L-Pulse Position Modulation
(L-PPM)

Proposal for 5 GHz High-Speed PHY

submitted to

IEEE 802.11

by

Reza Ahy

RadioLAN, Inc.

Outline

• 5 GHz High-Speed PHY Goals
• L-PPM Characteristics
• L-PPM Symbol Detection Errors
• Indoor Communication Channel
• L-PPM over Multipath, Dispersive Channel
• 20 Mbps L-PPM Issues
• FCC & L-PPM
• L-PPM Product Feasibility
• Conclusions
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 Transmitters (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 selective 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 implementation is.
- Sub-optimal simple receivers are OK
- Maximum-likelihood Estimation (MLSE) Receivers 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.
- L-PPM for U-NII bands

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.