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A Study on Optimal 4G Cellular Tower Distribution

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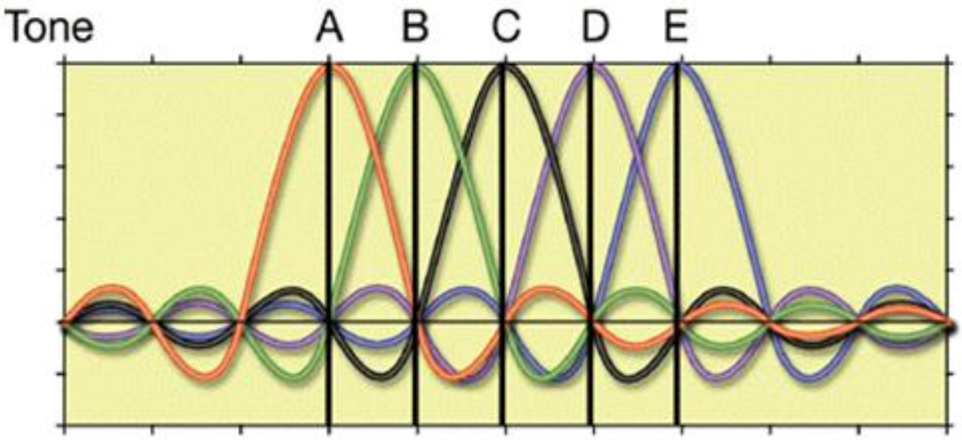
Abstract: There is a widely accepted vision of a system that enables an "Always Best Connected (ABC)" mode of communication. This concept, generally accepted as 4G (Fourth Generation), presupposes a heterogeneous communication landscape comprising different wireless access systems integrated on a platform, where the user enjoys undeterred connectivity and ubiquitous access to applications and services. Such features and services can be incorporated in an educational environment to foster the realization of educational objectives. The use of 4G devices for educational purposes, have enormous benefits: access to volumes of information just anywhere and at anytime; promotion of mobile collaboration among tutors and students, and so on. The 4G features, if integrated with mobile learning capabilities can go a long way in enhancing distance education schemes. This study explores the 4th Generation (4G) Technological Infrastructure and Enhanced Mobile Learning; seeing an integration of both technologies as an effective tool for Open and Distance Education. An extensive review of related literatures was also done. The study proposes that M-learning integrated on 4G platforms provide the best learning method, not just for Open and Distance Education, but also for conventional classroom oriented mode of learning, to make learning more exciting and interactive.

Keywords: Cellular Networks, LTE Networks, Optimal Tower Locations, Optimizations.

I. INTRODUCTION

For the LTE and WIMAX technologies, Security issues and future scope of 4G technologies. The demand of mobile user is ever increasing in this world of digital systems. Consumers demand more from their technology. Whether it is a television, cellular phone, Washing machine or refrigerator, the latest technology purchase must have new features. With the advent of the Internet, the most-wanted feature is better, faster access to information. The time not far away when access to all necessary information and the power of a personal computer, sits in the palm of one's hand. To support such a powerful system, we need pervasive, high-speed wireless connectivity. The drawbacks of the current mobile communication technology have led the researchers to come up with more advanced and efficient technologies. 4G mobile technology is the outcome in this direction. 4G is the next generation of wireless networks that will totally replace existing 3G networks. It is supposed to provide its customers with better speed and all IP based multimedia services. In the present scenario existing technologies are capable of performing functions like broadband data access, supporting voice traffic using voice over IP (VoIP), in mobile environment etc., but there is a great requirement of integrating all such technologies into a single combined system. 4G promises a solution to this problem by seamlessly integrating the terminals, networks and applications. This paper presents an overall study of the 4G systems, architecture, standard, benefits, challenges in implementation, design.



