

ISO/IEC 8802-11 :2005-08 (E)

Information technology_ - Telecommunications and information exchange between systems_ - Local and metropolitan area networks_ - Specific requirements_ - Part_11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) specifications

Contents

1.	Overview.....	1
1.1	Scope.....	1
1.2	Purpose.....	1
2.	Normative references.....	3
3.	Definitions	5
4.	Abbreviations and acronyms	9
5.	General description	13
5.1	General description of the architecture	13
5.1.1	How wireless LAN systems are different	13
5.1.1.1	Destination address does not equal destination location	13
5.1.1.2	The media impact the design	13
5.1.1.3	The impact of handling mobile stations.....	13
5.1.1.4	Interaction with other IEEE 802 layers.....	14
5.2	Components of the IEEE 802.11 architecture.....	14
5.2.1	The independent BSS (IBSS) as an ad hoc network.....	14
5.2.1.1	STA to BSS association is dynamic	14
5.2.2	Distribution system (DS) concepts	15
5.2.2.1	Extended service set (ESS): The large coverage network	15
5.2.3	Area concepts.....	16
5.2.4	Integration with wired LANs	18
5.3	Logical service interfaces.....	18
5.3.1	SS.....	19
5.3.2	DSS	19
5.3.3	Multiple logical address spaces	20
5.4	Overview of the services.....	21
5.4.1	Distribution of messages within a DS.....	21
5.4.1.1	Distribution	21
5.4.1.2	Integration	22
5.4.2	Services that support the distribution service	22
5.4.2.1	Mobility types	22
5.4.2.2	Association.....	22
5.4.2.3	Reassociation	23
5.4.2.4	Disassociation	23
5.4.3	Access and confidentiality control services.....	23
5.4.3.1	Authentication.....	24
5.4.3.2	Deauthentication	25
5.4.3.3	Privacy	25
5.5	Relationships between services.....	25
5.6	Differences between ESS and IBSS LANs.....	27
5.7	Message information contents that support the services.....	28
5.7.1	Data	29
5.7.2	Association.....	29
5.7.3	Reassociation	29
5.7.4	Disassociation	30
5.7.5	Privacy	30

5.7.6	Authentication.....	30
5.7.7	Deauthentication.....	31
5.8	Reference model.....	31
6.	MAC service definition.....	33
6.1	Overview of MAC services.....	33
6.1.1	Asynchronous data service.....	33
6.1.2	Security services.....	33
6.1.3	MSDU ordering.....	33
6.2	Detailed service specification.....	34
6.2.1	MAC data services.....	34
6.2.1.1	MA-UNITDATA.request.....	34
6.2.1.2	MA-UNITDATA.indication.....	35
6.2.1.3	MA-UNITDATA-STATUS.indication.....	36
7.	Frame formats.....	39
7.1	MAC frame formats.....	39
7.1.1	Conventions.....	39
7.1.2	General frame format.....	39
7.1.3	Frame fields.....	40
7.1.3.1	Frame Control field.....	40
7.1.3.2	Duration/ID field.....	43
7.1.3.3	Address fields.....	43
7.1.3.4	Sequence Control field.....	45
7.1.3.5	Frame Body field.....	45
7.1.3.6	FCS field.....	45
7.2	Format of individual frame types.....	46
7.2.1	Control frames.....	46
7.2.1.1	RTS frame format.....	46
7.2.1.2	CTS frame format.....	47
7.2.1.3	ACK frame format.....	47
7.2.1.4	PS-Poll frame format.....	47
7.2.1.5	CF-End frame format.....	48
7.2.1.6	CF-End+CF-Ack frame format.....	48
7.2.2	Data frames.....	48
7.2.3	Management frames.....	50
7.2.3.1	Beacon frame format.....	51
7.2.3.2	IBSS ATIM frame format.....	52
7.2.3.3	Disassociation frame format.....	52
7.2.3.4	Association Request frame format.....	52
7.2.3.5	Association Response frame format.....	52
7.2.3.6	Reassociation Request frame format.....	53
7.2.3.7	Reassociation Response frame format.....	53
7.2.3.8	Probe Request frame format.....	53
7.2.3.9	Probe Response frame format.....	54
7.2.3.10	Authentication frame format.....	55
7.2.3.11	Deauthentication.....	55
7.3	Management frame body components.....	56
7.3.1	Fixed fields.....	56
7.3.1.1	Authentication Algorithm Number field.....	56
7.3.1.2	Authentication Transaction Sequence Number field.....	56
7.3.1.3	Beacon Interval field.....	56

