Proposed Comment Resolution for the MR-O-QPSK PHY

January 5, 2011

IEEE P802.15
Wireless Personal Area Networks

Title:	Proposed Comment Resolution for the MR-O-QPSK PHY
Date Submitted:	January 5, 2011
Source:	Michael Schmidt - Atmel (email: michael.schmidt@atmel.com)
Re:	Task Group 15.4g LB59 comment resolution
Abstract:	Proposed comment resolution for the MR-O-QPSK PHY
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CID 43

Comment:

- Section 6.12c: This bullet list repeats normative text given in Table 1.
- delete redundant text

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- delete redundant text

Response:

- Accept in principle.

CID 43

Comment:

- Section 6.12c: This bullet list repeats normative text given in Table 1.
- delete redundant text

Response:

- Accept in principle.

Resolution:

- delete lines 51 to 54 at page 83 and lines 1 through 6 at page 84
- change as indicated: The MR-O-QPSK PHY supports multiple PSDU data rates within each supported frequency band (see Table 1), employing a concatenation of outer FEC coding, interleaving and spreading.

CID 44

Comment:

- The sentence ”At least one of the defined frequency bands shall be implemented when supporting SUN applications” is incorrect (not all SUN applications will require MR-O-QPSK PHYs).
- change to: “An MR-O-QPSK compliant device shall support at least one of the frequency bands designated in Table 1”.

CID 44

Comment:

- The sentence "At least one of the defined frequency bands shall be implemented when supporting SUN applications" is incorrect (not all SUN applications will require MR-O-QPSK PHYs).
- change to: "An MR-O-QPSK compliant device shall support at least one of the frequency bands designated in Table 1".

Response:

- Accept.

CID 45

Comment:

- If the PHR is transmitted using DSSS and only the PSDU may be sent using MDSSS, how is it possible for a compliant device to implement only MDSSS?
- Clarify what is required for an MR-O-QPSK implementation to be conform.

CID 45

Comment:

- If the PHR is transmitted using DSSS and only the PSDU may be sent using MDSSS, how is it possible for a compliant device to implement only MDSSS?
- Clarify what is required for an MR-O-QPSK implementation to be conform.

Response:

- Accept in principle.

cont. CID 45

Resolution:

- In principle, the “SpreadingMode” is only relevant for the PSDU and has nothing do do with the PHR.

cont. CID 45

Resolution:

- In principle, the “SpreadingMode” is only relevant for the PSDU and has nothing do do with the PHR.
- The specification of PHR coding and spreading offer:

cont. CID 45

Resolution:

- In principle, the “SpreadingMode” is only relevant for the PSDU and has nothing do do with the PHR.
- The specification of PHR coding and spreading offer:
  - the lowest data rate and therefore most robust transmission mode,

cont. CID 45

Resolution:

- In principle, the “SpreadingMode” is only relevant for the PSDU and has nothing do do with the PHR.
- The specification of PHR coding and spreading offer:
  - the lowest data rate and therefore most robust transmission mode,
  - the option for non-coherent detection due to bit differential encoding (BDE),

cont. CID 45

Resolution:

- In principle, the “SpreadingMode” is only relevant for the PSDU and has nothing do do with the PHR.
- The specification of PHR coding and spreading offer:
  - the lowest data rate and therefore most robust transmission mode,
  - the option for non-coherent detection due to bit differential encoding (BDE),
  - the simplest spreading scheme: $(N, 1)$-DSSS,

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Resolution:

- In principle, the "SpreadingMode" is only relevant for the PSDU and has nothing do do with the PHR.
- The specification of PHR coding and spreading offer:
  - the lowest data rate and therefore most robust transmission mode,
  - the option for non-coherent detection due to bit differential encoding (BDE),
  - the simplest spreading scheme: $(N, 1)$-DSSS,
  - the lowest complexity of the decoder for FEC (operating at the lowest data rate)

cont. CID 45

Resolution:

- In principle, the "SpreadingMode" is only relevant for the PSDU and has nothing do do with the PHR.
- The specification of PHR coding and spreading offer:
  - the lowest data rate and therefore most robust transmission mode,
  - the option for non-coherent detection due to bit differential encoding (BDE),
  - the simplest spreading scheme: $(N, 1)$-DSSS,
  - the lowest complexity of the decoder for FEC (operating at the lowest data rate)
  - offers the simplest way to compute soft values for outer FEC. In contrast to $(N, 4)$-DSSS or $(N, 8)$-MDSSS, there are only two a posteriori values to be computed when SISO decoding a $(N, 1)$ block code.

cont. CID 45

- However, a device supporting mandatory FEC and spreading specified for the PHR will most likely support SpreadingMode “DSSS” and RateMode zero.

