Electrical Engineering department
EE411 -111

Project title:

Implementing of Multi-Input Multi-Output Wireless Communication System on a Software-Radio Platform

By :Abdullah AlKhater, Fares AlHarbi, Abdullah AlAnazi, Musaad AlOlayan . For D.r Wajih AboAl-Saud, D.r Adnnan Andalusi

LYRTECH

OBJECTIVES

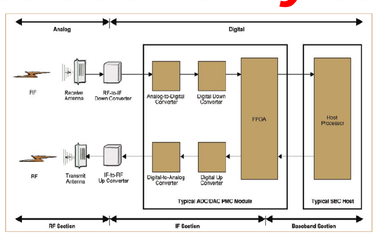
- Testing and evaluating the performance of several communication systems on a Software Defined Radio (SDR) system that is built by the Canadian company, Lyrtech.

- Test 4 cases of transmission:
- 1x1: 1 antenna transmitting from the transmitter to 1 antenna from the receiver.
- 2x1: 2 antennas transmitting from the transmitter to 1 antenna from the receiver.
- 1x2: 1 antenna transmitting from the transmitter to 2 antennas from the receiver.
- 2x2: 2 antennas transmitting from the transmitter to 2 antennas from the receiver.
- Comparisons between these four cases and choose the best of them.

Advantages of MIMO:

- Transmitting two or more data streams in the same bandwidth.
- Higher data rate can be transmitted using the same WLAN (up to 6 times more speed)
- All received signals will be processed and the receiver will interpolate them to build up the original signal.
- Easy mitigation of the multipath interference
- Better robustness and reliability in the wireless links.

Illustration of Lyrtech:



- **Signal transmission:**

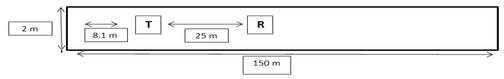
- **Signal reception:**

Cases of transmission:

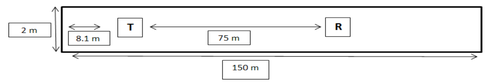
❖ Line of sight

In which the two devices see each other as in figure. In each situation we examine the four different cases of transmission: 1Tx1R, 1Tx2R, 2Tx1R, 2Rx2R

A-Short distance: the distance between the transmitter and the receiver is about 24 m.



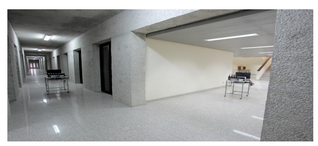
B-Medium distance: between the transmitter and the receiver which is about 60m.



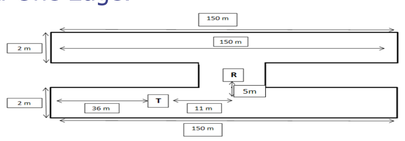
C-long distance: long distance between the transmitter and the receiver which is about 124.2 m.

❖Non line of sight:

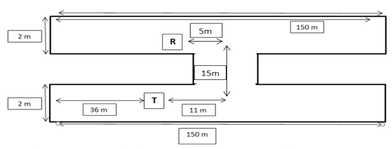
The transmitter and the receiver in situation so that the signal cannot propagate directly which is the much usual case.



a-One Edge:

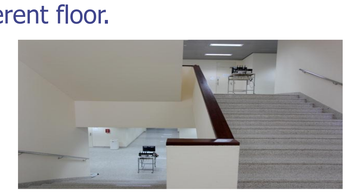


b. Two Edge:



❖Non line of sight- different floors:

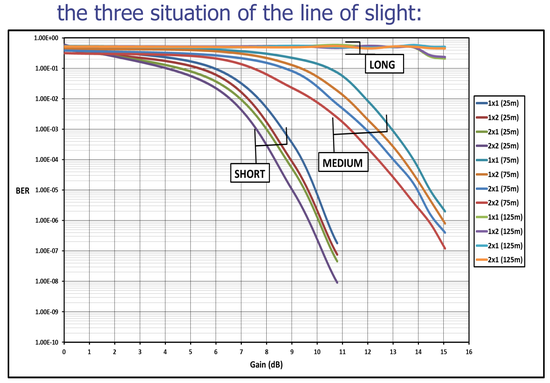
In this case the Transmitter and the receiver are in different floor.



