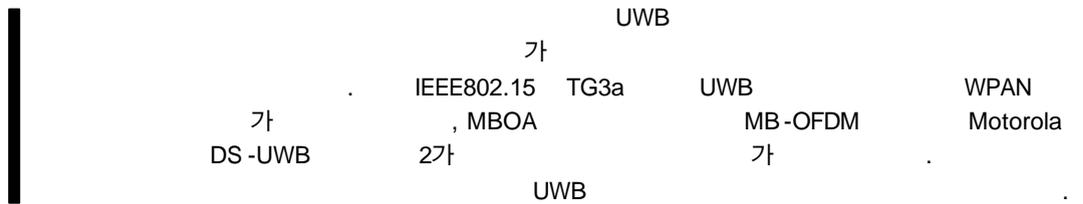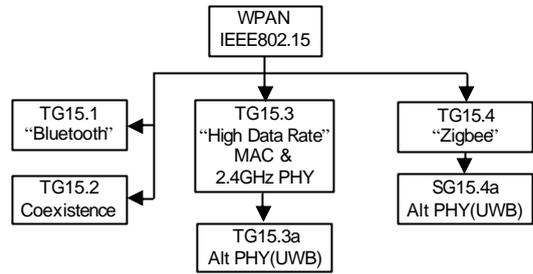UWB

Introduction of High Data-Rate UWB Technology and IEEE802.15.3a Standardization Status for Wireless Home Network

(S.S. Choi)   ,
(C.H. Shin)
(B.J. Kang)

UWB

.   IEEE802.15   TG3a   UWB   WPAN
, MBOA   MB-OFDM   Motorola
DS-UWB   2   .
UWB   .

I

UWB   500MHz

.   , 400Mbps

,

5   1

HDTV,   Hi-Fi, MP3   ,   ,

WPAN(Wireless Personal Network)
[1].

IEEE802.15   TG3   50Mbps
WPAN
,   WPAN
LAN, Home RF,

IEEE 1394,
(spatial capacity)   100~400Mbps
UWB
, 2002   UWB   WPAN
(Alt-PHY layer)

TG3a
[2].
2003   3   (Dallas) Plenary
23

MBOA(Multi-Band OFDM
Alliance)   OFDM   Multi-
band   (Multi-Band OFDM: MB-
OFDM)[3]   Motorola   Direct Sequence
single/dual-band   (Direct
Sequence UWB: DS-UWB)[4]   .
, down selection

(confirmation
vote)   75%

MB-OFDM   DS-UWB
down selection   conformation

7 (Portland)
Plenary IEEE802.15 TG3a

,

MBOA MB- OFDM UWB
Motorola DS- UWB

,

,

.

II.

WPAN (1)
IEEE802.15 . WPAN
TG3 2.4GHz ISM
50Mbps WPAN MAC
. ,

, UWB
100~400Mbps WPAN
.

2002 11 UWB WPAN
Study Group 3a
, 2002 12 UWB
CFA(Call For Application)
CFA 2003 1
UWB
.
2003 2 31 (call for in-
tent) 2003 3 Time
Domain, Xtremespectrum, Texas Instrument,
Intel, Wisair, Philips, GA 23
.

2003 3 , 5
<
1> 6 .

TI, Intel, Wisair, Staccato 13
MBOA Xtremespectrum

(1) IEEE802.15 WPAN

CRL	Soft Spectrum	QPSK & M- ary PSM
MBOA	3.1~ 4.8GHz 5.1~ 10.6GHz	QPSK
STMicro	3.1~ 10.6GHz	M- ary PPM & Polarity
Xtremespectrum	3.1~ 5.15GHz 5.825~ 10.6GHz	PSK & MBOK
OKI	156MHz/Channel	DQPSK
Parthusa Ceva	3.8~ 7.7GHz	Ternary Spreading

.

2003 7 WG
Letter Ballot Draft Standard
down selection , 1
CRL OKI , 2 Parthausa
Ceva Xtremespectrum 3 STMicro
MBOA down selec-
tion MBOA 1 .
1 95,
63 75%
, 9 Interim
2 62 , 43 ,
3 75%
. 7
MBOA,
Xtremespectrum, OKI- CRL 3
down selection OKI- CRL
1 Xtremespectrum
MBOA MB- OFDM
Xtremespectrum DS- UWB 2

.