cont. CID 45

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- uses the same spreading and coding scheme

cont. CID 45

- However, a device supporting mandatory FEC and spreading specified for the PHR will most likely support SpreadingMode "DSSS" and RateMode zero.
- uses the same spreading and coding scheme
- only the interleaver depth is slightly different:
  - PHR: 60 code bits
  - PSDU: 176 code bits

cont. CID 45

For the sake of clarity, it is therefore most useful to specify compliance in the following way:

cont. CID 45

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- At 6.12c, delete and change as indicated: "For the frequency bands 779-787 MHz, 917-923.5 MHz, 902-928 MHz and 2400-2450 MHz, the MR-O-QPSK PHY supports ~~a co-alternative~~ an alternative spreading mode during the PSDU part, called multiplexed direct sequence spread spectrum (MDSSS).~~For those frequency bands, a compliant to this PHY shall support at least one of the spreading modes~~ ... ~~For a given frequency band, it is recommended to implement at least RateMode zero with SpreadingMode DSSS, since for this mode, coding and spreading is similar to coding and spreading of the PHR (see 6.12c.1.3 and 6.12c.1.4).~~"

cont. CID 45

For the sake of clarity, it is therefore most useful to specify compliance in the following way:

- At 6.12c, delete and change as indicated: "For the frequency bands 779-787 MHz, 917-923.5 MHz, 902-928 MHz and 2400-2450 MHz, the MR-O-QPSK PHY supports ~~a co-alternative~~ an alternative spreading mode during the PSDU part, called multiplexed direct sequence spread spectrum (MDSSS).~~For those frequency bands, a compliant to this PHY shall support at least one of the spreading modes~~ ... ~~For a given frequency band, it is recommended to implement at least RateMode zero with SpreadingMode DSSS, since for this mode, coding and spreading is similar to coding and spreading of the PHR (see 6.12c.1.3 and 6.12c.1.4).~~"
- At 6.12c add : "A compliant device shall implement at least RateMode zero with SpreadingMode DSSS. All other possible combinations of RateMode and SpreadingMode (depending on the frequency band) are optional."

CID 225

Comment:

- The Header Check Sequence (HCS) field is 8 bits in length and contains an 8-bit ITU-T CRC." The text then describes the HCS calculations in detail, which represents a duplication of the description.
- Either reference the ITU-T document in detail and delete the following text describing the HCS (preferred), or delete the reference to the ITU-T.

CID 225

Comment:

- The Header Check Sequence (HCS) field is 8 bits in length and contains an 8-bit ITU-T CRC." The text then describes the HCS calculations in detail, which represents a duplication of the description.
- Either reference the ITU-T document in detail and delete the following text describing the HCS (preferred), or delete the reference to the ITU-T.

Response:

- Accept in principle.

CID 225

Comment:

- The Header Check Sequence (HCS) field is 8 bits in length and contains an 8-bit ITU-T CRC." The text then describes the HCS calculations in detail, which represents a duplication of the description.
- Either reference the ITU-T document in detail and delete the following text describing the HCS (preferred), or delete the reference to the ITU-T.

Response:

- Accept in principle.

Resolution:

- Detailed description preferred, since it gives a clear guideline for the implementer.
- Change as indicated: The Header Check Sequence (HCS) field $\underline{(H_7 - H_0)}$ ~~is 8 bits in length and contains an 8-bit ITU-T CRC. The HCS~~ is calculated over the first 16 PHR bits ...

CID 636

Comment:

- "This simplifies sensing of legacy preambles while sensing for a preamble of the MR-O-QPSK PHY?." is hard to understand.
- Re-write this sentence and give the explanation.

CID 636

Comment:

- "This simplifies sensing of legacy preambles while sensing for a preamble of the MR-O-QPSK PHY?." is hard to understand.
- Re-write this sentence and give the explanation.

Response:

- Accept in principle.

CID 636

Comment:

- "This simplifies sensing of legacy preambles while sensing for a preamble of the MR-O-QPSK PHY?." is hard to understand.
- Re-write this sentence and give the explanation.

Response:

- Accept in principle.

Resolution:

- Explanation: Since the chip rate is the same, the RF front end and the sample rate converter can be shared, while listening simultaneously for a legacy (802.15.4-2006 O-QPSK PHY) preamble and a preamble of the MR-O-QPSK PHY.

CID 636

Comment:

- "This simplifies sensing of legacy preambles while sensing for a preamble of the MR-O-QPSK PHY?." is hard to understand.
- Re-write this sentence and give the explanation.

Response:

- Accept in principle.

