IEEE P802.11
Wireless LANs

Performance Comparison of Joint BreezeCom+NEC Proposal vs BreezeCom Proposal

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Author: Tal Kaitz Naftali Chayat

BreezeCom
Atidim Technology Park, Bldg 1
Tel Aviv 61131, ISRAEL
email: {talk,naftalic}@breezecom.co.il

Introduction

Shortly before the March 98 meeting BreezeCom and NEC decided to present a joint proposal based on Offset Quadrature Modulation. Since the merger and until the presentation at 802.11 we did not prepare a separate evaluation of the joint proposal, hinging on the similarity of the OQM modulation in the joint vs. previous BreezeCom proposal (as presented in 98/76 and 97/76r1). The assumption was that only ACI data will change.

This document is an update on performance evaluation of the joint proposal. Contrary to our previous assumptions, there is slight degradation in multipath performance when SRRC pulse is used, versus the situation when GMSK-like pulse is used. The change is slight, yet there is a need to understand its source; this will be performed in the near future.

In the performance update equalizer with 16 feedforward taps and 23 feedback taps was compared. For initial comparison 64 byte packets were addressed.

General Description

Parameter	Value(s)
Data Rates Supported	20.9677 Mbit/s (mandatory), 25.0000 Mbit/s (mandatory), 41.9355 Mbit/s (optional), 50.0000 Mbit/s (optional), 62.9032 Mbit/s (optional/impractical), 75.0000 Mbit/s (optional/impractical), 83.8710 Mbit/s (optional/impractical), 100.0000 Mbit/s (optional/impractical)
Channel Spacing (Breeze proposal)	25 MHz
Channel Spacing (joint proposal)	20 MHz
Center Frequencies (Breeze proposal)	lower: 5.175, 5.200, 5.225, 5.250 GHz middle 5.275, 5.300, 5.325 GHz upper: 5.750, 5.775, 5.800 GHz
Center Frequencies (joint proposal)	lower: 5.170, 5.190, 5.210, 5.230, 5.250 GHz middle 5.270, 5.290, 5.310, 5.330 GHz upper: 5.745, 5.765, 5.795, 5.815 GHz
Power Levels	Resulting from 12.5 MHz bandwidth, Lower band: 30 mW Middle band: 150 mW

	Upper band: 600 mW
Sensitivities	20.9677 Mbit/s: -77 dBm 25.0000 Mbit/s: -75 dBm 41.9355 Mbit/s: -67 dBm 50.0000 Mbit/s: -65 dBm
CCA threshold	
Clock Rate accuracy	10 ppm
Carrier Frequency accuracy	10 ppm (60 kHz)
Waveform implementation accuracy specification method	RMS residual ISI when optimizing with respect to slack parameters – frequency, phase and timing offset, and a short equalizer (joint Breeze+NEC proposal)
Power Backoff in RF PA	Saturated in Breeze proposal 1 dB to 6 dB depending on modulation and U-NII subband (Breeze+NEC)
Implementation Complexity	100-200 Kgates, depending on equalizer length. The power consumption for the implementation with long equalizer is expected to be 350 mW with equalizer adaptation and 250 mW without adaptation along the packet. (based on 0.25 micron process)

Per-Rate Feature Summary

Parameter	21 Mbit/s	25 Mbit/s	42 Mbit/s	50 Mbit/s
Data rate	20.9677 Mbit/s	25.0 Mbit/s	41.9355 Mbit/s	50.0 Mbit/s
ECC method	Hamming	none	Hamming	none
Interleaving method	write rows, encode columns, read rows depth 8	None	write rows, encode columns, read rows depth 16	none
Suggested minimal sensitivity	-77 dBm	-75 dBm	-67 dBm	-65 dBm
Suggested Co-Channel rejection				
Suggested Adjacent Channel rejection				
Suggested Alternate Channel rejection				
Implementation Accuracy (joint propsal)	23 dB residual ISI	23 dB residual ISI	30 dB residual ISI	30 dB residual ISI

Per-Rate Performance Summary

The data relates to DFE receiver with 16 taps in feed-forward filter and 15 decision feedback taps. Data for shorter equalizers will be provided soon.