2003   1 1   Albuquerque Plenary
MBOA   1, 2
                                , 2004   1   Van-
couver Interim   , 3   Orlando Plenary   ,
5   Anaheim Interim   MBOA   MB-
OFDM

75%
down selection
.

Xtremespectrum   2003   12
Motorola   Xtremespectrum   Mo-
torola   DS- UWB

<   2>   .
2004   7   Portland Plenary
DS- UWB

MBOA   MB- OFDM   1

,   1   50%
9   Berlin Interim
Motorola
2   .

<   2>

2003/7 Plenary		MBOA	63 95	1
2003/9 Interim		MBOA	41 59	2
2003/11 Plenary		MBOA	96 69	1
2004/1 Interim		MBOA	76 37	2
2004/3 Plenary		MBOA	85 50	1
2004/5 Interim		MBOA	61 39	2
2004/7 Plenary			72 76	1
2004/9 Interim			62 73	2

down selection   MBOA
1
.   MBOA

.

Ⅲ.

IEEE802. 15.3a   WPAN   Alt- PHY
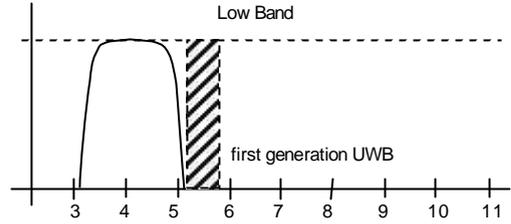UWB   ,
Intel, TI, Wisair, Staccato
MBOA   MB- OFDM
Motorola   DS- UWB   .

OFDM   MB- OFDM   DS-
CDMA   DS- UWB 2
.

1. DS- UWB

Xtremespectrum   DS- UWB
2003   12   Motorola   Xtremespectrum
Motorola   DS- UWB
.

Motorola   DS- UWB   2
,
low band   high band   .
6
.
28Mbps
1.32Gbps   8
1/2   3/4
BPSK   4BOK   . Low
band   high band

. Low band
1300~

1365MHz   , high
band
2600~2730MHz   low band   2
                        .

     . Low Band

                    (2)   3.1~4.85
GHz   28~1320Mbps
                         ,   BPSK
               L=24   L=1
     28~1320Mbps   ,
        4BOK   L=12
     L=2   110~1320
Mbps   . Low band

              <   3>   .

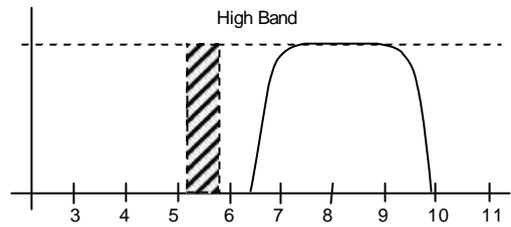   . High Band

                    (3)   6.2~9.7GHz
               55~1320Mbps
                    ,   BPSK
               L=24   L=2
55~1320Mbps   ,
        4BOK   L=12
     L=4   220~1320
Mbps   .
     High band

                              <   4>   .
     • DS-UWB

     DS-UWB   (4)
                    ,   k=6, k=4   ,
     BPSK   4-BOK   ,   ,
 ,   . BPSK
4BOK
          .   L=24
                         , BPSK   low
band   28Mbps   high band   55Mbps

(2) Low Band

<   3> Low Band

Data Rate	FEC Rate	Code Length	Range(AWGN)
28Mbps	1/2	24	29m
55Mbps	1/2	12	23m
110Mbps	1/2	6	18.3m
220Mbps	1/2	3	13m
500Mbps	3/4	2	7.3m
660Mbps	1	2	4.1m
1000Mbps	3/4	1	5.1m
1320Mbps	1	1	2.9m