Resolution:

- Explanation: Since the chip rate is the same, the RF front end and the sample rate converter can be shared, while listening simultaneously for a legacy (802.15.4-2006 O-QPSK PHY) preamble and a preamble of the MR-O-QPSK PHY.
- Change as indicated: ~~This simplifies sensing of legacy preambles while sensing for a preamble of the MR-O-QPSK PHY.~~ This simplifies simultaneous sensing of legacy preambles and preambles of the MR-O-QPSK PHY.

CID 1185

Comment:

- Lower data rate should be considered in 470-510 MHz band for improved link budget.
- Add new data rate of 6.25 kbps with N(8,1)-DSSS and rate 1/2 FEC.

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Response:

- Accept in principle.

cont. CID 1185

Resolution:

- Add the new spreading mode to all supported frequency bands where narrow band DSSS is applied:

cont. CID 1185

Resolution:

- Add the new spreading mode to all supported frequency bands where narrow band DSSS is applied:
  - 470-510 MHz

cont. CID 1185

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- Add the new spreading mode to all supported frequency bands where narrow band DSSS is applied:
  - 470-510 MHz
  - 868-870 MHz

cont. CID 1185

Resolution:

- Add the new spreading mode to all supported frequency bands where narrow band DSSS is applied:
  - 470-510 MHz
  - 868-870 MHz
  - 950-958 MHz

cont. CID 1185

Resolution:

- Add the new spreading mode to all supported frequency bands where narrow band DSSS is applied:
  - 470-510 MHz
  - 868-870 MHz
  - 950-958 MHz
- All those frequency bands are regulated by constrained output power.

cont. CID 1185

Resolution:

- Add the new spreading mode to all supported frequency bands where narrow band DSSS is applied:
  - 470-510 MHz
  - 868-870 MHz
  - 950-958 MHz
- All those frequency bands are regulated by constrained output power.
- Works well as a complementary mode to 50 ... 150 kbps FSK type signaling (similar RF bandwidth).

cont. CID 1185

cont. CID 1185

- At the highest carrier frequency (958 MHz) and at the highest overall frequency offset $(20 + 20)$ ppm, the maximum normalized frequency deviation per chip ($f_{chip} = 100$ kchip/s) is given by

$$\Omega = 2\pi \cdot 958 \times 10^6 \cdot 40 \times 10^{-6} / 100 \times 10^3 \approx 2.41 < \pi$$

cont. CID 1185

- At the highest carrier frequency (958 MHz) and at the highest overall frequency offset (20 + 20) ppm, the maximum normalized frequency deviation per chip ($f_{chip} = 100$ kchip/s) is given by

$$\Omega = 2\pi \cdot 958 \times 10^6 \cdot 40 \times 10^{-6} / 100 \times 10^3 \approx 2.41 < \pi$$

- simplifies frequency offset estimation

cont. CID 1185

- For SHR, use $(32,1)_{k=0}$-DSSS given in Table 75aa

cont. CID 1185

- For SHR, use $(32, 1)_{k=0}$-DSSS given in Table 75aa
- For PHR and PSDU, apply a new spreading code $(8, 1)_{0/1}$-DSSS with FEC.

cont. CID 1185

- For SHR, use $(32,1)_{k=0}$-DSSS given in Table 75aa
- For PHR and PSDU, apply a new spreading code $(8,1)_{0/1}$-DSSS with FEC.
- Instead of chip whitening, apply a time varying spreading code.

cont. CID 1185

- For SHR, use $(32,1)_{k=0}$-DSSS given in Table 75aa
- For PHR and PSDU, apply a new spreading code $(8,1)_{0/1}$-DSSS with FEC.
- Instead of chip whitening, apply a time varying spreading code.
  - carrier sense

cont. CID 1185

- For SHR, use $(32, 1)_{k=0}$-DSSS given in Table 75aa
- For PHR and PSDU, apply a new spreading code $(8, 1)_{0/1}$-DSSS with FEC.
- Instead of chip whitening, apply a time varying spreading code.
  - carrier sense
  - good spectral properties even without chip whitening

cont. CID 1185

- Add new Tables to section 6.12c.1.9

k	Input bit	Chip values ($c_0 c_1 \ldots c_7$)
0	0	10110001
	1	01001110
1	0	01100011
	1	10011100

Table: $(8, 1)_k$-DSSS bit-to-chip mapping

Input bit	Chip values ($c_0 c_1$)
0	01
1	10

Table: $(2, 1)$-DSSS bit-to-chip mapping

cont. CID 1185

- In section 6.12c.1.9, unify description for $(N, 1)_{0/1}$-DSSS for N = 8,16 and 32.

cont. CID 1185

- In section 6.12c.1.11, change Table 75ai as follows

Frequency Band (MHz)	RateMode
470-510	**1 and 2 and 3**
779-787	2 and 3
868-870	**1 and 2 and 3**
902-928	2 and 3
950-958	**1 and 2 and 3**
2400-2483.5	3