7.3.1.4	Capability Information field	56
7.3.1.5	Current AP Address field.....	58
7.3.1.6	Listen Interval field.....	59
7.3.1.7	Reason Code field.....	59
7.3.1.8	AID field	60
7.3.1.9	Status Code field	60
7.3.1.10	Timestamp field	61
7.3.2	Information elements	61
7.3.2.1	SSID element	62
7.3.2.2	Supported Rates element	62
7.3.2.3	FH Parameter Set element	63
7.3.2.4	DS Parameter Set element	63
7.3.2.5	CF Parameter Set element.....	64
7.3.2.6	TIM	64
7.3.2.7	IBSS Parameter Set element.....	65
7.3.2.8	Challenge Text element	65
7.3.2.9	Country information element.....	66
7.3.2.10	Hopping Pattern Parameters information element.....	67
7.3.2.11	Hopping Pattern Table information element	67
7.3.2.12	Request information element	68
8.	Authentication and privacy	71
8.1	Authentication services	71
8.1.1	Open System authentication	71
8.1.1.1	Open System authentication (first frame).....	71
8.1.1.2	Open System authentication (final frame).....	71
8.1.2	Shared Key authentication	72
8.1.2.1	Shared Key authentication (first frame).....	72
8.1.2.2	Shared Key authentication (second frame).....	72
8.1.2.3	Shared Key authentication (third frame)	73
8.1.2.4	Shared Key authentication (final frame).....	73
8.2	The WEP algorithm	73
8.2.1	Introduction.....	73
8.2.2	Properties of the WEP algorithm.....	74
8.2.3	WEP theory of operation	74
8.2.4	WEP algorithm specification	76
8.2.5	WEP Frame Body expansion.....	76
8.3	Security-Related MIB attributes	77
8.3.1	Authentication-Related MIB attributes.....	77
8.3.2	Privacy-Related MIB attributes	77
9.	MAC sublayer functional description.....	83
9.1	MAC architecture.....	83
9.1.1	DCF.....	83
9.1.2	PCF	83
9.1.3	Coexistence of DCF and PCF	84
9.1.4	Fragmentation/defragmentation overview	84
9.1.5	MAC data service	85
9.2	DCF	85
9.2.1	CS mechanism	86
9.2.2	MAC-Level acknowledgments	86
9.2.3	IFS.....	86

9.2.3.1	SIFS	87
9.2.3.2	PIFS	87
9.2.3.3	DIFS	88
9.2.3.4	EIFS	88
9.2.4	Random backoff time	88
9.2.5	DCF access procedure	89
9.2.5.1	Basic access	89
9.2.5.2	Backoff procedure	90
9.2.5.3	Recovery procedures and retransmit limits	91
9.2.5.4	Setting and resetting the NAV	92
9.2.5.5	Control of the channel	93
9.2.5.6	RTS/CTS usage with fragmentation	94
9.2.5.7	CTS procedure	95
9.2.6	Directed MPDU transfer procedure	95
9.2.7	Broadcast and multicast MPDU transfer procedure	96
9.2.8	ACK procedure	96
9.2.9	Duplicate detection and recovery	97
9.2.10	DCF timing relations	98
9.3	PCF	99
9.3.1	CFP structure and timing	100
9.3.2	PCF access procedure	101
9.3.2.1	Fundamental access	101
9.3.2.2	NAV operation during the CFP	102
9.3.3	PCF transfer procedure	102
9.3.3.1	PCF transfers when the PCF STA is transmitter or recipient	103
9.3.3.2	Operation with overlapping point-coordinated BSSs	104
9.3.3.3	CFPMaxDuration limit	105
9.3.3.4	CF usage rules	105
9.3.4	CF polling list	105
9.3.4.1	Polling list processing	106
9.3.4.2	Polling list update procedure	106
9.4	Fragmentation	106
9.5	Defragmentation	107
9.6	Multirate support	108
9.7	Frame exchange sequences	109
9.8	MSDU transmission restrictions	110
9.9	Operation across regulatory domains	111
9.9.1	Operation upon entering a regulatory domain	111
9.9.2	Support for FH PHYs	111
9.9.2.1	Determination of hopping patterns	111
10.	Layer management	115
10.1	Overview of management model	115
10.2	Generic management primitives	116
10.3	MLME SAP interface	116
10.3.1	Power management	117
10.3.1.1	MLME-POWERMGT.request	117
10.3.1.2	MLME-POWERMGT.confirm	117
10.3.2	Scan	118
10.3.2.1	MLME-SCAN.request	118
10.3.2.2	MLME-SCAN.confirm	119
10.3.3	Synchronization	120
10.3.3.1	MLME-JOIN.request	120

