

Physical Layer

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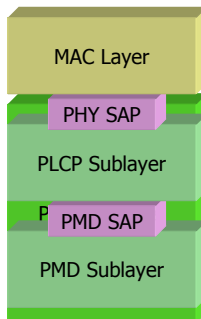
1

Outline

- Physical Layer Architecture
- Physical Layer Operations
- IEEE 802.11 Physical Layer
 - FHSS
 - DSSS
 - IR

2

Physical Layer Architecture



3

PLCP Sublayer

- Physical Layer Convergence Procedure
- Communicate to MAC via primitives through Physical Layer Service Access Point (SAP)
- Prepare PLCP protocol data unit (PPDU) (append fields to MPDU)
- PPDU provides for asynchronous transfer of MPDU between stations

4

PMD Sublayer

- Physical Medium Dependent
- Provide actual transmission and reception of Physical Layer entities via wireless medium
- Interface directly to the medium
- Provides modulation and demodulation of the transmission frame

5

Physical Layer Operations

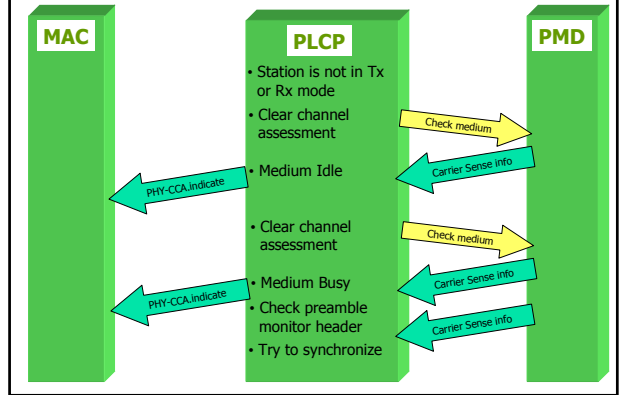
- 3 State machines
 - Carrier Senses: determine the state of the medium
 - Transmit: send the data frame
 - Receive: receive the data frame

6

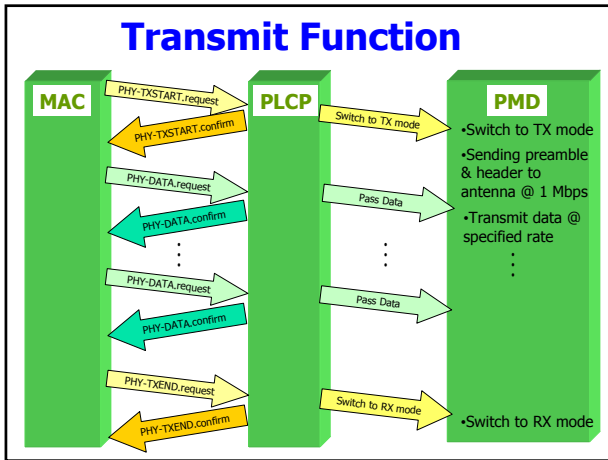
Physical Layer Service Primitives

MAC → PLCP	PLCP → MAC	Description
	PHY-CCA.indication	(busy/idle : send every channel changes state)
PHY-TXSTART.request	PHY-TXSTART.confirm	Start TX
PHY-DATA.request	PHY-DATA.confirm	Transfer Data
PHY-TXEND.request	PHY-TXEND.confirm	End TX
PHY-CCARESET.request	PHY-CCARESET.confirm	Reset Clear Channel Assessment state machine
	PHY-DATA.indication	Transfer Data
	PHY-RXSTART.indication	Received a valid start frame/PLCP header
	PHY-RXEND.indication	

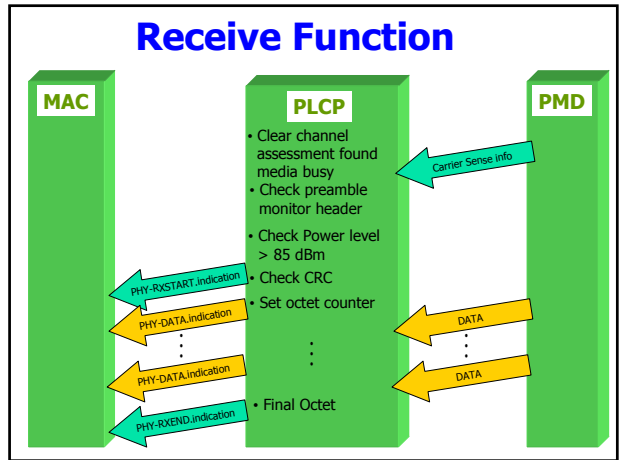
Carrier Sense Function



Transmit Function



Receive Function



Multiple Antenna Diversities

- Receive function will operate with
 - Single Antenna
 - Multiple Antennas
- Signal Degradation Factors
 - Distance
 - Atmosphere
 - Barrier
- Multiple-path propagation
 - Decrease the signal strength
 - Use multiple antennas (diversity) to improve the received signal

