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Call Drop Minimization Using Vertical Handover Algorithm in 4G

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Abstract: **-In this research, we aim to find such an approach which provides results in reduced call drop rate with less handover failure. In mobile communication, as nodes are mobile, there is a situation always present known as handoff. Such kinds of handoff process failures incur maximum communication loss. Recent studies that have been done for reducing call drop problem, provide different algorithms and approaches to reduce call drop rate. As in 4G network, vertical handover is performed, so our main aim is to reduce handover failure and improve the quality of communication in 4G.**

Index terms: - **BS, Handover, simulation, analysis.**

I. INTRODUCTION

The swift growth in wireless communication technology has changed human living standards. This effect is visible with the exponential increase in mobile users. To match with the rising demand, there is a very fast evolution in communication standards. This results in rapid movement of standards from one generation to other.

The evolution of wireless communication technologies are represented by their generations. The mobile wireless industry started way back in 1970's with the first generation of mobile communication technology called 1G [1]. The mobile 1G was Nordic Mobile Communication (NMT) and Total Access Communication Systems (TACS) operates on analog technology [2]. The technology was primarily designed to provide voice services. Large size phone, frequent call drops and a limited mobility were the main drawbacks of this generation systems [3].The fourth generation (4G) Long Term Evolution (LTE) is the advancement of 3G technology. In addition to the usual voice and other services of 3G, 4G provides mobile broadband internet access, through smart phones, and other mobile devices [4]. Potential and current applications of 4G include amended mobile web access, IP telephony, gaming services, high-definition mobile TV, video conferencing, 3D television and cloud computing. Table 1 presents a comparative overview of the major wireless communication evolutions with their technology features [4].

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II.HETEROGENEOUS WIRELESS NETWORKS

New generation of technology in mobile brings more appealing applications for the end-users. It is very natural for the new technology to demand for the co-existence of the new applications along with existing applications. The heterogeneous wireless networks constitute technologies ranging from 2.75G to 4G [7] and is expected to go beyond. A Heterogeneous Wireless Network (HWN) consists of multi-tier networks with different capabilities in terms of operating systems, hardware, protocols and applications with mobility. So, the HWN has the ability to meet the expectations of the end user for better connectivity and mobility with all possible applications [1].

This reiterates the importance of mobility of the end users. With the focus to achieve better mobility, heterogeneous multi-tier network is mapped in a typical urban environment and the multi-tier constitutes standards like GSM, EDGE, UMTS, Wireless Local Area Network(WLAN), LTE etc. A prediction of use and demand for mobility in an Indian scenario is represented in Figure 1.1. This brings about the challenges in divergent activities of the network management [8]. It is highly essential for the end user to seamlessly avail the services without disruption while travelling.

Handoff: An oversight

The process of transfer of an ongoing connection from the serving base station to the adjacent base station without interruption is known as handoff. The handoff is demonstrated in Figure 1.2, where the handoff takes place while the user moves from one cell coverage area to adjacent coverage area.

There are two basic handoff techniques, Network Controlled Handoff (NCHO) Mobile Controlled Handoff (MCHO). In NCHO, the network makes handoff decision based on measurements of the signal quality at mobile station (MS) at a number of candidate base stations (BS). Specifically, if the MS is measured to have a weaker signal in its existing cell, while a stronger signal is available in the neighboring cell, a handoff decision can be made by the network to switch the user to new BS from the old cell. Such type of handoff general takes 100-200ms and often produces a noticeable interruption in the conversation. However, overall delay of such a type of handoff in general is in the range of 5-10ms [1]. Thus, this type of handoff is not suitable to a rapid changing environment and a high density of users. NCHO was used in the first-generation analogue systems such as AMPS [2, 9].

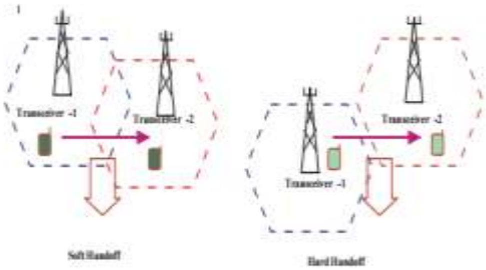

Figure 1: Hard Handoff and Soft Handoff

In contrast to NCHO, it is the MS that totally control the decision process of handoff in MCHO approach. A MS measures signal strength from all the surround base stations (BS). If the MS find that there is a new BS which has a higher Receiving Signal Strength (RSS) than the existing BS then it may consider to handoff from the old BS to the new BS given a certain signal threshold is reached [1]. MCHO is the highest degree of handoff decentralization, thereby enabling very fast handoff, typically on the order of 0.1ms as used in higher generations of networks. There are two common types of handoff in each network type.

- Hard handoff
- Soft handoff

A hard handoff is one in which the channel in the serving cell is first released and only then the channel in the target cell is engaged. Thus the connection to the source is broken before, the connection to the target is made. Such handoff process is also known as break-before-make. Hard handoffs are intended to be instantaneous in order to minimize the disruption to the call. A hard handoff is perceived by network engineers as an event during the call [10]. It requires least processing by the network providing service. When mobile is between base stations, then mobile can switch to any of base stations. So, base station bounces the link with mobile device back and forth. This is the Ping-Pong effect.

