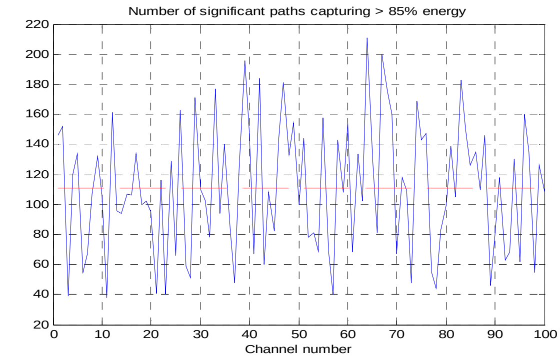


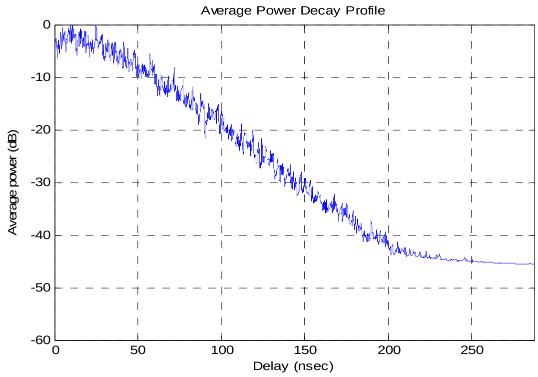


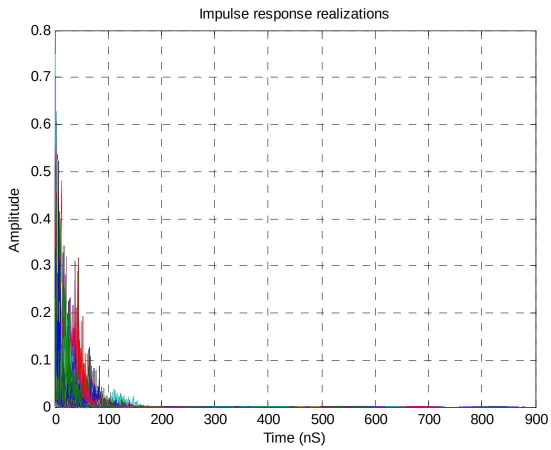
Fig 4.2: Simulation result for Residential (NLOS) environments

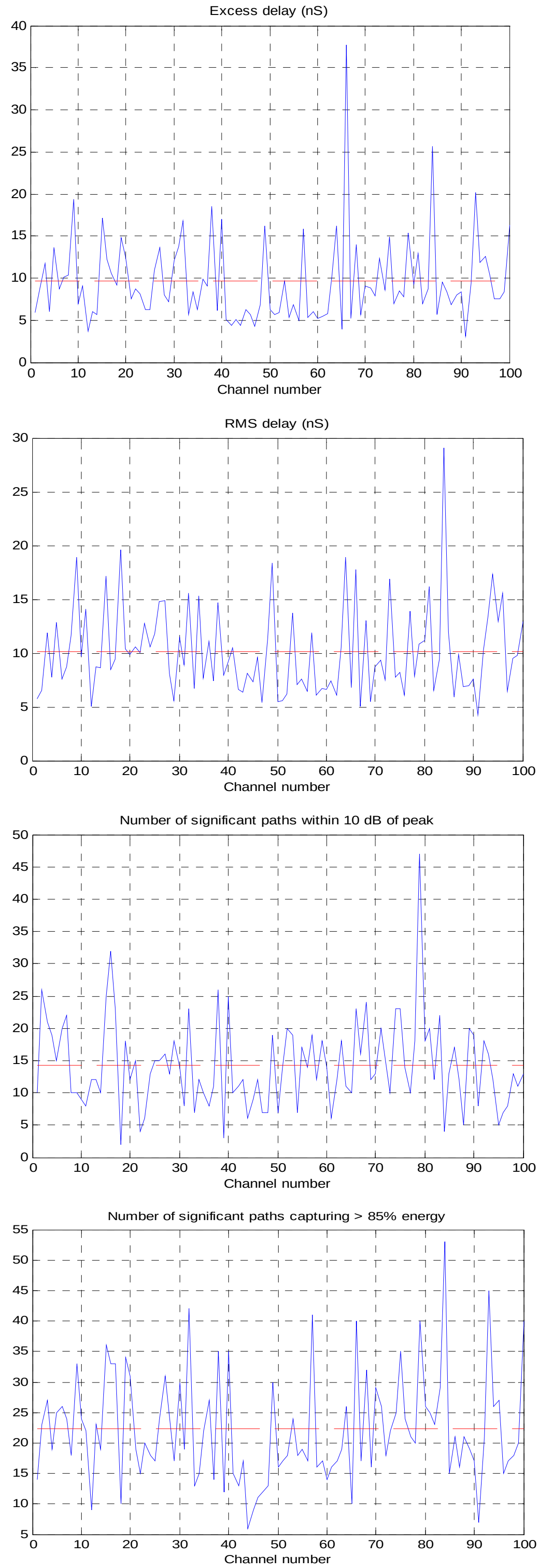
Channel model parameters:

