# Index

## A

Additive White Gaussian Noise  ..163
Additive White Gaussian Noise channel  ..260
ad-hoc  ..446; 463; 471; 474
admission control  ..464; 475–476; 479
  distributed admission control  ..476
Aloha  ..398; 464
  Multi-Code Spread Slotted Aloha  ..470
  slotted Aloha  ..464
ARQ  ..See Automatic Repeat on reQuest
  Automatic Repeat on reQuest  ..481
AWGN  ..See Additive White Gaussian Noise
  AWGN channel  ..See Additive White Gaussian Noise channel

## B

bandwidth  ..See energy bandwidth
  base-band  ..5; 15; 17; 27
  base-station  ..463; 479
  Bessel function  ..81
  best effort  ..475; 479
  Binary Phase Shift Keying  ..36
  bit duration  ..See bit interval
  bit interval  ..30; 38
  Bluetooth  ..460; 471–472
  Bluetooth interponet interference  ..483
  BPSK  ..See Binary Phase Shift Keying
  BTMA  ..See Busy Tone Multiple Access
  Busy Tone Multiple Access  ..468
  Dual Busy Tone Multiple Access  ..469
  Receiver Initiated BTMA  ..470

## C

Carrier Sensing Multiple Access  ..464–465
  Carrier Sensing Multiple Access with Collision Avoidance  ..466–467; 474
  CDMA  ..See Code Division Multiple Access
  cellular network  ..463; 475
  centralized wireless network  ..475
  chip interval  ..See chip time
  chip time  ..28; 36
  code assignment strategy  ..471
  common code  ..471; 481
  receiver code  ..471
  transmitter code  ..471; 481
  Code Division Multiple Access  ..368
  Frequency-Hopping CDMA  ..472
  random CDMA access  ..470
  code spectrum  ..125; 127
  code-repetition coder  ..27; 36; 38
  coherent demodulator  ..166
  common channel  ..481
  congestion  ..475
  connectivity  ..461
  continuous transmission  ..1
  control channel  ..481
  correlation receiver  ..449
  Cramer-Rao lower bound  ..429
  CRC  ..See Cyclic Redundancy Code
  cross-layer design  ..460
  CSMA  ..See Carrier Sensing Multiple Access
  CSMA-CA  ..See Carrier Sensing Multiple Access with Collision Avoidance
  Cyclic Redundancy Code  ..464
D
Data Link Control...............................460
DBTMA See Busy Tone Multiple Access
delay ...................................................461
delay .................................................479–480
delay spread ........................................275; 282
DFT ...... See Discrete Fourier Transform
DFWMAC .... See Distributed Foundation
Wireless Medium Access Control
Digital Audio Broadcasting ...............155
Direct-Sequence
Direct Sequence code ......................38
Direct-Sequence Spread Spectrum ..26;
36
Direct-Sequence UWB ..............26; 124; 382
spectrum of Direct-Sequence UWB
...................................................125–126
Discrete Fourier Transform ..........42; 146
discrete-time channel model ..........276
Distributed Foundation Wireless Medium
Access Control ......................................466
distributed positioning ..........482
dither ...............................................30
time dither .......................................26
dithering .........................................See dither
DLC.............. See Data Link Control
DSSS ......... See Direct-Sequence (Direct-
Sequence Spread Spectrum)
DS-SS-UWB .... See Direct-Sequence
(Direct-Sequence Spread Spectrum)
DS-UWB ...... See Direct-Sequence UWB

E
early-late gate synchronizer .............426
Effective Isotropic Radiated Power ...157
EIRP spectral density ......................158
EGC ............. See Equal Gain combining
EIRP ...... See Effective Isotropic Radiated
Power
emission mask ..........3; 157–158; 162; 195
FCC indoor emission mask ............159
energy bandwidth ....................1–2
minimum bandwidth ............3; 26
percent bandwidth ...............3
relative bandwidth .................3
Energy Spectral Density ...............2; 5
Equal Gain Combining...............296
ESD ........ See Energy Spectral Density
exposed terminal ......................465–467

F
fair access ...........................................See fairness
fairness ..............................................461; 478
Weighted Fair Queueing algorithm 478
FAMA .... See Floor Acquisition Multiple
Access
Fast Fourier Transform .................17
Inverse FFT ....................................69
FCFS ........ See First Come First Served
FDMA .See Frequency Division Multiple
Access
FEC ........ See Forward Error Correction
FFT ................ See Fast Fourier Transform
FH ................. See Frequency-Hopping
FH-CDMA ... See Code Division Multiple
Access (Frequency-Hopping CDMA)
FH-SS .......... See Frequency-Hopping
(Frequency-Hopping Spread
Spectrum)
field strength ..................157–158
First Come First Served ..............478
Floor Acquisition Multiple Access ....466
Forward Error Correction .............481
fractional energy bandwidth ..........2; 26
free-space attenuation ..............164
free-space propagation ...............164
Frequency Division Multiple Access ..368
Frequency-Hopping
Frequency-Hopping Spread Spectrum
...................................................27