(3) High Band

<   4> High Band

Data Rate	FEC Rate	Code Length	Range(AWGN)
55Mbps	1/2	24	23m
110Mbps	1/2	12	18.3m
220Mbps	1/2	6	13m
500Mbps	3/4	4	7.3m
660Mbps	1	4	4.1m
1000Mbps	3/4	2	5.1m
1320Mbps	1	2	2.9m

              . BPSK
     L=24   L=12,6,4,3,2,1
     L=24   L=12
                                        L=6

(图 4) DS- UWB 发射机框图

.
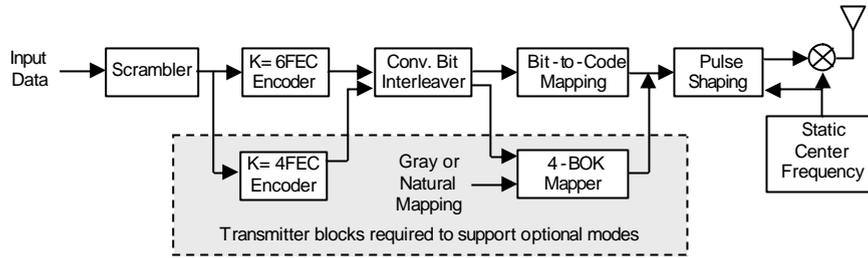
, 4- BOK
L=12 和 L=2   ,
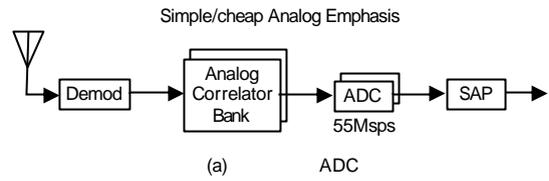2

.

DS- UWB
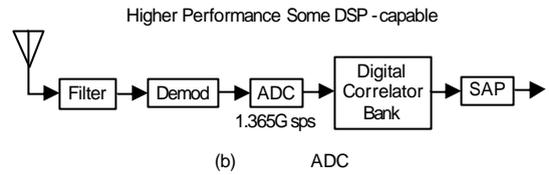,

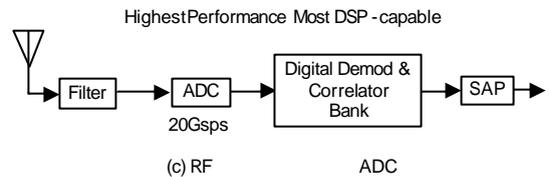BPSK   4- BOK
ternary

ternary
FIR   D/A
.   ,
D/A   D/A
LPF   LPF

.

,

2   2.7GHz   5.4GHz
D/A

.

• DS- UWB

DS- UWB   ADC
(图 5)
. (图 5) 的 (a)

Simple/cheap Analog Emphasis

(a)   ADC

Higher Performance Some DSP- capable

(b)   ADC

Highest Performance Most DSP- capable

(c) RF   ADC

(图 5) ADC

A/D
.   ,
110Mbps
2004   220Mbps
.
, (b)   ADC
1.5GHz   3   ADC
,

,
(图 6)   .
(图 6)
AGC,
,   ,
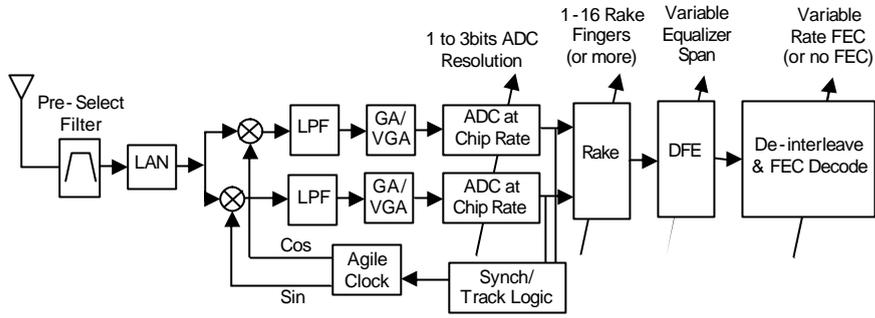
(6)   DS-UWB

(7) MB-OFDM UWB

(8) Mode 1

ETRI

, 2004   FPGA

(5) (c)   20bps   ADC

,

ADC

.

