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Purpose:
The purpose of this slide set is to introduce our contribution C802.16j-06_275.

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Configurable Frame Structure Features and Benefits

- We propose a configurable frame structure that:
  - Supports both in-band and out-of-band relay using any frequency allocation scheme
  - Supports 2 hop deployment with optimized configuration
  - Supports in-band multi-hop with optimized configuration with 5 ms access frame
  - Provides flexibility for out-of-band case
    - Simplest configuration looks like 802.16e frame structure
    - Allows sharing of channel between multiple relay links
- Key Feature – Multiple phases:
  - Control of interference between RSs
    - Configurable number of Tx/Rx regions for relays sharing a channel
      - Allows tradeoff of overhead and latency for reduced interference and lower complexity
      - Don’t assume directional antennas or coordinated scheduling will solve all problems
  - Support for pure tree as well as tree-like topology with multiple paths between MR-BS and RS.
Configurable Frame Structure

In Band Relay

Out of Band Relay
Example Configurations

In- Band
Two hop network

In- Band
Multi-hop network
Backup
### Specific Requirements and Constraints

<table>
<thead>
<tr>
<th>Requirements and Constraints</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Where flexibility is required</strong></td>
</tr>
<tr>
<td>• Configurable number of Tx/Rx regions for relays sharing a channel</td>
</tr>
<tr>
<td>- Deployment-specific tradeoff between overhead and latency and ability to limit interference</td>
</tr>
<tr>
<td>- Don’t assume directional antennas or coordinated scheduling will solve all problems</td>
</tr>
<tr>
<td>• Support for tree topology as well as tree-like topology with multiple paths between MR-BS and RS.</td>
</tr>
<tr>
<td>• Support for various frequency allocation schemes</td>
</tr>
<tr>
<td>- In band (Access and Relay links share a channel)</td>
</tr>
<tr>
<td>- Out of Band (Access and Relay links operate on different channels).</td>
</tr>
<tr>
<td>- Sharing of channel by multiple relay links</td>
</tr>
<tr>
<td><strong>Some practical constraints:</strong></td>
</tr>
<tr>
<td>• Access link is required to be 802.16e compliant</td>
</tr>
<tr>
<td>• In band solution must be able to work with 5 ms access frame and UL subframe of no larger than 18 symbols.</td>
</tr>
</tbody>
</table>
Details of an In-band Phase

- FCH
- DL Map
- Relay FCH
- Relay DL Map
- G
- LT
- G
- LU
- G
- LU
- G
- LU
- G
- LU
- G
- LU
- G
- LU
In the Access Zones

- Each IS is allowed to transmit preamble, FCH, map
- Each IS is allowed to schedule transmission of data to MSs in the DL and from the MSs in the UL.
- Each IS is allowed to use the Access zones in every phase
- Transparent relay is supported by not having RSs transmit preamble and FCH.
In the Relay Zones of Each Phase

- Relay links are assigned to phases
- A Relay link can be assigned to more than one phase
- Within a phase an IS can be assigned to be an upstream station, a downstream station, or neither.
- An IS can be an upstream station in more than one phase
- An IS can be a downstream station in more than one phase
Relay Links are Assigned to Phases – An Example
A second Relay Link Assignment Example

Upstream Station on Phase 1 and 3

MR-BS

Downstream Stations on Phase 1 and 3

Upstream Stations on Phase 2

Phase 1 and 3

Phase 2

RS 1

RS 2

RS 3

RS 4

RS 5

RS 6

RS 7
A Third Relay Link Assignment Example

Upstream Station on Phase 1 and 3

Downstream Station on Phase 1

Upstream Station on Phase 2

Phase 1

Phase 2

Phase 3

RS 1

RS 2

RS 3

RS 4

RS 5

RS 6

RS 7

MR-BS

Downstream Stations on Phase 3

Downstream Stations on Phase 2
Example 2: Two Phase In-Band Configuration for Multi-hop Network (1)

<table>
<thead>
<tr>
<th>Even Phase duration</th>
<th>Odd Phase duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 access frame</td>
<td>1 access frame</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Even Phase</th>
<th>Odd Phase</th>
</tr>
</thead>
<tbody>
<tr>
<td>DL portion</td>
<td>UL portion</td>
</tr>
<tr>
<td>Even</td>
<td>LU, V, D</td>
</tr>
<tr>
<td>Phase</td>
<td>L, S, C</td>
</tr>
<tr>
<td>DL portion</td>
<td>UL portion</td>
</tr>
<tr>
<td>L, U, V, D</td>
<td>L, S, C</td>
</tr>
<tr>
<td>D, S, C, A</td>
<td>L, U, V, D</td>
</tr>
<tr>
<td>L, U, V</td>
<td>D, S, C, A</td>
</tr>
<tr>
<td>D, S, C</td>
<td>L, U, V, D</td>
</tr>
<tr>
<td>L, U</td>
<td>D, S, C, A</td>
</tr>
<tr>
<td>D</td>
<td>L, U, V, D</td>
</tr>
<tr>
<td>S</td>
<td>D, S, C, A</td>
</tr>
<tr>
<td>C</td>
<td>L, U, V, D</td>
</tr>
<tr>
<td>A</td>
<td>D, S, C, A</td>
</tr>
</tbody>
</table>
Example 2: Two Phase In-Band Configuration for Multi-hop Network (2)
Example 2: Two Phase In-Band Configuration for Multi-hop Network (3)

Odd UL Phase

Even UL Phase
Out-of-Band Configuration

Phase 0 duration

Phase 1 duration

Phase M-1 duration

DL portion

UL portion

Phase 0

Phase 1

Phase M-1

1 relay frame
Details of an out-of-band Phase

- Relay FCH
- Relay DL Map

Diagram:

- Relay FCH
- Relay DL Map
- LD
- GT
- LU
Reasons for having more than 2 phases

- To avoid interference between RSs assigned to the same phase
  - Preamble, FCH, DL map in particular
- To support non-tree topologies (multiple paths)
  - Provide QoS differentiation along different paths
  - Increase datarate by using multiple paths
  - Other uses we haven’t yet considered?
Inter-cell interference using 2-phase only

- Consider standard 19-cell deployment with 3 MMR-cells next to each other.
- white RS 8/9 will get interfered from blue RS2.
- SINR at white RS8 with signal from white RS2 = 1dB;
- RS12 will get interference from yellow RS4, white RS16/17 will get interference from yellow RS6…
- Hence, DL-MAP transmission is not robust.
Increased data rate from reuse on multiple paths

Phase 1: carries 2x Mbps on relay links
Phase 2: carries 2x Mbps on relay links
Phase 3: carries x Mbps on relay links