PERFORMANCE ANALYSIS OF LTE NETWORK USING RUNTIME PRE-CODING ALGORITHM

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Abstract - LTE (Long Term Evolution) meets the requirement of high data rates, improved end user performance, better spectrum utilization, no interference and many more. All this is possible because of its features, one of which is multipoint transmission with single user as well as multi user. But whenever user receives signal from number of transmitting a points, it becomes difficult to calculate the precoders and corresponding filters. The paper describes one of such scenario where user receives signal from multiple eNodeBs. We have implemented a runtime algorithm to estimate the pre-coders and its corresponding filters for system level simulation of LTE network using Matlab.

Keywords - 3GPP, LTE, Link abstraction, Link quality model, Downlink multipoint transmission, Runtime pre-coding, Matlab System level simulation.

I. INTRODUCTION

LTE aims at increasing cell edge user performance as well as reduce the interference. This is achieved by multi-point transmission and reception. Coordinated multi-point transmission/reception is widely used to achieve high performance of LTE networks where different transmission schemes are used. But this comes with a drawback. We are designing a LTE network, where focus is on downlink transmission. Whenever user receives signal from number of eNodeBs or from one eNodeB with spatially separated antennas, then it becomes difficult to determine the pre-coders and filters. Thus desired channel estimation becomes difficult. To overcome this problem, a runtime pre-coding algorithm will be developed that will be implemented in UE. This algorithm will help determine pre-coders and filters and thus upscale simulations and network performance.

System level simulation is being carried out that considers large number of network elements for performance evaluation unlike link level simulations that considers only one link for performance evaluation. Also link level model is highly complex and requires mathematical computations. We have designed the system using matlab simulator. The performance evaluations are to be done for both scenarios i.e. LTE network without algorithm implementation and network with algorithm implementation. A comparison is to be made in these two models to know the efficiency of algorithm implemented.

II. ORGANISATION OF THE PAPER

In the paper, following sections are organized as follows. Section III describes briefly the advantages of simulator used, section IV describes the system model, section V shows the

obtained results and section VI gives an overall conclusion.

III. SIMULATION TOOL

There are various simulation tools that are used to develop simulation level scenarios of wireless networks. This includes NS2, NS3, Matlab, Omnet, etc. out of these, we have chosen Matlab. It is high performance software and is used by professionals, teachers and students worldwide. It has an inbuilt LTE toolbox that makes easy to develop physical layer and algorithm development. It supports all downlink transmission modes and provides link adaption strategies.
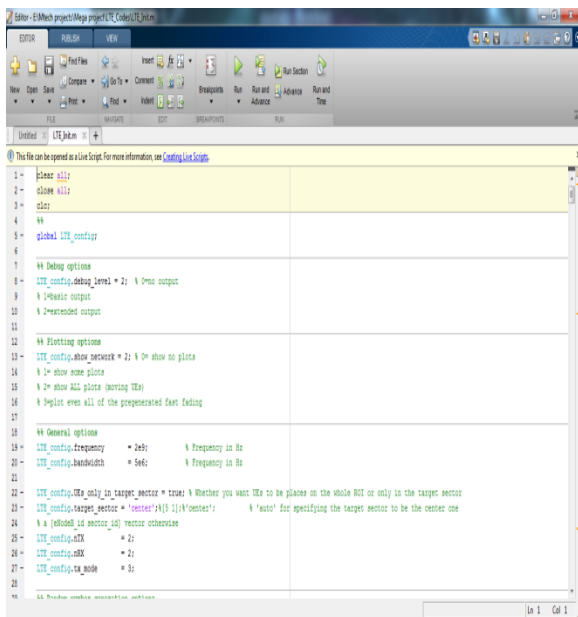

Figure.1. Matlab simulator

IV. SYSTEM MODEL

The general block diagram of the system is as shown in figure.1 below. The transmission link is divided into link quality model and link performance model. The link quality model will measure the quality of the received signal and link performance model will translate this into throughput, BLER, BER, etc. As every wireless transmission faces losses and interference, here also path loss, shadow fading and small scale fading is considered. Also this will later

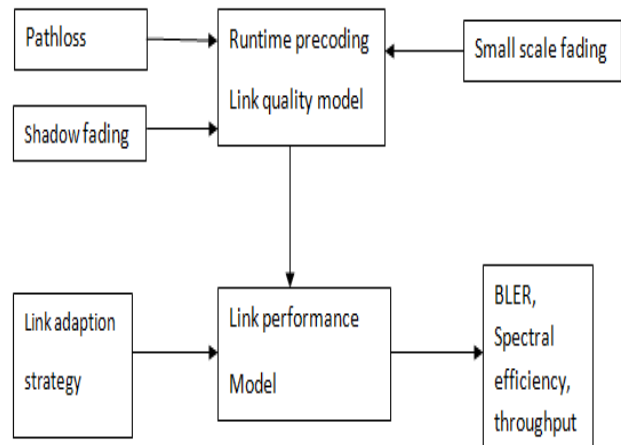contribute while working of the algorithm being developed.