Table: Chip Whitening for DSSS

cont. CID 1185

- In section 6.12c.1.12, change Table 75aj as follows

Frequency Band (MHz)	length N_p (# of chips)	spacing M_p (# of chips)	chip sequence $p = (p_0, p_1, \ldots, p_{N_p-1})$
FB	32	512	1101_1110_1010_0010_ _0111_0000_0110_0101

Table: Pilot length, spacing and chip sequences

where FB = either 470-510, 868-870, 950-958.

cont. CID 1185

- In Table 75t replace $(16, 1)_0$-DSSS with $(32, 1)_0$-DSSS
- In Table 75u replace $(4, 1)$-DSSS with $(8, 1)_{0/1}$-DSSS
- Change Table 75v as follows:

Frequency band (MHz)	Chip rate (kchip/s)	Rate Mode	BDE	Spreading	rate $\frac{1}{2}$ FEC + Int.	data rate (kbps)
FB	100	0	yes	$(8, 1)_{0/1}$-DSSS	yes	6.25
		1	yes	(4,1)-DSSS	yes	12.5
		2	yes	(2,1)-DSSS	yes	25
		3	no	none	yes	50

where FB is either 470-510, 868-870, 950-958.

cont. CID 1185

- In Table 75t replace $(16,1)_0$-DSSS with $(32,1)_0$-DSSS
- In Table 75u replace $(4,1)$-DSSS with $(8,1)_{0/1}$-DSSS
- Change Table 75v as follows:

Frequency band (MHz)	Chip rate (kchip/s)	Rate Mode	BDE	Spreading	rate $\frac{1}{2}$ FEC + Int.	data rate (kbps)
FB	100	0	yes	$(8,1)_{0/1}$-DSSS	yes	6.25
		1	yes	(4,1)-DSSS	yes	12.5
		2	yes	(2,1)-DSSS	yes	25
		3	no	none	yes	50

where FB is either 470-510, 868-870, 950-958.

- Complexity for coherent detection is reasonably low for RateMode = 3. The symbol duration is 10 us only. The chip SNR is relative high. Therefore, BDE is disabled.

cont. CID 1185

- In Table 75t replace $(16, 1)_0$-DSSS with $(32, 1)_0$-DSSS
- In Table 75u replace $(4, 1)$-DSSS with $(8, 1)_{0/1}$-DSSS
- Change Table 75v as follows:

Frequency band (MHz)	Chip rate (kchip/s)	Rate Mode	BDE	Spreading	rate $\frac{1}{2}$ FEC + Int.	data rate (kbps)
FB	100	0	yes	$(8, 1)_{0/1}$-DSSS	yes	6.25
		1	yes	(4,1)-DSSS	yes	12.5
		2	yes	(2,1)-DSSS	yes	25
		3	no	none	yes	50

where FB is either 470-510, 868-870, 950-958.

- Complexity for coherent detection is reasonably low for RateMode = 3. The symbol duration is 10 us only. The chip SNR is relative high. Therefore, BDE is disabled.
- For RateModes = 0,1 and 2 the symbol duration is 80, 40 and 20 us, respectively. A non-coherent aproach is suggested here. Those modes are designed for lower chip SNR. Therefore, BDE is enabled.

cont. CID 1185

In Table 75ak replace:

- 768 by 1536
- 7680 by 15360
- 240 by 480
- 2400 by 4800

cont. CID 1185: Simulation

IF:	300 kHz

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IF:	300 kHz
analog receive filter:	2-nd order $f_{cut} = 100$ kHz

cont. CID 1185: Simulation

IF:	300 kHz
analog receive filter:	2-nd order $f_{cut} = 100$ kHz
analog high pass filter:	2-nd order $f_{cut} = 50$ kHz

cont. CID 1185: Simulation

IF:	300 kHz
analog receive filter:	2-nd order $f_{cut} = 100$ kHz
analog high pass filter:	2-nd order $f_{cut} = 50$ kHz
ADC:	6 bit at 4 MHz

cont. CID 1185: Simulation

IF:	300 kHz
analog receive filter:	2-nd order $f_{cut} = 100$ kHz
analog high pass filter:	2-nd order $f_{cut} = 50$ kHz
ADC:	6 bit at 4 MHz
discrete time receive filter:	FIR + 5-th order IIR ($f_{cut} = 62.5$ kHz)

cont. CID 1185: Simulation

IF:	300 kHz
analog receive filter:	2-nd order $f_{cut} = 100$ kHz
analog high pass filter:	2-nd order $f_{cut} = 50$ kHz
ADC:	6 bit at 4 MHz
discrete time receive filter:	FIR + 5-th order IIR ($f_{cut} = 62.5$ kHz)
LNA noise:	-174 dBm/Hz + 5 dB noise figure

