Summary status report of the proposals for the IEEE P802.11b project: Higher Speed Extension in the 2.4 GHz band

Prepared: March 20, 1998

For more detailed information, please refer to the comparison matrix. The following 5 proposals are the subject of the selection procedure in Task Group b:

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Alantro

Modulation Technique: QPSK

- 1, 2, 2.75, 5.5, 11, 14 2/3, 16.5, 17.6, 18 1/3 and 19.25 Mbps data rates supported
- Uses 64 state, punctured binary convolutional codes for large coding gain
- Low to high implementation complexity dependent on optimality of receiver/decoder
- Three non-overlapping 30 MHz channels available over the 2.4 GHZ ISM band
- Fully interoperable with 1,2 Mbps DS IEEE802.11 systems
- Uses same RF modulation scheme as low rate standards
- Fully compliant with the IEEE802.11 defined MAC
- Optional short high rate preamble for improved throughput
- Payload modulated by PN sequence for increased ACI immunity

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Harris semiconductor

Modulation Technique: M-Mary Bi-Orthogonal Keying

- 1,2,5.5,11 Mbps data rates supported.
- Use of the 8 bit /symbol Walsh function orthogonal set
- Low implementation complexity.
- 3 Frequency channels available over the 2.4 GHZ ISM band .
- Fully interoperable with 1,2 Mbps DS IEEE802.11 systems.
- Fully compliant with the IEEE802.11 defined MAC
- Short high rate preamble available for improved throughput.
- Optional architecture enhancements available to provide high performance to demanding indoor environments (i.e. industrial).

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Lucent Technologies

Modulation technique: BCPM, Barker Code Position Modulation

System characteristics:

- 5, 8 and 10 Mbit/s
- extension of current 802.11 Direct Sequence Spread Spectrum standard
  - fully coexistent with current standard
  - fully interoperable with current standard by fall back rates
  - uses same Barker 11 spreading
  - same channelization, 3 non-overlapping frequency channels
- operates in office, department stores and industrial environments
- implementable in a PCMCIA form factor
- optional short preamble to gear up high speed data throughput
- high sensitivity; range in free space approx. 1000 meters

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MICRILOR, Inc.

Modulation technique: 16-ary Differential Bi-Orthogonal Keying (16-ary DBOK)

Key feature is dividing the 2.4-Ghz band into two frequency channels (instead of three used for the existing DSSS standard; this increases the signal bandwidth by a factor of three (32 Mchip/s), for:

- 12 dB processing gain for use under Part 15.247 (passed FCC in Spring 1996)
- Power-efficient (~7 dB E_B/N_0) 5-bit/symbol via 16-ary DBOK
- Hundreds of PN-code channels for spatial re-use of frequency channel
- Resolution of multipath signals to mitigate fading
- Optional randomization of PN-codes for uncoordinated environments

Other features include:

- Low complexity baseband chip (~ 35K gates)
- Short PHY Preamble&Header for low overhead to enable high throughput (>9.5 Mbps streaming)
- Small Slot time and SIFS for high throughput with protocol
- Coexsistence with installed DS and FH, where desired, by optional deferal to such transmissions enabled by clear-channel-assessment (CCA) technique
- Efficient power-amplifier operation because the MSK chip modulation employed enables operation

up to gain compression with little spectral splatter
- Reduced data rate of 8.7 Mbps for poor channel, and enhanced data rate of 18 Mbps for good channel.

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Raytheon

Modulation Technique: Offset Quadrature Bi-Orthogonal Keying (OQBO)

This is a modification to the M-Mary Bi-Orthogonal Keying Modulation Technique proposed by Harris semiconductor. The modification allows operation with a saturated RF Transmitter Power Amplifier. This minimizes power consumption.
There are two data rates:

HDR (11 Mb/s)

MDR (6.975 Mb/s)

- For HDR (11 Mb/s)
  - Eight information bits are mapped into each symbol for the HDR data rate case.
    - For the I channel:
      - 3 bits are used to pick one of eight 8-ary Walsh functions
      - 1 bit to modulate the sign of this function
    - For the Q channel:
      - 3 bits are used to pick one of eight 8-ary Walsh functions
      - 1 bit to modulate the sign of this function
  - The symbols are covered by an 8 bit PN. For the HDR date rate case: the chipping rate of the PN sequence is 11 MHz.
- For MDR (6.875 Mb/s)
  - Ten information bits are mapped into each symbol for the MDR data rate case.
    - For the I channel:
      - 4 bits are used to pick one of sixteen 16-ary Walsh functions
      - 1 bit to modulate the sign of this function
    - For the Q channel:
      - 4 bits are used to pick one of sixteen 16-ary Walsh functions
      - 1 bit to modulate the sign of this function
  - The symbols are covered by a 16 bit PN For the MDR date rate case: the chipping rate of the PN sequence is also 11 MHz.
- For both HDR and MDR modes
  - The Q channel is delayed ½ chip with respect to the I channel before both are modulated onto the carrier via an I/Q modulator.
  - This waveform is designed to operate with a saturated transmitter RF power amplifier. This minimizes power consumption.
  - 3 Frequency channels available over the 2.4 GHZ ISM band .

- Fully interoperable with 1,2 Mbps DS IEEE802.11 systems.
- Fully compliant with the IEEE802.11 defined MAC
- operates in office, department stores and industrial environments
- implementable in a PCMCIA form factor
- optional short preamble to gear up high speed data throughput
- optional Frequency Hopped PHY backwards compatability (as proposed by doc:IEEE P802.11-98/144, by Dean Kawaguchi of Symbol.

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