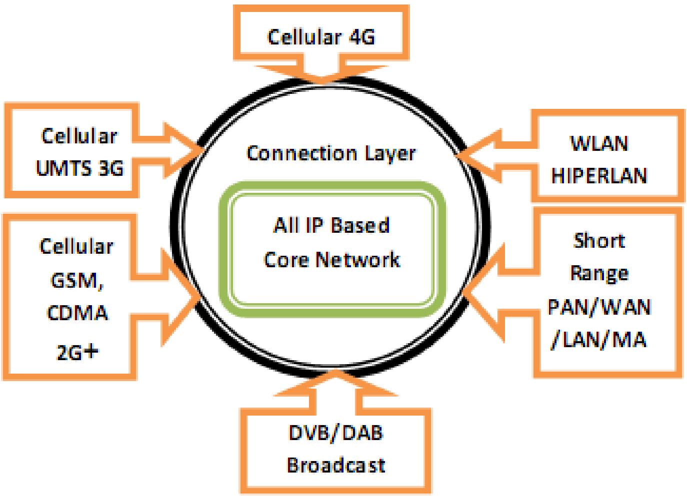


Figure 1. Cellular Networks

4G system is expected to provide a comprehensive and secure all- based solution to laptop computer and other mobile devices. such as Internet access, gaming services, and streamed multimedia may be provided to users. 4G technologies such as and first-release (LTE) have been on the market since 2006, 2008, and 2009 respectively. -Advanced compliant versions of LTE and WIMAX are under development and called "" and "" respectively. ITU has decided that LTE Advanced and Wireless MAN-Advanced should be accorded the official designation of IMT-Advanced. On December 6, 2010, ITU recognized that current versions of LTE, WI Max and other evolved 3G technologies that do not fulfill "IMT-Advanced" requirements could nevertheless be considered "4G", provided they represent forerunners to IMT-Advanced and "a substantial level of improvement in performance and capabilities with respect to the initial third generation systems now deployed. Basically 4G standard is based on two technologies: standardized by the and standardized by the (i.e. Wireless MAN-Advanced).

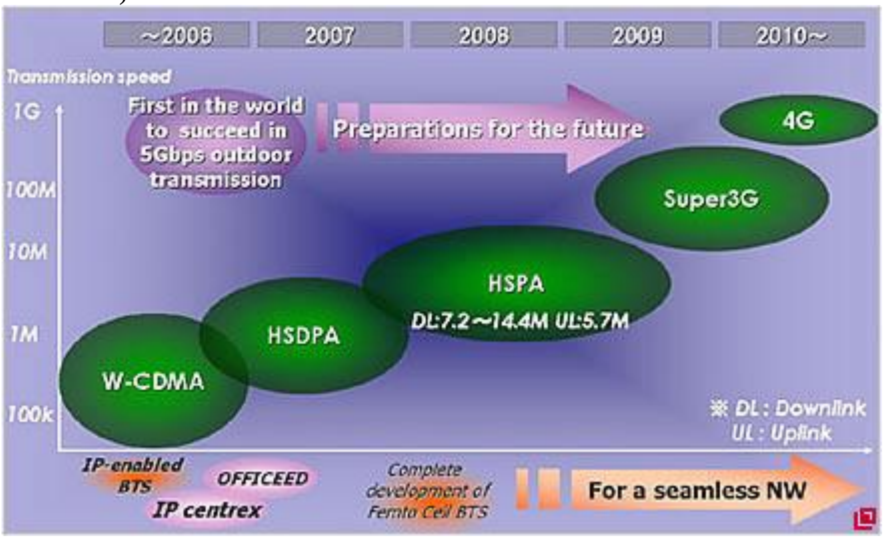


Figure 2. Preparations for Future

II. METHODOLOGY

LTE network reference model, consisting of LTE entities and EC entities (S-GW, P-GW, MME, HSS, PCRF, SPR, OCS and OFCS). A PDN is an internal or external IP domain of the operator that a UE wants to communicate with, and provides the UE with services such as the Internet or IP Multimedia Subsystem (IMS).