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LNA noise:	-174 dBm/Hz + 5 dB noise figure
carrier frequency:	868.3 MHz

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IF:	300 kHz
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discrete time receive filter:	FIR + 5-th order IIR ($f_{cut} = 62.5$ kHz)
LNA noise:	-174 dBm/Hz + 5 dB noise figure
carrier frequency:	868.3 MHz
crystal tolerance:	± 20 ppm

cont. CID 1185: Simulation

IF:	300 kHz
analog receive filter:	2-nd order $f_{cut} = 100$ kHz
analog high pass filter:	2-nd order $f_{cut} = 50$ kHz
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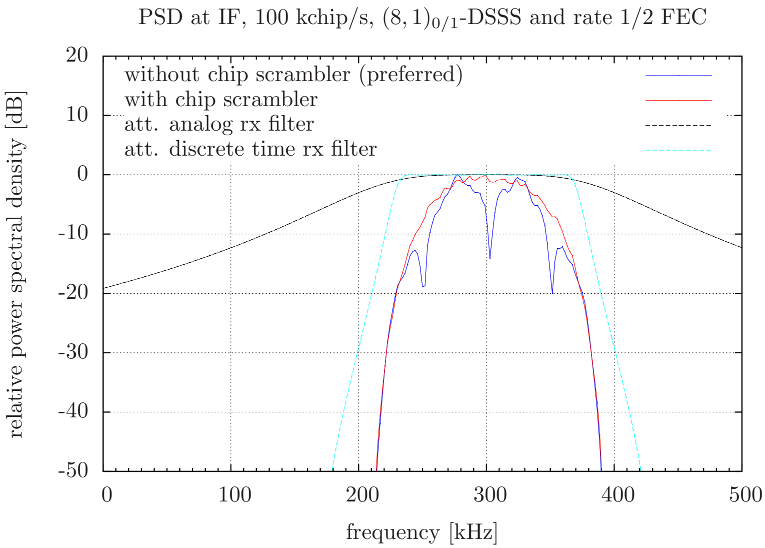
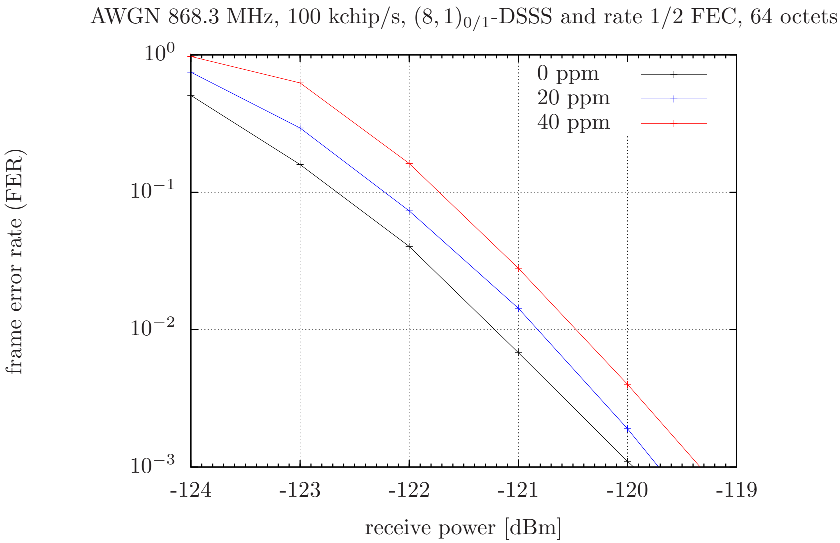
LNA noise:	-174 dBm/Hz + 5 dB noise figure
carrier frequency:	868.3 MHz
crystal tolerance:	$\pm$20 ppm

- true timing sync
- true frequency offset estimation

cont. CID 1185



cont. CID 1185



CID 638, 1186

Comment:

- Cross correlation of (8,4)-DSSS code is poor
- Non-coherent detection is not possible
- Consider (8,4)-DSSS code given in 15-10-0281-04-004g

Response:

- Reject.

cont. CID 638, 1186

Resolution:

The analysis given in 15-10-0281-04-004g is misleading:

[1] This would require QPSK modulation.

[2] Note that chip-differential demodulation may cause considerable multipath degradation for a chip duration of $T_c \leq 1$ us.

cont. CID 638, 1186

Resolution:

The analysis given in 15-10-0281-04-004g is misleading:

- It is not clearly described what is meant by non-coherent detection.

[1] This would require QPSK modulation.

