Layered Random Beamforming OFDMA with Fair Scheduling Algorithms

Introduction

- In a multi-user environment, combining MIMO layered random beamforming (LRB) technique and OFDMA is capable of achieving near maximal benefits from MIMO and multi-user diversity whilst requiring minimal feedback.
- 3 dynamic scheduling algorithms are proposed for LRB-OFDMA and they show a trade-off between maintaining fairness and minimising delay.

Physical Layer Model of LRB-OFDMA

- Low Feedback Compared to Eigenbeam forming: LRB-OFDMA only requires the feedback of ESINR based data rate from every cluster of sub-carriers of each spatial layer of MIMO channels.
- Multi-user Diversity Gain: Achieve spatial multiplexing gain, spatial multi-user diversity gain and spectral multi-user diversity gain.

PHY Parameters and Transmission Modes

<table>
<thead>
<tr>
<th>Mode</th>
<th>Modulation</th>
<th>Coding Rate (subcarrier)</th>
<th>Coded Bits (subcarrier)</th>
<th>Max. Data Rate (R) Overall</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>BPSK</td>
<td>½</td>
<td>1</td>
<td>64 Mbps</td>
</tr>
<tr>
<td>2</td>
<td>QPSK</td>
<td>½</td>
<td>2</td>
<td>128 Mbps</td>
</tr>
<tr>
<td>3</td>
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<td>½</td>
<td>2</td>
<td>256 Mbps</td>
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<tr>
<td>4</td>
<td>16 QAM</td>
<td>¼</td>
<td>4</td>
<td>512 Mbps</td>
</tr>
<tr>
<td>5</td>
<td>16 QAM</td>
<td>¼</td>
<td>4</td>
<td>512 Mbps</td>
</tr>
<tr>
<td>6</td>
<td>64 QAM</td>
<td>¼</td>
<td>6</td>
<td>576 Mbps</td>
</tr>
</tbody>
</table>

Performance of LRB-OFDMA in Statistical Channel

An uncorrelated MIMO implementation of the statistical channel model E of the ETSI BRAN channel models is used for system simulation. Channel model E has a sampling period of 10ns and the rms delay spread of 250ns.

- Adjusting window length of PFA shows in a trade off between throughput and fairness.
- The BER performance of FCA is very close to PFA with a high window length at 100 and FCA distributes the resources more fairly than PFA with a window length of 10.

Performance of LRB-OFDMA in Ray Tracing Channel

A 12-MSs outdoor environment (Bristol city-centre, U.K.) is considered for simulation (2x2 MIMO channels) and each MS moves along a pre-defined and independent route.

- Adjusting window length of PFA shows in a trade off between throughput and fairness.
- The BER performance of FCA is very close to PFA with a high window length at 100 and FCA distributes the resources more fairly than PFA with a window length of 10.

Conclusions

- A greedy algorithm, a proportional fair algorithm and a fair cluster algorithm considered for LRB-OFDMA are shown to have increasing fairness.
- For PFA, increasing the window length improves the overall throughput performance but degrades the fairness.

- The FCA achieves a good balance between the overall throughput and both short and long term fairness. However, overall throughput may be degraded while maintaining a fair resource allocation as the difference in fading statistics of MSs becomes more significant.

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User k Input Data Serial Concatenation Scrambling/FEC/ Puncturing/Interleaving/ Modulation Spatial Layer Allocation Random Matrix for Every Cluster