	10.3.3.2	MLME-JOIN.confirm	121
10.3.4		Authenticate	122
	10.3.4.1	MLME-AUTHENTICATE.request	122
	10.3.4.2	MLME-AUTHENTICATE.confirm	123
	10.3.4.3	MLME-AUTHENTICATE.indication	123
10.3.5		Deauthenticate	124
	10.3.5.1	MLME-DEAUTHENTICATE.request	124
	10.3.5.2	MLME-DEAUTHENTICATE.confirm	125
	10.3.5.3	MLME-DEAUTHENTICATE.indication	125
10.3.6		Associate	126
	10.3.6.1	MLME-ASSOCIATE.request	126
	10.3.6.2	MLME-ASSOCIATE.confirm	127
	10.3.6.3	MLME-ASSOCIATE.indication	127
10.3.7		Reassociate	128
	10.3.7.1	MLME-REASSOCIATE.request	128
	10.3.7.2	MLME-REASSOCIATE.confirm	129
	10.3.7.3	MLME-REASSOCIATE.indication	129
10.3.8		Disassociate	130
	10.3.8.1	MLME-DISASSOCIATE.request	130
	10.3.8.2	MLME-DISASSOCIATE.confirm	130
	10.3.8.3	MLME-DISASSOCIATE.indication	131
10.3.9		Reset	131
	10.3.9.1	MLME-RESET.request	132
	10.3.9.2	MLME-RESET.confirm	132
10.3.10		Start	133
	10.3.10.1	MLME-START.request	133
	10.3.10.2	MLME-START.confirm	134
10.4		PLME SAP interface	135
10.4.1		PLME-RESET.request	135
	10.4.1.1	Function	135
	10.4.1.2	Semantics of the service primitive	135
	10.4.1.3	When generated	135
	10.4.1.4	Effect of receipt	135
10.4.2		PLME-CHARACTERISTICS.request	135
	10.4.2.1	Function	135
	10.4.2.2	Semantics of the service primitive	135
	10.4.2.3	When generated	136
	10.4.2.4	Effect of receipt	136
10.4.3		PLME-CHARACTERISTICS.confirm	136
	10.4.3.1	Function	136
	10.4.3.2	Semantics of the service primitive	136
	10.4.3.3	When generated	138
	10.4.3.4	Effect of receipt	138
10.4.4		PLME-DSSSTESTMODE.request	138
	10.4.4.1	Function	138
	10.4.4.2	Semantics of the service primitive	138
	10.4.4.3	When generated	139
	10.4.4.4	Effect of receipt	139
10.4.5		PLME-DSSSTESTOUTPUT.request	139
	10.4.5.1	Function	139
	10.4.5.2	Semantics of the service primitive	139
	10.4.5.3	When generated	139
	10.4.5.4	Effect of receipt	139

10.4.6	PLME-TXTIME.request.....	140
10.4.6.1	Function	140
10.4.6.2	Semantics of the service primitive.....	140
10.4.6.3	When generated	140
10.4.6.4	Effect of receipt	140
10.4.7	PLME-TXTIME.confirm.....	140
10.4.7.1	Function	140
10.4.7.2	Semantics of the service primitive.....	140
10.4.7.3	When generated	140
10.4.7.4	Effect of receipt	140
11.	MLME	141
11.1	Synchronization	141
11.1.1	Basic approach.....	141
11.1.1.1	TSF for infrastructure networks.....	141
11.1.1.2	TSF for an IBSS.....	141
11.1.2	Maintaining synchronization	141
11.1.2.1	Beacon generation in infrastructure networks	141
11.1.2.2	Beacon generation in an IBSS	142
11.1.2.3	Beacon reception.....	142
11.1.2.4	TSF timer accuracy.....	143
11.1.3	Acquiring synchronization, scanning	143
11.1.3.1	Passive scanning	144
11.1.3.2	Active scanning.....	144
11.1.3.3	Initializing a BSS.....	145
11.1.3.4	Synchronizing with a BSS	145
11.1.4	Adjusting STA timers	146
11.1.5	Timing synchronization for FH PHYs.....	146
11.2	Power management	146
11.2.1	Power management in an infrastructure network	146
11.2.1.1	STA Power Management modes	147
11.2.1.2	AP TIM transmissions	148
11.2.1.3	TIM types.....	148
11.2.1.4	AP operation during the CP	149
11.2.1.5	AP operation during the CFP.....	149
11.2.1.6	Receive operation for STAs in PS mode during the CP	150
11.2.1.7	Receive operation for STAs in PS mode during the CFP.....	150
11.2.1.8	STAs operating in the Active mode.....	151
11.2.1.9	AP aging function	151
11.2.2	Power management in an IBSS	151
11.2.2.1	Basic approach.....	151
11.2.2.2	Initialization of power management within an IBSS.....	153
11.2.2.3	STA power state transitions	153
11.2.2.4	ATIM and frame transmission.....	153
11.3	Association and reassociation	154
11.3.1	STA association procedures.....	154
11.3.2	AP association procedures	154
11.3.3	STA reassociation procedures	155
11.3.4	AP reassociation procedures.....	155
11.4	MIB definitions	155

