Preamble Modification for Improved Selection Diversity

R. Mahany
Norand Corporation

Assumptions

- Diversity is not a Requirement of Either PHY
  - Standard Should Enable, not Mandate Diversity
  - Manufacturers Free to Determine Whether their Customers will Pay for, Benefit from Diversity
  - Other Channel Optimization Alternatives Exist, and Should not be Precluded
  - Algorithms Should not be Specified by the Standard
- Anything That Can be Done at the Transmitter to Make the Receiver's Job Easier, Should be Done

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**Which Antenna?**

Must Consider Noise Limited \([C/N]\), and Interference Limited \([C/I]\) Cases

Longer Observation Intervals on Each Antenna Provide the Opportunity to make a Better Decision

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**Best /Satisfactory Antenna**

From 94/70, 93/37

Best Antenna, Worst Case Sampling

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Satisfactory Antenna, Worst Case Sampling

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**Issues**

- **Constraints**
  - Antenna Sampling and Start of Message are Asynchronous
  - Preamble Length and Content are Set
  - RX Setting Times Determined by Physical Constraints
  - Overall System Performance is Sensitive to PHY Overhead

- **Results**
  - Not Enough Time to Evaluate Signal During Preamble to Implement Best Antenna Approach Reliably in FH
  - DS Has Longer Preamble — Maybe OK, Maybe too Long?

**Proposal:** Give Receiver More Knowledge by Including Timestamp in Preamble

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**Current Preambles**

- **Direct Sequence**
  - 11111111 .......................................................... 11111111 Unique Word
  - 128 symbols

- **Frequency Hopping**
  - 01010101 ..................................................... 10101 Unique Word
  - 80 symbols

**Timestamp Concept**

- **DS**
  - 0000 .......................................................... 11111111 Unique Word
  - Symbols 48,49

- **FH**
  - 1010 .......................................................... 10101 Unique Word
  - Symbols 32,33

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Best or Satisfactory Algorithm

Scan for RSSI and Sync

Evaluate SNR

Not OK: No Timestamp

OK: Timestamp

Start of Frame

Compare Other Antenna

Select Best

Implementation Concept

IF Despreeder

SNR Clock Valid
SNR Valid
Clock Data
Timestamp Detect

From Demod/Slicer

Clock Recovery

SNR Clock Valid
SNR Valid
Clock Data
Timestamp Detect

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Timing Simulation Results

With Discernible Signals at Both Antennas

Using 94/70 Timing Parameters

<table>
<thead>
<tr>
<th>Preamble A: Minimum SNR Interval</th>
<th>Preamble A: Average SNR Interval</th>
<th>Preamble B: Observation Interval</th>
<th>Best Antenna Branch Execution (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 μsec</td>
<td>26 μsec</td>
<td>20 μsec</td>
<td>72%</td>
</tr>
<tr>
<td>16 μsec</td>
<td>25 μsec</td>
<td>18 μsec</td>
<td>83%</td>
</tr>
<tr>
<td>16 μsec</td>
<td>24 μsec</td>
<td>16 μsec</td>
<td>94%</td>
</tr>
</tbody>
</table>

Assumed System Parameters

Antenna Switching Time: 8 μsec
Clock Detection Interval: 10 μsec

Summary and Comments

- Inclusion of Timestamp in Preamble
  - Provides Critical Timing Information to Diversity Selection Algorithm
  - Allows Best Antenna Algorithms using Long Observation Windows for Preamble Assessment
  - Does not Preclude use of Other Channel Compensation Techniques
  - Meets Unique Word Distance Requirement
  - Requires Tolerance of Change in Preamble Content in Receiver Synchronization and Preamble Detection Circuitry

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