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Comparative Simulation for Throughput Testing of LTE Downlink Channel for EPA model

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Abstract –Performance of wireless mobile communication system is always depends upon quality of signal delivered to mobile user. The signal quality is measured by the performance of throughput varies at different location based upon their duplexing method in downlink channel. LTE uses two duplexing techniques FDD and TDD. This paper shows a comparison of throughput performance of LTE downlink channel for extended fading model (EPA) based on FDD and TDD in terms of average running throughput & Bit error rate (BER) performance for the SNR values. The simulation results are taken out from LTE system toolbox TS 36 101 specified in MATLAB version 2014a.

Key Words: SNR, Long term Evolution, Throughput, Duplexing, Simulation, fading.

1. INTRODUCTION

4G LTE (long term evolution) is a revolutionary technology in telecommunication. 3GPP launched LTE network with great advancement in network, high speed, fine voice quality, data rates etc. As every mobile communication system performance is depends upon its signal strength. Signal strength in communication system always vary at different-2 locations due to environmental conditions and also some types of fading or scattering of signal. There are three type of fading channel model occurs in LTE network in downlink channel i.e. EPA, EVA & ETU fading model for pedestrian, vehicular and urban conditions.
Throughput performance is the estimation or measurement of signal quality on this fading condition. This throughput performance varies depend upon various factors like duplexing method, antenna correlation, SNR values and also use of Doppler spreads. LTE downlink channel use two duplexing methods i.e. TDD and FDD.

In this research paper we are focusing to estimate throughput testing for these two duplexing method separately. Simulation result are taken out in terms of % of average running throughput per no. of frames transmitted per SNR values and % of throughput for SNR values and BER performance.
Throughput testing is done in LTE system toolbox TS36 101in MATLAB 2014a. This paper is organized as follows: section 2nd & 3rd describes the LTE-FDD/TDD & Related terms respectively. Section 4th states about the simulation result. Conclusion & future scope detailed in section 5th.

2. LTE-FDD/TDD

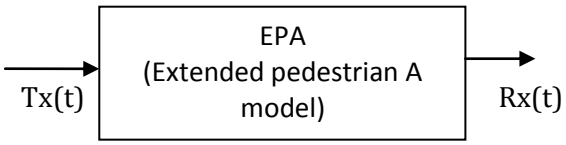

Figure 1: EPA model

In mobile communication a duplex system provides a way of organizing the transmitter and receiver so that they can transmit and receive the data.LTE use two duplexing technique FDD & TDD. It accommodates both paired spectrum(FDD) and unpaired spectrum(TDD).FDD use two channel, one for Tx & other for Rx whereas TDD use one frequency allocates different time slots for Tx and Rx.

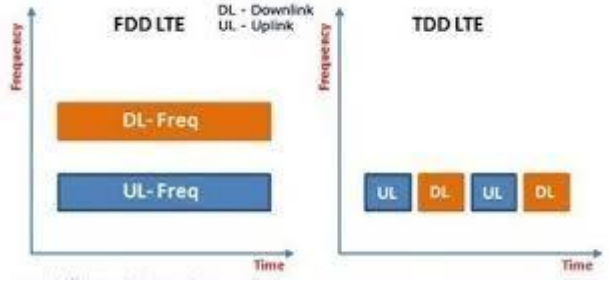

Figure 2: LTE-FDD/TDD

TDD has some advantage over FDD that TDD offers flexibility to configure channel capacity w.r.t to symmetric downlink or uplink traffic. TDD system allows changing this configuration. FDD system uses a fixed symmetric suboptimal system which cannot be altered.