[2] Note that chip-differential demodulation may cause considerable multipath degradation for a chip duration of $T_c \leq 1$ us.

cont. CID 638, 1186

Resolution:

The analysis given in 15-10-0281-04-004g is misleading:

- It is not clearly described what is meant by non-coherent detection.
- In contrast to $(N, 1)$, it is not obvious how a $(N, K > 1)$ block code can be made rotational invariant for O-QPSK modulation[1].

[1] This would require QPSK modulation.

[2] Note that chip-differential demodulation may cause considerable multipath degradation for a chip duration of $T_c \leq 1$ us.

cont. CID 638, 1186

Resolution:

The analysis given in 15-10-0281-04-004g is misleading:

- It is not clearly described what is meant by non-coherent detection.
- In contrast to $(N, 1)$, it is not obvious how a $(N, K > 1)$ block code can be made rotational invariant for O-QPSK modulation[1].
- It appears that chip-differential demodulation is considered[2].

[1] This would require QPSK modulation.

[2] Note that chip-differential demodulation may cause considerable multipath degradation for a chip duration of $T_c \leq 1$ us.

cont. CID 638, 1186

Resolution:

The analysis given in 15-10-0281-04-004g is misleading:

- It is not clearly described what is meant by non-coherent detection.
- In contrast to $(N, 1)$, it is not obvious how a $(N, K > 1)$ block code can be made rotational invariant for O-QPSK modulation[1].
- It appears that chip-differential demodulation is considered[2].
- The fact that MR-O-QPSK applies outer FEC with (8,4)-DSSS is neglected.

[1] This would require QPSK modulation.

[2] Note that chip-differential demodulation may cause considerable multipath degradation for a chip duration of $T_c \leq 1$ us.

cont. CID 638, 1186

Resolution:

The analysis given in 15-10-0281-04-004g is misleading:

- It is not clearly described what is meant by non-coherent detection.
- In contrast to $(N, 1)$, it is not obvious how a $(N, K > 1)$ block code can be made rotational invariant for O-QPSK modulation[1].
- It appears that chip-differential demodulation is considered[2].
- The fact that MR-O-QPSK applies outer FEC with (8,4)-DSSS is neglected.
- Importance of non-coherent reception in conjunction with a relative high chip rate and a relative long SHR is over-rated.

[1] This would require QPSK modulation.

[2] Note that chip-differential demodulation may cause considerable multipath degradation for a chip duration of $T_c \leq 1$ us.

cont. CID 638, 1186

Input bits ($b_0 b_1 b_2 b_3$)	Chip values ($c_0 c_1 \ldots c_7$)
0000	00000001
1000	11010000
0100	01101000
1100	10111001
0010	11100101
1010	00110100
0110	10001100
1110	01011101
0001	10100010
1001	01110011
0101	11001011
1101	00011010
0011	01000110
1011	10010111
0111	00101111
1111	11111110

Table: (8,4)-DSSS code of P802.15.4g/D2 : $C_0(8,4)$

cont. CID 638, 1186

Input bits ($b_0 b_1 b_2 b_3$)	Chip values ($c_0 c_1 \ldots c_7$)
0000	01011100
1000	00101110
0100	00010111
1100	10001011
0010	11000101
1010	11100010
0110	01110001
1110	10111000
0001	00001001
1001	10000100
0101	01000010
1101	00100001
0011	10010000
1011	01001000
0111	00100100
1111	00010010

Table: (8,4)-DSSS code proposed in 15-10-0281-04-004g : $C_1(8,4)$

cont. CID 638, 1186

- In conjunction with FEC, inner non-coherent detection is usually not recommended.

cont. CID 638, 1186

- In conjunction with FEC, inner non-coherent detection is usually not recommended.
- For MR-O-QPSK, support for inner non-coherent detection using $(N, 1)$-DSSS in conjunction with BDE is a compromise (see doc IEEE 802.15-10-0435-02-004g for further details).

cont. CID 638, 1186

- In conjunction with FEC, inner non-coherent detection is usually not recommended.
- For MR-O-QPSK, support for inner non-coherent detection using $(N, 1)$-DSSS in conjunction with BDE is a compromise (see doc IEEE 802.15-10-0435-02-004g for further details).
- For (8,4)-DSSS, the chip SNR is relative high (at the sensitivity limit).

