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IEEE 802.4L Wireless Radio LAN
Modulation and Coding
Proposal and Tradeoffs

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1. Introduction

This document proposes a modulation and coding approach for the IEEE 802.4L radio transmission. The approach offers advantages over the 802.4L/89-16 DQPSK technique presently under consideration. We present a description and discussion of the new approach and a comparison table between it and the 802.4L/89-16 approach.

2. Modulation and Coding Approach

Data enters the modulator at 2 Mbps. The clock is provided by the radio to the DTE. (I need to investigate this interface some more.) Control signals on the interface drive the frame formatter. (This also needs to be verified.) Data enters the R 3/4 convolutional encoder which produces a parallel 2-bit output which we can call I/Q. (I felt that the symbol time would be too small with rate 1/2.) These I/Q pairs appear at the rate of 1.33 MHz.

This data is then scrambled and differentially encoded. The frame format controller inserts the preamble symbols into the data path and also assures that the convolutional encoder is flushed at appropriate times. (Note that this type of operation requires messages longer than a packet be stopped and started at each packet time. How difficult this is depends on the 802.4L VLSI interface chip.)

The formatted I/Q data is then chipped with the Barker sequence. The chipped output is then filtered with 11 MHz baseband filters. These are multiplied in quadrature at some convenient IF such as 70 or 140 MHz (What does the $\pi/4$ QPSK modulator really look like?) and combined to form the $\pi/4$ QPSK composite signal. This signal is then anti-aliasing filtered and upconverted again to 915 MHz frequency. A filter is required to remove the unwanted sideband. A single upconversion stage may be possible depending on component performance.

3. Comparison

Comparisons of the 802.4L/89-16 scheme and new modulation techniques are presented in the table. Overall, the HNS scheme seems better, primarily because it introduces FEC into the system. We feel that FEC is important for its protection against impulsive interference, line interference, and frequency selective fading, in addition to its traditional use in combatting Additive White Gaussian Noise. This is particularly important in the factory environment where these effects are more serious than in the retail environment. The effect on noise can be treated as simply changing the range (distance from transmitter) over which a particular radio can operate.

Also the π/4 QPSK may simplify the receiver. Discriminator detection does not require that accurate (any) quadrature channels be developed in the receiver. The 1.5 dB degradation against AWGN is not significant.

Parameter	HNS	802.4L/89-16	Comment
Average Data Rate	1 Mbps	1 Mbps	50% Duty Cycle, 2 Mbps ping/pong
FEC	R 3/4	None	FEC will improve impulse noise resistance, lower required power (or increase range), and combat demodulator imperfections. It will marginally increase complexity.
RF Bandwidth	22 MHz	22 MHz	Equal resistance to frequency selective fades and equal impulse clipping potential
Modulation	π/4 QPSK	QPSK	Equal performance for differential demodulation. π/4 allows discriminator detection if channel phase is very bad. It also is better suited to Class C operation (required at 2.4 and 5.7 GHz).
Filtering	$.7R_s$	R_s	HNS filtering somewhat more difficult but should not change production costs.
Delay Spread	.8 symbols	.6 symbols	HNS has larger percentage delay spread but it is still within one symbol.

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