12.	PHY service specification.....	157
12.1	Scope.....	157
12.2	PHY functions.....	157
12.3	Detailed PHY service specifications.....	157
12.3.1	Scope and field of application	157
12.3.2	Overview of the service	157
12.3.3	Overview of interactions.....	157
12.3.4	Basic service and options.....	157
12.3.4.1	PHY-SAP peer-to-peer service primitives.....	158
12.3.4.2	PHY-SAP sublayer-to-sublayer service primitives	158
12.3.4.3	PHY-SAP service primitives parameters.....	158
12.3.4.4	Vector descriptions	159
12.3.5	PHY-SAP detailed service specification	159
12.3.5.1	PHY-DATA.request	159
12.3.5.2	PHY-DATA.indication	159
12.3.5.3	PHY-DATA.confirm	160
12.3.5.4	PHY-TXSTART.request.....	160
12.3.5.5	PHY-TXSTART.confirm	161
12.3.5.6	PHY-TXEND.request.....	161
12.3.5.7	PHY-TXEND.confirm.....	162
12.3.5.8	PHY-CCARESET.request	162
12.3.5.9	PHY-CCARESET.confirm	163
12.3.5.10	PHY-CCA.indication.....	163
12.3.5.11	PHY-RXSTART.indication.....	164
12.3.5.12	PHY-RXEND.indication	164
13.	PHY management.....	167
14.	Frequency-Hopping spread spectrum (FHSS) PHY specification for the 2.4 GHz industrial, scientific, and medical (ISM) band	169
14.1	Overview.....	169
14.1.1	Overview of FHSS PHY.....	169
14.1.2	FHSS PHY functions.....	169
14.1.2.1	PLCP sublayer	169
14.1.2.2	PLME.....	169
14.1.2.3	PMD sublayer	169
14.1.3	Service specification method and notation	169
14.2	FHSS PHY-specific service parameter lists.....	170
14.2.1	Overview.....	170
14.2.2	TXVECTOR parameters.....	170
14.2.2.1	TXVECTOR LENGTH.....	170
14.2.2.2	TXVECTOR DATARATE.....	170
14.2.3	RXVECTOR parameters	170
14.2.3.1	TRXVECTOR LENGTH	171
14.2.3.2	RXVECTOR RSSI	171
14.3	FHSS PLCP sublayer	171
14.3.1	Overview.....	171
14.3.1.1	State diagram notation	171
14.3.2	PLCP frame format.....	172
14.3.2.1	PLCP Preamble.....	173
14.3.2.2	PLCP Header field.....	173
14.3.2.3	PLCP data whitener	174

14.3.3	PLCP state machines	175
14.3.3.1	Transmit PLCP	175
14.3.3.2	CS/CCA procedure	178
14.3.3.3	Receive PLCP	181
14.4	PLME SAP layer management	184
14.4.1	Overview	184
14.4.2	FH PHY specific MLME procedures	184
14.4.2.1	Overview	184
14.4.2.2	FH synchronization	184
14.4.3	FH PLME state machines	184
14.4.3.1	Overview	184
14.4.3.2	PLME state machine	184
14.4.3.3	PLME management primitives	186
14.5	FHSS PMD sublayer services	187
14.5.1	Scope and field of application	187
14.5.2	Overview of services	187
14.5.3	Overview of interactions	187
14.5.4	Basic service and options	187
14.5.4.1	PMD_SAP peer-to-peer service primitives	187
14.5.4.2	PMD_SAP sublayer-to-sublayer service primitives	188
14.5.4.3	PMD_SAP service primitives parameters	188
14.5.5	PMD_SAP detailed service specification	188
14.5.5.1	PMD_DATA.request	188
14.5.5.2	PMD_DATA.indicate	189
14.5.5.3	PMD_TXRX.request	189
14.5.5.4	PMD_PA_RAMP.request	190
14.5.5.5	PMD_ANTSEL.request	190
14.5.5.6	PMD_TXPWRLVL.request	191
14.5.5.7	PMD_FREQ.request	192
14.5.5.8	PMD_RSSI.indicate	192
14.5.5.9	PMD_PWRMGMT.request	193
14.6	FHSS PMD sublayer, 1.0 Mbit/s	193
14.6.1	1 Mbit/s PMD operating specifications, general	193
14.6.2	Regulatory requirements	193
14.6.3	Operating frequency range	194
14.6.4	Number of operating channels	195
14.6.5	Operating channel center frequency	195
14.6.6	Occupied channel bandwidth	197
14.6.7	Minimum hop rate	197
14.6.8	Hop sequences	198
14.6.9	Unwanted emissions	200
14.6.10	Modulation	200
14.6.11	Channel data rate	201
14.6.12	Channel switching/settling time	201
14.6.13	Receive to transmit switch time	201
14.6.14	PMD transmit specifications	202
14.6.14.1	Nominal transmit power	202
14.6.14.2	Transmit power levels	202
14.6.14.3	Transmit power level control	202
14.6.14.4	Transmit spectrum shape	202
14.6.14.5	Transmit center frequency tolerance	203
14.6.14.6	Transmitter ramp periods	203
14.6.15	PMD receiver specifications	203
14.6.15.1	Input signal range	203

