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Scalable Uninterrupted Network Service Using LTE

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Abstract: ***Mobile communication systems revolutionized the way people communicate, joining together communications and mobility. A long way in a remarkably short time has been achieved in the history of wireless. Evolution of wireless access technologies is about to reach its fourth generation (4G). Looking past, wireless access technologies have followed different evolutionary paths aimed at unified target: performance and efficiency in high mobile environment. The first generation (1G) has fulfilled the basic mobile voice, while the second generation (2G) has introduced capacity and coverage. This is followed by the third generation (3G), which has quest for data at higher speeds to open the gates for truly "mobile broadband" experience, which will be further realized by the fourth generation (4G). The Fourth generation (4G) will provide access to wide range of telecommunication services, including advanced mobile services, supported by mobile and fixed networks, which are increasingly packet based, along with a support for low to high mobility applications and wide range of data rates, in accordance with service demands in multiuser environment. This paper provides a high level overview of the evolution of Mobile Wireless Communication Networks in 4G networks***

Keywords: Mobile Communication Systems, Wireless Communication, Code Division Multiple Access, Mobile Adhoc Network, Long Term Evolution (LTE)

1. Introduction

With all the technological advances, and the simultaneous existence of the 2G, 2.5G and 3G networks, the impact of services on network efficiency have become even more critical. Many more designing scenarios have developed with not only 2G networks but also with the evolution of 2G to 2.5G or even to 3G networks. Along with this, inter-operability of the networks has to be considered. 1G refers to analog cellular technologies; it became available in the 1980s. 2G denotes initial digital systems, introducing services such as short messaging and lower speed data. CDMA2000 1xRTT and GSM are the primary 2G technologies, although CDMA2000 1xRTT is sometimes called a 3G technology because it meets the 144 kbps mobile throughput requirement. EDGE, however, also meets this requirement. 2G technologies became available in the 1990s. 3G requirements were specified by the ITU as part of the International Mobile Telephone 2000 (IMT-2000) project, for which digital networks had to provide 144 kbps of throughput at mobile speeds, 384 kbps at pedestrian speeds, and 2 Mbps in indoor environments. UMTS-HSPA and CDMA2000 EV-DO are the primary 3G technologies, although recently WiMAX was also designated as an official 3G technology. 3G technologies began to be deployed last decade. The emergence of new technologies in the mobile communication systems and also the ever increasing growth of user demand have triggered researchers and industries to come up with a comprehensive manifestation of the up-coming fourth generation (4G) mobile communication system. In contrast to 3G, the new 4G framework to be established will try to accomplish new levels of user experience and multi-service capacity by also integrating all the mobile technologies that exist (e.g. GSM - Global System for Mobile Communications, GPRS - General Packet Radio Service, IMT-2000 – International Mobile Communications, Wi-Fi - Wireless Fidelity, Bluetooth). The fundamental reason for the transition to the All-IP is to have a common platform for all the technologies that have been developed so far, and to harmonize with user expectations of the many services to be provided. The fundamental difference between the GSM/3G and All-IP is that the functionality of the RNC and BSC is now distributed to the BTS and a set of servers and gateways. This means that this network will be less expensive and data transfer will be much faster. 4G will make sure - "The user has freedom and flexibility to select any desired service with reasonable QoS and affordable price, anytime, anywhere." 4G mobile communication services started in 2010 but will become mass market in about 2014-15.

In on-demand trend, routing information is only created to requested destination. Link is also monitored by periodical Hello messages. If a link in the path is broken, the source needs to rediscovery the path. On-demand strategy causes less overhead and easier to scalability. However, there is more delay because the path is not always ready. The following part will present AODV, DSR, TORA and ABR as characteristic protocols of on-demand trend.

