L-Pulse Position Modulation (L-PPM)

Proposal for 5 GHz High-Speed PHY

submitted to

IEEE 802.11

by

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Outline

- 5 GHz High-Speed PHY Goals
- L-PPM Characteristics
- L-PPM Symbol Detection Errors
- Indoor Communication Channel
- L-PPM over Multipath, Dispersive Channel
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- FCC & L-PPM
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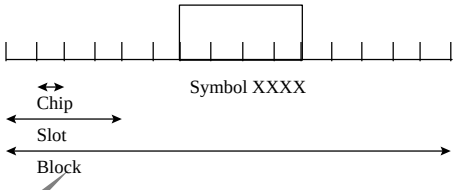
5 GHz High-Speed PHY Goals

- 20 Mbps nominal rate
- 10 Mbps fall-back rate
- Robustness against multipath
- Low-Cost
- Low-Power
- Maximize System Capacity

L-PPM Characteristics

- Power-efficient RF transmission
- Simple Transmiters (compared to OFDM, QPSK & others)
- Power-efficient DC
- AWGN moderate bandwidth efficiency
- Multipath-channel good bandwidth efficiency
- Low hardware complexity
- Low cost



L-PPM Symbol Detection Errors

- Multipath-induced ISI error
- Erasure error
- False-alarm error
- Wrong-slot error

Indoor Communication Channel

- Multipath (Rayleigh envelope)
- Dispersive (Delay spread)
- Frequency selelctive Fading
- Time-varying

L-PPM over Multipath, Dispersive Channel

- Challenges
  - ISI
  - ICI
  - Multipath distortion
  - Multipath Fading
- Possibilities
  - Systems approach
  - Distributed signal conditioning & processing of the signal
  - 10 Mbps systems feasible with very simple solutions

20 Mbps L-PPM Issues

- Higher-order L-PPM candidates (16-PPM)
- Feasibility is NOT the question: Low-cost implmentation is.
- Sub-optimal simple receivers are OK
- Maximum-likelihood Estimation (MLSE) Recivers could be too complex
- Chip & Frame Synchronization

FCC & L-PPM

- L-PPM efficient power transmission is a plus.
- L-PPM for ISM bands
  - RadioLAN 10 Mbps, 5.8 GHz FCC-approved products
    - Desktop solutions: December 1996.
    - Laptop solutions: July 1997.
- L-PPM for U-NII bands
    - FCC-approved RadioLAN U-NII product: May 1997.

L-PPM Product Feasibility

- RadioLAN Products: 10 Mbps
- Irda Products: 4 Mbps
- IEEE 802.11 IR-based products

Conclusions

- L-PPM meets the modulation method criteria of
  - 20 Mbps
  - Multipath-robust,
  - Low-cost
  - Low-power
  - Power efficient
- L-PPM Radio LANs have been demonstrated as 10 Mbps products.
- L-PPM low-cost IR LANs have been demonstrated as 4 & 16 Mbps products.
- L-PPM could potentially co-exist with IEEE 802.11 low-speed.
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