A soft handoff is one in which the channel in the source cell is retained and used for a while in parallel with the channel in the target cell. In each case the connection to the target is established before the connection from the source is broken, hence this handoff is also called make-before-break. The interval, during which the two connections exist, may be brief or substantial. For this reason the soft handoff is perceived by network engineers as a state of the call, rather than a brief event. Soft handoff may involve using connections to more than two cells, e.g. connections to three, four or more cells can be maintained by one mobile unit at the same time. When a call is in a state of soft handoff the signal of the best of all used channels can be utilized for the call at a given moment or all the signals can be combined to produce a clearer copy of the signal. The latter is more advantageous, and when such combining is performed both in the downlink (forward link) and in the uplink (reverse link), the handoff is termed as softer. Softer handoffs are possible when the cells involved in the handoff have a single cell site. Handover based on network type:

- Horizontal Handoff
- Vertical Handoff

A. Horizontal handoff: Handoff occurring within the same network is known as horizontal handoff. The concern of horizontal handoff is to maintain the ongoing call, with the change of connectivity due to the movement of a mobile node. Maintaining the on-going call is done by dynamically updating the changed connectivity address. The majority of proposed handoff mechanism might be included the horizontal handoff option because it focuses on to maintain ongoing call even though the location is changed within the same wireless network technology [12].

B. Vertical handoff: Handoff occurring within heterogeneous networks is known as vertical handoff. Vertical handoff is different from horizontal handoff. The access technology used is also changed along with the IP address, because the mobile nodes move different access network which uses different access technology. In this scenario, the main concern of vertical handoff is to maintain on-going call with the change of network interfaces, QoS characteristics, RSS [13].

III. CALL DROP PROBLEM

In cellular systems, when a base station has no free channels to allocate a mobile user, call blocking occurs. When a user moves from one cell to another cell then sometime handover does not exist and call is disconnected due to signal loss. This is known as call drop. Call dropping has many reasons of occurrence like.

A. Radio frequency call drop (RF call drop),
B. Handover failure,
C. Low level of system configuration settings etc.

A. Radio frequencies Call Drop: RF call drop is due to downlink and uplink failure. As we know in presence of several interference in downlink and uplink, MS cannot decode SACCH (slow associated control channel)**. SACCH** carries the system information message which necessary for call connection. When MS fails to decode the SACCH, it releases radio channel connection abruptly which results in call drop.

Reasons for RF call drop:

- Weak coverage area and radio signal.
- Intra-network interference.
- Absence of proper radio parameter settings.
- Hardware failure.
- Power failure.

B. Handover failure: As we know that cell size is limited and an MS is always in moving state from one place to another. Sometimes it moves from one cell to another neighboring cell. To continue its call base station need to perform handover. In handover, base station transfers the active call from one cell to another cell without disturbing the call. Handover is based on signal strength received by MS from current base station. When a mobile station is moving from one cell towards its neighboring cell the received signal strength of mobile station decreases as it is moving far from its base station.

IV. VERTICAL HANDOFF SCHEME TECHNIQUES AVAILABLE

The present vertical handoff decision algorithm of the heterogeneous network is summarized, and existing problems and the future research direction are discussed [4, 8, 16]. It is seen that the traditional handoff algorithm based on pre-defined path loss model with RSS is not suitable for heterogeneous wireless network with different kinds of user services at different terrain across all locations [13, 17–19]. The decision algorithms which take into consideration, the comprehensive network and decision factors, appeared to provide better handoff performance and improved user satisfaction index with better QOS [20, 21]. On the other hand, Next Generation Wireless Network (NGWN) is of complex structure resulted from the integration of heterogeneous wireless networks. In these networks, the design of an effective vertical handoff balancing algorithm to improve the comprehensive performance of the whole system is a very important issue.

V. SIMULATION RESULTS

Different metrics are calculated after simulation. Simulator used for performing proposed vertical handover algorithm is NS-3. LTE module is combined with NS-3 library. Metrics are as:

Table I metrics with values

Metrics	***Values***
Throughput	33308.6 Kbps
Packet Delivery Ratio	96.17%
Packet Lost ratio	6%
End-to-End Delay	0.012606
Convergence time	0.1's
Transmitted Bytes	3.03058e+06 Bytes
Routing Overhead	1.38696%
Received Bytes	416358 Bytes

The simulation work is performed on simulation software named NS-3. It is an open simulation environment for computer networking research that will be preferred. NS-3 is built using C++ and python. Different modules are present in NS-3 to perform different network simulation. To perform algorithm simulation in 4G LTE we need LTE module which is present in NS-3. The LTE module in NS-3 includes the LTE radio protocol stack (RRC, PDCP, RLC, MAC, and PHY). LTE module has been designed to support the evaluation of following aspects of LTE system.