Routing in AODV consists of two phases: Route Discovery and Route Maintenance. When a node wants to communicate with a destination, it looks up in the routing table. If the destination is found, node transmits data in the same way as in DSDV. If not, it start Route Discovery mechanism: Source node broadcast the Route Request packet to its neighbor nodes, which in turns rebroadcast this request to their neighbor nodes until finding possible way to the destination. When intermediate node receives a RREQ, it updates the route to previous node and checks whether it satisfies the two conditions: (a) there is an available entry which has the same destination with RREQ (b) its sequence number is greater or equal to sequence number of RREQ. If no, it rebroadcast RREQ. If yes, it generates a RREP message to the source node. When RREP is routed back, node in the reverse path updates their routing table with the added next hop information. If a node receives a RREQ that it has seen before (checked by the sequence number), it discards the RREQ for preventing loop. If source node receives more than one RREP, the one with greater sequence number will be chosen. For two RREPs with the same sequence number, the one will less number of hops to destination will be chosen. When a route is found, it is maintained by Route Maintenance mechanism: Each node periodically send Hello packet to its neighbors for proving its availability. When Hello packet is not received from a node in a time, link to that node is considered to be broken. The node which does not receive Hello message will invalidate all of its related routes to the failed node and inform other neighbor using this node by Route Error packet.

1.1 Table-Driven (or Proactive)

The nodes maintain a table of routes to every destination in the network, for this reason they periodically exchange messages. At all times the routes to all destinations are ready to use and as a consequence initial delays before sending data are small. Keeping routes to all destinations up-to-date, even if they are not used, is a disadvantage with regard to the usage of bandwidth and of network resources.

1.2 On-Demand (or Reactive)

These protocols were designed to overcome the wasted effort in maintaining unused routes. Routing information is acquired only when there is a need for it. The needed routes are calculated on demand. This saves the overhead of maintaining unused routes at each node, but on the other hand the latency for sending data packets will considerably increase.

1.3 DSDV(Destination-Sequence Distance Vector)

DSDV has one routing table, each entry in the table contains: destination address, number of hops toward destination, next hop address. Routing table contains all the destinations that one node can communicate. When a source A communicates with a destination B, it looks up routing table for the entry which contains destination address as B. Next hop address C was taken from that entry. A then sends its packets to C and asks C to forward to B. C and other intermediate nodes will work in a similar way until the packets reach B. DSDV marks each entry by sequence number to distinguish between old and new route for preventing loop. DSDV use two types of packet to transfer routing information: full dump and incremental packet. The first time two DSDV nodes meet, they exchange all of their available routing information in full dump packet. From that time, they only use incremental packets to notice about change in the routing table to reduce the packet size. Every node in DSDV has to send update routing information periodically. When two routes are discovered, route with larger sequence number will be chosen. If two routes have the same sequence number, route with smaller hop count to destination will be chosen.

DSDV has advantages of simple routing table format, simple routing operation and guarantee loop-freedom. The disadvantages are (a) a large overhead caused by periodical update (b) waste resource for finding all possible routes between each pair, but only one route is used. Route discovery to get a new path. AODV has advantages of decreasing the overhead control messages, low processing, quick adapt to net work topology change, more scalable up to 10000 mobile nodes. However, the disadvantages are that AODV only accepts bi-directional link and has much delay when it initiates a route and repairs the broken link.

2. Literature Survey

This section literature review has provides an overview and a critical evaluation of a body of literature relating to a research problem. Literature review is the most important step in software development process.

2.1 Overview of 3GPP LTE-Advanced Carrier Aggregation for 4G Wireless Communications

In this paper [1], to satisfy the ever increasing demand for higher throughput and data rates, wireless communication systems need to operate in wider bandwidths. 3GPP LTE-Advanced with carrier aggregation enables operators to maximally and optimally utilize their available spectrum resources for increased data rates and user experience while reducing their incurred OPEX and CAPEX. This article provides a tutorial overview of 3GPP LTE-Advanced with carrier aggregation as specified in Rel-10 including deployment scenarios of interest, main design features, PHY/MAC procedures, and potential enhancements for future standard releases.