G
Gaussian pulse ..................169; 188
combination of Gaussian pulses ...196–197
differentiation of Gaussian pulse ..190–191
second derivative of Gaussian pulse ..................................32–33; 108; 126; 188
Global Positioning System ........421; 444
differential GPS ..................................451
GPS........See Global Positioning System

H
hard decision.................................259; 269
Hermite pulse ................................189; 202
hidden terminal...........................465–467
HIPERLAN/2 .....................................155
Hop-TERRAIN ..................................443; 451

I
IDFT......See Discrete Fourier Transform
IEEE 802.11a..................................155
IEEE 802.11b .........460; 466–467
IEEE 802.15.3 ... .460; 471; 473–474; 491
IEEE 802.15.4 .................................. vi; 463
IEEE 802.15.SG3a channel model ..........242; 277; 282
impulse response of the IEEE model ....................................................278
IEEE 802.15.TG3a . 27; 40; 43; 145; 147; 152; 470
IFFT............See Fast Fourier Transform
Impulse Radio..................................26
pulsed transmission .......................1–2
Industrial Scientific and Medical radio bands ..................................460
instantaneous energy ......................1–2
Inter Symbol Interference .................41
interconnection ................................475
Inverse Discrete Fourier Transform......See Discrete Fourier Transform
IR..................See Impulse Radio
IR-UWB ..................See Impulse Radio
ISI...............See Inter Symbol Interference
ISM........See Industrial Scientific and Medical radio bands

J
jitter ........................................480
clock jitter .....................................311
time jitter ....................................243

L
Large Current Radiator antenna......187
LCR antenna. See Large Current Radiator antenna
Least Square Error ..............200; 435; 437
Line of Sight propagation .......243; 275
link budget..................................162
localization ................................421
LOS propagation . See Line of Sight propagation
LSE..................See Least Square Error

M
MA..................See Multiple Access
MAC............See Medium Access Control
MACA............See Multiple Access with Collision Avoidance
MACA-BI............See MACA-By Invitation
MACA-By Invitation..................483
MACAW ........................................483
MAGiC world .........................421; 446
MAP detector See Maximum A Posteriori detector
master..........................See master-slave
master-slave ..................................472
matched filter................................166
Maximal Ratio Combining ...............296
Maximum A Posteriori detector ..........166
Maximum Likelihood ....................166
Maximum Likelihood estimator ..........245
mb..........................See measured bandwidth
MB..........................See Multi-Band
MC-CDMA........See Multi-Carrier Code Division Multiple Access
measured bandwidth...........158; 160
Medium Access Control
MAC architecture ..............462
MAC domain ...............471–472; 474
MAC functions ..............460
MAC organization ..............464
MAC protocol ..................461
Index

MAC-ProtocolDataUnit ................ 482
time sharing ..................................464
modulating signals for PPM
generic periodic ..................74; 87–88
random .....................................74; 98
sinusoidal ..........................74; 77
monocycle .................................187
MRC ..................See Maximal Ratio Combining
Multi User Interference ... 242; 368; 375;
380; 382; 398
Multi-Band ..................27; 40; 147; 369
Multi-Band OFDM.............See OFDM
Multi-Carrier Code Division Multiple
Access ..................................26; 369
multi-channel ..........................470–471; 481
multi-code ..............See multi-channel
multi-hop
multi-hop connections ..........462
multi-path gain
total multi-path gain ...........274
multi-path UWB radio channel...273; 320
Multi Access ..................368
Multi Access with Collision
Avoidance .........................466; 469
multi-user communication ..368

N
natural sampling .....................73
NAV ..................See Network Allocation Vector
near-far .....................................479
network ....................................462
distributed network architecture vi; 463
network architecture ..............461
network module ..................461–462
network scalability ..............475
network topology ....................461
Network Allocation Vector ..........467
Network Simulator ..................461
NLOS propagation See Non Line of Sight
propagation
noise figure .........................163; 166
noise temperature ..................163
Non Line of Sight propagation ...243; 275

O
OMNeT++ .................................461
optimum detector .................166; 245
optimum receiver ..................166
optimum receiver for 2PAM ..........253
optimum receiver for 2PAM-DS ...254
optimum receiver for MPAM , 255–256
optimum receiver for multi-pulse
signals ..................................258
optimum receiver for non-orthogonal
2PPM ..................................250
optimum receiver for orthogonal
2PPM ..................................246–247
optimum receiver for orthogonal
2PPM-TH .........................248
optimum receiver for orthogonal
MPPM ..................................251
optimum receiver for orthogonal
MPPM-TH .............................252
optimum receiver for the AWGN
channel ..................................244; 266
Orthogonal Frequency Division
Multiplexing ..............26; 41; 43; 174
cyclic prefix ......................41; 146
guard interval ..................41; 43; 69; 146
Multi-Band OFDM ..................43
OFDM modulator ...................42
OFDM symbol duration ..........41; 147
spectrum of OFDM ..........145; 147–148
outage probability ..............480
out-of-band signaling ...........464; 468