Parameter	21 Mbit/s	25 Mbit/s	42 Mbit/s	50 Mbit/s
Eb/No at PER=10%, AWGN, 64b	7.2 dB	9.5 dB	10 dB	12.5 dB
Trms at PER=10%, noise free, 64b	240 nsec	230 nsec	120 nsec	100 nsec

Eb/No @ 20%, with Trms @ 10%, 64b				17 dB
Eb/No at PER=10%, AWGN, 1000b	8.5 dB	11.2 dB	12.5 dB	14.2 dB
Trms at PER=10%, noise free, 1000b	185 nsec	170 nsec	95 nsec	70 nsec
Eb/No @ 20%, with Trms @ 10%, 1000b	15 dB?	17 dB?	19 dB	22 dB?
CCI immunity [dB]	-13 dB	-15 dB	-17 dB	-20 dB
ACI immunity [dB] for BreezeCom proposal	40 dB 28 dB (sat adj)	42 dB 30 dB (sat adj)	34 dB	36 dB
ACI immunity [dB] for joint Breeze+NEC proposal (P=1 PA model)	25-26 dB at 2 dB backoff	23-24 dB at 2 dB backoff	17 dB at 6 dB backoff	15 dB at 6 dB backoff
CW jammer immunity [dB]	-10 dB	-11 dB	-18.5 dB	-21 dB
Narrowband Gaussian noise immunity [dB]				
Phase noise tolerance, (BW=50 kHz), rad^2 [dBc] at which PER becomes 10%	-10 dB	-12 dB	-16 dB	-20 dB

Timing and Overhead related parameters

Attach verbal explanation of the assumptions taken for each parameter

Attribute	Suggested Value
aSlotTime	6.0 µs in Breezecom 7.4 µs in joint proposal
aCCATime	3.0 µs
aRxTxTurnaroundTime	1.4 µs
aTxPLCPDelay	0.4 µs
aRxTxSwitchTime	0.4 µs.
aTxRampOnTime	0.4 µs.
aTxRFDelay	0.4 µs.
aSIFSTime	12.0 µs. in Breezecom 13.4 µs in joint proposal
aRxRFDelay	1.0 µs.
aRxPLCPDelay	7.0 µs.
aMACProcessingDelay	0.6 µs. in Breezecom 2.0 µs in joint proposal
aTxRampOffTime	0.4 µs.
aPreambleLength	10.24 µs in Breezecom 12.8 µs in joint proposal
aPLCPHdrLength	3.2 µs
aMPDUDurationFactor	1.1923 (if ECC used)
aAirPropagationTime	0.8 µs
aCWmin	15
aCWmax	1023

Performance in multipath 64 bytes 21Mb/s
Nf=16 Nb=23
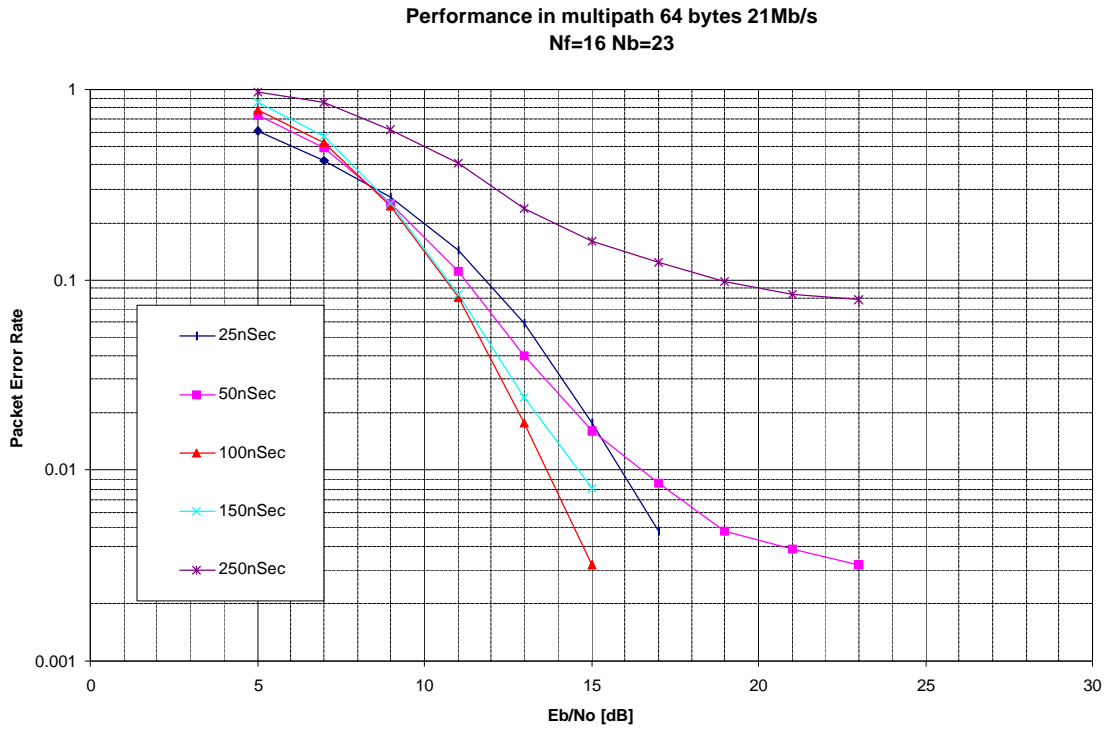
Fig.1: Packet Error Rate vs. multipath and Eb/No, coded binary 21 Mbit/s, BreezeCom.