IEEE 802.11 PHY Layer

- FHSS Physical Layer
- DSSS Physical Layer
- Infrared (IR) Physical Layer

FHSS Physical Layer

- Lowest cost
- Lowest power consumption
- Most tolerant to noise
- Lowest potential data rate
- Medium range (< DSSS)

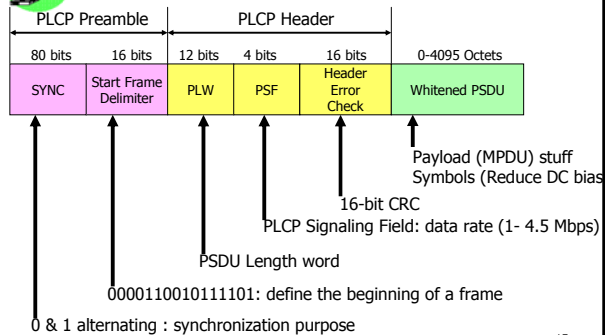
13

FHSS Architecture

- FHSS PLCP Sublayer
- PHSS PMD Sublayer
- Primitives

14

FHSS PLCP frame



15

FHSS PMD

- Perform actual Tx/Rx of PPDU
- Provides FHSS modulation/demodulation

16

FHSS PMD Service Primitives

PLCP → PMD	PMD → PLCP	Description
PMD_DATA.request	PMD_DATA.indicate	Transfer Data
PMD_TXRX.request		Set Tx/Rx mode
PMD_PA_RAMP.request		Set Ramp up/down Tx power
PMD_ANTSEL.request		Select antenna (1..N)
PMD_PWRMGMT.request		Put radio in sleep mode
PMD_TXPWRLVL.request		Select power level
PMD_FREQ.request		Tx Freq (channel ID)
	PMD_RSSI.indication	Signal Strength (0-15)

17

DSSS Physical Layer

- Highest cost
- Highest power consumption
- Highest potential data rate
- More range

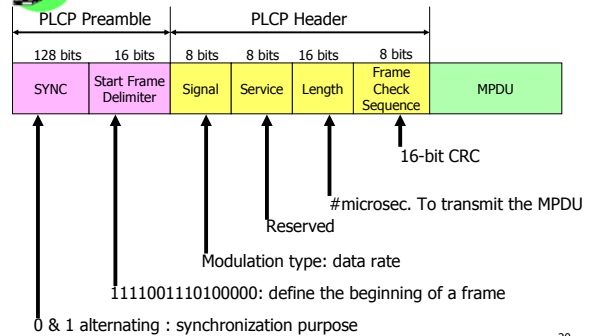
18

DSSS Architecture

- DSSS PLCP Sublayer
- DSSS PMD Sublayer
- Primitives

19

DSSS PLCP frame



20

DSSS PMD

- Perform actual Tx/Rx of PPDU
- Provides DSSS modulation/demodulation

21

DSSS PMD Service Primitives

PLCP → PMD	PMD → PLCP	Description
PMD_DATA.request	PMD_DATA.indicate	Transfer Data
PMD_TXSTART.request PMD_TXEND.request PMD_TXPWRLVL.request		Start Tx End Tx Select power level
PMD_ANTSEL.request	PMD_ANTSEL.indicate	Select antenna (1..N)
PMD_RATE.request	PMD_RATE.indicate	Select data rate
PMD_ED.request	PMD_ED.indicate	Energy > Threshold
	PMD_RSSI.indication PMD_SQ.indication PMD_CS.indication PMD_CAA.indication	Signal Strength (0-15) Signal Quality (PN code) Valid 802.11 DS Detect RF as CCA algo.

IR Physical Layer

- Lowest cost
- Highest tolerant to RF noise → example !
- Lowest range
- Need ceiling
- More secure
- No frequency regulating
- No product ?
- IrDA: Infrared Data Association Standard

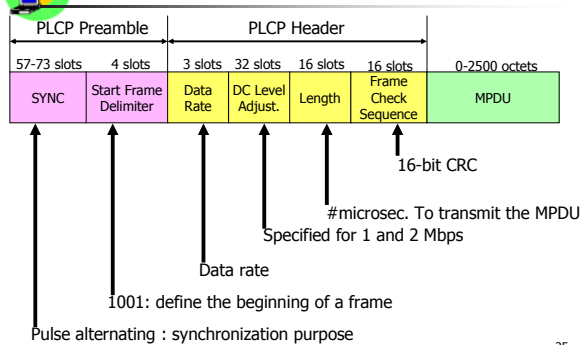
23

IR Architecture

- IR PLCP Sublayer
- IR PMD Sublayer

24

IR PLCP frame



25

IR PMD

- Mostly use diffused infrared
- Perform actual Tx/Rx of PPDU, translate binary to infrared light
- Provides IR modulation/demodulation
- Pulse position modulation :PPM
 - Vary position of pulse
- For 1 Mbps → 16 PPM
- For 2 Mbps → 4 PPM

26

Pulse Position Modulation

Data bits	16-PPM signal	Data bits	4-PPM signal
0000	00000000 00000001	00	0001
0001	00000000 00000010	01	0010
...	...	10	0100
1000	10000000 00000000	11	1000

27