Performance Analysis of Handovers Using TDD and FDD in Long Term Evolution

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ABSTRACT

In Long Term Evolution Advanced Technology Handovers is the basic criteria of mobility of the user in cellular networks in Time Division Duplex and Frequency Division Duplex. Handover is one of the essential elements that can affect the Quality of Service (QoS) and Capacity of Mobile Broadband Networks. In the cellular network communication systems, a limited shared resource (spectrum) needs to be shared with all users so full duplex communication is possible. This paper involves studying the different Hand over delay parameters and also focusing on reducing “Hard Handover delay” by reducing interruption time, activation time, wireless channel access time and the wireless link transmission delay. An efficient handover is implemented by post optimization in order to reduce the handover delay time in Time Division Duplex network and it also reduces the wireless channel access time and the wireless link transmission delay. By analyzing the handover parameters with different air cell selection, cluster areas, signal strength and post optimization improvement in the Quality of service can be achieved. The future work on hard handover may be by applying different handover strategies to get better performance and Quality of service in Time Division Duplex and Frequency division Duplex mobile network.

Key words: QoS Quality of Service, TDD Time division duplex, FDD Frequency division duplex.

I. INTRODUCTION

Handover or Handoff is a process in telecommunication and mobile communication in which a connected cellular cell or data session is transferred from one cell site (base station) to another without disconnecting the session. Handover has become a mainstay in cellular wireless networks as it allows User Equipment to be mobile without losing Connectivity. Although handover allows one to maintain continuous connection, it also involves a lot of overhead and causes delay for the packets to be delivered to the destination User Equipment. Time division duplex is a technique widely used in two way digital communications systems where the two directions of traffic (up and down) of one channel are carried on the same carrier frequency but in discrete time intervals in a time divided way. These time intervals are often of fixed duration with equal time allocated for up- and down-link directions. TDD uses a single frequency to transmit signals in both the downstream and upstream directions. In fixed wireless allocation through time slots to downstream transmission intervals than upstream. This is upstream directions. TDD
II. TIME DIVISION DUPLEX

TDD uses a single frequency to transmit signals in both the downstream and upstream directions. In fixed wireless point-to-point systems that use TDD, a single frequency channel is used to transmit signals in both the downstream and upstream directions. TDD operates by toggling transmission directions over a time interval. This toggling takes place very rapidly and is imperceptible to the user. Thus, TDD can support voice and other symmetrical communication services as well as asymmetric data services. TDD also can handle a dynamic mix of both traffic types. The relative capacity of the downstream and upstream links can be altered in favor of one direction over the other. This is accomplished by giving a greater time allocation to downstream transmission than upstream. This asymmetry is useful for communication processes characterized by unbalanced information flow. An obvious application for this technique is Internet access in which a user enters a short message upstream and receives large information payloads downstream. In contrast, TDD systems require a guard time (instead of a guard band) between transmit and receive streams. The TX/RX Transition Gap (TTG) is a gap between downstream transmission and the upstream transmission.

This gap allows time for the base station to switch from transmit mode to receive mode and subscribers to switch from receive mode to transmit mode. The TDD frame structure is shown in fig 2.3 which consists of uplink and downlink frequencies.

TDD systems use the same frequency for transmission and reception, and the transmitted and received signals are separated in the time-domain. This contrasts with FDD, where each transceiver transmits and receives on two different frequencies, separated by the duplex spacing as defined in various CEPT recommendations. CEPT recommended channel arrangements for both point-to-point and point-to-multipoint make little explicit reference to duplex method although those arrangements which incorporate paired frequencies clearly are able to accommodate FDD systems but do not necessarily preclude TDD systems. However Regulators often overlook the P-MP possibilities offered by TDD, especially in bands traditionally occupied by FDD systems. TDD was not a practical alternative to FDD for analogue systems, which is one reason why FDD is traditionally used in some bands.
Advantages

Advantage of TDD is that the uplink and downlink radio paths are likely to be very similar. This means that techniques such as beam forming work well with TDD systems.

Advantage in the case where there is asymmetry of the uplink and downlink data rates. As the amount of uplink data increases, more communication capacity can be dynamically allocated, and as the traffic load becomes lighter, capacity can be taken away. It is possible to dynamically change the UL and DL capacity ratio to match demand.