Performance in multipath 64 bytes 21Mb/s
SRRC Pulse Nf=16 Nb=23
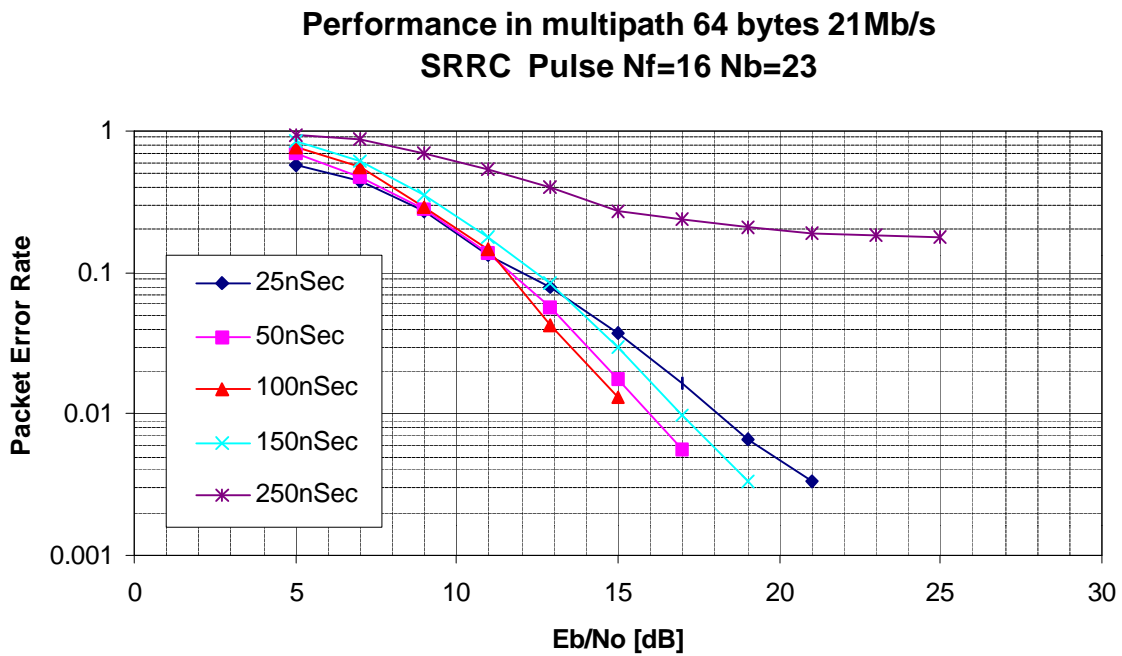
Fig.2: Packet Error Rate vs. multipath and Eb/No, coded binary 21 Mbit/s, Breeze+NEC.