Traffic Flow on the LTE Network:

The flow of user plane traffic accessing the Internet in the LTE network reference architecture. Figure 3 (a) shows the traffic flow from a UE to the Internet and Figure 3(b) shows one from the Internet to a UE. IP packets are forwarded through the GTP tunnel over S1-U and S5 interfaces. These GTP tunnels are established per EPS bearer when a user is attached to the LTE network .More than one EPS bearer is established on each of the S1-U and S5 interfaces. So, in order to identify these bearers, a Tunnel Endpoint Identifier (TEID) is assigned to the end points (UL and DL) of each GTP tunnel (When identifying a GTP tunnel, a TEID, IP address and UDP port number are used in general Here, however, for convenience of description, only a TEID is used for this purpose). The receiving end side of the GTP tunnel locally assigns the TEID value the transmitting side has to use. The TEID values are exchanged between tunnel endpoints using control plane protocols

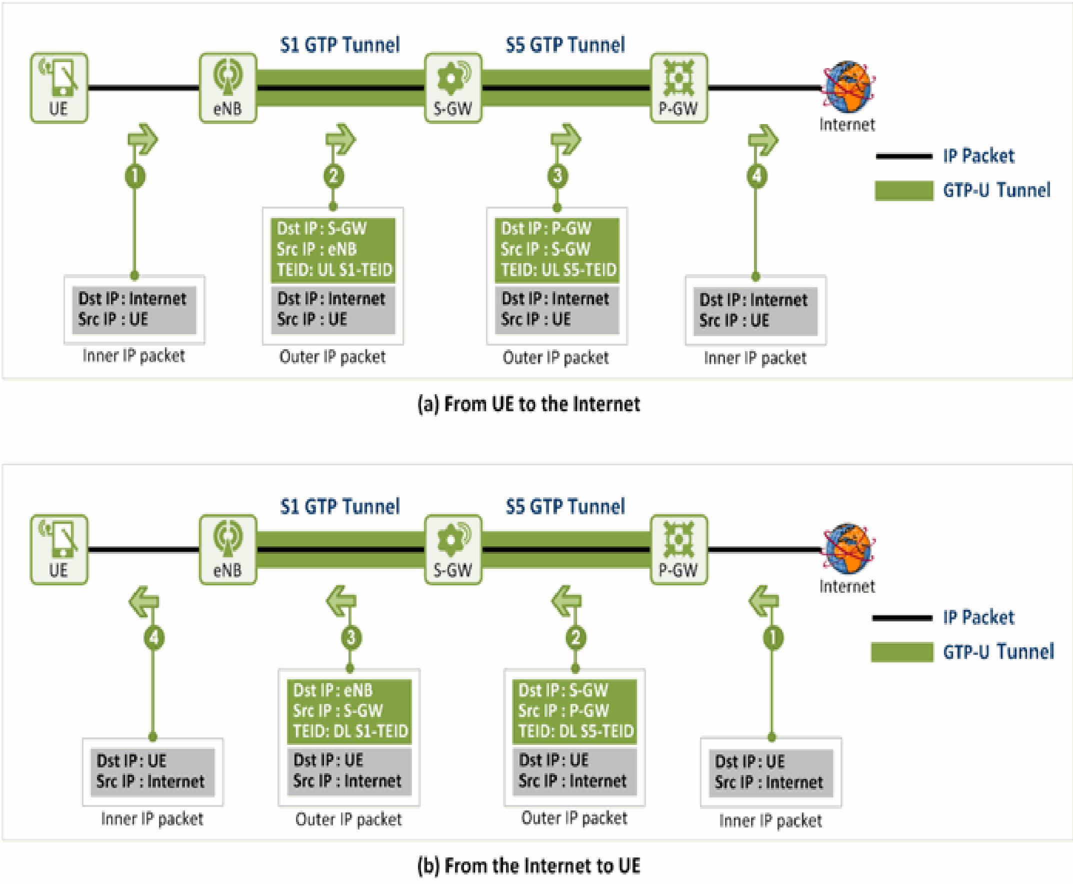


Figure 3. Traffic flow on the LTE network

III. RELATED WORKS

- The data rate with peak uplink of 500Mbps and peak downlink of 1Gbps.
- Provide spectrum efficiency with more than three times that provided by LTE.
- Offer spectrum efficiency in uplink 15 bps/Hz and in downlink 30 bps/Hz.
- The spectrum using the capability to backing the scalable bandwidth and the aggregation of spectrum where noncontiguous spectrum is need to using.
- The link latency in case from idle status to connected
  The data rate with peak uplink of 500Mbps and pe

Related WorPinals, L. et al, in "Link Regime and Power Savings of Decode-Forward Relaying in Fading Channels" 2015 [1], the authors describe in this paper, they re-examine the relay channel under the decode-forward (DF) strategy. Contrary to the established belief that blocks Markov coding is always the rate-optimal DF strategy, under certain channel conditions (a link regime); independent signaling between the source and relay achieves the same transmission rate without requiring coherent channel phase information. Further, this independent signaling regime allows the relay to conserve power. As such, they design a composite DF relaying strategy that achieves the same rate as block Markov DF but with less required relay power. The finding is attractive from the link adaptation perspective to adapt relay coding and relay power according to the link state. They examine this link adaptation in fading under both perfect channel state information (CSI) and practical CSI, in which nodes have perfect receive and long-term transmit CSI, and derive the corresponding relay power savings in both cases. They also derive the outage probability of the composite relaying scheme which adapts the signaling to the link regime. Through simulation, they expose a novel trade-off for relay placement showing that the relay conserves the most power when closer to the destination but achieves the most rate gain when closer to the source.

