

**IEEE P802.11
Wireless LANs**

Sharing Performance Evaluation for TGa PHY Submission

Date: Match 1998

Author: Richard van Nee⁺, Masahiro Morikura and Hitoshi Takanashi

Lucent Technologies⁺ NTT Wireless Systems Labs.

Previous proposals from Lucent Technologies and NTT are merged into one proposal that is described by a draft of full document uploaded to the ftp site. Evaluations of the merged proposal are performed in Lucent and NTT. Evaluations of 16-QAM are reported by Lucent, that of DQPSK and DPSK are reported by NTT.

Submission List

- 1) Sharing Performance Evaluation for TGa PHY Submission (this document)
- 2) Computer simulation results on view graphs
- 3) A draft of a merged full document

General Description

(Lucent: 16-QAM (30 Mbit/s and 20 Mbit/s) with coherent detection / NTT: DQPSK (15 Mbit/s, 10 Mbit/s and DBPSK (5 Mbit/s) with differential detection)

Parameter	Value(s)
Data Rates Supported	30, 20, 15, 10, 5 Mbit/s
Channel Spacing	15 MHz
Center Frequencies	Lower band ;5170,5185, 5200, 5215, 5230 Middle band ; 5270,5285, 5300, 5315, 5330 Upper band ; 5745,5760, 5775, 5790, 5805
Power Levels	5.15-5.25 GHz: 30 mW 5.25-5.35 GHz: 150 mW 5.725-5.825 GHz: 600 mW
Sensitivities	30 Mbit/s : -77 dBm (coherent) 20 Mbit/s : -81 dBm (coherent) 15 Mbit/s : -83.5 dBm (differential) 10 Mbit/s : - 86.3dBm (differential) 5 Mbit/s : -89.6 dBm (differential)
CCA threshold	-78 dBm
Clock Rate accuracy	40 ppm maximum
Carrier Frequency accuracy	40 ppm maximum
Waveform implementation accuracy specification method	insensitive
Power Backoff in RF PA	5 dB for the all rate (Output Back off)
Implementation Complexity	Hardware size : 173 k gates (Base band) Power Consumption : (Full duty cycle) 30 Mbit/s : 186 mW 20 Mbit/s : 124 mW

	15 Mbit/s : 93 mW 10 Mbit/s : 62 mW 5 Mbit/s : 31 mW

Per-Rate Feature Summary

Parameter	30 Mbit/s	20 Mbit/s	15 Mbit/s	10 Mbit/s	5 Mbit/s
Data rate	30 Mbit/s	20 Mbit/s	15 Mbit/s	10 Mbit/s	5 Mbit/s
ECC method	r=3/4 Convolutio nal	r=1/2 Convolutio nal	r=3/4 Convolutio nal	r=1/2 Convolutio nal	r=1/2 Convolutio nal
Interleaving method	block of 192 bits	block of 192 bits	12 x 8	12 x 8	6 x 8
Suggested minimal sensitivity NF = 10 dB / 1000 Byte packet	-75 dBm (coherent)	-72 dBm (coherent)	-78 dBm (differential)	-81 dBm (differential)	-84 dBm (differential)
Suggested Co-Channel rejection required CIR of 1000 Byte packet + α	-16 dB (coherent)	-12 dB (coherent)	-10 dB (differential)	-7 dB (differential)	-4 dB (differential)
Suggested Adjacent Channel rejection required CIR of 1000 Byte packet + α	11 dB (coherent)	15 dB (coherent)	17 dB (differential)	21 dB (differential)	23 dB (differential)
Suggested Alternate Channel rejection required CIR of 1000 Byte packet + α	50 dB (coherent)	50 dB (coherent)	46 dB (differential)	49 dB (differential)	50 dB (differential)
Implementation Accuracy	Not sensitive by skipping the center sub carrier				

Performance

If the receiver implementation complexity can be traded for performance, bring data for typical (simpler?) implementation and for extended (possible, but higher end) implementation.