cont. CID 638, 1186

- In conjunction with FEC, inner non-coherent detection is usually not recommended.
- For MR-O-QPSK, support for inner non-coherent detection using $(N, 1)$-DSSS in conjunction with BDE is a compromise (see doc IEEE 802.15-10-0435-02-004g for further details).
- For (8,4)-DSSS, the chip SNR is relative high (at the sensitivity limit).
- Moderate implementation complexity of a phase control loop

cont. CID 638, 1186

- In conjunction with FEC, inner non-coherent detection is usually not recommended.
- For MR-O-QPSK, support for inner non-coherent detection using $(N, 1)$-DSSS in conjunction with BDE is a compromise (see doc IEEE 802.15-10-0435-02-004g for further details).
- For (8,4)-DSSS, the chip SNR is relative high (at the sensitivity limit).
- Moderate implementation complexity of a phase control loop
- The very first pilot signal during PSDU simplifies initial phase estimation.

cont. CID 638, 1186

Minimum Hamming Distance d_{min}:

- $$2 = d_{min}^{C_1(8,4)} < d_{min}^{C_0(8,4)} = 4 = d_{min}^{opt}$$

[3]Instead of computing phase deviation based on the chip values, using the ML codeword of the (8,4) block code gives more reliable phase estimates.

cont. CID 638, 1186

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cont. CID 638, 1186

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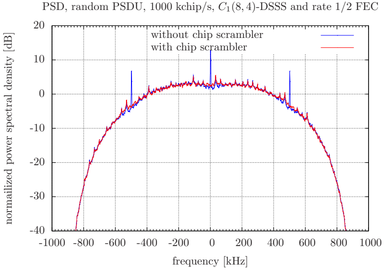
- $C_0(8,4)$ is and extended BCH code.
- The distance properties of the inner block code are less relevant (due to outer rate 1/2 FEC).
- However, the coding gain of $C_0(8,4)$ can be exploited for a decision feedback based phase control loop[3].

[3] Instead of computing phase deviation based on the chip values, using the ML codeword of the (8,4) block code gives more reliable phase estimates.

cont. CID 638, 1186

Spectral lines:

- $C_1(8,4)$ shows noticeable spectral lines with a DC.



cont. CID 638, 1186

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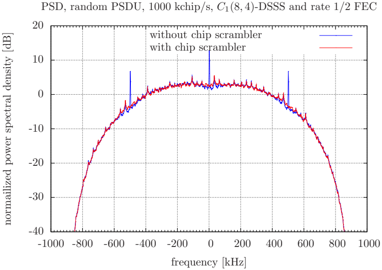

- relevant for operation at max. power in 902-928 MHz band (FCC §15.247: spectral density limit of 8 dBm/3 kHz).

cont. CID 638, 1186

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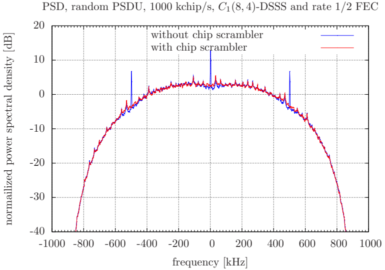

- relevant for operation at max. power in 902-928 MHz band (FCC §15.247: spectral density limit of 8 dBm/3 kHz).
- DC and spectral lines can be removed by chip whitening, see P802.15.4g/D2 6.12c.1.11.

cont. CID 638, 1186

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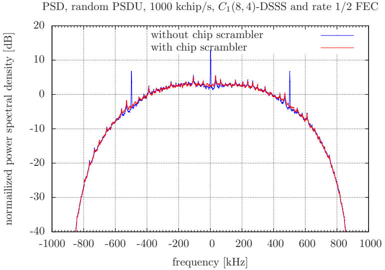

- relevant for operation at max. power in 902-928 MHz band (FCC §15.247: spectral density limit of 8 dBm/3 kHz).
- DC and spectral lines can be removed by chip whitening, see P802.15.4g/D2 6.12c.1.11.
- However, any possible advantage of $C_1(8,4)$ with regard to multipath robustness is nearly lost once chip whitening needs to be introduced anyway.

CID 205

Comment:

- MROQPSKRATEMode shall be a written "MROQPSKRateMode"
- Give a more precise description in Table 8.
- Alternatively, should be moved to a a PIB, since the PSDU data rate may not change with every sent frame.

CID 205

Comment:

- MROQPSKRATEMode shall be a written "MROQPSKRateMode"
- Give a more precise description in Table 8.
- Alternatively, should be moved to a a PIB, since the PSDU data rate may not change with every sent frame.

Response:

- Accept in principle.

CID 205

Resolution:

- Both, the MR-O-QPSK PHY and the MR-OFDM PHY follow a traditional multi-rate PHY approach, where information on the data rate is transmitted within each frame (see, e.g. IEEE 802.11).

CID 205

Resolution:

- Both, the MR-O-QPSK PHY and the MR-OFDM PHY follow a traditional multi-rate PHY approach, where information on the data rate is transmitted within each frame (see, e.g. IEEE 802.11).
- This gives a solid concept in order to signal the PSDU data rate at the price of some preamble overhead for higher data rates.