Parzysz, F. et al, in "Impact of Propagation Environment on Energy-Efficient Relay Placement: Model and Performance Analysis" 2014 [2], the authors describe the performance of a relay-based cellular network is greatly affected by the relay location within a cell. Existing results for optimal relay placement do not reflect how the radio propagation environment and choice of the coding scheme can impact system performance. In this paper, they analyze the impact on relaying performance of node distances, relay height and line-of-sight conditions for both uplink and downlink transmissions, using several relay coding schemes. Our first objective is to propose a geometrical model for energy-efficient relay placement that requires only a small number of characteristic distances. Our second objective is to estimate the maximum cell coverage of a relay-aided cell given power constraints, and conversely, the averaged energy consumption given a cell radius. They show that the practical full decode-forward scheme performs close to the energy-optimized partial decode-forward scheme when the relay is ideally located. However, away from this optimum relay location, performance rapidly degrades and more advanced coding scheme, such as partial decode-forward, is needed to maintain good performance and allow more freedom in the relay placement. Finally, they define a trade-off between cell coverage and energy efficiency, and show that there exists a relay location for which increasing the cell coverage has a minimal impact on the average energy consumed per unit area.

Biao Han et al, in "Optimal relay node placement for multi-pair cooperative communication in wireless networks" 2013 [3], the authors describe Relaying and cooperation have emerged as important research topics in wireless communication over the past half-decade. During cooperative communication, spatial diversity can be achieved by exploiting the relaying capabilities of the involved relay nodes, which may vastly enhance the achieved system capacity. The potential gains largely depend on the location of relay nodes. In this paper, they study the relay node placement problem for multi-pair cooperative communication in wireless networks, where a finite number of candidate relay nodes can be placed to help the transmission of multiple source-destination pairs. Our objective is to maximize the system capacity. After formulating the relay node placement problem, they comprehensively study the effect of relay location on cooperative link capacity and show several attractive properties of the considered problem. As the main contribution, they develop a geographic aware relay node placement algorithm which optimally solves the relay node placement problem in polynomial time. The basic idea is to place a set of relay nodes to the optimum locations so as to maximize the system capacity. The efficiency of their proposed algorithm is evaluated by the results of series experimental studies.