	14.6.15.2 Receive center frequency acceptance range	203
	14.6.15.3 CCA power threshold	203
	14.6.15.4 Receiver sensitivity	203
	14.6.15.5 Intermodulation	204
	14.6.15.6 Desensitization (Dp)	204
	14.6.15.7 Receiver radiation	204
	14.6.16 Operating temperature range	204
14.7	FHSS PMD sublayer, 2.0 Mbit/s	204
	14.7.1 Overview	204
	14.7.2 4GFSK modulation	205
	14.7.2.1 Frame structure for HS FHSS PHY	206
	14.7.3 Channel data rate	206
	14.7.3.1 Input dynamic range	206
	14.7.3.2 Receiver sensitivity	207
	14.7.3.3 IMp	207
	14.7.3.4 Dp	207
14.8	FHSS PHY MIB	207
	14.8.1 FH PHY attributes	207
	14.8.2 FH PHY attribute definitions	209
	14.8.2.1 dot11PHYType	209
	14.8.2.2 dot11RegDomainsSupported	209
	14.8.2.3 dot11CurrentRegDomain	209
	14.8.2.4 dot11TempType	210
	14.8.2.5 dot11CurrentPowerState	210
	14.8.2.6 dot11SupportedDataRatesTX	210
	14.8.2.7 dot11SupportedDataRatesRX	210
	14.8.2.8 aMPDUMaxLength	210
	14.8.2.9 dot11SupportedTxAntennas	211
	14.8.2.10 dot11CurrentTxAntenna	211
	14.8.2.11 dot11SupportedRxAntenna	211
	14.8.2.12 dot11DiversitySupport	211
	14.8.2.13 dot11DiversitySelectionRx	212
	14.8.2.14 dot11NumberSupportedPowerLevels	212
	14.8.2.15 dot11TxPowerLevel1-8	212
	14.8.2.16 dot11CurrentTxPowerLevel	212
	14.8.2.17 dot11HopTime	213
	14.8.2.18 dot11CurrentChannelNumber	213
	14.8.2.19 dot11MaxDwellTime	213
	14.8.2.20 dot11CurrentSet	213
	14.8.2.21 dot11CurrentPattern	213
	14.8.2.22 dot11CurrentIndex	213
	14.8.2.23 dot11CurrentPowerState	214
14.9	FH PHY characteristics	214
15.	DSSS PHY specification for the 2.4 GHz band designated for ISM applications	217
	15.1 Overview	217
	15.1.1 Scope	217
	15.1.2 DSSS PHY functions	217
	15.1.2.1 PLCP sublayer	217
	15.1.2.2 PMD sublayer	217
	15.1.2.3 PLME	217
	15.1.3 Service specification method and notation	218
15.2	DSSS PLCP sublayer	218

15.2.1	Overview.....	218
15.2.2	PLCP frame format.....	218
15.2.3	PLCP field definitions	218
15.2.3.1	PLCP SYNC field.....	218
15.2.3.2	PLCP SFD.....	219
15.2.3.3	PLCP IEEE 802.11 SIGNAL field	219
15.2.3.4	PLCP IEEE 802.11 SERVICE field	219
15.2.3.5	PLCP LENGTH field.....	219
15.2.3.6	PLCP CRC field.....	219
15.2.4	PLCP/DSSS PHY data scrambler and descrambler	221
15.2.5	PLCP data modulation and modulation rate change.....	221
15.2.6	Transmit PLCP	221
15.2.7	Receive PLCP	222
15.3	DSSS PLME	225
15.3.1	PLME_SAP sublayer management primitives	225
15.3.2	DSSS PHY MIB	226
15.3.3	DS PHY characteristics	227
15.4	DSSS PMD sublayer.....	227
15.4.1	Scope and field of application	227
15.4.2	Overview of service	228
15.4.3	Overview of interactions.....	228
15.4.4	Basic service and options.....	228
15.4.4.1	PMD_SAP peer-to-peer service primitives	228
15.4.4.2	PMD_SAP peer-to-peer service primitive parameters	229
15.4.4.3	PMD_SAP sublayer-to-sublayer service primitives	229
15.4.4.4	PMD_SAP service primitive parameters.....	229
15.4.5	PMD_SAP detailed service specification	230
15.4.5.1	PMD_DATA.request	230
15.4.5.2	PMD_DATA.indicate	231
15.4.5.3	PMD_TXSTART.request	231
15.4.5.4	PMD_TXEND.request.....	232
15.4.5.5	PMD_ANTSEL.request.....	232
15.4.5.6	PMD_ANTSEL.indicate.....	232
15.4.5.7	PMD_TXPWRLVL.request	233
15.4.5.8	PMD_RATE.request.....	233
15.4.5.9	PMD_RATE.indicate.....	234
15.4.5.10	PMD_RSSI.indicate.....	234
15.4.5.11	PMD_SQ.indicate	235
15.4.5.12	PMD_CS.indicate	235
15.4.5.13	PMD_ED.indicate.....	236
15.4.5.14	PMD_ED.request.....	236
15.4.5.15	PHY-CCA.indicate	237
15.4.6	PMD operating specifications, general.....	237
15.4.6.1	Operating frequency range.....	237
15.4.6.2	Number of operating channels	238
15.4.6.3	Spreading sequence.....	238
15.4.6.4	Modulation and channel data rates	239
15.4.6.5	Transmit and receive in-band and out-of-band spurious emissions	239
15.4.6.6	TX-to-RX turnaround time	239
15.4.6.7	RX-to-TX turnaround time	239
15.4.6.8	Slot time.....	240
15.4.6.9	Transmit and receive antenna port impedance	240
15.4.6.10	Transmit and receive operating temperature range.....	240