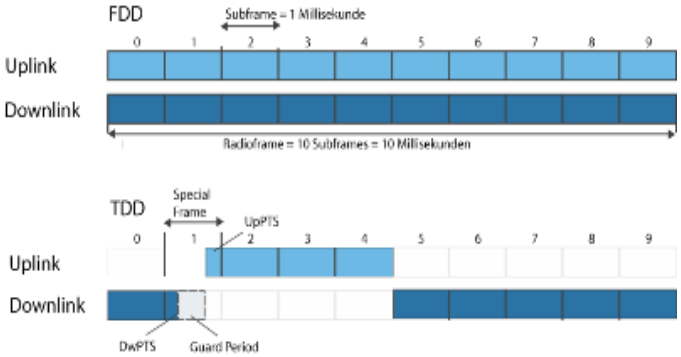

Figure 3: LTE frame structure

Benefits of TDD over FDD-

- TDD does not require paired spectrum like FDD
- TDD is cheaper than FDD
- In TDD facility to change uplink and downlink capacity radio dynamically.
- But in FDD no cross slot interference occurs like TDD.
- TDD requires a large guard band rather than FDD.

3. RELATED TERMS(SIMULATIN BASED)

➢ **SNR:** SNR is the measure used in science and engineering that compares level of a desired signal to the level of background noise. It is the ratio of signal power to noise power. It is expressed in decibel (db) unit. A ratio higher than 1.1 indicated more signal than noise.

SNR= P signal/P noise

➢ **ANTENNA CORRELATION:** Performance of a LTE network is critically depending on availability of independent multiple channels. Channel correlation will downgrade the performance of LTE network, especially its capacity. Channel correlation is a measure of similarity or likeliness between channels. In extreme cases, if channels are fully correlated LTE will have no difference from a single antenna communication system. Capacity of LTE network not only depends upon no. of channel but also on correlation between channels. Greater the channel correlation, smaller the channel capacity. Channel correlation of LTE system is mainly due to the two components.

- Spatial correlation.
- Antenna mutual coupling.

➢ **BIT ERROR RATE (BER):** BER is the no. of bit error per unit time. It is the no. of bit error divided by total no. of transferred bits during a studied time interval. In communication system, receiver side BER may be affected by Tx channel noise, interference, distortion, bit synchronization and multipath fading. BER can be improved by choosing a strong signal or high SNR values or by robust modulation or by line coding scheme.

4. SIMULATION RESULT

Simulation results are taken out in % of throughput versus SNR & no. of frames Tx & the raw BER for throughput values.

Ref. channel	R.12
Duplex mode	FDD/TDD
Tx scheme	Tx diversity
PDSCH rho(db)	-3
Propagation model	EPA
Doppler(hz)	5 hz
Antenna correlation	Low
No. of Rx. Antenna	2
SNR(db)	3..5 -2.5 -1.5 0 1.5 2.5 3.5
Frame length	20
HARQ	7/8
Channel estimation	Yes
PMI mode	Wideband
Simulation result	Simresult

Table 1: Simulation parameter

Case 1: FDD Based simulation

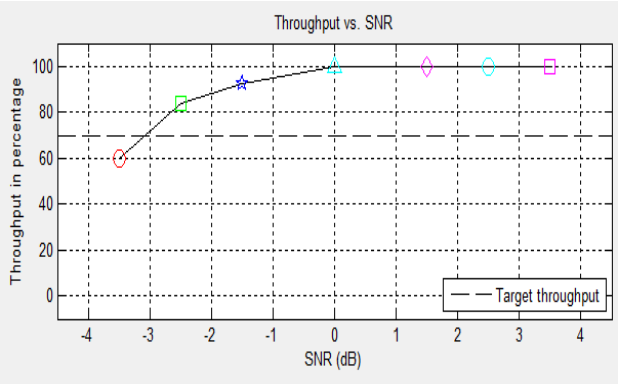

Figure 4: % throughput per SNRs

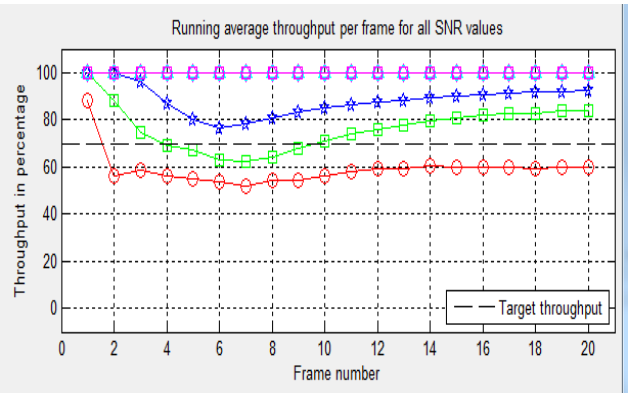

Figure 5: average throughput per frame per SNR

throughput	tpPerFrame	rawBER
59.7775	1x20 double	0.2020
83.8056	1x20 double	0.1752
92.3888	1x20 double	0.1486
100	1x20 double	0.1108
100	1x20 double	0.0764
100	1x20 double	0.0565
100	1x20 double	0.0403