, DS-UWB   DAC ADC

2. MB-OFDM

MB-OFDM UWB   FCC
        3.1~10.6GHz   (7)
528MHz   14

:
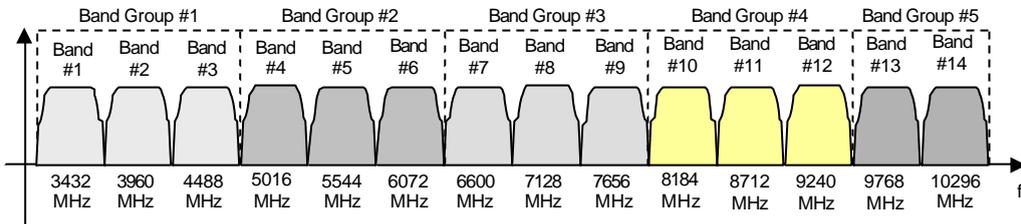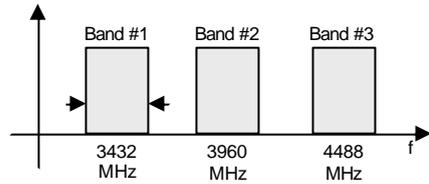
(MHz) = 2904 + 528 × nb

, nb = 1, …, 14

MB-OFDM UWB   ,   1
        (8)   1~3
mandatory mode   ,

.

. MB-OFDM UWB

MB-OFDM UWB   RF

.

$$r_{RF}(t) = \mathrm{Re}\left\{\sum_{k=0}^{N-1} r_k(t - kT_{SYM})\exp(j2\pmb{p}f_k t)\right\}$$

, Re(·)   ,
$r_k(t)$ 0~T_{SYM} k

OFDM . MB- OFDM .

UWB OFDM (8) MB- OFDM UWB < 6>

< 5> TF(Time Frequency) . 55, 110, 200MHz

, k OFDM mandatory , MB- OFDM UWB

f_k . 1

(8) Mandatory < mandatory .

5> preamble pattern 2 MB- OFDM . MB- OFDM UWB

(9)

MB- OFDM UWB

< 5> TP Codes (10) . MB- OFDM UWB

Preamble Pattern	Time Frequency Code					
1	1	2	3	1	2	3
2	1	3	2	1	3	2
3	1	1	2	2	3	4
4	1	1	3	3	2	2
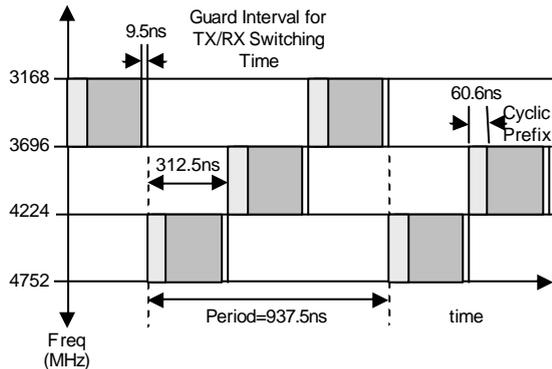
OFDM

TF

, MB- OFDM UWB ,

528MHz 480Mbps

TF

.

(9) TF MB- OFDM

IV.

2002 IEEE802.15 TG3a UWB

WPAN Alt- PHY

.