15.4.7	PMD transmit specifications.....	240
15.4.7.1	Transmit power levels.....	240
15.4.7.2	Minimum transmitted power level.....	240
15.4.7.3	Transmit power level control.....	240
15.4.7.4	Transmit spectrum mask.....	240
15.4.7.5	Transmit center frequency tolerance.....	241
15.4.7.6	Chip clock frequency tolerance.....	241
15.4.7.7	Transmit power-on and power-down ramp.....	241
15.4.7.8	RF carrier suppression.....	242
15.4.7.9	Transmit modulation accuracy.....	242
15.4.8	PMD receiver specifications.....	244
15.4.8.1	Receiver minimum input level sensitivity.....	244
15.4.8.2	Receiver maximum input level.....	244
15.4.8.3	Receiver adjacent channel rejection.....	244
15.4.8.4	CCA.....	245
16.	Infrared (IR) PHY specification.....	247
16.1	Overview.....	247
16.1.1	Scope.....	248
16.1.2	IR PHY functions.....	248
16.1.2.1	PLCP sublayer.....	248
16.1.2.2	PMD sublayer.....	248
16.1.2.3	PLME.....	248
16.1.3	Service specification method and notation.....	248
16.2	IR PLCP sublayer.....	249
16.2.1	Overview.....	249
16.2.2	PLCP frame format.....	249
16.2.3	PLCP modulation and rate change.....	249
16.2.4	PLCP field definitions.....	250
16.2.4.1	PLCP SYNC field.....	250
16.2.4.2	PLCP SFD field.....	250
16.2.4.3	PLCP DR field.....	250
16.2.4.4	PLCP DCLA field.....	250
16.2.4.5	PLCP LENGTH field.....	251
16.2.4.6	PLCP CRC field.....	251
16.2.4.7	PSDU field.....	251
16.2.5	PLCPs.....	251
16.2.5.1	Transmit PLCP.....	251
16.2.5.2	Receive PLCP.....	252
16.2.5.3	CCA procedure.....	252
16.2.5.4	PMD_SAP peer-to-peer service primitive parameters.....	252
16.3	IR PMD sublayer.....	253
16.3.1	Overview.....	253
16.3.2	PMD operating specifications, general.....	253
16.3.2.1	Modulation and channel data rates.....	253
16.3.2.2	Octet partition and PPM symbol generation procedure.....	254
16.3.2.3	Operating environment.....	254
16.3.2.4	Operating temperature range.....	255
16.3.3	PMD transmit specifications.....	255
16.3.3.1	Transmitted peak optical power.....	255
16.3.3.2	Basic pulse shape and parameters.....	255
16.3.3.3	Emitter radiation pattern mask.....	256
16.3.3.4	Optical emitter peak wavelength.....	258

16.3.3.5	Transmit spectrum mask	258
16.3.4	PMD receiver specifications	258
16.3.4.1	Receiver sensitivity	258
16.3.4.2	Receiver dynamic range	259
16.3.4.3	Receiver field of view (FOV)	259
16.3.5	ED, CS, and CCA definitions	259
16.3.5.1	ED signal	259
16.3.5.2	CS signal	259
16.3.5.3	CCA	260
16.3.5.4	CHNL_ID	260
16.4	PHY attributes	260
17.	Orthogonal frequency division multiplexing (OFDM) PHY specification for the 5 GHz band	263
17.1	Introduction	263
17.1.1	Scope	263
17.1.2	OFDM PHY functions	263
17.1.2.1	PLCP sublayer	263
17.1.2.2	PMD sublayer	263
17.1.2.3	PLME	263
17.1.2.4	Service specification method	264
17.2	OFDM PHY specific service parameter list	264
17.2.1	Introduction	264
17.2.2	TXVECTOR parameters	264
17.2.2.1	TXVECTOR LENGTH	264
17.2.2.2	TXVECTOR DATARATE	265
17.2.2.3	TXVECTOR SERVICE	265
17.2.2.4	TXVECTOR TXPWR_LEVEL	265
17.2.3	RXVECTOR parameters	265
17.2.3.1	RXVECTOR LENGTH	265
17.2.3.2	RXVECTOR RSSI	265
17.2.3.3	DATARATE	266
17.2.3.4	SERVICE	266
17.3	OFDM PLCP sublayer	266
17.3.1	Introduction	266
17.3.2	PLCP frame format	266
17.3.2.1	Overview of the PPDU encoding process	266
17.3.2.2	RATE-dependent parameters	268
17.3.2.3	Timing related parameters	268
17.3.2.4	Mathematical conventions in the signal descriptions	269
17.3.2.5	Discrete time implementation considerations	270
17.3.3	PLCP preamble (SYNC)	271
17.3.4	SIGNAL field	272
17.3.4.1	RATE field	273
17.3.4.2	PLCP LENGTH field	273
17.3.4.3	Parity (P), Reserved (R), and SIGNAL TAIL fields	274
17.3.5	DATA field	274
17.3.5.1	SERVICE field	274
17.3.5.2	PPDU TAIL field	274
17.3.5.3	Pad bits (PAD)	274
17.3.5.4	PLCP DATA scrambler and descrambler	275
17.3.5.5	Convolutional encoder	275
17.3.5.6	Data interleaving	276
17.3.5.7	Subcarrier modulation mapping	278