Sung-Rae Cho et al, in "QOS Provisioning Relay Selection in Random Relay Networks" 2011 [4], the authors describe In this paper, they propose an analytical framework for determining the outage probability of random and best relay selection schemes given a Poisson field of relay nodes and the presence of path loss and fading. For relay selection, relays geographically close to the source and destination are preferred to others. This selection guideline ensures a target quality of service and reduces the signaling overhead and the relay selection delay. A spatial region called the QOS region is obtained for the random relay selection and is shown to shrink as the distance between the source and the destination increases and the interfering node density increases. When the QOS region for random relay selection is not large enough and cannot probabilistically ensure a reliable relay therein, the best relay selection is employed since the required relay node density and selection range for a desired QOS can be reduced for the best relay selection. The gain of the best relay selection with respect to the random relay selection is quantified in terms of relay node density reduction and coverage extension due to selection diversity.

Jianhua Mo et al, in "Secure Beam forming for MIMO Two-Way Communications With an Untrusted Relay" 2014 [5], the authors describe This paper studies the secure beam forming design in a multiple-antenna three-node system where two source nodes exchange messages with the help of an untrusted relay node. The relay acts as both an essential signal forwarder and a potential eavesdropper. Both two-phase and three-phase two-way relay strategies are considered. Our goal is to jointly optimize the source and relay beam formers for maximizing the secrecy sum rate of the two-way communications. They first derive the optimal relay beam former structures. Then, iterative algorithms are proposed to find source and relay beam formers jointly based on alternating optimization. Furthermore, they conduct asymptotic analysis on the maximum secrecy sum-rate. Our analysis shows that when all transmit powers approach infinity, the two-phase two-way relay scheme achieves the maximum secrecy sum rate if the source beam formers are designed such that the received signals at the relay align in the same direction. This reveals an important advantage of signal alignment technique in against eavesdropping. It is also shown that if the source powers approach zero, the three-phase scheme performs the best while the two-phase scheme is even worse than direct transmission. Simulation results have verified the efficiency of the proposed secure beam forming algorithms as well as the analytical findings.

Xu, H. et al, in "Shared Relay Assignment (SRA) for Many-to-One Traffic in Cooperative Networks" 2015 [6], the authors describe Relay assignment significantly affects the performance of the cooperative communication, which is an emerging technology for the future mobile system. Previous studies in this area have mostly focused on assigning a dedicated relay to each source destination pair for one-to-one (121) traffic. However many-to-one (M21) traffic which is also common in many situations (for example several users associate with one access point in a wireless access network such as a WLAN) hasn't been well studied. This paper addresses the shared relay assignment (SRA) problem for M21 traffic. They formulate two new optimization problems: one is to maximize the minimum throughput among all the sources (hereafter called M21-SRA-MMT), and the other is to maximize the total throughput over all the sources while maintaining some degree of fairness (hereafter called M21-SRA-MTT). As the optimal solutions the two problems are hard to find, they propose two approximation algorithms whose performance factors are 5.828 and 3, respectively, based on the rounding mechanism. Extensive simulation results show that their algorithms for M21-SRA-MMT can significantly improve the minimum throughput compared with existing algorithms, while their algorithm for M21-SRA-MTT can achieve the close-to-optimal performance.