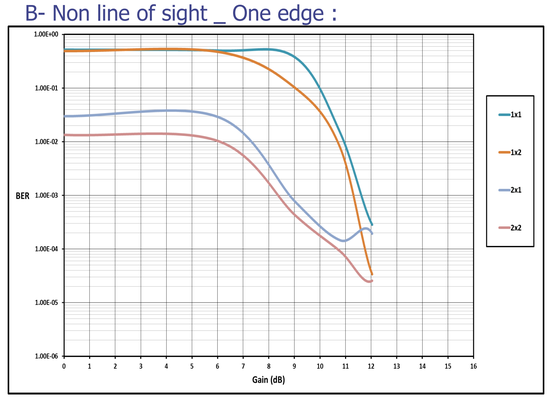
Results

In each case we calculated the **Bit Error Rate** (**BER**), which shows how many the received bits of a data stream that have been altered due to noise divided by the total number of transferred bits during a studied time interval versus the gain in dB.

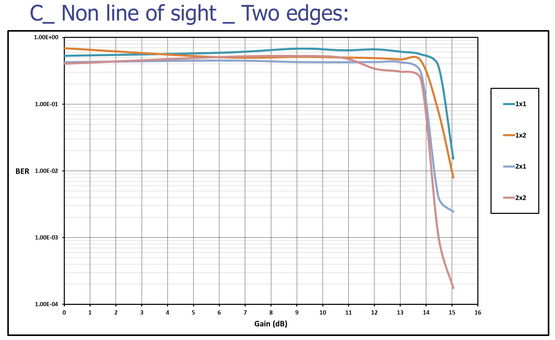
A- The following figure combines all the BER curves for the three situation of the line of slight:



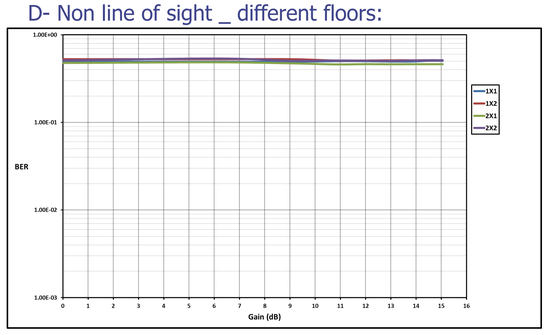
B- Non line of sight _ One edge :



C_ Non line of sight _ Two edges:



D- Non line of sight _ different floors:

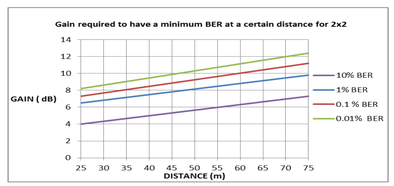


Recommendations

Some recommendations, according to readings and BER curves, are suggested in the following points for a proper use of the system:

- It is always advised to use all the antennas of the transmitter and the receiver since it has the best performance ever as the number antennas increase.
- The gain of the transmitter should not exceed the value 30 to ensure that the signal is not saturated when received.
- To have the best performance of the system, put the devices in front of each other where having the shorter distance to get the best performance.
- Never try to use the system where the transmitter and the receiver do not have a direct or indirect path, such as a wall blocks the signal totally, since the gain of the signal for the system has not worked in that case when we tried it.

- In the following figure, the gain of the transmitter that should be used for the line of sight 2x2 MIMO system as a function of the distance between the transmitter and the receiver. (Note: linear approximation is used to generalize over any distance value in the range 25m to 75m based on the tests done):



- For any separating distance between the transmitter deriver we can selected the proper gain to achieve the desired Bit per Error rate
- As a comparison between non line of sight systems, we noticed that he system for the one edge has the best performance, followed by the performance of the two edges system, then the two levels system, and this is as expected theoretically since the performance of communication system decreases as the number of objects that block the signal increase.
- Finally we really noticed that MIMO system 2Tx2R have much better performances than 2TxR1, 1Tx2R and, 1Tx1R systems over the all situations.