P
packet collision .........................398
packet error probability ..........482
packet loss ..........................480
packet scheduling ..............464; 478
PAM ..........................See Pulse Amplitude Modulation
PAM-DS-UWB .....................38; 40
PAM-TH-UWB .....................30; 131; 134
spectrum of PAM-TH-UWB ...132; 137
PDP ..................See Power Delay Profile
piconet ..................See Power Delay Profile
piconet controller .................472
index

piconet topology ................................474–475
PN .................................. See Pseudo Noise code
PNC .................................. See piconet controller
polling .................................................472
positioning ........................................421; 446
absolute positioning ..........421; 424; 443
geographical positioning .See absolute positioning
hyperbolic positioning ..........433; 452
node-centered positioning ......421–422
relative positioning ..............421; 424
spherical positioning ..........421; 442
positioning protocol
anchor-based protocol .............442–443
anchor-free protocol ..............442
power control .........................464; 478–479
Power Delay Profile .....................276
Power Spectral Density ..............13; 27
PPM ........ See Pulse Position Modulation
PPM-TH-UWB .........................30; 105; 108
spectrum of PPM-TH-UWB ..........107
PPS ........ See Precise Positioning System
PRake .......................... See RAKE receiver
Precise Positioning System ......442
Probability of Bit Error .............166; 480
Probability of Symbol Error ......166
PSD .................. See Power Spectral Density
PSD of OFDM See Orthogonal Frequency Division Multiplexing (spectrum of OFDM)
PSD of PAM-TH-UWB .... See PAM-TH-UWB
Pseudo Noise code .................26; 28
Pseudo Noise binary-valued sequence
.....................................................36
Pseudo random code........... See Pseudo Noise code
Pulse Amplitude Modulation26; 38; 166–168
PAM modulator .........................36
pulse collision .... 376; 381; 398; 401; 404
Pulse Position Modulation ....26; 31; 167–168
analog PPM ..........................73
PPM modulator .........................28
pulse shaper .........................27; 36; 187; 195
QoS .................. See Quality of Service
QoS parameters ......................480
QPSK See Quadrature Phase Shift Keying
Quadrature Phase Shift Keying ....43
Quality of Service .................464; 475; 479
R
radio access point ..................462–463
Radio Frequencies .................27
RF notch filter .........................40; 145
RAKE receiver ..................... 242; 296; 300
Partial RAKE .......................299
Selective RAKE .....................299
random access .........................464
ranging ........................................421; 425
ranging handshake protocol ......428
Received Signal Strength Indicator ...425
relaying ........................................474
resource .......................................446
RF .................. See Radio Frequencies
root mean square delay spread . See delay spread
Round Robin .........................478
routing .........................442; 464; 461–462
RSSI .................................. See Received Signal Strength Indicator
S
Saleh-Valenzuela channel model......277
scatternet .........................472
scheduled access .......................464; 472
SD .................................. See Selection Diversity
Selection Diversity ..................296
self-organizing .......................... See ad-hoc
Self-Positioning Algorithm ........444
sensor network ......................... See ad-hoc
SGA .................................. See Standard Gaussian Approximation
shape factor .........................32; 188–189
Signal to Interference noise Ratio....378
Signal to Noise Ratio ..............163
Index

SIR See Signal to Interference noise Ratio ............................... 503
slave............................ See master-slave
SNR ............................... See Signal to Noise Ratio ............................... 258; 269
soft decision................................ 258; 269
SPA....... See Self-Positioning Algorithm
SPS ...... See Standard Positioning System
SRake ........................ See RAKE receiver
Standard Gaussian Approximation ....369; 374; 383–384; 404
limit of SGA ....................... 383; 391
Standard Positioning System ....... 442
standard temperature .................. 163
synchronization ...................... 243; 310; 312
packet synchronization ............... 310
signal acquisition ....................... 310; 313
tracking .................................. 311; 313
tracking errors ......................... 243
system margin........................... 165
system throughput ................. See throughput

T

TDMA .... See Time Division Multiple Access
temporal diversity .................... 296
text recognition ......................... 450
TH.......................... See Time-Hopping
TH code ............ See Time Hopping code
thermal noise .......................... 163; 242
THMA .......... See Time Hopping Multiple Access
throughput ......................... 461; 465; 476
TH-UWB .......... See Time-Hopping UWB
Time Division Multiple Access ....... 368
Time Hopping code ................... 31
pseudo random TH code .............. 31
Time Hopping Multiple Access ....... 369
PAM-THMA ......................... 379
PPM-THMA ......................... 371
Time Of Arrival ............... 425; 444; 447
Time-Hopping UWB .............. 26
timing error ......................... 311
TOA.......................... See Time of Arrival
traffic classes ......................... 479
transmission coder .................. 27; 36

U

Ultra Wide Band ..................... 1
broadband .......................... 9
narrowband ......................... 9
wideband ......................... 9
uniform sampling .................... 73
UWB applications .................. vi; 463
UWB network ....................... 460