Mean delays: excess (tau_m) = 19.9 ns, RMS (tau_rms) = 19 ns,

No of paths: NP_10dB = 35.6, NP_85% = 110.7.

4.3 Simulations for indoor Line-of-sight (LOS) environments (CM3)





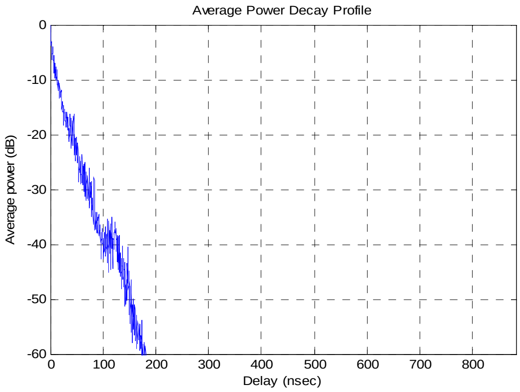
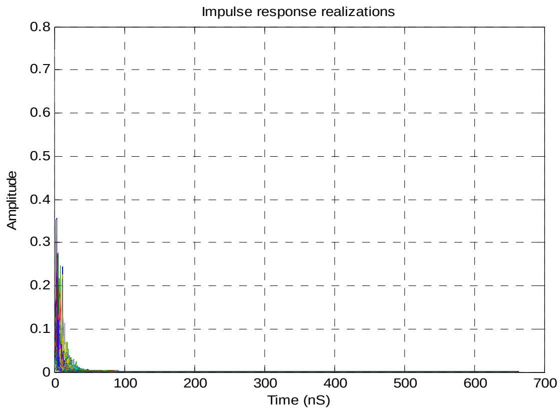
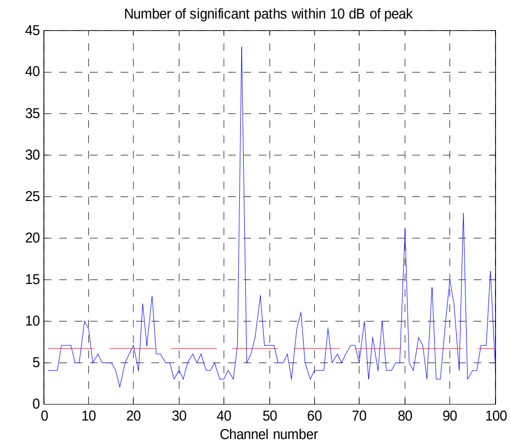


Fig 4.3: Simulation result for Indoor (LOS) environments
Channel model parameters:
Mean delays: excess (tau_m) = 9.6 ns, RMS (tau_rms) = 10 ns,
No of paths: NP_10dB = 14.3, NP_85% = 22.3.