Shahbazi, S. et al, in "On Placement of Passive Stationary Relay Points in Delay Tolerant Networking" 2011 [7], the authors describe Recently, there has been focus on augmenting Delay/Disruption Tolerant Networks (DTNs) with easily deployable stationary relay nodes making an unconnected infrastructure to facilitate the data delivery by increasing forwarding opportunities. Relay nodes are capable of downloading, storing, and forwarding the data messages from/to the mobile nodes. Placing the relay nodes is an important issue in DTNs as the performance of the network is dependent to their positions. Relay placement is an NP-hard problem hence it makes it a more complicated issue in DTNs. Existing works in the literature are based on simulation which are suffering from computational complexities dictated by simulation. Moreover, they are optimizing the relay placement only based on specific scenarios. In this paper, they propose a generic analytical model in order to evaluate the performance of DTNs in presence of relay nodes. Our model is dependent on the mobile nodes' mobility pattern, and they consider the case when the mobile nodes move according to the random waypoint model. In order to use the proposed model for placing the relays efficiently, they utilize two heuristic approaches. The first approach is based on optimization of the network performance using simulated annealing and the second one relies on a greedy approach to find the best location for each relay one at a time. Our simulation results show that their approaches outperform the simulation based approaches in terms of data delivery performance.

Qimei Cui et al, in "Optimal Energy-Efficient Relay Deployment for the Bidirectional Relay Transmission Schemes" 2014 [8], the authors describe recently, the energy efficiency of a relay network has become a hot research topic in the wireless communication society. In this paper, they investigate the energy efficiency of three basic bidirectional relay transmission schemes [i.e., the four time-slot (4TS), three time-slot (3TS), and two time-slot (2TS) schemes] from the angle of relay deployment. Since a realistic power consumption model is very important in analyzing energy efficiency, and a power amplifier (PA) consumes up to 70% of the total power, they consider a realistic non ideal PA model. The derived closed-form expressions for the optimal relay deployment and the simulation results reveal the following important conclusions. First, it is possible to achieve the optimal energy efficiency and enlarge the cell coverage simultaneously in bad channel conditions, but it may be very challenging in good channel conditions. Second ,under asymmetric traffic conditions, particularly when the downlink rate is larger than the uplink rate, all the aforementioned three schemes have almost the same optimal relay deployment, but the 2TS scheme has the highest energy efficiency when the spectral efficiency is large. Third, the relay node should be deployed closer to the base station with the non ideal PA than that with the ideal PA, and the optimal energy efficiency with the non ideal PA is much higher than that with the ideal PA. Moreover, the impact of small-scale fading depends on the value of path loss. To overcome the small-scale fading, the relay network needs to consume more energy.

Liu, S. et al, in "On impact of relay placement for energy-efficient cooperative networks" 2014 [9], the authors describe this study considers communication from a source to a destination with the aid of a set of cooperative relaying nodes. Unlike previous studies in energy efficiency, the authors studied the effect of relay placements together with different relay-selection timing on the performance. The cooperative relaying schemes for a general relay placement and some specialized relay placements are characterized and analyzed by a Markov chain model. They derive the expressions for the throughput and the expected energy consumption for both proactive and reactive relay selection for different relay placements and densities. By using the analytical expressions, the authors find the optimal relay locations for different relay-selection schemes to achieve higher energy efficiency with the consideration of system throughput. The performance improvements offered by the authors proposed relay placement are demonstrated by numerical results. Moreover, the two new cooperative relaying schemes with selection combining for a certain relay placement are discussed. Their throughput and energy consumption are also derived and compared with the existing techniques.

Xian Li et al, in "Energy-efficient link selection scheme in a two-hop relay scenario with considering a mobile relay" 2015 [10], the authors describe recently researches show that significant energy saving can be achieved by introducing mobile relays into wireless sensor networks. However, due to the extra transceiver circuit energy and the mobility energy consumed by the mobile relay, it is not always better to pass data through the relay rather than to send it from source to destination directly. In this study, the authors study a novel link selection problem in a two-hop relay scenario where the relay has the ability to move. In this scenario, data from source can be passed through three kinds of links: the direct link, the initial relay link and the adjusted relay link. From the energy-saving perspective, the optimal moving direction, the position adjustment criterion and the optimal position of the mobile relay are firstly studied through mathematical analysis. Based on a comprehensive discussion of the energy performances of these three kinds of links, and energy-efficient link selection scheme is then presented. Both the amount of data to be sent and the distance between source and destination are shown to be closely related to the link selection scheme. Finally numerical simulations are carried out to verify the theoretical results.