Performance in multipath 64 bytes 25 Mb/s
Nf=16 Nb=23
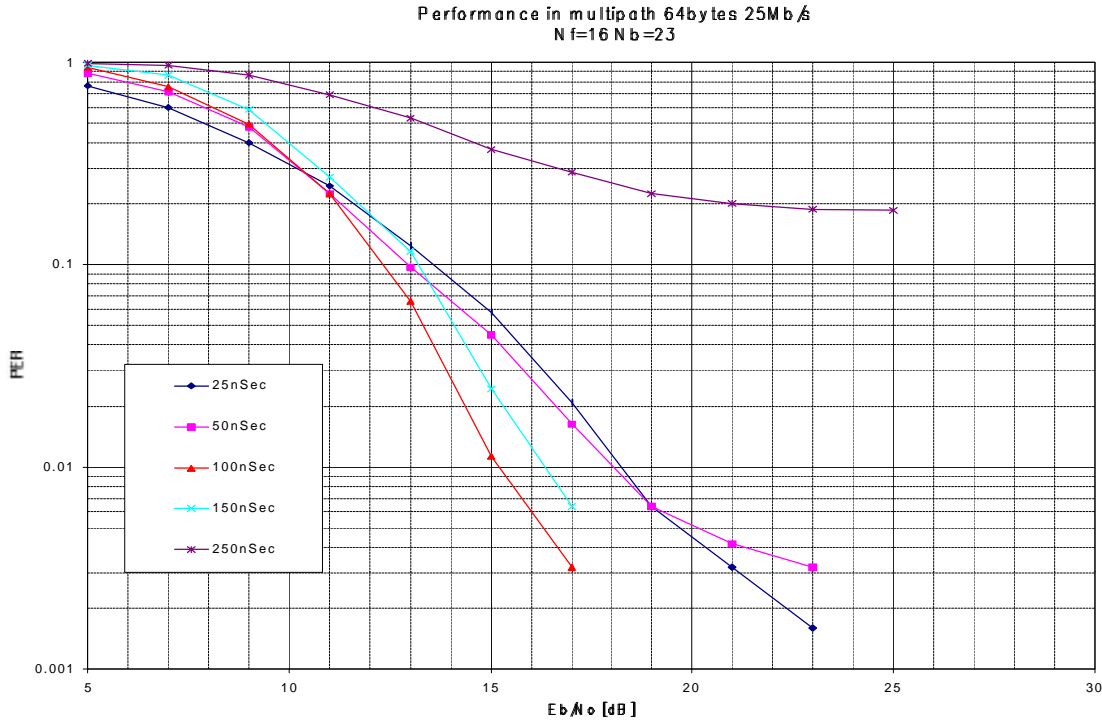
Fig.3: Packet Error Rate vs. multipath and Eb/No, uncoded binary 25 Mbit/s, BreezeCom.

