Duplex and Multiplex Configurations for OFDMA In-Band Relay

Document Number: C802.16mmr-05-011
Date Submitted: 2005-09-09
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Base Document: N/A
Purpose: To present a single RF head in-band relay duplex and multiplex for IEEE802.16e OFDMA mode
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Background

• The Meshed Wireless Network Vision
  – Introduce the relay function in the conventional cellular network
    • To allow to extend to multi-hop network topology
    • To allow to extend to mesh network topology
• To enable multi-hop and/or mesh network
  – Require new duplex RF architecture for
    • FDD and TDD arrangement
  – Require new multi-user multiplex scheme to
    • Increase spectrum efficiency and reduce interference

• Analogy relay
  – External band relay
    • Dual RF transceiver chains (Double Cost!)
  – In-band relay
    • Noise enhancement and feedback isolation

• Digital relay
  – External band relay
    • Dual RF transceiver chains (Double Cost!)
  – TDD in-band relay
  – FDD Solution with Conventional FDD RF Head

This contribution aims to present the possible duplex/multiplex configurations in the IEEE 802.16 OFDMA context
New Networking Modes and Topologies
(Fixed Relay Station)

- **Down link direction**
  - BS to MS (BM)
  - BS to FRS (BR)
  - FRS to MS (RM)

- **Up link direction**
  - MS to BS (MB)
  - MS to FRS (MR)
  - FRS to BS (RB)
# In-Band OFDM/TDM Relay Mode

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Time</th>
<th>Sub-Slot</th>
<th>DL</th>
<th>UL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1</td>
<td>BM</td>
<td>MB</td>
</tr>
<tr>
<td></td>
<td></td>
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<td>RB</td>
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<tr>
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<td>3</td>
<td>RM</td>
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<tr>
<td>BS</td>
<td></td>
<td>BM</td>
<td>BS</td>
<td>BS</td>
</tr>
</tbody>
</table>

- **LB** (Lower Band)
- **HB** (Higher Band)
- **FDD** (Frequency Division Duplex)
- **TDD** (Time Division Duplex)

### Frequency and Time Table

<table>
<thead>
<tr>
<th>Time</th>
<th>Sub-Slot</th>
<th>DL</th>
<th>UL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tr>
<tr>
<td>BS</td>
<td>BM</td>
<td>BS</td>
<td>BS</td>
</tr>
</tbody>
</table>
### In-Band OFDMA/TDM Relay FDD Mode

#### Frequency

- **LB** (Lower Band)
- **HB** (Higher Band)
- **FDD** (Frequency Division Duplex)
- **Umbrella Band** (sub-channel)

#### Time

- **Sub-Slot**
- **DL** (Downlink)
  - Umbrella Band
  - Relay Band
- **UL** (Uplink)
  - Umbrella Band
  - Relay Band

#### Relay Band (sub-channel)

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</tr>
</thead>
<tbody>
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<td></td>
</tr>
<tr>
<td>Band</td>
<td></td>
<td>BR</td>
</tr>
<tr>
<td><strong>UL</strong> Umbrella</td>
<td></td>
<td>MB</td>
</tr>
<tr>
<td>Band</td>
<td>RB</td>
<td>MR</td>
</tr>
<tr>
<td><strong>Relay Personality</strong></td>
<td>MS</td>
<td>BS</td>
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</table>
In-Band OFDMA/TDM Relay TDD Mode

<table>
<thead>
<tr>
<th></th>
<th>DL</th>
<th>UL</th>
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</thead>
<tbody>
<tr>
<td><strong>Sub-Slot</strong></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td><strong>DL</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Umbrella Band</td>
<td>BM</td>
<td>MB</td>
</tr>
<tr>
<td>Relay Band</td>
<td>BR</td>
<td>RM</td>
</tr>
<tr>
<td>Relay Personality</td>
<td>MS</td>
<td>BS</td>
</tr>
</tbody>
</table>

**FDD**

Frequency

Time

Relay band (sub-channel)

umbrella band (sub-channel)
Relay Node Zero-IF Architecture with Variable Duplexer or Switched Duplexer

A single transceiver with switch matrix for Relay Node reduces the cost
Summary and Applications

• An OFDMA/TDM hybrid relay multiplex and duplex arrangement is presented
  – The relay performance can be optimized by
    • Allocation of relay band (relay sub-channels)
    • Allocation of relay slot
• Relay node architecture with variable duplexer and switched RF synthesizer enable FDD Relay
• Relay-node link configuration can be paired with spectrum allocation for relay band
  – The configuration can be combined with TDM and OFDMA operation
  – The configuration can be combined with TDD and OFDMA operation
• To keep the relay node RF chain simple, only one configuration per node is allowed for a given time slot