro cell towers. Support for 64 simultaneous calls in 200 kbps of available bandwidth through implementation of multiplexing on the Real Time Protocol (RTP) link over a standard IPSec tunnel. The Home NodeB Management System (HMS) uses an interface based on the TR-069 standards widely used in DSL modem and DVB set-top-box management and updates. The management system sends the configuration data to the HNB and helps the HNB in HNBGW discovery. It can also initiate HNB software updates and perform HNB location verification. Below table gives the high level comparison between Macro and femto-cell .

Table 1 .Comparison of Femto-macro cell

Parameters	Macro-cell	Femto-cell
Installation cost & capex	High cost and more complex hardware	Low cost and plug and play
Inferences	very high due to high power signal	Very low as less power signal
Indoor coverage	Moderate 10km	High coverage 10-20meters
Quality of service	Normal	Enhance with reduced latency
Authorization	Accessed by all users	Accessed by authorized users
Density	Small number of high capacity sites	Large number of lower capacity sites
Data rates	uplink 5.4 Mbps Downlink >14Mbps	Uplink >7mbps , Downlink >42 Mbps
Modulation schemes	QPSK,16QAM	QPSK 16QAM, 64QAM

Femto-cell Application and advantages: Increased coverage and voice quality, increased data speeds, Innovative service plans, increased battery life, one phone bill, Traffic offload from macro network: offload from radio access network to femto-cell and offload backhaul to subscriber's broadband connection, Ability for the operator to place the coverage/capacity exactly where the demand exists i.e. where the revenue is greatest, easy to operate plug and play

Femto-cell Field Deployment challenges: The placement of a femto-cell has a critical effect on the performance of the wider network, and this is the key issue to be addressed for successful deployment. Because femto-cells can use the same frequency bands as the conventional cellular network, there has been the worry that rather than improving the situation they could potentially cause problems in order to overcome this problem proper frequency channels planning should taken before deploying ,If the femto network is sharing the channel (co-channel) with the macro network, interference can occur. However, if the interference management techniques advocated by the Femto Forum are adopted, the resulting interference can be mitigated in most cases.

6. CONCLUSIONS

Femto-cell is a advanced technology that is considered for higher data rates and better signal quality by using the higher modulation schemes ,lower delay ,lower power transmission with reduced interference on radio link ,by using MIMO m*n receiving and transmitting antenna it support for High speed downlink packet access (HSDPA) ,High speed uplink packet access (HSUPA) with all release 8 features as it fully tested and deployed by various operator ,as day by day users have the high demand of Multimedia services, value-added services on mobile internet as the spectrum is limited so femto-cell is playing a vital role for the User services demands with less installation and maintenance cost for the operator and higher spectral efficiency utilization, Future enhancement of femto-cell includes enhancing to the Rel-9-10-upcoming features set and support up to 100Mbs data rate in downlink .

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