Helsinki2 MIMO Channel Sounding Campaign

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BBC R&D

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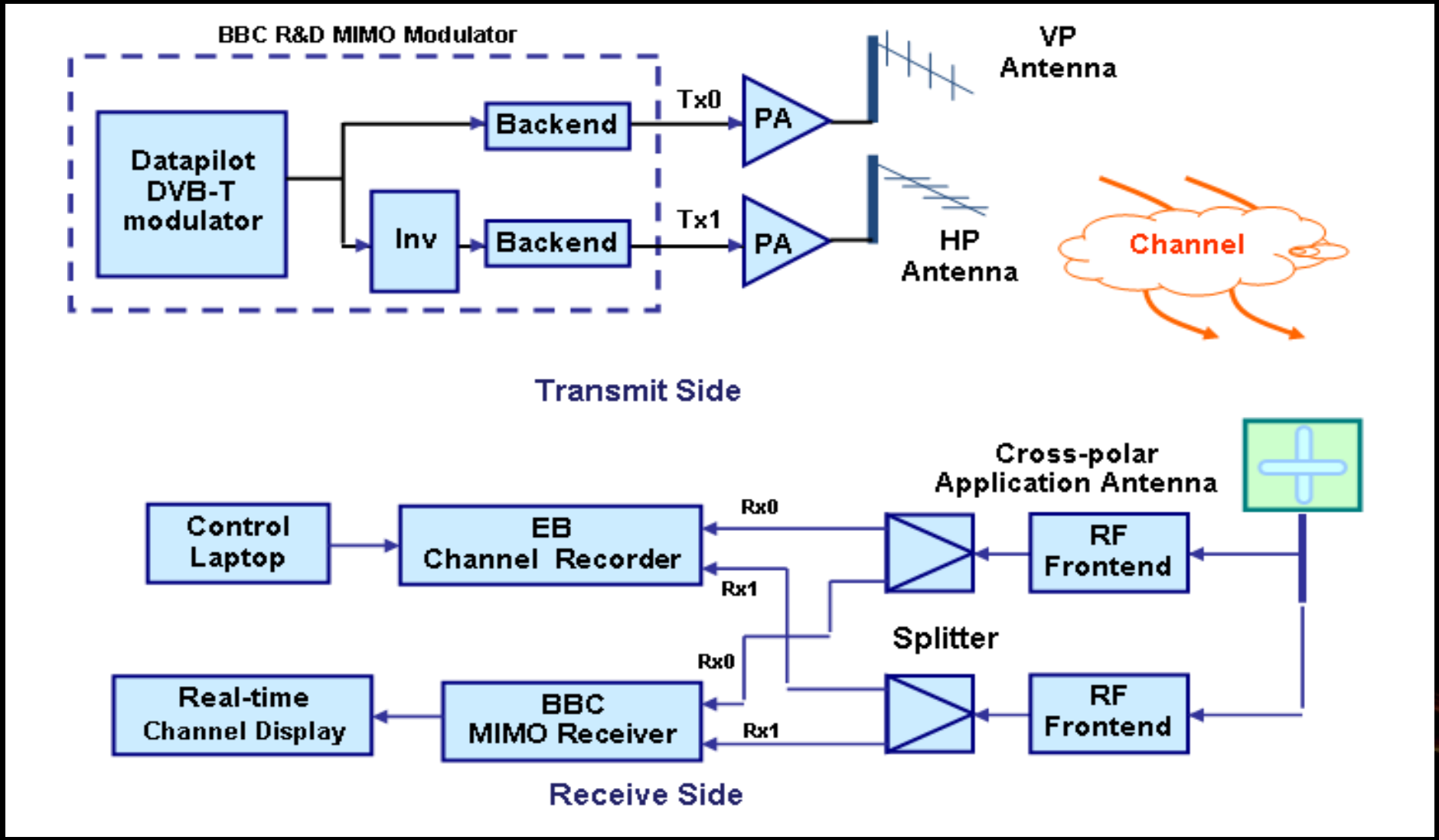
Channel Sounding: Overview

