UNIT 5- MULTIPLE ANTENNA TECHNIQUES

5.1 MIMO SYSTEMS

MIMO systems are systems with Multiple Element Antennas (MEAs) at both link ends.

In a MIMO system, same data is transmitted through multiple antennas over the same path in the same bandwidth. Because of this each signal reaches the receiving antenna through a different path, resulting in more reliable data. The data rate also increases by a factor determined by the number of transmit and receive antennas.

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 using what were previously seen as interference paths.

The MEAs (The multiple element Antennas) of a MIMO system can be used for four different purposes: (i) Beamforming, (ii) Diversity, (iii) Interference suppression, and (iv) Spatial multiplexing (transmission of several data streams in parallel).

The first three concepts are the same as for smart antennas. Having multiple antennas at both link ends leads to some interesting new technical possibilities, but does not change the fundamental effects of this approach.

Spatial multiplexing, is a new concept, and has thus drawn the greatest attention. It allows direct improvement of capacity by simultaneous transmission of multiple data streams.

One of the core ideas behind MIMO wireless systems is the space-time signal processing in which time (the natural dimension of digital communication data) is complemented with the spatial dimension inherent in the use of multiple spatially distributed antennas, i.e. the use of multiple antennas located at different points.

Accordingly MIMO wireless systems can be viewed as a logical extension to the smart antennas that have been used for many years to improve wireless.

It is found between a transmitter and a receiver, the signal can take many paths. Additionally by moving the antennas even a small distance the paths used will change. The variety of paths available occurs as a result of the number of objects that appear to the side or even in the direct path between the transmitter and receiver.

Previously these multiple paths only served to introduce interference. By using MIMO, these additional paths can be used to advantage. They can be used to provide additional robustness to the radio link by improving the signal to noise ratio, or by increasing the link data capacity.

The two main formats for MIMO are given below:

Spatial diversity: Spatial diversity is often refers to transmit and receive diversity. These two methodologies are used to provide improvements in the signal to noise ratio and they are characterised by improving the reliability of the system with respect to the various forms of fading.

Spatial multiplexing *:* This form of MIMO is used to provide additional data capacity by utilising the different paths to carry additional traffic, i.e. increasing the data throughput capability.

As a result of the use multiple antennas, MIMO wireless technology is able to considerably increase the capacity of a given channel while still obeying Shannon's law.

By increasing the number of receive and transmit antennas it is possible to linearly increase the throughput of the channel with every pair of antennas added to the system. This makes MIMO wireless technology one of the most important wireless techniques to be employed in recent years.