![Diagram of TDD](image)

**Fig 1: TDD frame**

### III. HANDOVER

The most basic form of handover is when a phone call in progress is redirected from its current cell (called source) to a new cell (called target). In terrestrial networks the source and the target cells may be served from two different cell sites or from one and the same cell site. Such a handover in which the source and the target are different cells (even if they are on the same cell site), is called inter-cell handover. The purpose of inter-cell handover is to maintain the call as the subscriber is moving out of the area covered by the source cell and entering the area of the target cell. The pictorial representation of handover before and after shown in below fig2

![Diagram of Handover](image)

**Fig 2: Handover operation**
The steps involved in the Handover Process

Compare the Target SINR-enb with the Servins SINR-enb plus HHM.

Compare UE velocity and predict user mobility.

If traffic used is voice do proactive handover else reactive handover.

Compare Target SINR-Henb with the Serving

SINR-enb plus HHM.

Compare UE velocity.

Don’t perform Hand-in or perform Hand-in or reactive Hand-in based on the Velocity value.

Compare Target SINR-Henb with the Serving

SINR-Henb plus HHM.

If traffic used is voice do proactive handover else reactive handover.

Compare Target SINR-enb with the Serving

SINR-Henb plus HHM.

If traffic used is voice do proactive handover else reactive handover.

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**Fig 3: Route Pattern of Driven User**

The attributes of cell and handover parameters are updated after each handover in to the User Mobility Database. To avoid the unnecessary handovers, the records which show the short time visit of User Equipment will be removed from the User Mobility Database or not recorded into the User Mobility Database. The storage points can be User Equipment, eNodeB, MME, or other network elements which have enough storage capacity and strong computing power.
Table:1 Cluster selected with surrounding areas

<table>
<thead>
<tr>
<th>CLUSTER:</th>
<th>Rajajinagar</th>
</tr>
</thead>
<tbody>
<tr>
<td>On Air Sites</td>
<td>8</td>
</tr>
<tr>
<td>Off Air Sites</td>
<td>0</td>
</tr>
<tr>
<td>Proposed Sites</td>
<td>0</td>
</tr>
<tr>
<td>IBS</td>
<td>1</td>
</tr>
<tr>
<td>Total SQ Km</td>
<td>0.8</td>
</tr>
</tbody>
</table>

Table:2 Areas covered under cluster

<table>
<thead>
<tr>
<th>AREA Covered:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Dr MC Modi hospital Road</td>
</tr>
<tr>
<td>2. Chord Road</td>
</tr>
<tr>
<td>3. Basaveshwara Nagar</td>
</tr>
<tr>
<td>4. RajajiNagar</td>
</tr>
</tbody>
</table>

Table:3 Location of the areas with Latitude and Longitude

<table>
<thead>
<tr>
<th>Location</th>
<th>Lat</th>
<th>Long</th>
</tr>
</thead>
<tbody>
<tr>
<td>KLE Law College</td>
<td>12.9957</td>
<td>77.5537</td>
</tr>
<tr>
<td>Citi hospital</td>
<td>12.9955</td>
<td>77.5508</td>
</tr>
<tr>
<td>Swati restuarant</td>
<td>12.9978</td>
<td>77.5500</td>
</tr>
<tr>
<td>Star Circle</td>
<td>12.9976</td>
<td>77.5503</td>
</tr>
<tr>
<td>Ranganath Swamy temple</td>
<td>12.9955</td>
<td>77.5503</td>
</tr>
<tr>
<td>J Spider training center</td>
<td>12.9949</td>
<td>77.5510</td>
</tr>
<tr>
<td>Nadgir institute of tech</td>
<td>12.9951</td>
<td>77.5468</td>
</tr>
<tr>
<td>UCO Bank</td>
<td>12.9965</td>
<td>77.5463</td>
</tr>
<tr>
<td>Rajajinagar RTO</td>
<td>12.9943</td>
<td>77.5536</td>
</tr>
<tr>
<td>Basaveshwar College</td>
<td>12.9946</td>
<td>77.5562</td>
</tr>
<tr>
<td>Sycone</td>
<td>12.9971</td>
<td>77.5507</td>
</tr>
<tr>
<td>KFC</td>
<td>12.9973</td>
<td>77.5464</td>
</tr>
<tr>
<td>Navya College</td>
<td>12.9986</td>
<td>77.5421</td>
</tr>
<tr>
<td>Modi Hospital</td>
<td>12.9975</td>
<td>77.5457</td>
</tr>
</tbody>
</table>
Fig 3: Rx Level Dedicated

