Project: IEEE P802.15 Working Group for Wireless Personal Area Networks (WPANs)

Submission Title: 64QAM extension to SUN-OFDM

Date Submitted: July 10, 2023

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Abstract: Overview of proposed resolutions

Purpose: Discussion

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Introduction:

- Trend: increasing traffic in SUN
  - Increased data rates are desirable
- Extending SUN-OFDM:
  - 64-QAM, code rate $\frac{3}{4}$
Proposing to add 64QAM with code rate $\frac{3}{4}$:

Table 20-10—Data rates for SUN OFDM PHY

<table>
<thead>
<tr>
<th>Parameter</th>
<th>OFDM Option 1</th>
<th>OFDM Option 2</th>
<th>OFDM Option 3</th>
<th>OFDM Option 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal bandwidth (kHz)</td>
<td>1094</td>
<td>552</td>
<td>281</td>
<td>156</td>
</tr>
<tr>
<td>Channel spacing (kHz)</td>
<td>1200</td>
<td>800</td>
<td>400</td>
<td>200</td>
</tr>
<tr>
<td>DFT size</td>
<td>128</td>
<td>64</td>
<td>32</td>
<td>16</td>
</tr>
<tr>
<td>Active tones</td>
<td>104</td>
<td>52</td>
<td>26</td>
<td>14</td>
</tr>
<tr>
<td># Pilot tones</td>
<td>8</td>
<td>4</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td># Data tones</td>
<td>96</td>
<td>48</td>
<td>24</td>
<td>12</td>
</tr>
<tr>
<td>MCS0 (kb/s) (BPSK rate 1/2 with 4x frequency repetition)</td>
<td>100</td>
<td>50</td>
<td>25</td>
<td>12.5</td>
</tr>
<tr>
<td>MCS1 (kb/s) (BPSK rate 1/2 with 2x frequency repetition)</td>
<td>200</td>
<td>100</td>
<td>50</td>
<td>25</td>
</tr>
<tr>
<td>MCS2 (kb/s) (QPSK rate 1/2 and 2x frequency repetition)</td>
<td>400</td>
<td>200</td>
<td>100</td>
<td>50</td>
</tr>
<tr>
<td>MCS3 (kb/s) (QPSK rate 1/2)</td>
<td>800</td>
<td>400</td>
<td>200</td>
<td>100</td>
</tr>
<tr>
<td>MCS4 (kb/s) (QPSK rate 3/4)</td>
<td>1200</td>
<td>600</td>
<td>300</td>
<td>150</td>
</tr>
<tr>
<td>MCS5 (kb/s) (16-QAM rate 1/2)</td>
<td>1600</td>
<td>800</td>
<td>400</td>
<td>200</td>
</tr>
<tr>
<td>MCS6 (kb/s) (16-QAM rate 3/4)</td>
<td>2400</td>
<td>1200</td>
<td>600</td>
<td>300</td>
</tr>
<tr>
<td>MCS7 (kb/s) (64-QAM rate $\frac{3}{4}$)</td>
<td>3600</td>
<td>1800</td>
<td>900</td>
<td>450</td>
</tr>
</tbody>
</table>
64-QAM Gray mapping (same as in 802.11a):
64-QAM → using same interleaving rules:

\[
i = \left( \frac{N_{cbps}}{N_{row}} \right) \times \left[ k \mod(N_{row}) \right] + \text{floor}\left( \frac{k}{N_{row}} \right)
\]

\[
j = s \times \text{floor}\left( \frac{i}{s} \right) + \left[ i + N_{cbps} - \text{floor}\left( \frac{N_{row} \times i}{N_{cbps}} \right) \right] \mod(s)
\]

- **\(N_{row} = 12\)**
  - Same as SUN OFDM PHY when no spreading is used
- **\(N_{cbps} = \) Number of data carriers X 6 bits**
  - Option 1 → \(N_{cbps} = 576\)
  - Option 2 → \(N_{cbps} = 288\)
  - Option 3 → \(N_{cbps} = 144\)
  - Option 4 → \(N_{cbps} = 72\)
Conclusion:

• 64-QAM with code rate $\frac{3}{4}$ is proposed
  • 50% rate boost
  • Up to 3.6 Mbit/s using Option 1
  • Higher data rates in bandwidth limited regulatory domains
    • 450 kbps in 200 kHz ch-spacing, e.g. EU, India
    • 1800 kbps in 800 kHz ch-spacing, e.g. JP