Performance in multipath 64 bytes 25Mb/s
SRRC Pulse Nf=16 Nb=23
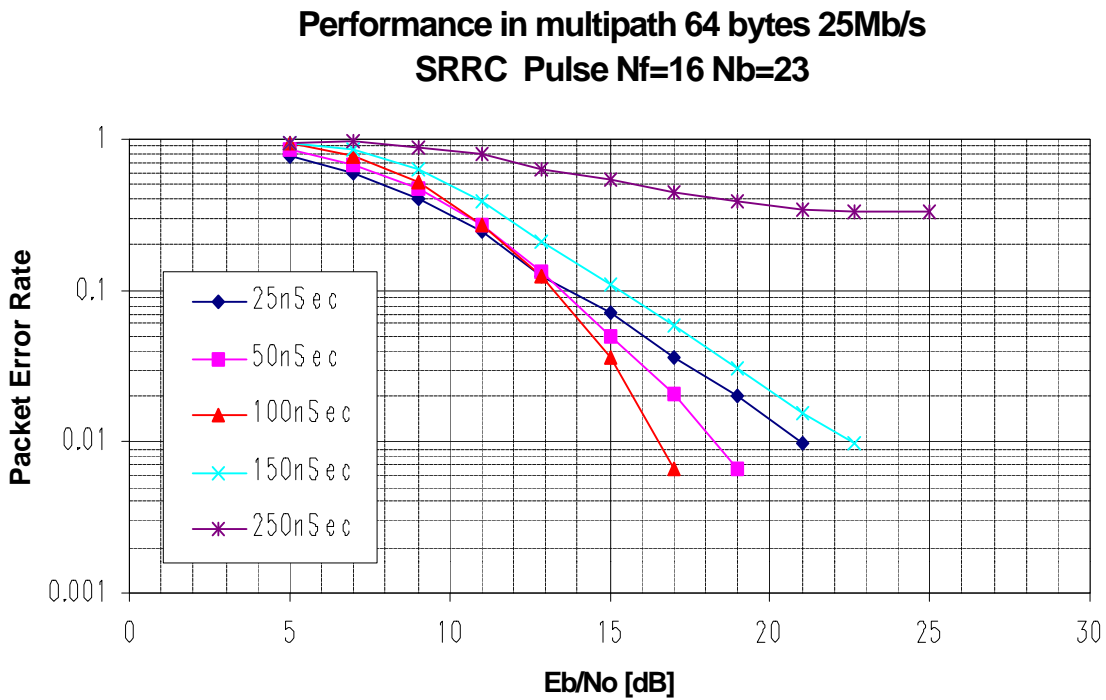
Fig.4: Packet Error Rate vs. multipath and Eb/No, uncoded binary 25 Mbit/s, Breeze+NEC.