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CID 205

Resolution:

- Both, the MR-O-QPSK PHY and the MR-OFDM PHY follow a traditional multi-rate PHY approach, where information on the data rate is transmitted within each frame (see, e.g. IEEE 802.11).
- This gives a solid concept in order to signal the PSDU data rate at the price of some preamble overhead for higher data rates.
- A transformation to a PIB attribute is not appropriate.
- As a consequence, both PHYs need an argument value for PD-DATA.request, selecting the PSDU data rate.

cont. CID 205

- Since the list of arguments of PD-DATA.request already contains such a variable, namely "DataRate", this variable can be overloaded.
- change Table 8 "PD-DATA.request parameters" accordingly:

cont. CID 205

DataRate	Enumeration	DATA_RATE_0 DATA_RATE_1 DATA_RATE_2 DATA_RATE_3 DATA_RATE_4 DATA_RATE_5 DATA_RATE_6 DATA_RATE_7 DATA_RATE_8	The data rate of the PHY frame to be transmitted by the PHY entity. A value of DATA_RATE_0 is used with a non-UWB or non-CSS PHY or non-MR-O-QPSK PHY or non-MR-OFDM PHY. ... DATA_RATE_1 through DATA_RATE_4 is used with the MR-O-QPSK PHY and DSSS spreading mode, where DATA_RATE_k corresponds to the parameter RateMode = k-1, (see Table 75v). DATA_RATE_5 through DATA_RATE_8 is used with the MR-O-QPSK PHY and MDSSS spreading mode, where DATA_RATE_k corresponds to the parameter RateMode = k-5, (see Table 75w). DATA_RATE_1 through DATA_RATE_7 is used with the MR-OFDM PHY, where DATA_RATE_k corresponds to the variable MCS$\{k-1\}$ (see table 75g).

Table: PD-DATA.request parameters

cont. CID 205

- Apply the same amendment for "DataRate" in the description for PD-DATA.indication (Table 10).

cont. CID 205

- Apply the same amendment for “DataRate” in the description for PD-DATA.indication (Table 10).
- Delete both “MROQKPSKRateMode” and “MROQKPSKSpreadingMode” in PD-DATA.request and PD-DATA.indication.

cont. CID 205

Change Table 9 PD-DATA.confirm parameters

cont. CID 205

Change Table 9 PD-DATA.confirm parameters

- delete the value "UNSUPPORTED_MROQPSK_SPREADING_MODE"

cont. CID 205

Change Table 9 PD-DATA.confirm parameters

- delete the value "UNSUPPORTED_MROQPSK_SPREADING_MODE"
- add the value "UNSUPPORTED_DATA_RATE" with the following description:

cont. CID 205

Change Table 9 PD-DATA.confirm parameters

- delete the value "UNSUPPORTED_MROQPSK_SPREADING_MODE"
- add the value "UNSUPPORTED_DATA_RATE" with the following description:
- If the DataRate parameter of the PD-DATA.request primitive is not supported the PHY entity will issue the PD-DATA.confirm primitive with a status of UNSUPPORTED_DATA_RATE.

cont. CID 205

Change List of MCPS-DATA.request parameters (7.1.1.1.1):

cont. CID 205

Change List of MCPS-DATA.request parameters (7.1.1.1.1):

- add the value “DataRate”

cont. CID 205

Change List of MCPS-DATA.request parameters (7.1.1.1.1):

- add the value "DataRate"
- add row to Table 77

DataRate	Enumeration	as defined in Table 8	as defined in Table 8

Table: MCPS-DATA.request parameters

cont. CID 205

Change List of MCPS-DATA.indication parameters:

cont. CID 205

Change List of MCPS-DATA.indication parameters:

- add the value “DataRate”

cont. CID 205

Change List of MCPS-DATA.indication parameters:

- add the value “DataRate”
- add row in Table of MCPS-DATA.indication parameters :

DataRate	Enumeration	as defined in Table 8	as defined in Table 8

Table: MCPS-DATA.indication parameters

cont. CID 205

The following comments are solved or obsolete when accepting the resolution of CID 205: CIDs: # 49, 67, 206, 352, 353, 428.

CID 224, 807

Comment:

- Confusion about “reserved bits”
- What does it mean that they “shall be set to zero if not used?”

CID 224, 807

Comment:

- Confusion about “reserved bits”
- What does it mean that they “shall be set to zero if not used?”

Response:

- Accept in principle.

CID 224, 807

Resolution:

- The reserved bits cannot be completely ignored on receive, since the evaluation of the HCS depends on them.
- Proposed change: "The field $(R_1 - R_0)$ shall be reserved for future usage".