- Radio Resource Management
- QoS- aware Packet Scheduling
- Inter-Cell Interference Coordination
- Dynamic Spectrum Access.

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Figure 2: Handover performed between nodes on simulation

VI. RESULTS

A. Throughput:

Table 2. Result metrics from different scenarios

Scenario	*Throughput (Kbps)*
1	32256.8
2	33308.6
3	31203.7
4	25863.9
5	28863.2
6	23965.4

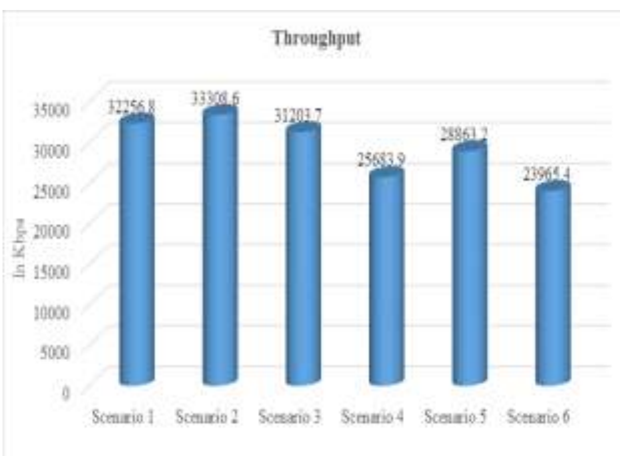

Figure 3: throughput simulation results

Here figure is showing the result analysis on different network simulator scenarios in terms of mobility and data transfer. The variation is here in mobility and data transfer. The figure shows that higher mobility causes less throughput in scenario- 6. As mobility is less, throughput is higher in scenario- 2.

B. Packet Delivery Ratio

Table 3: Packet delivery ratio outputs

Scenario	*Packet Delivery ratio (%)*
1	90.23
2	96.17
3	89.23
4	72.35
5	80.25
6	64.37

Higher throughput indicates overall performance with improved efficiency and output to input ratio. The performance of a system is measured by its energy consumption, output provided by the system as compared with provided input to that system. Asystem should give higher output with less input taking

Figure 4: Packet delivery ratio analysis

Here figure is showing the result analysis of packet delivery ratio on different network simulator scenarios in terms of mobility and data transfer. The variation is here in mobility and data transfer. The figure shows that higher mobility causes less packet delivery ratio scenario-6. As mobility is less, packet delivery ratio is higher in scenario 1 and 2.

C. Packet lost Ratio

Table 4: Packet lost ratio outputs on simulation

Scenario	*Packet Lost ratio (%)*
1	8.11
2	6
3	10.77
4	14.65
5	13.02
6	20.37

Less packet lost ratio leads to successful delivery of more number of packet between end users on network.

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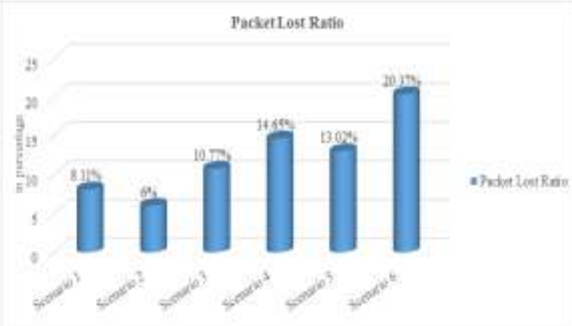

Figure 5: packet lost ratio analysis

Here figure is showing the result analysis of packet lost ratio on different network simulator scenarios in terms of mobility and data transfer. The variation is here in mobility and data transfer. The figure shows that higher mobility causes higher packet lost ratio in scenario 4 and 6. And as mobility is less, packet lost ratio is less like in scenario 1 and 2.

VII. CONCLUSION and SUMMERY

This research work gives attention call drop problem and handover failure. Overall it discusses with practical solutions like improving technical specifications like quality of signal should be improved, increase number of towers in a cell area, better communication between towers to perform handover. All these improvements results in reduce chances of handover failure. A diverse taxonomy of paradigm is introduced and discussed along with definitions at related places. As study and researches are showing that handover failure is the major cause for call drop. Call drop increases proportionally with handover failure. As the mobile communication infrastructure is growing from a generation to next generation. It becomes complex to perform handover between different networks. So, a deeply research is must for this problem. The findings from literature review is discussed and major contribution of the authors are highlighted.

The problem of call drop with handover failure is discussed as a major issue. A study on vertical handover algorithm is performed with different scenarios. Results of proposed algorithm from simulation on a series of network scenarios closely captures the objective of research. Different matrices is calculated from simulation of vertical handover algorithm. The proposed vertical handover algorithm provides results in favor of call drop minimization. Higher packet delivery with less packet loss and negligible end-to-end delay with higher throughput are key points of research work. Proposed algorithm results with less handover failure as well as less call drop rate. Hence the proposed vertical handover algorithm meets the identified objectives.

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