Figure 6: raw BER per throughput

Case 2: TDD based simulation

throughput	tpPerFrame	rawBER
58.9844	1x20 double	0.1997
81.9922	1x20 double	0.1734
88.9844	1x20 double	0.1488
100	1x20 double	0.1101
100	1x20 double	0.0753
100	1x20 double	0.0557
100	1x20 double	0.0395

Figure 7: raw BER per throughput

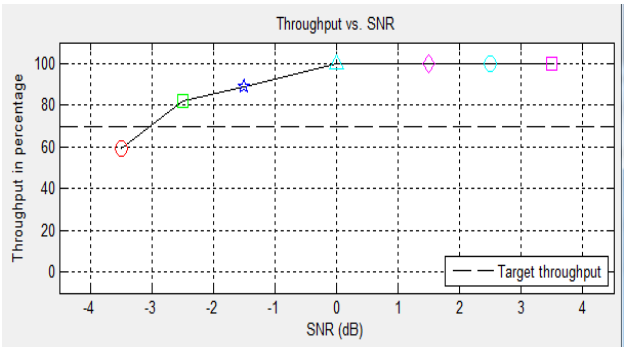

Figure 8: % throughput per SNR

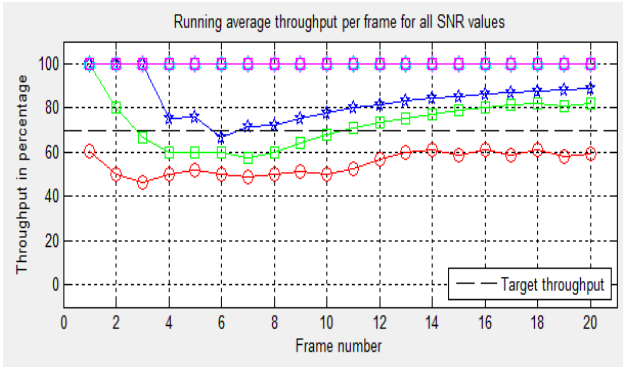

Figure9: average throughput per frame per SNR

5. CONCLUSION

Simulation result shows the comparison between throughput performance of LTE downlink channel for FDD and TDD method. Result shows that FDD have better throughput performance rather than TDD for low (-ve) SNR (db) values & TDD have just less BER than FDD.

Model		EPA	
Duplex method		**FDD**	**TDD**
Frame length		20	20
Antenna correlation		Low	Low
Doppler(hz)		5hz	5hz
SNR(db)	-3.5	59.78	58.98
	-2.5	83.81	81.99
	-1.5	92.39	88.98
	0	100	100
	1.5	100	100
	2.5	100	100
	3.5	100	100

Table 2: Throughput simulation

Model	EPA			
Duplex method	FDD		TDD	
Frame length	20		20	
SNR	% Thp	BER	% Thp	BER
-3.5	59.78	**0.2020**	58.98	**0.1997**
-2.5	83.81	**0.1752**	81.99	**0.1734**
-1.5	92.39	**0.1486**	88.98	**0.1488**
0	100	**0.1108**	100	**0.1101**
1.5	100	**0.764**	100	**0.0753**
2.5	100	**0.565**	100	**0.0557**
3.5	100	**0.0403**	100	**0.0395**

Table 3: BER simulation per throughput

6. FUTURE SCOPE

In future work, another fading model can be used like EVA or ETU model for throughput estimation for taking no. of frames (50 or 100 frames)and change transmission scheme for the network.

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