3GPP TSG-RAN WG1#80 R1-150560

Athens, Greece, 9-13 February 2015

ERICSSON

SOURCE: ERICSSON

TITLE: CODEBOOK FOR 2D ANTENNA ARRAYS

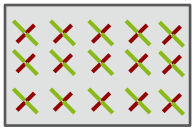
AGENDA ITEM: 7.2.4.3.1

DOCUMENT FOR: DISCUSSION AND DECISION

BACKGROUND

- eNB antennas comes in many different sizes and shapes
  - The size is determined by environmental and installation factors such as wind uptake, antenna weight, macro, micro, pico etc
  - The size/volume also depends on the heat dissipation capacity, cooling method and ultimately the implementation choices
  - When existing antennas are replaced for 2DAA capable antennas it is in many cases desirable for the operator if the physical size is unchanged so that site and site permit can be reused

- For a given size, as many antenna sub-element as possible is desirable within the given size and volume limit
  - Hence, arrays used for 2DAA could have arbitrary number of columns M and rows N



Example: (M,N,P) = (3,5,2)

BACKGROUND

- So far in this SI only values that are a multiple of 2 has been discussed for
  - The number of antenna columns N=1,2,4,8,16
  - The number of antenna rows M=2,4,8

- If the design of eNB antennas for 2DAA is restricted to these few antenna sizes, the flexibility in antenna design will be severely impaired!

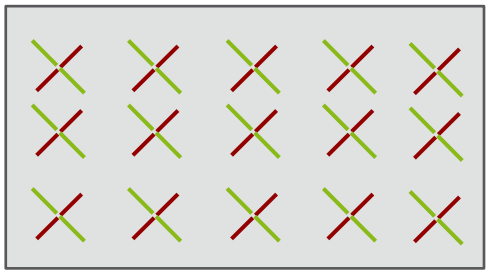
PROPOSAL

- *A new precoder codebook design is needed for EB/FD-MIMO that support feedback for arbitrary (not artificially constrained to the power of two) values of (N,M)*

EXAMPLE OF SCALABLE CODEBOOK DESIGN

- Codebook design follows the well established principles used in Rel.10 and Rel.12 codebook design
  - Simple extension to arbitrary N,M by parameterization and using a Kronecker structure to give 2D design
  - Example codebook given below for 3x5 array
    - Grid of beam based on DFT matrix with 2 times spatial oversampling

$$b_v = \begin{bmatrix} 1 \\ e^{j2\pi\left(\frac{k}{10}\right)} \\ e^{j2\pi\left(\frac{2k}{10}\right)} \\ e^{j2\pi\left(\frac{3k}{10}\right)} \\ e^{j2\pi\left(\frac{4k}{10}\right)} \end{bmatrix}, k = 0,1,..,9 \qquad b_h = \begin{bmatrix} 1 \\ e^{j2\pi\left(\frac{l}{6}\right)} \\ e^{j2\pi\left(\frac{2l}{6}\right)} \end{bmatrix}, l = 0,1,..,5$$



$$W = W_1 W_2 = \begin{bmatrix} b_h \otimes b_v & 0 \\ 0 & b_h \otimes b_v \end{bmatrix} \begin{bmatrix} 1 \\ e^{j\alpha} \end{bmatrix}$$

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