Experiment - 8: Effect of Channel capacity on Signal to interference ratio for various MIMO Systems

1. **Aim:** To understand the concept of MIMO system, to plot channel capacity versus SNR for SISO and MIMO system and for different MIMO systems

2. **Requirements:** Matlab/Scilab/Phyton

3. **Pre-Experiment Exercise**
   3.1 Brief Theory

   MIMO Key Technology used in 3G and 4G. Transmission of very high data rates over the transmission channels is possible due to this technology. MIMO is the use of multiple antennas at both the transmitter and receiver to improve communication performance. Wi-Fi, LTE; Long Term Evolution, and many other radio, wireless and RF technologies are using the new MIMO wireless technology to provide increased link capacity and spectral efficiency combined with improved link reliability. SISO, MISO and SIMO are the special forms of MIMO that are depicted in Fig. 1The cellular concept was a major breakthrough in solving the problem of spectral congestion and user capacity. It offered very high capacity in a limited spectrum allocation without any major technological changes.

Fig.1 Special forms of MIMO

Enhance mobile broadband is an important use case of 5G system, which uses massive MIMO antenna, mm Wave, beamforming techniques to offer very high-speed connectivity across a wide range of areas. Massive MIMO will play a crucial role in the deployment of future 5G mobile communication as greater spectral and energy efficiency could be enabled. From 1G to 4G technology one cell consists of 10

antennas. But, in 5G technologies one cell consist of more than 100 antennas. Hence, one small cell at the same time can handle multiple users as shown in Fig. 2.
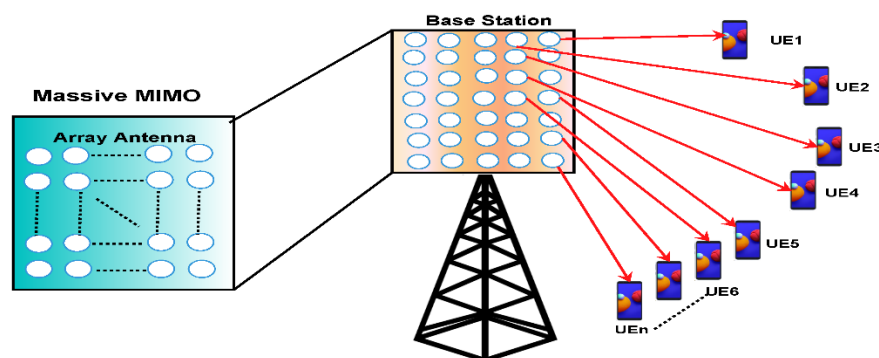

Fig. 2. Pictorial representation of multi-input and multi-output (MIMO).

The capacity of SISO, SIMO and MIMO system is given

Capacity of SISO Channel: $C = \log_2(1 + SNR)$

Capacity of SIMO Channel $C = \log_2(1 + SNR\, M^2)$

Capacity of MIMO Channel $C = M log_2(1 + SNR)$

4. Laboratory exercise Procedure

1) Write a program to find the capacity of SISO, SIMO and MIMO channel for various values of SNR

5. **Post-experiment Exercise**
   5.1 Conclusion

   5.2 Questions

   1. What do you understand by the term smart antennas

   2. What happens if we increase more number of transmitting antennas and receiving antennas