	17.3.5.8	Pilot subcarriers	281
	17.3.5.9	OFDM modulation.....	281
17.3.6		CCA	282
17.3.7		PLCP data modulation and modulation rate change.....	282
17.3.8		PMD operating specifications (general)	283
	17.3.8.1	Outline description.....	283
	17.3.8.2	Regulatory requirements.....	284
	17.3.8.3	Operating channel frequencies.....	284
	17.3.8.4	Transmit and receive in-band and out-of-band spurious emissions	285
	17.3.8.5	TX RF delay.....	285
	17.3.8.6	Slot time	286
	17.3.8.7	Transmit and receive antenna port impedance	286
	17.3.8.8	Transmit and receive operating temperature range.....	286
17.3.9		PMD transmit specifications.....	286
	17.3.9.1	Transmit power levels.....	286
	17.3.9.2	Transmit spectrum mask.....	287
	17.3.9.3	Transmission spurious	287
	17.3.9.4	Transmit center frequency tolerance.....	287
	17.3.9.5	Symbol clock frequency tolerance.....	287
	17.3.9.6	Modulation accuracy.....	288
	17.3.9.7	Transmit modulation accuracy test	288
17.3.10		PMD receiver specifications	289
	17.3.10.1	Receiver minimum input level sensitivity	289
	17.3.10.2	Adjacent channel rejection.....	290
	17.3.10.3	Nonadjacent channel rejection.....	290
	17.3.10.4	Receiver maximum input level	291
	17.3.10.5	CCA sensitivity.....	291
17.3.11		Transmit PLCP	291
17.3.12		Receive PLCP	293
17.4		OFDM PLME	295
	17.4.1	PLME_SAP sublayer management primitives	295
	17.4.2	OFDM PHY MIB	295
	17.4.3	OFDM TXTIME calculation	297
	17.4.4	OFDM PHY characteristics	298
17.5		OFDM PMD sublayer.....	299
	17.5.1	Scope and field of application	299
	17.5.2	Overview of service	299
	17.5.3	Overview of interactions.....	299
	17.5.4	Basic service and options.....	299
	17.5.4.1	PMD_SAP peer-to-peer service primitives	299
	17.5.4.2	PMD_SAP sublayer-to-sublayer service primitives	300
	17.5.4.3	PMD_SAP service primitive parameters	300
17.5.5		PMD_SAP detailed service specification	300
	17.5.5.1	PMD_DATA.request	301
	17.5.5.2	PMD_DATA.indicate	301
	17.5.5.3	PMD_TXSTART.request	302
	17.5.5.4	PMD_TXEND.request.....	302
	17.5.5.5	PMD_TXPWRLVL.request	302
	17.5.5.6	PMD_RATE.request.....	303
	17.5.5.7	PMD_RSSI.indicate.....	303

18.	High Rate direct sequence spread spectrum (HR/DSSS) PHY specification	305
18.1	Overview	305
18.1.1	Scope	305
18.1.2	High Rate PHY functions	305
18.1.2.1	PLCP sublayer	306
18.1.2.2	PMD sublayer	306
18.1.2.3	PLME	306
18.1.3	Service specification method and notation	306
18.2	High Rate PLCP sublayer	306
18.2.1	Overview	306
18.2.2	PPDU format	306
18.2.2.1	Long PPDU format	307
18.2.2.2	Short PPDU format (optional)	307
18.2.3	PPDU field definitions	307
18.2.3.1	Long PLCP SYNC field	308
18.2.3.2	Long PLCP SFD	308
18.2.3.3	Long PLCP SIGNAL field	308
18.2.3.4	Long PLCP SERVICE field	309
18.2.3.5	Long PLCP LENGTH field	309
18.2.3.6	PLCP CRC (CRC-16) field	311
18.2.3.7	Long PLCP data modulation and modulation rate change	313
18.2.3.8	Short PLCP synchronization (shortSYNC)	313
18.2.3.9	Short PLCP SFD field (shortSFD)	313
18.2.3.10	Short PLCP SIGNAL field (shortSIGNAL)	314
18.2.3.11	Short PLCP SERVICE field (shortSERVICE)	314
18.2.3.12	Short PLCP LENGTH field (shortLENGTH)	314
18.2.3.13	Short CRC-16 field (shortCRC)	314
18.2.3.14	Short PLCP data modulation and modulation rate change	314
18.2.4	PLCP/High Rate PHY data scrambler and descrambler	314
18.2.5	Transmit PLCP	315
18.2.6	Receive PLCP	317
18.3	High Rate PLME	320
18.3.1	PLME_SAP sublayer management primitives	320
18.3.2	High Rate PHY MIB	321
18.3.3	DS PHY characteristics	322
18.3.4	High Rate TXTIME calculation	323
18.3.5	Vector descriptions	323
18.4	High Rate PMD sublayer	324
18.4.1	Scope and field of application	324
18.4.2	Overview of service	324
18.4.3	Overview of interactions	324
18.4.4	Basic service and options	324
18.4.4.1	PMD_SAP peer-to-peer service primitives	325
18.4.4.2	PMD_SAP sublayer-to-sublayer service primitives	325
18.4.5	PMD_SAP detailed service specification	325
18.4.5.1	PMD_DATA.request	325
18.4.5.2	PMD_DATA.indicate	326
18.4.5.3	PMD_MODULATION.request	327
18.4.5.4	PMD_PREAMBLE.request	327
18.4.5.5	PMD_PREAMBLE.indicate	328
18.4.5.6	PMD_TXSTART.request	328
18.4.5.7	PMD_TXEND.request	329
18.4.5.8	PMD_ANTSEL.request	329