2003 7 Plenary

< 6> MB- OFDM

Info. Data Rate	55Mbps	80Mbps	110Mbps	160Mbps	200Mbps	320Mbps	480Mbps
Modulation/ Constellation	OFDM/ QPSK	OFDM/ QPSK	OFDM/ QPSK	OFDM/ QPSK	OFDM/ QPSK	OFDM/ QPSK	OFDM/ QPSK
FFT Size	128	128	128	128	128	128	128
Coding Rate(K=7)	R=11/32	R=1/2	R=11/32	R=1/2	R=5/8	R=1/2	R=3/4
Spreading Rate	4	4	2	2	2	1	1
Data Tones	100	100	100	100	100	100	100
Info. Length	242.4ns	242.4ns	242.4ns	242.4ns	242.4ns	242.4ns	242.4ns
Cyclic Prefix	60.6ns	60.6ns	60.6ns	60.6ns	60.6ns	60.6ns	60.6ns
Guard Interval	9.5ns	9.5ns	9.5ns	9.5ns	9.5ns	9.5ns	9.5ns
Symbol Length	312.5ns	312.5ns	312.5ns	312.5ns	312.5ns	312.5ns	312.5ns
Channel Bit Rate	640Mbps	640Mbps	640Mbps	640Mbps	640Mbps	640Mbps	640Mbps
Multi- path Tolerance	60.6ns	60.6ns	60.6ns	60.6ns	60.6ns	60.6ns	60.6ns

(a)

(b)
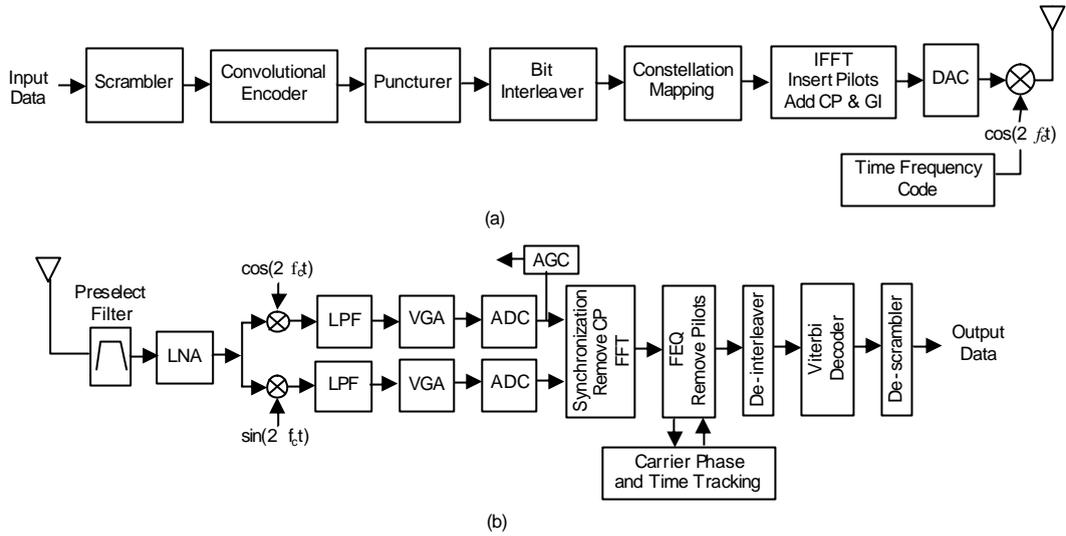
(10) MB- OFDM UWB

2004 5 Anaheim Interim MBOA MB- OFDM UWB
MB- OFDM Motorola . IEEE
DS- UWB 60 40 802.15 TG3a UWB
down selection .

2003 11 Albuquerque Plenary
Motorola . UWB
ad- hoc
MBOA
Motorola .

2004 7 Portland Plenary
Motorola DS- UWB

. MBOA
9 Berlin
Plenary
.
Motorola

, MBOA 150 MB-
OFDM
Motorola

[1] J. Foerster, E. Green, S. Somayazulu, and D. Leeper, "Ultra- Wideband Technology for Short or Medium Range Wireless Communications," *Intel Technology Journal*, Q2, 2001.

[2] Matt Welborn and Bill Shvodian "Ultra- Wideband Technology for WPAN- The IEEE802.15.3/3a Standards" UWBST Tutorial, Nov. 17, 2003.

[3] Anuj Batra et al., "Multi-band OFDM Physical Layer Proposal for IEEE802.15 Task Group 3a," IEEE802.15- 03/286r3, Mar. 2004.

[4] Matt Welborn et al., "DS- UWB Physical Layer Proposal for IEEE802.15 Task Group 3a," IEEE 802.15- 03/140r7, July 2004.