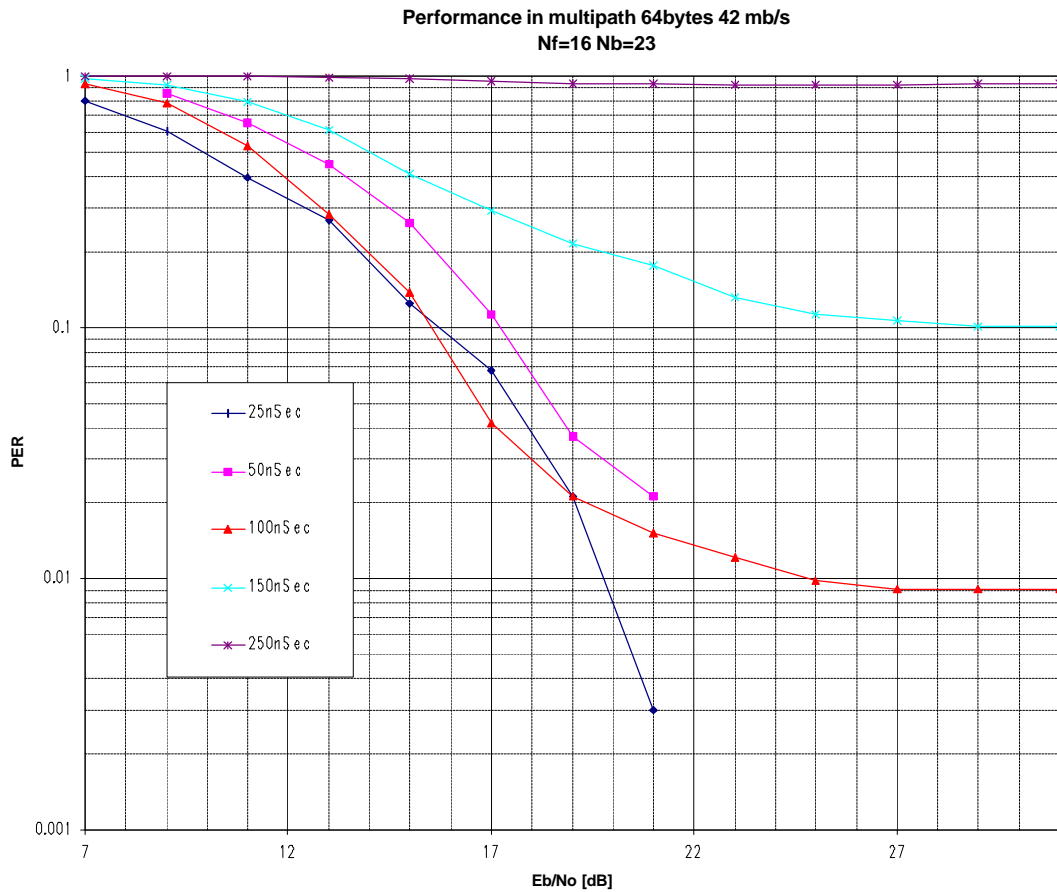
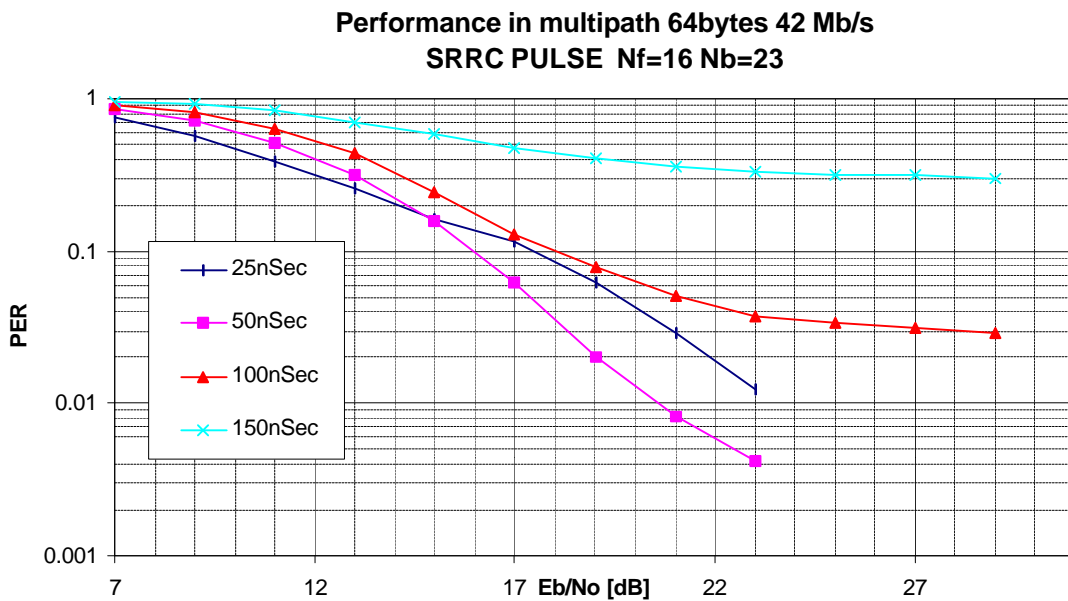Fig.5: Packet Error Rate vs. multipath and Eb/No, coded binary 42 Mbit/s, BreezeCom.