IV. NEED FOR OPTIMIZATION

The technical optimization variables contain the following; High price of running the center station; the percentage that use utility manipulation supply can be optimized across constructing close to basis of domination, thought of renewable and green manipulation to curb sound and pollution. Use of rooftop tops; surveys expose that the use of rooftop tops for dense city spans alongside elevated development constructing to be extra helpful, these options might be exploited across larger holistic arranging and larger area enlightenment. Collocation agreement ; the regulations administrating collocation demand to be enhanced for larger ability delivery. Intelligent planning; there is demand for a extra Intelligent arranging that ought to seize topographic features of terrain, interference of supplementary ability providers etc as variables needing negligible drive examination and manual examination of locations.

V. PROBLEM FORMULATION

In the need to check the power consumption of cellular webs as maintaining ability quality and omnipresent admission, lofty is a flexible and frugal resolution to enhance presentation, remove coverage dead zones or alleviate traffic hot zones. Towering is an enthusing feature of upcoming cellular webs and is envisioned as portion of subsequent creation cellular networks. The scenarios envisioned by the two standards for 4g webs and LTE are the following:

(a) cluster mobility: towers can aggregate the traffic connected to a cluster of users inside a train or a bus;
(b) Capacity coverage extension: towers ought to rise user experience in indoor or permit connection in shadowed zones;
(c) boost: by employing low-cost tower stations, a cellular operator can density its web and rise its capacity.

Unlike tiny cells, tower stations are not related to the core web across a wire line backhaul connection but have to rely on wireless transmission to admission the center station. This proposals momentous groundwork price reduction and placement flexibility but, at the alike period, can aggravate the interference issue. Discovering optimized lofty jointly alongside interference reduction and choice of coding scheme opens new perspectives for effectual tower deployment we demand to tackle the setback of optimal tower arrangement for capacity rise in an 4g and LTE like cellular web.

VI. COMMON TECHNIQUES

- **Interference free** – place away the cell phone and especially the modem away from any other electronic device, just to make sure that something may not interfere with the signal. Usually, household appliances like TVs, radios and especially microwave ovens can cause slower speeds.
- **Maximize modem signal** – 4G towers use waves to send traffic towards the modem, so in order to ensure that a high amount of these waves reach the terminal, you should place the modem near a window. Avoid placing the unit behind anything solid, like a concrete wall, metal and especially, trees (water found inside the leaves has high influence over signal loss).
- **Change position** – orientating the modem position may align its antenna with the one placed on the tower, increasing LTE signal strength. Although it sounds a bit voodoo, tower antennas are usually unidirectional and matching the right degree will boost speeds.