Figure.2. General block diagram of proposed system

a) LTE network development :

Matlab provides us with an inbuilt LTE toolbox. So, the main focus in our work is on physical layer development of the LTE network. The main work is carried on physical data shared channel (PDSCH).

2x2 antenna configuration is used and random data is generated and sent. The data bits are coded using STBC coder which generates data in form of matrices with columns equal to number of transmitting antennas and rows equal to time slots. The modulation scheme basically depends on the CQI, that user sends feedback information to the network about channel quality. For downlink transmission, LTE uses OFDM multiplexing scheme, this overcomes multipath fading. Cyclic prefix is added to the data to avoid interference. Normal cyclic prefix is used. Also, pilots are added for estimation of channel characteristics. The channel used for transmission is AWGN channel. This is basically selected to keep the complexity low. On the receiver side, corresponding opposite processes are carried out upon receiving the signal.

The parameters used to configure LTE network are as listed in Table.1 below.

Table 1. LTE configuration parameters

PARAMETER	VALUE
Frequency	2GHz
Bandwidth	5MHz
Antenna configuration	2x2
Transmission mode	OLSM
Simulation time	100 TTI
Transmitting power	40W
Inter eNB distance	500m
Channel model	PedB
Feedback channel delay	3 TTI
SINR averaging algorithm	MIESM
Cyclic prefix	Normal
Receiver type	ZF
Receiver noise figure	9 dB

b) Runtime pre-coding algorithm :

The algorithm will be implemented in user's link quality model. When signal is received from spatially separated antennas or from multiple eNodeBs then it is possible to pre-generate the normalized small scale fading matrices. The composite channel of desired signal can be obtained by stacking the matrices from transmitter site and then weighting them with corresponding losses. This gives us the effective channel where optimal pre-coders and filters are determined at runtime.

The steps of algorithm are as follows:

1. RP implementation in UE's link quality model

2. Signal reception

3. Collect small scale fading channels and macro-scale losses

4. Channel stacking from each transmitter site

5. Weight them with macro-scale losses

6. Corresponding pre-coders are determined and Receive filter is computed.

V. RESULTS

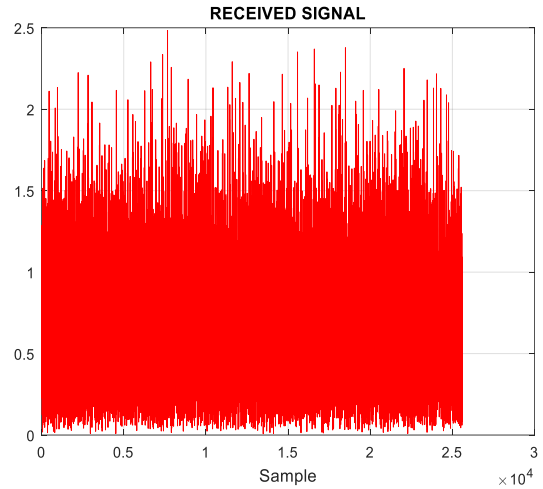Figure 3 shows the received signal that is distorted due to noise added in it.

Figure 3. Received signal

The below figure 4 shows the throughput of the LTE network generated on simulation level. The graph shows a gradual increase in the throughput with respect to Eb/No.
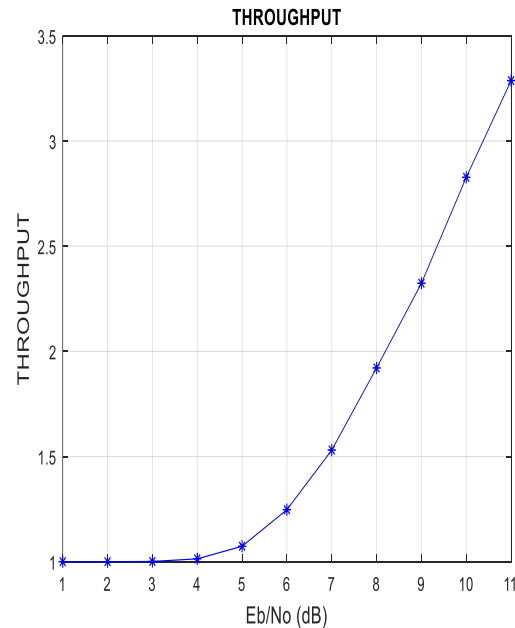

Figure.4. Overall throughput of the network

VI. CONCLUSION

In downlink transmission, whenever user receives from multiple transmitting points, predicting the pre-coders and filters is not possible. Thus, a system level simulation of LTE network is done using appropriate link abstraction model. A runtime pre-coding algorithm is to be developed, which after implementing in UE can show better network efficiency.

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