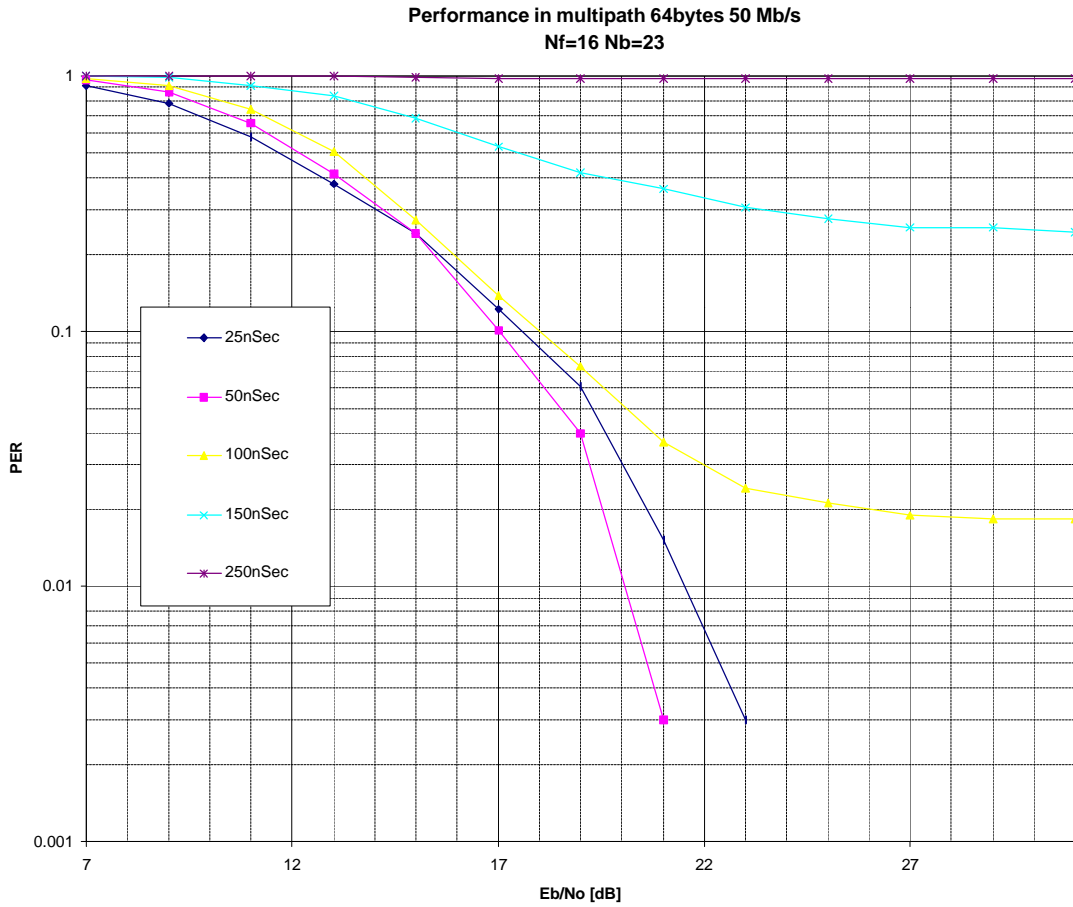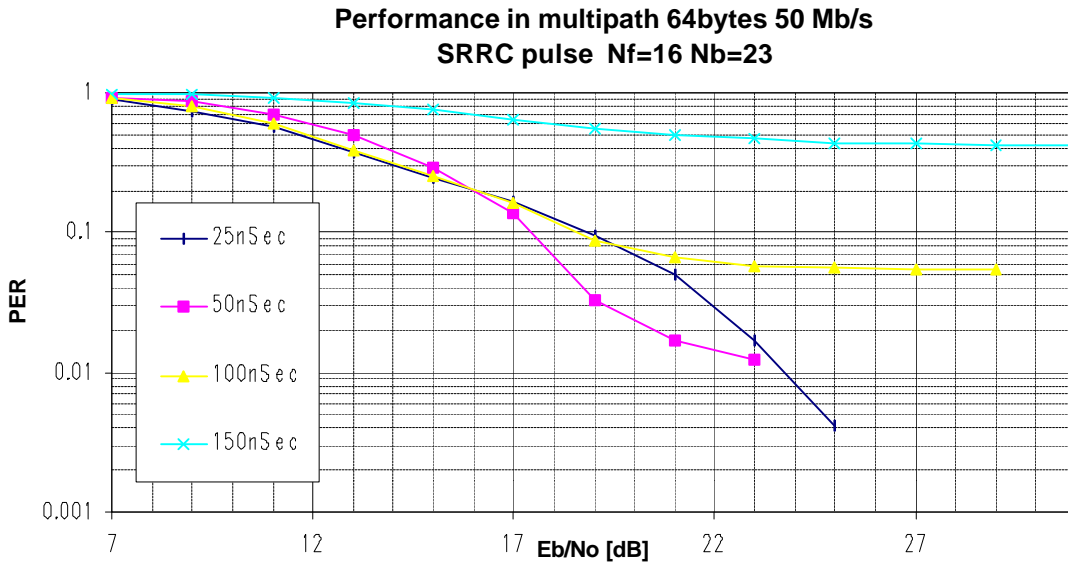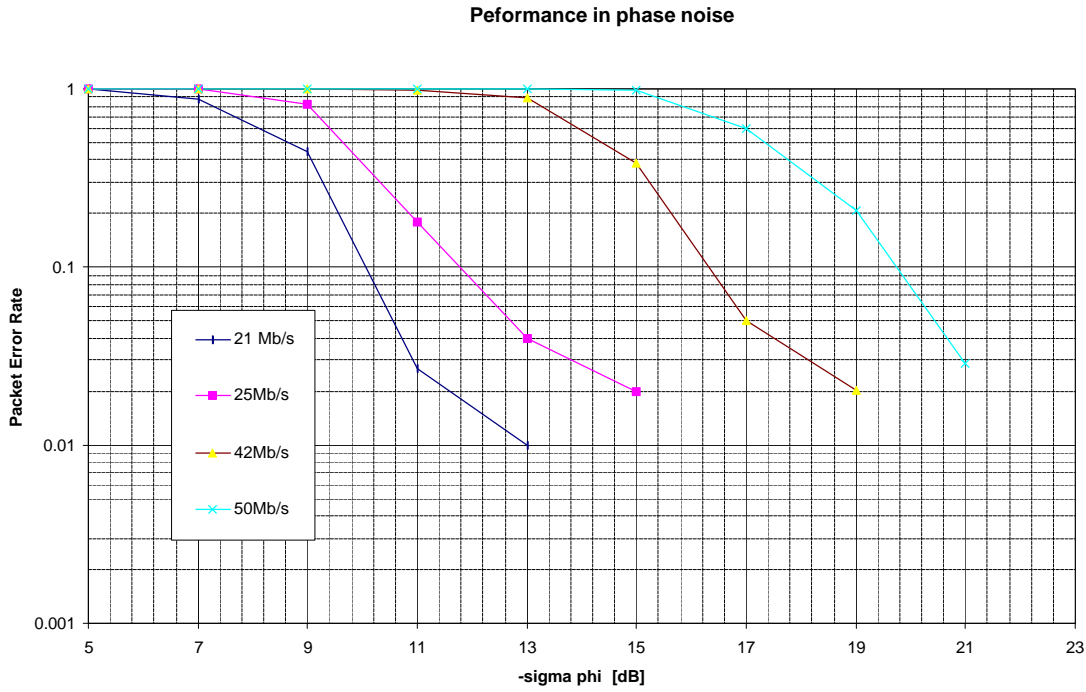Fig.6: Packet Error Rate vs. multipath and Eb/No, coded binary 42 Mbit/s, Breeze+NEC.