4.4. Simulations for industrial line-of-sight (los) environments (cm7)





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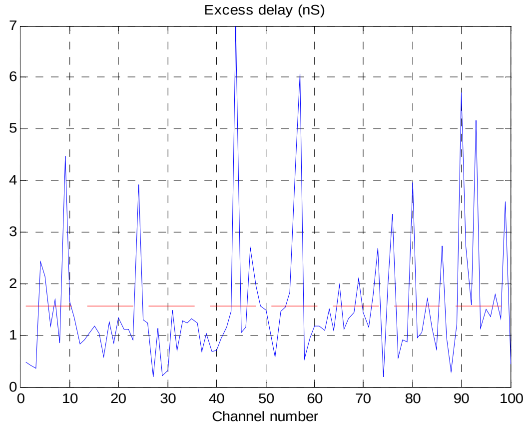

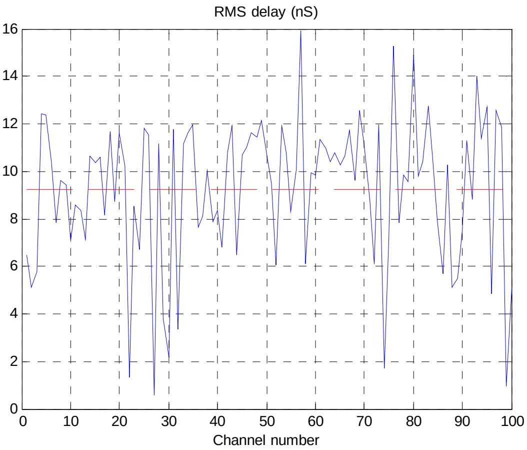

Fig 4.4: Simulation result for Industrial (LOS) environments
Channel model parameters:
Mean delays: excess (tau_m) = 1.6 ns, RMS (tau_rms) = 9 ns,
No of paths: NP_10dB = 6.7, NP_85% = 8.7

5. Modulation techniques for IEEE 802.15.4a

5.1. Differential binary phase shift keying (DBPSK) Modulation

In Differential BPSK (DBPSK), the bits are modulated using the following formula

$$E_n = R_n \otimes E_{n-1}$$

E_n is the n_{th} DBPSK encode bit, R_n is the n_{th} data bit, initially E_0 taken as '0'.

5.2. Offset qudrature phase-shift keying (OQPSK)

The phase of the carrier wave can be changed in one of four ways to represent the symbols 00, 01, 10, and 11. The advantage of QPSK is that two bits can be represented per symbol unlike BPSK, which can only represent one bit per symbol. However, QPSK is more susceptible to noise than BPSK. Compared to a BPSK system, noise can cause a particular phase value to appear as the other phase values with a higher probability as the phase shift values are closer to each other in an OQPSK system. QPSK works because the sine wave and the cosine wave are orthogonal with respect to each other.