- Date : 28th June – 2nd July 2010
- Location : Helsinki, Finland
- Transmitter : Pasila Tower (north of Helsinki)
- Channel : Ch27 522MHz (Horizontal & Vertical – 2x2)
- Participants :
  - Amphenol, Digita Oy, Elektrobit, Nokia, Tampere University, TUAS and BBC
- Application Antennas :
  - Amphenol, Nokia, TUAS (x2) and BBC
- Locations :
  - Digita office (indoor & outdoor)
  - Olympic stadium car-park (outdoor)
  - Tekes office (indoor & outdoor)
  - Pasila area (outdoor)

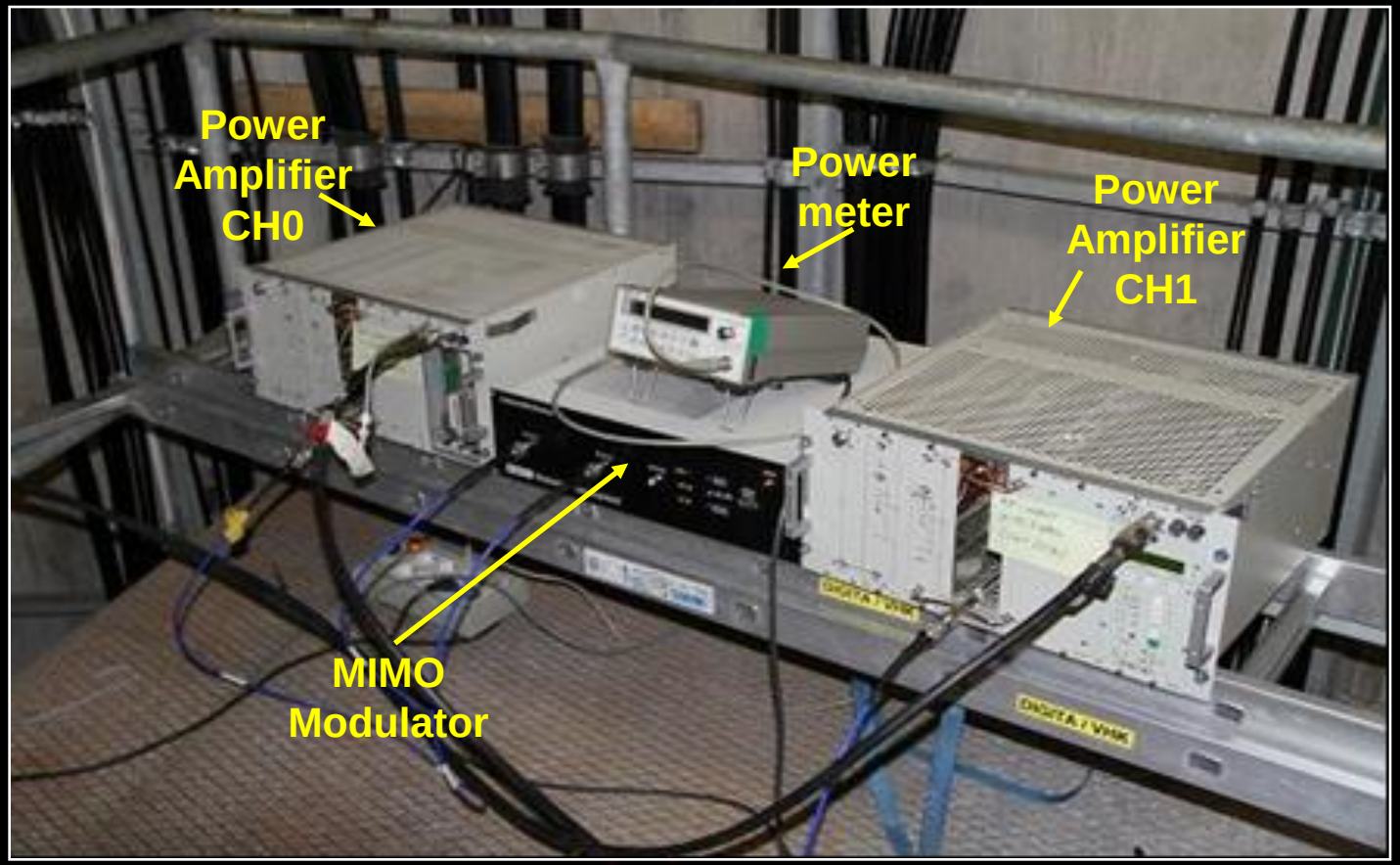
Channel Sounding: Tx & Rx Block



Channel Sounding: Transmitter(1)