Fig 4: Rx Quality

Table: 4 Receiver Quality Statistics

<table>
<thead>
<tr>
<th>Rx Quality</th>
<th>4G</th>
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<tbody>
<tr>
<td></td>
<td>Samples</td>
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<tr>
<td>0 to 5</td>
<td>59088</td>
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<tr>
<td>5 to 7</td>
<td>12387</td>
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Table: Optimization changes proposed

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SUMMARY OF OPTIMIZATION CHANGES PROPOSED</strong></td>
<td></td>
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<tr>
<td>1</td>
<td>BANG251A Optimization Planned</td>
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<td></td>
<td>Azimuth 40 10</td>
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<td></td>
<td>Electrical tilt 6 4 Completed</td>
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<tr>
<td>2</td>
<td>BANG241C Optimization Planned</td>
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<tr>
<td></td>
<td>Azimuth 240 210</td>
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</tr>
<tr>
<td></td>
<td>M-Tilt 2 1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Electrical tilt 6 3 Completed</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>BANG129B Optimization Planned</td>
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</tr>
<tr>
<td></td>
<td>Mechanical Tilt 1 0</td>
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</tr>
<tr>
<td></td>
<td>Electrical Tilt 8 5 Completed</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>BLRG257B &amp; C Optimization planned</td>
<td></td>
</tr>
<tr>
<td></td>
<td>BLRG257B</td>
<td></td>
</tr>
<tr>
<td></td>
<td>M-Tilt 2 1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>BLRG257C</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Azimuth 300 270</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Electrical Tilt 7 4 Completed</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>BANG129C Optimization Planned</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Electrical Tilt 7 4 Completed</td>
<td></td>
</tr>
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Fig 5: Poor Rx-Quality Area
Fig 6: POST OPTIMIZATION

Fig 7: Poor Rx-Quality Area

Fig 8: Post Optimization
AREA Covered:

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<td>3</td>
<td>Basaveshwara Nagar</td>
</tr>
<tr>
<td>4</td>
<td>Rajaji Nagar</td>
</tr>
</tbody>
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Table:7 Location with Latitude and Longitude

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</tr>
<tr>
<td>Modi Hospital</td>
<td>12.9975</td>
<td>77.5457</td>
</tr>
</tbody>
</table>

Table:6 Cluster with 7 on Air sites

<table>
<thead>
<tr>
<th>Cluster: Rajajinagar</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>On Air Sites</td>
<td>7</td>
</tr>
<tr>
<td>Off Air Sites</td>
<td>0</td>
</tr>
<tr>
<td>Proposed Sites</td>
<td>0</td>
</tr>
<tr>
<td>IBS</td>
<td>0</td>
</tr>
<tr>
<td>Total SQ Km</td>
<td>0.8</td>
</tr>
</tbody>
</table>
Table 8: 3G BIN COUNT with RSCP

<table>
<thead>
<tr>
<th>RSCP</th>
<th>Count</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to -74</td>
<td>156138</td>
<td>72.76</td>
</tr>
<tr>
<td>(-74 to -84)</td>
<td>54785</td>
<td>25.53</td>
</tr>
<tr>
<td>(-84 to -90)</td>
<td>2825</td>
<td>1.31</td>
</tr>
<tr>
<td>(-90 to -94)</td>
<td>822</td>
<td>0.38</td>
</tr>
<tr>
<td>(-94 to -102)</td>
<td>11</td>
<td>0.005</td>
</tr>
</tbody>
</table>
Table 9: 3G BIN COUNT Ec/No

<table>
<thead>
<tr>
<th>Range</th>
<th>Count</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to -8</td>
<td>95141</td>
<td>44.33</td>
</tr>
<tr>
<td>(-8 to -12)</td>
<td>107549</td>
<td>50.12</td>
</tr>
<tr>
<td>(-12 to -16)</td>
<td>11742</td>
<td>5.47</td>
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<tr>
<td>(-16 to -20)</td>
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</tr>
<tr>
<td>(-20 to -32)</td>
<td>37</td>
<td>0.01</td>
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</tbody>
</table>

VIII CONCLUSION

The paper provides an efficient method of Handover by optimizing the handover parameters like number of air sites selected, cluster area, Signal strength in order to improve the quality of Service in mobile communication for driven wards. Simulation results shows that the handover percentage is improved and the access and delay time are reduced.

REFERENCES