5.3. Simulation results

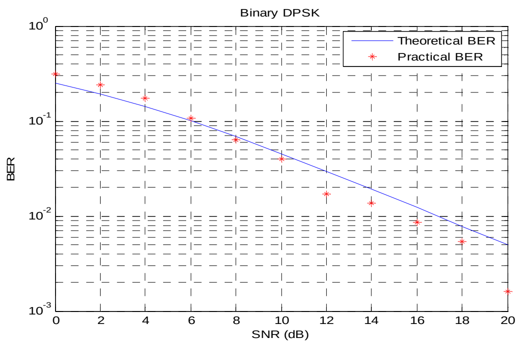

Fig 5.1(a): comparison of BERs of DBPSK and OQPSK systems

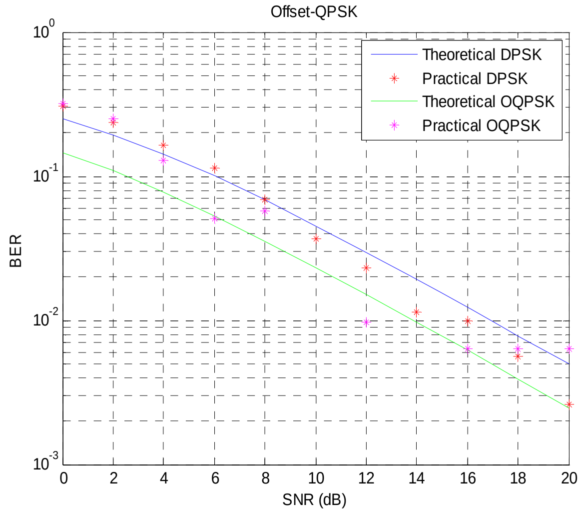

Fig 5.1(b): comparison of BERs of DBPSK and OQPSK systems

5.5. Comparisons of dpsk and oqpsk in terms of bit error rates (bers)

SNR (dB)	DPSK Bit error rate	OQPSK Bit error rate
0	$10^{-0.7}$	$10^{-0.7}$
2	$10^{-0.76}$	$10^{-0.75}$
4	$10^{-0.93}$	$10^{-0.95}$
6	$10^{-0.98}$	$10^{-1.6}$
8	$10^{-1.3}$	$10^{-1.5}$

Table 4.b: Comparison of DBPSK and OQPSK systems

5.6 Comparisons of channel model parameters

	Residential		Indoor		Outdoor		Industrial		Open outdoor
	LOS	NLOS	LOS	NLOS	LOS	NLOS	LOS	NLOS	NLOS
tau_m (ns)	16	19.9	9.6	18.4	26.8	72.8	1.61	23.9	17.2
tau_rms (ns)	17	19	10	13	30	74	9	20	22
NP_10dB	15.3	35.6	14.3	30.4	17.9	24.7	6.7	128.5	5.4
NP_85%	54.6	110.7	22.3	45.4	35.9	65	8.7	186.6	6.5

Table 4.a: Comparison of channel model parameters

6. Conclusion and future work

The channel model IEEE802.15.4a is based on a large number of measurement and simulation campaigns and includes the most important propagation effects in UWB channels, including the frequency selectivity of the path loss, stochastic interarrival times of the MPCs. in some NLOS situations. The model allows to test a wide variety of UWB transceivers in a unified and reproducible way. We have also discussed the limits of applicability and possibilities for future improvement and generalization .For residential environment the maximum excess delay (excess delay for which power level fallows below the threshold, 10dB) is more in NLOS environment (19.9 ns) than LOS environments (16 ns), the number multipath components required to capture the 85% of total transmitted power is more in NLOS environment (110.7 components) than LOS environments (54.6 components), the rms delay (difference between times of arrival of first multipath component to last multipath component) is more in NLOS environment (19 ns) than LOS environment (17 ns). Similarly for any channel environments of the IEEE 802.15.4a, maximum excess delay is more in NLOS than LOS environment, the rms delay is also more in NLOS than LOS environment, the number of multipath components required to capture the 85% of total energy is more in NLOS than LOS environments, for such a sparse impulse response, a relatively small number of Rake fingers can collect most of the received energy.

The channel impulse response is a sum of delayed, attenuated, and distorted MPCs and impulse response can become sparse (not every resolvable delay bin contains significant MPCs).Compare the bit error rate performances through the application of impulse radio signal, of DBPSK and OQPSK systems with rake receiver at the IEEE 802.15.4a channel environment. From simulation result DBPSK shows better performance than that of OQPSK system for medium and larger SNRs.

Nomenclature

IR-UWB : Impulse Radio Ultra Wideband
FCC : Federal Communications Commission
NLOS : Non Line-of-Sight
DBPSK : Differential Binary Phase Shift Keying
OQPSK : Offset Qudrature Phase Shift Keying
P L0 : Path loss at 1m distance
N : Path loss exponent
Σs : Shadowing standard deviation
A ant : Antenna loss

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