18.4.5.9	PMD_TXPWRLVL.request	330
18.4.5.10	PMD_RATE.request	330
18.4.5.11	PMD_RSSI.indicate	331
18.4.5.12	PMD_SQ.indicate	332
18.4.5.13	PMD_CS.indicate	332
18.4.5.14	PMD_ED.indicate	333
18.4.5.15	PMD_ED.request	334
18.4.6	PMD operating specifications, general	334
18.4.6.1	Operating frequency range	334
18.4.6.2	Number of operating channels	335
18.4.6.3	Modulation and channel data rates	336
18.4.6.4	Spreading sequence and modulation for 1 and 2 Mbit/s	336
18.4.6.5	Spreading sequences and modulation for CCK modulation at 5.5 Mbit/s and 11 Mbit/s	336
18.4.6.6	DSSS/PBCC data modulation and modulation rate (optional)	338
18.4.6.7	Channel Agility (optional)	341
18.4.6.8	Transmit and receive in-band and out-of-band spurious emissions	344
18.4.6.9	TX-to-RX turnaround time	344
18.4.6.10	RX-to-TX turnaround time	344
18.4.6.11	Slot time	344
18.4.6.12	Channel switching/settling time	344
18.4.6.13	Transmit and receive antenna port impedance	344
18.4.6.14	Transmit and receive operating temperature range	344
18.4.7	PMD transmit specifications	344
18.4.7.1	Transmit power levels	345
18.4.7.2	Transmit power level control	345
18.4.7.3	Transmit spectrum mask	345
18.4.7.4	Transmit center frequency tolerance	346
18.4.7.5	Chip clock frequency tolerance	346
18.4.7.6	Transmit power-on and power-down ramp	346
18.4.7.7	RF carrier suppression	346
18.4.7.8	Transmit modulation accuracy	347
18.4.8	PMD receiver specifications	350
18.4.8.1	Receiver minimum input level sensitivity	350
18.4.8.2	Receiver maximum input level	350
18.4.8.3	Receiver adjacent channel rejection	350
18.4.8.4	CCA	350

Annex A (normative) Protocol Implementation Conformance Statement (PICS) proforma	353
---	-----

A.1	Introduction	353
A.2	Abbreviations and special symbols	353
A.2.1	Symbols for Status column	353
A.2.2	General abbreviations for Item and Support columns	353
A.3	Instructions for completing the PICS proforma	354
A.3.1	General structure of the PICS proforma	354
A.3.2	Additional information	354
A.3.3	Exception information	354
A.3.4	Conditional status	355
A.4	PICS proforma—IEEE Std 802.11, 2003 Edition	356
A.4.1	Implementation identification	356
A.4.2	Protocol summary	356
A.4.4	MAC protocol	357
A.4.3	IUT configuration	357

A.4.5	Frequency hopping (FH) PHY functions.....	362
A.4.6	Direct sequence PHY functions.....	364
A.4.7	IR baseband PHY functions.....	367
A.4.8	OFDM PHY functions.....	370
A.4.9	High Rate, direct sequence PHY functions.....	374
A.4.10	Regulatory Domain Extensions.....	379
Annex B (informative)	Hopping sequences.....	381
Annex C (normative)	Formal description of MAC operation.....	395
C.1	Introduction to the MAC formal description.....	398
C.1.1	Fundamental assumptions.....	398
C.1.2	Notation conventions.....	398
C.1.3	Modeling techniques.....	399
C.2	Data type and operator definitions for the MAC state machines.....	400
C.3	State machines for MAC stations.....	449
C.4	State machines for MAC AP.....	525
Annex D (normative)	ASN.1 encoding of the MAC and PHY MIB.....	595
Annex E (informative)	Bibliography.....	647
E.1	General.....	647
E.2	Specification and description language (SDL) documentation.....	648
Annex F (informative)	High Rate PHY/FH interoperability.....	649
F.1	Additional CCA recommendations.....	649
Annex G (informative)	An example of encoding a frame for OFDM PHY.....	651
G.1	Introduction.....	651
G.2	The message.....	651
G.3	Generation of the preamble.....	653
G.3.1	Generation of the short sequences.....	653
G.3.2	Generation of the long sequences.....	656
G.4	Generation of the SIGNAL field.....	658
G.4.1	SIGNAL field bit assignment.....	658
G.4.2	Coding the SIGNAL field bits.....	658
G.4.3	Interleaving the SIGNAL field bits.....	658
G.4.4	SIGNAL field frequency domain.....	659
G.4.5	SIGNAL field time domain.....	661
G.5	Generating the DATA bits.....	662
G.5.1	Delineating, SERVICE field prepending, and zero padding.....	662
G.5.2	Scrambling.....	663
G.6	Generating the first DATA symbol.....	666
G.6.1	Coding the DATA bits.....	666
G.6.2	Interleaving the DATA bits.....	667
G.6.3	Mapping into symbols.....	670
G.7	Generating the additional DATA symbols.....	671
G.8	The entire packet.....	672