

Proposal for an OFDM based 802.16.3 Air Interface Physical Layer

IEEE 802.16 Presentation Submission Template (Rev. 8)

Document Number: IEEE 802.16.3p-00/44

Date Submitted: 2000-11-08

Source:

Jose Francia

Alcatel

Ramirez de Prado, 5

Madrid

Voice: +34 91 330 4679

Fax: +34 91 330 5082

E-mail: veq@alcatel.es

Venue:

802.16. Session # 10Tampa,FL Nov. 2000

Base Document:

http://grouper.ieee.org/groups/802/16/tg3/contrib/802163c-00_44.pdf

Purpose:

802.16.3 PHY proposal for presentation, discussion and decision

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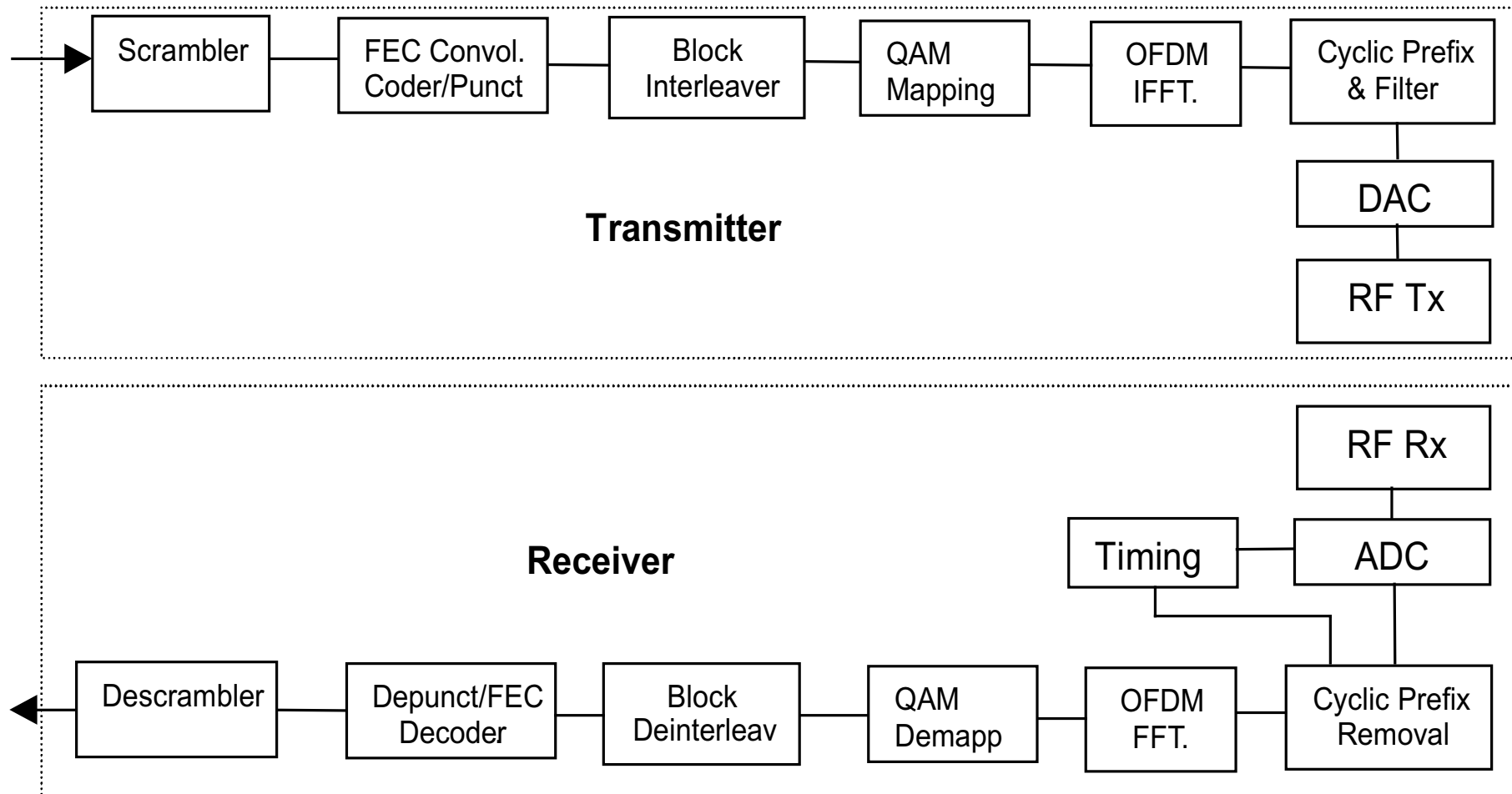
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Basics

- **Based on HiperLAN2, 802.11 a**
- **TDD and FDD duplexing modes**
- **Burst format**
- **OFDM as multiplexing/transmission technique**
- **TDMA as Multiple Access Technique**
- **Open to improvements/add-ons**

