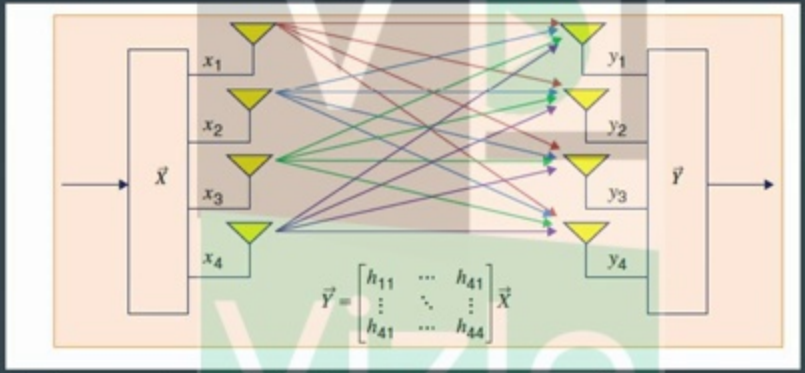
MIMO in LTE

- MIMO (Multiple input and multiple output) is a key part of LTE deployments. LTE standard is based on a combination of MIMO multi-antenna techniques and OFDM multicarrier techniques.



- The relationship between the received and transmitted signals on different antennas is expressed by a system of linear equations. In this system, the vector of received signals is expressed as a product of channel matrix (H) and the transmitted signal.

MIMO in LTE

- Transmission matrix H contains the channel impulse responses h{n,m}, which reference the channel between the transmit antenna m and the receive antenna n. Rank of the transmission matrix H defines the number of independent data streams that can be transmitted simultaneously.

$$y = H * x$$

$$H = \begin{bmatrix} h_{11} & h_{12} & h.. & h_{1m} \\ h_{21} & h_{22} & h.. & h_{2m} \\ h.. & h.. & h.. & h_{.m} \\ h_{n1} & h_{n2} & h_{n.} & h_{nm} \end{bmatrix}$$

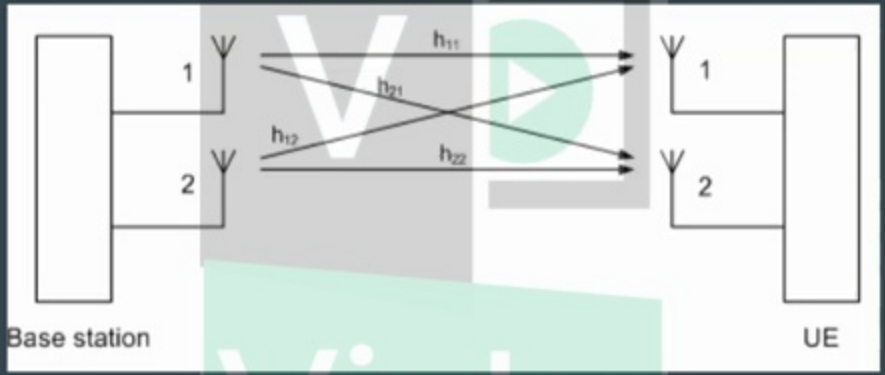
MIMO in LTE

- Transmit diversity - Increasing the robustness of data transmission. In this case the same data is transmitted redundantly over more than one transmit antenna. This increases the signal to noise ratio at the receiver. Space-time codes are used to generate a redundant signal.

- Spatial Multiplexing - Increasing the data rate. In this case data is divided in separate streams, which are then transmitted simultaneously over the same air interface resources. The transmission includes special signals called reference signals, which are known to the RX. This helps the RX in channel estimation. Spatial MUX can either be closed loop or open loop.

- Further Spatial MUX can be either single User or multi-user. In single user scenario, the data rate is increased for a single UE. When individual streams are assigned to multiple UE's at the same time it is called multi-user MIMO.

U-MIMO in LTE



MU-MIMO in LTE