2.2 Performance Analysis of Downlink Inter-Band Carrier Aggregation in LTE Advanced

According to this paper [3], Carrier aggregation (CA) is one of the most distinct features for LTE-Advanced systems, which can support a much wider transmission bandwidth up to 100 MHz by aggregating two or more individual component carriers (CCs) belonging to the same (intra-band) or different (inter-band) frequency bands. With CA, it is possible to schedule user equipment (UE) on multiple CCs simultaneously. From radio resource management (RRM) perspective, CC selection plays an important role in optimizing the system performance, especially in the case of inter-band CA where the radio propagation characteristics of each CC can be different. In this paper, we investigate the downlink resource allocation for inter-band CA, i.e., how to assign carrier(s) to different UEs. A simple yet effective G-factor based carrier selection algorithm, which takes both traffic load and radio channel characteristics into considerations, is proposed with the objective to guarantee good coverage for Rel'8 UEs and robustness for Rel'10 UEs. Simulation results show that our proposed G-factor based carrier selection algorithm can achieve much better coverage performance compared to the least-load carrier selection in scenarios with relatively high inter-site distance and relatively high frequency separation between carriers, at the expense of some marginal average user throughput loss.

2.3 Component Carrier Management for Carrier Aggregation in LTE Advanced System

This paper focuses on[2], investigating appropriate management of Component Carriers(CCs) in carrier aggregation(CA) system, which is identified as one of the most distinct features of 4G systems including Long Term Evolution Advanced (LTE-A). An LTE user equipment (UE) is allowed to concurrently utilize multiple carriers, which leads to scalable increase in user throughput. However, in certain circumstances, aggregating entire available carriers for a UE is not meaningful due to probably low channel quality or high traffic load in some of the CCs. Therefore, how to make good use of multiple carriers in real deployment scenarios is an important issue. Based on the analysis of resource allocation across multiple carriers in Layer-2, two CC management methods in Layer 3 are proposed. The proposed method is shown by simulation results to be effective in providing comparable user throughput with lower implementation complexity, as compared to solely ingenious resource allocation.

2.3 Multiuser Scheduling on the LTE Downlink with Meta-Heuristic Approaches

In this paper [5], the issue of multi-user radio resource scheduling on the downlink of a Long Term Evolution (LTE) cellular communication system is addressed. An optimization model has been proposed earlier, where radio resources for multiple users are jointly allocated at the air-interface. It has been shown that an optimal solution to such a problem may provide reasonable gain over a simply greedy approach. However, the complexity of such an optimal approach could be prohibitively high. By exploiting meta-heuristic methods such as Genetic Algorithm (GA) and Simulated Annealing (SA), the results in this paper show that significant reduction in complexity can be obtained while achieving near-optimal solutions.

2.5 Qos Guaranteed Resource Block Allocation Algorithm for LTE Systems

According to this paper [4], Using conventional resource allocation algorithms in OFDM systems, each user can employ different Modulation and Coding Scheme (MCS) on allocated subcarriers to achieve good throughput. However, in the downlink transmission of LTE systems, the minimum allocation unit for one user is Scheduling Block (SB) and all SB assigned to one user must adopt the same MCS. Therefore, the application of conventional resource allocation algorithms in LTE results in degraded performance since MCS must be chosen according to the worst SB. To solve this problem, a QoS guaranteed resource block allocation algorithm is proposed for LTE systems, which takes into account both the constraint on MCS and the requirement of Quality of Services (QoS). The proposed algorithm firstly estimates the number of SB required by each user and then allocates SBs to users according to their priorities. Simulation results show that compared to conventional schemes, the proposed algorithm can achieve high throughput as well as significant improvement in guaranteeing users' QoS requirements.