Performance in multipath 64bytes 50 Mb/s
Nf=16 Nb=23

Fig.7: Packet Error Rate vs. multipath and Eb/No, uncoded binary 50 Mbit/s, BreezeCom.

Performance in multipath 64bytes 50 Mb/s
SRRC pulse Nf=16 Nb=23

Fig.8: Packet Error Rate vs. multipath and Eb/No, uncoded binary 50 Mbit/s, Breeze+NEC.

Peformance in phase noise

Fig.9: Packet Error Rate vs. phase noise, BreezeCom.
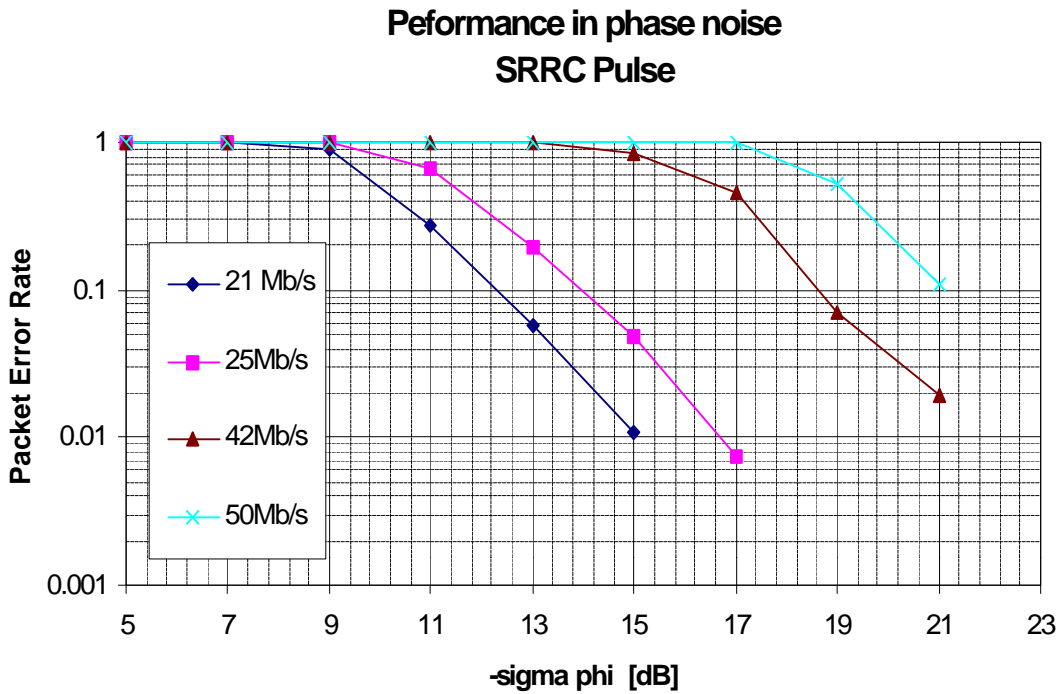
Peformance in phase noise
SRRC Pulse

Fig.10: Packet Error Rate vs. phase noise, Breeze+NEC.