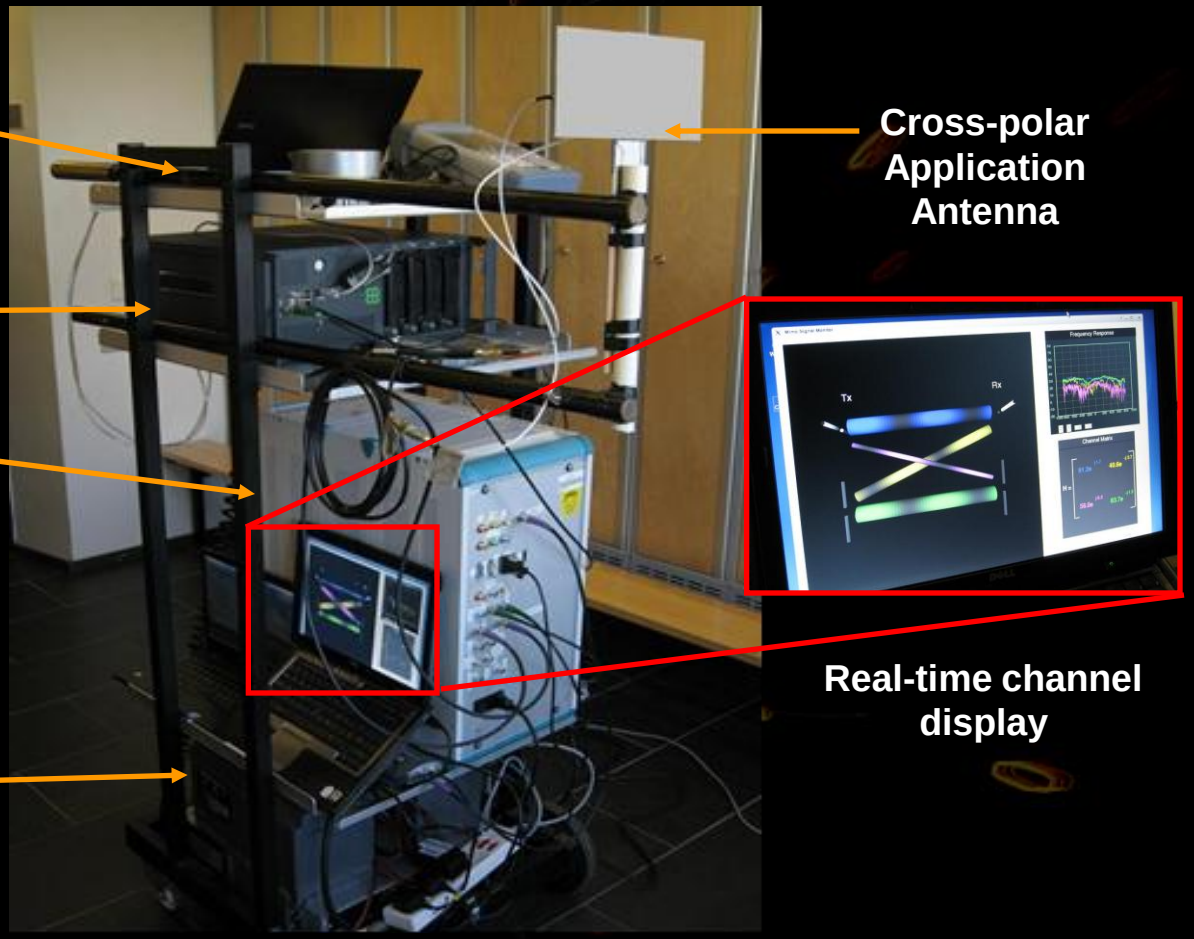
- Pasila Tower
  - YLE Transmission Tower
  - 112 meters high
  - Access through Digita Oy