3. Proposed Approach

In the Proposed Approach, User requirements are growing faster than ever and the limitations of the current mobile communication systems have forced the researchers to come up with more advanced and efficient technologies. 4G mobile technology is the next step in this direction. 4G is the next generation of wireless networks that will totally replace 3G networks. It is supposed to provide its customers with better speed and all IP based multimedia services. 4G is all about an integrated, global network that will be able to provide a comprehensive IP solution where voice, data and streamed multimedia can be given to users on an "Anytime, Anywhere" basis. At present we have many technologies each capable of performing functions like supporting voice traffic using voice over IP (VoIP), broadband data access in mobile environment etc., but there is a great need of deploying such technologies that can integrate all these systems into a single unified system. 4G presents a solution of this problem as it is all about seamlessly integrating the terminals, networks and applications. The race to implement 4G is accelerating as well as quite challenging. The aim of this proposed is to highlight the benefits, challenges in deployment and scope of 4G technologies and reduces the drop rate and voice handover.

- Group size, Handoff-rate.
- Procedure
- Combine the two RSs having maximum handoff and made as group.
- Combine the adjacent RS having maximum handoff.
- Continue the process until group size is reached.
- Create the groups by following the steps 4 to 6.
- Repeat the process upto step 7 with 10 minutes interval.
- Handoff-rate, Throughput.

4. System Design

4.1 System Architecture

The major part of the project development sector considers and fully survey all the required needs for developing the project. Before developing the tools and the associated designing it is necessary to determine and survey the time factor, resource requirement, man power, economy, and company strength. Once these things are satisfied and fully surveyed, then the next step is to determine about the software specifications in the respective system such as what type of operating system the project would require, and what are all the necessary software are needed to proceed with the next step such as developing the tools, and the associated operations. Generally algorithms shows a result for exploring a single thing that is either be a performance, or speed, or accuracy, and so on. An architecture description is a formal description and representation of a system, organized in a way that supports reasoning about the structures and behaviors of the system. System architecture can comprise system components, the externally visible properties of those components, the relationships (e.g. the behavior) between them.