Performance in Noise and Multipath

Attach graphs of PER vs. Eb/N0, for

- 1) AWGN channel
 - 2) Exponential Profile Rayleigh Fading channel for $T_{RMS} = 25$ nsec
 - 3) Exponential Profile Rayleigh Fading channel for $T_{RMS} = 50$ nsec
 - 4) Exponential Profile Rayleigh Fading channel for $T_{RMS} = 100$ nsec
 - 5) Exponential Profile Rayleigh Fading channel for $T_{RMS} = 150$ nsec
 - 6) Exponential Profile Rayleigh Fading channel for $T_{RMS} = 250$ nsec
 - 7) Attach graph of PER vs. T_{RMS} without additive noise, covering a range of 10 nsec to 500 nsec
- Bring the graphs for each data rate supported by the proposed PHY, for packet lengths of 64 and 1000 bytes.

Per-Rate Performance Summary

If the receiver implementation complexity can be traded for performance, bring data for typical (simpler?) implementation and for extended (possible, but higher end) implementation.

Differential Detection

Parameter	30 Mbit/s	20 Mbit/s	15 Mbit/s	10 Mbit/s	5 Mbit/s
Eb/No at PER=10%, AWGN, 64b	10 dB	8 dB	7.6 dB	6.5 dB	6.4 dB
Trms at PER=10%, noise free, 64b	175 ns	300 ns	320 ns	> 500 ns	> 500 ns
Eb/No @ 20%, with Trms @ 10%, 64b	20 dB	16 dB	20.6 dB	15.8 dB	10.9 dB*1
Eb/No at PER=10%, AWGN, 1000b	12 dB	10 dB	8.7 dB	7.7 dB	7.4 dB
Trms at PER=10%, noise free, 1000b	150 ns	225 ns	240 ns	460 ns	> 500 ns
Eb/No @ 20%, with Trms @ 10%, 1000b	23 dB	20 dB	23.7dB	19.9 dB	13.9 dB*1
CCI immunity [dB]	-14 dB	-10.5 dB	-8.3 dB (64B) -9.4 dB (1000B)	-5.5 dB (64B) -6.6 dB (1000B)	-2.3 dB (64B) -3.1 dB (1000B)
ACI immunity [dB]	14 dB	18 dB	19.3 dB (64B) 17.8 dB (1000B)	22.8 dB (64B) 21.3 dB (1000B)	25.7 dB (64B) 23.8 dB (1000B)
CW jammer immunity [dB]	-18 dB	-13 dB	-13.5 dB (64B) -15.2 dB (1000B)	-2.2 dB (64B) -7.7 dB (1000B)	3.5 dB (64B) 0.9 dB (1000B)
Narrowband Gaussian noise immunity [dB]	-18 dB	-13 dB	-11.9 dB (64B) -13.5 dB (1000B)	-7.7 dB (64B) -9.6 dB (1000B)	-3.7 dB (64B) -5.5 dB (1000B)
Phase noise tolerance, (BW=50 kHz), rad ² [dBc] at which PER becomes 10%	-14 dBc	-13 dBc	-11.7 dBc (64B) -14.1 dBc (1000B)	-10.1 dBc (64B) -12.5 dBc (1000B)	-6.0dBc (64B) -8.0 dBc (1000B)

*1 : PER never exceed 10 % with T_{rms} of 25 - 500 ns. PER of 20% is assumed instead at T_{rms} of 500 ns.

Timing and Overhead related parameters

Attach verbal explanation of the assumptions taken for each parameter

Attribute	Suggested Value
aSlotTime	6 μ s
aCCATime	≤ 4 μ s
aRxTxTurnaroundTime	implementation dependent
aTxPLCPDelay	implementation dependent
aRxTxSwitchTime	implementation dependent
aTxRampOnTime	Not applicable
aTxRFDelay	implementation dependent
aSIFSTime	13 μ s
aRxRFDelay	4 μ s
aRxPLCPDelay	7 μ s
aMACProcessingDelay	implementation dependent
aTxRampOffTime	Not applicable
aPreambleLength	19 μ s
aPLCPHdrLength	4 μ s (for 30Mbit/s) 5 μ s (for 20Mbit/s) 6 μ s (for 15Mbit/s) 7 μ s (for 10Mbit/s) 12 μ s (for 5Mbit/s)
aMPDUDurationFactor	(coding rate) ⁻¹
aAirPropagationTime	<1 μ s
aCWmin	15
aCWmax	1023

Level definitions

The suggested minimal sensitivity depends on a system design.

