LTE Dynamic TDD

Mirza Nazrul Alam

Supervisor: Prof. Riku Jäntti
Outline

1. A Quick review of the work flow from the beginning.

2. Distributed Frame Selection Algorithm in Dynamic TDD Network. (Introduction to current work).
1. A Quick review of previous works
At first, TDD frame Types (3GPP) were implemented. Available symbols for user data were considered separately from the symbols used for control signals. The structure of the LTE TDD simulator was proposed.

RR scheduler, ACK bundling, HARQ, Chase combining, packet fragmentation, defragmentation, packet ordering, retransmission procedure were implemented. Queueing delay of UDP packets was measured for a single macro cell with 5 users.
Work flow review-2

- PHY layer and Adaptive Modulation were implemented and the percentage of retransmission was measured for a 3 adjacent macro cell having same TDD frame types.

- For different TDD frame types, the UL throughput was measured for a 3 adjacent macro cell scenario. The UL transmission was completely destroyed if there was simultaneous DL transmission. The Study also suggested that at very low DL load, lost probability of UL SF decreases, i.e., there could be a point of frame switching.
Work flow review-3

- The above study was further extended to a sectored 19 macro cell [TR 36.814] with horizontal and vertical antenna tilt. The traffic model used was UDP. The study suggested that simultaneous UL and DL transmission can’t co-exist.

- The Feasibility study for different frame types was then carried out for a large femto network [ETSI TR 101 112]. The results show that in case of small cell, the simultaneous UL and DL transmission can co-exist. This reopens the possibility of using different frame types in a Dynamic TDD network.
Work flow review-4

- Three Soft computing based Algorithm are recently proposed for UL-DL transmission mode optimization. The performance was studied in a large femto network. A Journal paper is submitted based on this result.
- Our current work addresses the distributed frame selection Algorithm. Such selection will optimize the total network interference.
2. Distributed Frame Selection Algorithm in Dynamic TDD Network (ongoing).
Objective

• Every cell in a Network will choose the right frame types de-centrally.
• Their combine actions will optimize the total network interference or The Network Utility Function.
• The Algorithm will converge within finite steps.
Frame types in TDD

<table>
<thead>
<tr>
<th>Uplink/downlink configuration</th>
<th>Downlink-to-Uplink Switch-point periodicity</th>
<th>Subframe number</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>5 ms</td>
<td>D S U U U U</td>
</tr>
<tr>
<td>1</td>
<td>5 ms</td>
<td>D S U U U D</td>
</tr>
<tr>
<td>2</td>
<td>5 ms</td>
<td>D S U D D S</td>
</tr>
<tr>
<td>3</td>
<td>10 ms</td>
<td>D S U U U D</td>
</tr>
<tr>
<td>4</td>
<td>10 ms</td>
<td>D S U U U D</td>
</tr>
<tr>
<td>5</td>
<td>10 ms</td>
<td>D S U U U D</td>
</tr>
<tr>
<td>6</td>
<td>5 ms</td>
<td>D S U U U D</td>
</tr>
</tbody>
</table>
Approaches

• Three Algorithms are Introduced
• First one uses Game Theoretic approach
• Second one is based on GADIA (Greedy Asynchronous Distributed Interference Avoidance Algorithm)
• Third one is based on Genetic Algorithm (GA) that searches for global minima.
• For the first two approaches, the Sub-modular Utility Function converges within few epochs regardless of the network size.
Deployment Scenario

Lay out of a Floor
No. of Epochs and Iterations
Frame interference

![Frame interference graph]