Discussion on Comparison Criteria of BCPM

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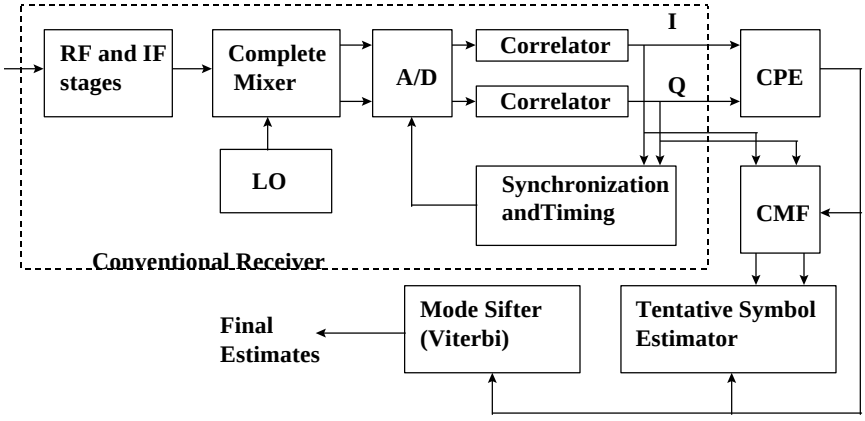
Purpose

- To discuss the comparison criteria of modulation methods for the higher speed extension for the 2.4 GHz PHY
- Barker Code Position Modulation as proposed by Lucent Technologies
  - document 97/124
  - document 98/10
- Criteria document 97/157r1

Receiver structure



CPE channel parameter estimator
CMF channel matched filter

Receiver structure cont'

- Complexity can be traded for performance
  - moderate complexity
    - CMF+TSE+MS
      - complexity of separate blocks can also be traded
      - e.g. length CMF and depth MS
  - low complexity
    - CMF only

Receiver structure cont'

- Implementation
  - RF/IF complexity comparable to low rate PHY
    - same LO, same bandwidth, …..
  - Baseband gate count for moderate complexity receiver about twice low rate PHY
  - NO equalizer

Receiver structure cont'

- Implementation
  - Diversity implementation
    - If DSSS preamble is used same antenna diversity as low rate PHY
    - BCPM is not dependent on long preamble
      - shorter preamble possible, antenna diversity (not required) within one slot on implementers choice
        - serial or parallel receivers
        - transmitter diversity (throughput performance penalty)
    - Multipath diversity inherent to BCPM.
      - performance dependent on receiver implementation

Immunity to multipath and noise

- Performance figures presented in November for 100 byte packet length.
- Performance figures for 64 and 1000 bytes in preparation
  - initial results

Immunity to multipath and noise cont'

- 100 byte packetlength

Bitrate	FER | TDS >	0 ns	50 ns	100 ns	200 ns
5 TSE+MS	10-2	22	20	20	19
	10-1	16	16	16	15
5 CMF only	10-2	22	20	17	25
	10-1	17	16	15	16
8 TSE+MS	10-2	24	24	21	23
	10-1	13	13	13	13
8 CMF only	10-2	26	x	x	x
	10-1	19	22	x	x
10 TSE+MS	10-2	22	24	30	x
	10-1	18	18	18	x
11 TSE+MS	10-2	24	29	x	x
	10-1	18	19	23	x

SNR

Immunity to multipath and noise
cont'

- Some initial results for 64 and 1000 bytes packetlength
  - no noise

	64 Bytes	1000 bytes
Full complexity RX	800 ns	430 ns
without MS	310 ns	210 ns

Tolerated TDS at PER 10%

Immunity to multipath and noise
cont'

- Center frequency accuracy
  - 25 ppm
  - relatively easy acquisition and tracking of LO offset
  - no noticeable performance degradation if implemented

Overhead

- Preamble Length
  - Current DSSS Preamble is proposed for full interoperability and coexistence with current Phy
  - BCPM does NOT need long preamble
    - optional short preamble
    - about 25 microsecond for synchronization and calculating the channel matched filter
    - one slottime (20 microseconds) for antenna diversity
      - technical feasible

Overhead cont'

- Slot Size
  - Current slottime of 20 microseconds will be maintained
    - interoperability and coexistence with current Phy
  - CCA mechanism will not change
  - detection time and turnaround times will not change

Overhead cont'

- SIFS time
  - current SIFS time of 10 microseconds will be maintained
    - interoperability and coexistence with current Phy
    - added to receiver delay compared with current Phy is delay of Mode Sifter (4 symbols if depth is 4); SIFS is enough to handle

Spectral efficiency

- Power spectrum is not changed compared to the current PHY
- The same channelization scheme is employed

Cell sharing

- 3 channels where same frequency of different cells share
- benchmarks:
  - topology should be comparable
    - 2 dimensional
    - multifloor

Range

- range
  - transmit power
    - 25 mW (14 dBm) Tx power
  - min receive level (Rx sensitivity)
    - - 86 dBm (SNR 15.8 dB @ BER 10-5)
    - @ noise factor and implementation loss 12dB
  - link budget 100dB - 40dB isotropic loss --> 60 dB
  - 60 dB --> 1000 meter free space (theoretical !)

Adjacent channel interference

- ACI must be such that a 3 channel solution is possible
- BCPM will not give 35dB as required in current standard
  - interfered devices will fall back in rate
  - system throughput more essential than the ACI figure

Co-channel interference

- 3 to 6 dB (dependent on delayspread)
- simulated data will be provided in March.

Interference immunity

- simulation to be done
- comparable test to be defined:
  - worst case single tone SIR per channel?

Critical points

- Extreme sensitivity to phase noise
  - no issue
- DC power consumption
  - about the same as low rate Phy's
- complexity
  - addressed
- RF PA backoff
  - not different from low rate if Tx power about 2.5 dB lower
- Dependence on antenna diversity/directivity
  - not more critical than low rate Phy
  - multipath diversity

Intellectual Property

- US patent 5,596,601 Bar-David
  - Method and apparatus for spread spectrum code pulse position modulation
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Interoperability / Coexistence

- With long 802.11 header BCPM is fully coexistence and interoperable (can fall back to 1 and 2 Mbit/s), making use of multi-rate capabilities of current standard
- If 20 micros slottime is maintained also with a short header coexistence and/or interoperability is possible

Interoperability / Coexistence cont'

- Shorter preamble is possible.
  - 24 microseconds for Rx training (synchronization, channel matched filter)
  - + time for energy detection and possibly antenna diversity
  - + time to send over header info at higher rate
  - total preamble time needed in the order of 50-70 microseconds

Interoperability / Coexistence cont'

- short preamble for higher rate as option
- use short preamble in a high rate network
  - fall back to long preamble to be interoperable with low rate Phy's
- Coexistence
  - low possibility in a mixed system that low rate Phy does not see BCPM if not synchronized (loosely coexistence, preamble is always recognized)
  - if this affects system throughput fall back to long preamble (full coexistence)