Investigation of WLAN throughput

Pre-laboratory exercises

As an introduction to IEEE 802.11 WLANs and supplementary standards are available in background material for the laboratory works.

Questions:

1. What is the difference between IEEE 802.11, 802.11a, 802.11b, etc.?

2. Find out the frequency range of IEEE 802.11b in Europe. Explain using the spectrum mask shown in Figure 1, how IEEE 802.11 radio channels should be used to have as many channels as possible operating at the same time without causing interference to each other.
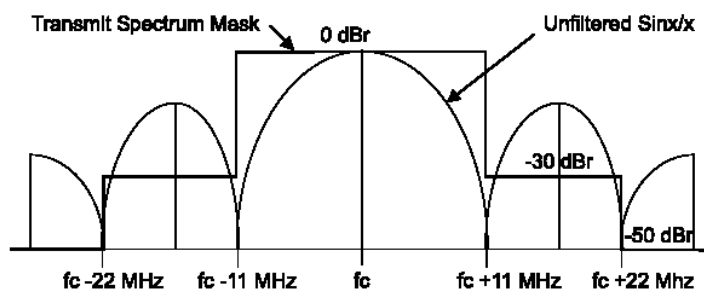

Figure 1 The transmit spectrum mask of a single channel in IEEE 802.11b [IE [3]99a, pp.219].

3. What are the structures of the following frames: MAC data, ACK, RTS and CTS frames?

4. Explain the different parts of the DSS physical layer in IEEE 802.11. Present the PPDU frame structure.

5. Explain how the CSMA/CA channel sharing scheme works.

6. Consider that STA A wants to transmit a single frame to STA B. Present the frame exchange between STAs A and B when RTS/CTS is used/ not used. Calculate the maximum throughput (use UDP SDU length 1470) achieved for UDP traffic using the information presented in Table 1. Calculate the throughput using both long and short preambles. Remember to take into account the time needed for the frame exchange (Table 2).

Table1HeaderinformationforanUDPpacketinIEE E802.11b.

Protocol		Overheadinbytes	Transmittedwith datarate[Mbit/s]
UDP		8	11
IP		20	11
LLC		4	11
802.11bMAC	MAC	34	11
802.11bPHY	withshort preamble	9inpreamble	1
		6inheader	2
	withlong preamble	18inpreamble	1
		6inheader	1

Table2Themostcommoninterframespacesin IEEE8 02.11.

Interframe space	Time[μs]
DIFS	50
SIFS	10

7. Assumeavoiceiscompressedto64kbit/sanda   voicepacketiscreatedfromthe samplescollectedover20 *ms*.Howmanybitsareinonevoicepacket?Howmany packetscanavoicepufferhaveifithastocomply withgood,medium,orbadvoice quality?

8. Calculatethemaximumnumberofsimultaneousbid irectional64kbit/sPCMbased VoiceoverIP(VoIP)connections.inanIEEE802.11g wirelessLANwherethe DSSS-OFDMoption(assuming"long"frameformat)is used.ThevoiceVoIPpacket iscollectedfromsamplesover20 *ms*timeperiod.ThewirelessLANusesone channelonly,andthemaximumbitrate(54Mbit/s) canbemaintainedbetweenall wirelessstationsandtheaccesspoint.Thecomplet eprotocolstackis"codedvoice overRTPoverUDPoverIPoverLLCoverMAC overPHY".

9. Byusingalinuxfunction"wlanconfig"writean   onelinecodethatcreatesavirtual accesspointinanad-hocmode.[man08]

References

[Bin99]BingBenny,MeasuredPerformanceoftheIEE E802.11WirelessLAN,24 [th]
ConferenceonLocalComputerNetworks,October17-2 0,1999
[Gas02]Gast,MatthewS.,802.11WirelessNetworks, TheDefinitiveGuide,O'Reilly&
Associates,2002
[IE[3]99a]IEEEStandard802.11,1999
[IE[3]99b]IEEE802.11HandbookAdesigner'sCompanion
[IE[3]99c]IEEEStandard802.11b,1999

[IE³99d]IEEEStandard802.11d,2001
[IE³99e]IEEEStandard802.11f,2003
[IE³99f]IEEEStandard802.11g,2003
[man08]Linuxmanpage:wlanconfig,   http://linux.die.net/man/8/wlanconfig,lastvisited
19.09.2008.
[ISO94]ISO/IEC7498-1:1994Informationtechnology   --OpenSystemsInterconnection--
BasicReferenceModel:TheBasicModel
[Kan04]KantanenJ.,InvestigationofVoiceTraffic   inWi-FiEnvironment,Master'sthesis
2004

ABBREVIATIONS

ACK	Acknowledgement
AP	AccessPoint
CSMA/CA	CollisionSenseMultipleAccesswithColli sionAvoidance
CTS	CleartoSend
DIFS	DCFInterframeSpace
DSSS	DirectSequenceSpreadSpectrum
IP	InternetProtocol
LAN	LocalAreaNetwork
LED	LightEmittingDiode
LLC	LogicalLinkControl
MAC	MediumAccessControl
PCMCIA	PersonalComputerMemoryCardInternational Association
PDU	ProtocolDataUnit
PPDU	PLCPPDU
RTS	RequesttoSend
SDU	ServiceDataUnit
SIFS	ShortInterframeSpace
SNR	SignaltoNoiseRatio
STA	Station
UDP	UserDatagramProtocol
WLAN	WirelessLocalAreaNetwork