Conceptual PHY Block Diagram



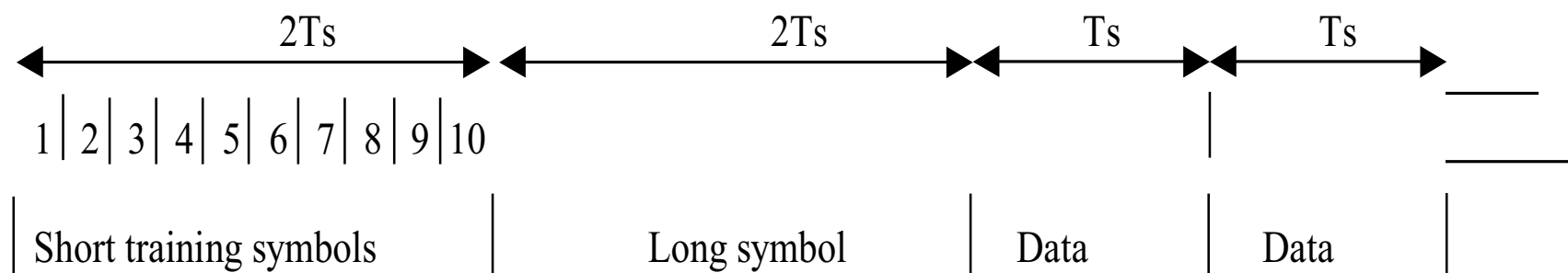
Main (OFDM) parameters

- Channel spacings conforming to F.R.D.
- 52 subcarriers with variable spacing
- 48 data carrying subcarriers and 4 pilot subcarriers for carrier phase reference.
- QPSK, 16-QAM , 64QAM modulation on each subcarrier with Gray-coded constellation mapping
- Block interleaver with block size equal to a single OFDM symbol.
- $K=7$, $R=1/2$ industry standard convolutional code with puncturing to rates of $R=9/16$ and $3/4$.
- Variable OFDM symbol duration according to channel width.

Example of numerical values of OFDM Parameters

RF Channel (MHz)	B	7	6	5	3,5	3	1,75
Sampling rate $1/T$ (MHz)	B	7	6	5	3,5	3	1,75
FFT size N	64	64	64	64	64	64	64
Subcarrier spacing f_c (KHz)	$B/64$	109,375	93,75	78,125	54,688	46,875	27,344
FFT time T_c (μ s)	$64 \times T$	9,143	10,667	12,800	18,286	21,333	36,571
Cyclic prefix time T_p (μ s)	$16 \times T$	2,286	2,667	3,200	4,571	5,333	9,143
Symbol duration T_s (μ s)	$80 \times T$	11,429	13,333	16,000	22,857	26,667	45,714
Symbol rate f_s (Ksym/s)	$1 / T_s$	87,500	75,000	62,500	43,750	37,500	21,875
Number of data subcarriers	48	48	48	48	48	48	48
Number of pilot subcarriers	4	4	4	4	4	4	4
Total number of subcarriers	52	52	52	52	52	52	52
Occupied BW (KHz)	$53 \times f_c$	5797	4969	4141	2898	2484	1449

Example of Burst & Preamble Structure



Variable burst size, variable preamble

Summary of Physical Parameters

Randomization	$1 + X^4 + X^7$
Convolutional coding	Selectable: rate 1/2, 9/16, 3/4.
Modulation	QPSK, 16-QAM, or 64-QAM.
Spectral shaping	Done in the time domain.
Interleaving block size:	One OFDM symbol.
OFDM FFT size	64
Number of subcarriers	48 data + 4 pilots
Preamble length:	Variable, up to 4Ts

Available Bit Rates for a 7 MHz RF channel

Modulation	Symbol rate (Mbaud/s)	Coded bit rate (Mbit/s)	Code rate	Payload bit rate (Mbit/s)
QPSK	4.2	8.4	1 / 2	4.2
QPSK	4.2	8.4	3 / 4	6.3
16QAM	4.2	16.8	9 / 16	9.45
16QAM	4.2	16.8	3 / 4	12.6
64QAM	4.2	25.2	3 / 4	18.9

Addressing the Evaluation Criteria

- **Very first estimations given:**
 - **2.71 bits/sec/Hz (user information)@ 7 MHz channel**
 - **System gain: 98–118 dB (NF 6 dB, IL 2 dB, 23 dBm)**
 - **Adjacent Channel Rejection**
 - **Transmit Mask**
 - **PA back-off: 7–9 dB (w/o PAPR mitigation techniques)**
 - **Phase noise -70 dBc/Hz at 10 KHz offset @ 1.75 MHz**
 - **Frequency stability: 2 ppm @ 1.75 MHz**