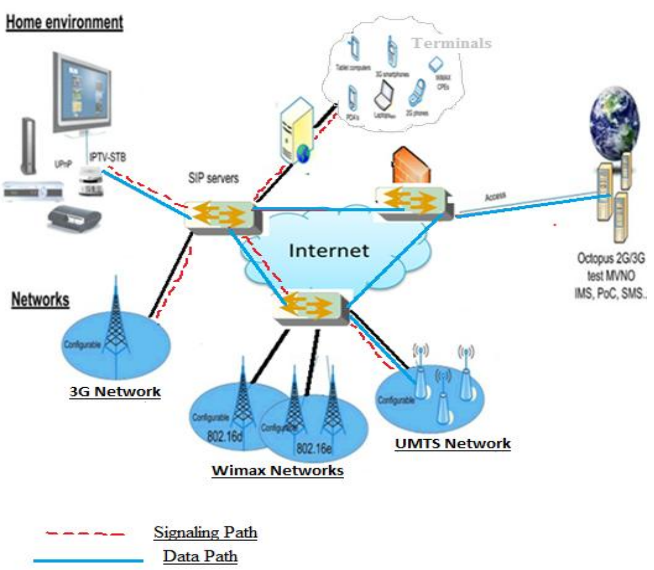


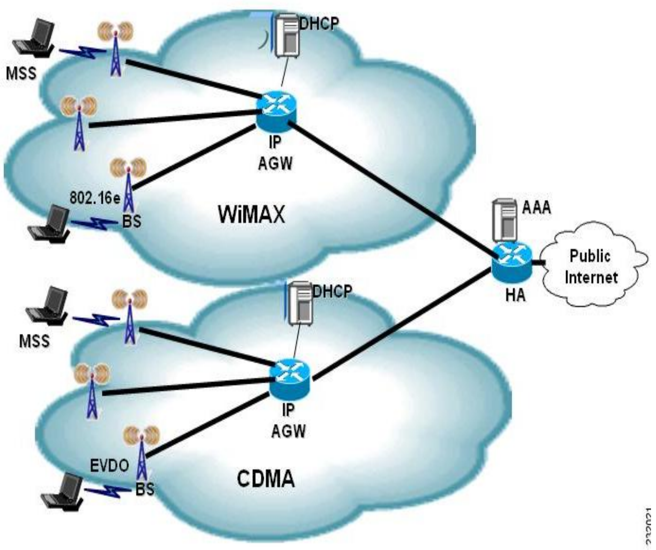
Figure 1: System Architecture

4.2 Modules

1. Network Deployment
2. Load Balancing
3. Resource Planning and Allocation
4. Evolution and Implementation of Service Behaviors
5. Results and Graphs

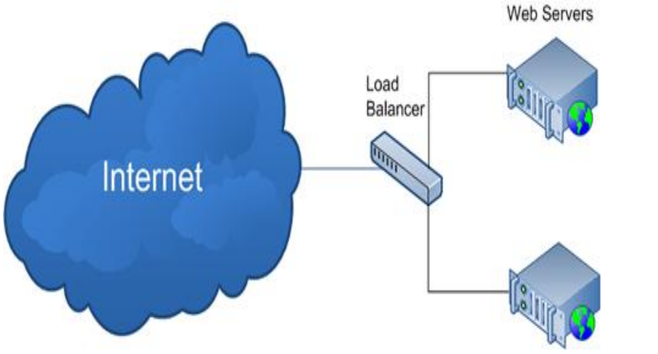
4.2.1 Network Deployment

Create a simulation environmentonWireless3G/ UMTS Network topology implemented with Existing protocol and with more number of nodes. The 3G network for broadband Wireless access at high speed and low cost.



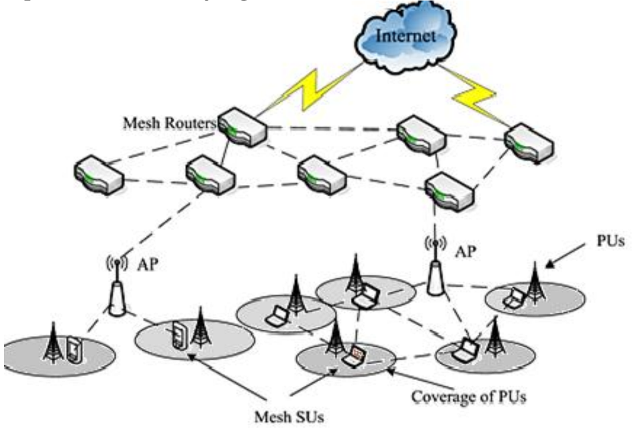
4.2.2 Load Balancing

Create a Wireless 3G network topology with more number of nodes and implement load balancing Mechanism in Wimax network and transfer the packets from Source to Destination.



4.2.3 Resource Planning and Allocation

Resource planning represents the allocations of system channels into cells. Accordingly, channel assignment strategies respond for using the allocated channels of cells to provide communication services in cells. Cellular system that experiences the varying of traffic distributions.



4.2.4 Evolution and Implementation of Service Behaviors

Cumulative Distribution Ratio, Throughput, average delay are measured for Load balancing problem in 3G network and outputs are shown using graphs.

- Simulation tool : NS2
- Languages used : C++
- Script Language : AWK,TCL
- Graph evaluation : PATH LOAD

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4.2.5 Results and Graphs

Compare AP allocation scheme with load balancing problem in 3G/UMTS network using the measured parameters(cumulative Distribution Ratio, Throughput, average delay) and outputs are shown using graphs.

5. Conclusion

This paper provided an overview of the 4G evolution and technologies. 4G will certainly add perceived benefit to an ordinary person's life over 3G. 4G will be an intelligent technology that will interconnect the entire world seamlessly. Projected 4G mobile communication system will reduce number of different technologies to a single global standard. Technologies are evolving every day and night but the final success of 4G mobile communication will depend upon the new services and contents made available to users. These new applications must meet user expectations, and give added value over existing offers.

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