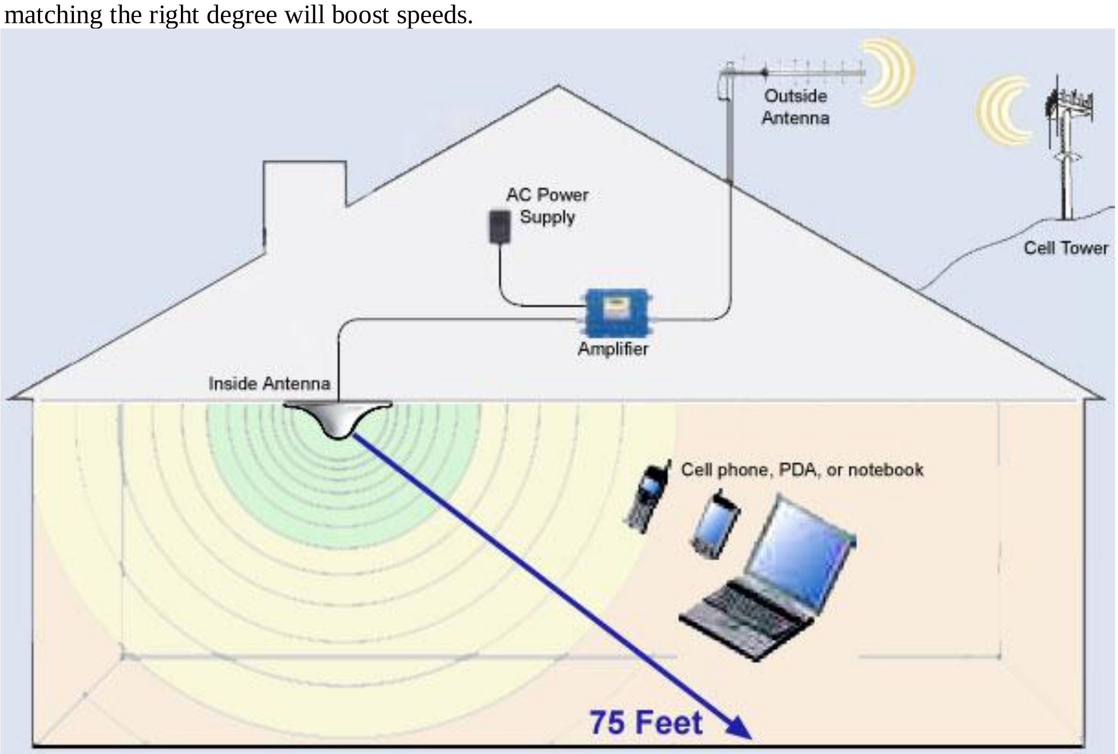


Figure 4. Amplify the signal

Best used for home or office environments, amplifiers can be seen as quite the investment when you want quality wireless internet access. For instance, someone wishing to boost their 4G speed inside the house can acquire a signal amplifier, a pair of compatible antennas and connect them for wonderful results. The concept is as follows:

1. One antenna is placed outside the house, on a fair altitude, so that it will capture more signal than the antenna mounted on the handset can. This eliminates the attenuation caused by the house walls and, depending on the antenna quality, it will increase gain dramatically.
2. Another antenna needs to be mounted inside the house, to retransmit the signal captured by the outside unit. This method will once more help disregard the attenuation produced by house walls.
3. Between the two antennas, an amplifier must be mounted that will increase the signal strength and help remove the feeder / cable loss.

VII. CONCLUSION

In this paper early setback believed is tower arrangement for maximum expansion of the cell radius. Rise in cell radius helps cut groundwork price of employing extra center stations to prop the quickly producing number of subscribers. The 4G services had only reached alongside in a little locations of India, so that it could seize period to grasp to supplementary states. One more main defect of this is that expansive group frequency spectrum that is demanded for 4G, is lacking. One more reason for this is that it is a price bearing item exceptionally for dispatching data. If it ought to be consented amid all clients, firstly it ought to be obtainable at a lower rate, for that the rate of spectrum ought to be declined. We counsel consequently an optimized method for tower arrangement employing pursuing methodology. Tower stations (RSs) are normally utilized to enhance the gesture strength for the users close to the cell boundary.

Though, transmission across a tower station needs two transmission periods, i.e., one is from the center station to the tower station and the supplementary is from tower station to mobile stations. Thus, tower could additionally cut arrangement capacity if two-phase transmission period is considered. As a consequence, whether or not data are sent by one-hop or two-hop transmission ought to be ambitious established on both gesture strength and throughput. In this work, we examine the optimal tower locale aiming to maximize arrangement capacity. We ponder a novel gesture strength-oriented tower selection law for ascertaining whether a hop transmission is necessary oriented. We will find that the gesture strength-oriented hop transmission could yield higher arrangement capacity we will additionally recognize the optimal tower locale that can accomplish the highest arrangement capacity.

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