Channel Sounding: Transmitter(2)

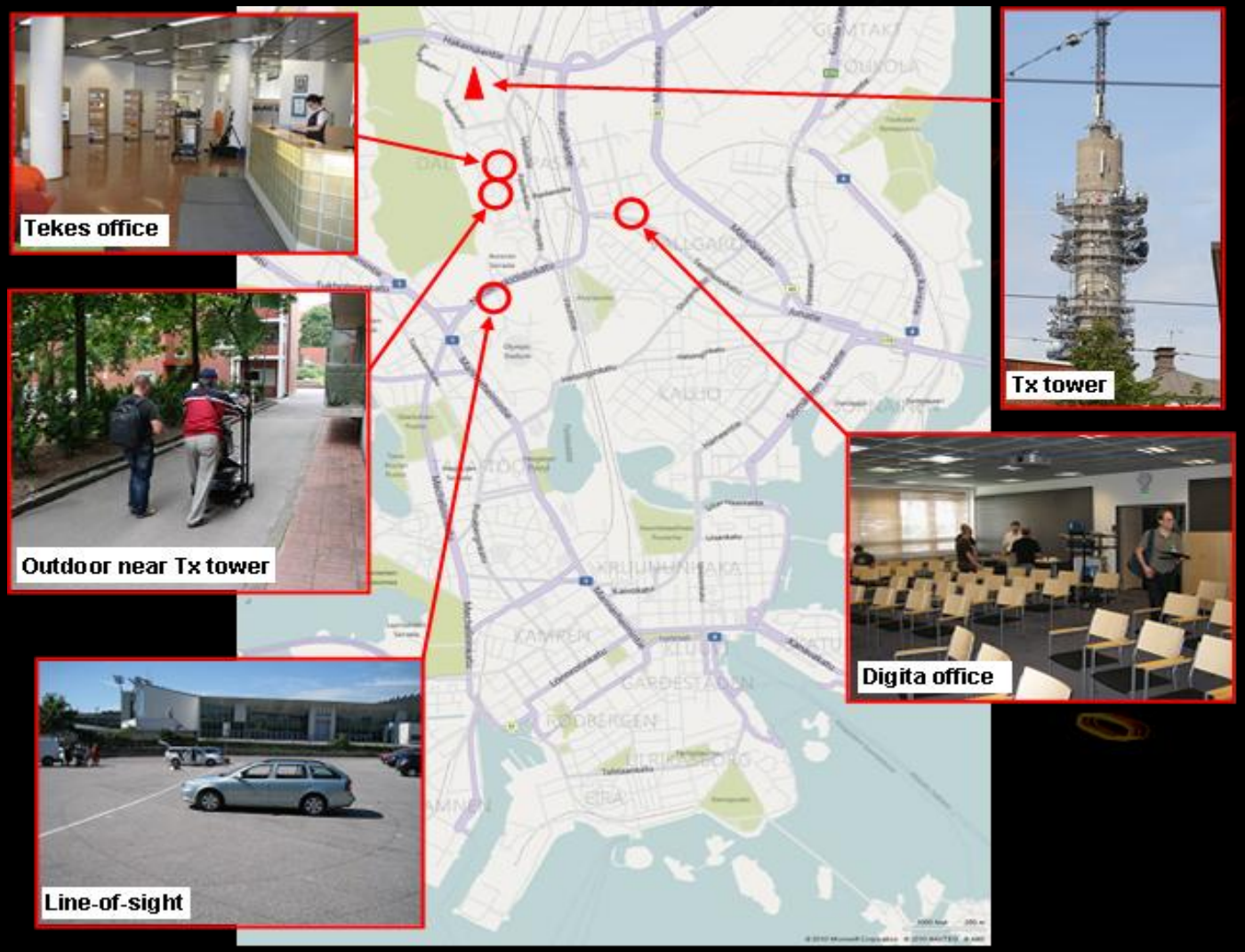


- Modulator output based on an agreed signal specification document
- Power Amplifier output: +41.6 dBm

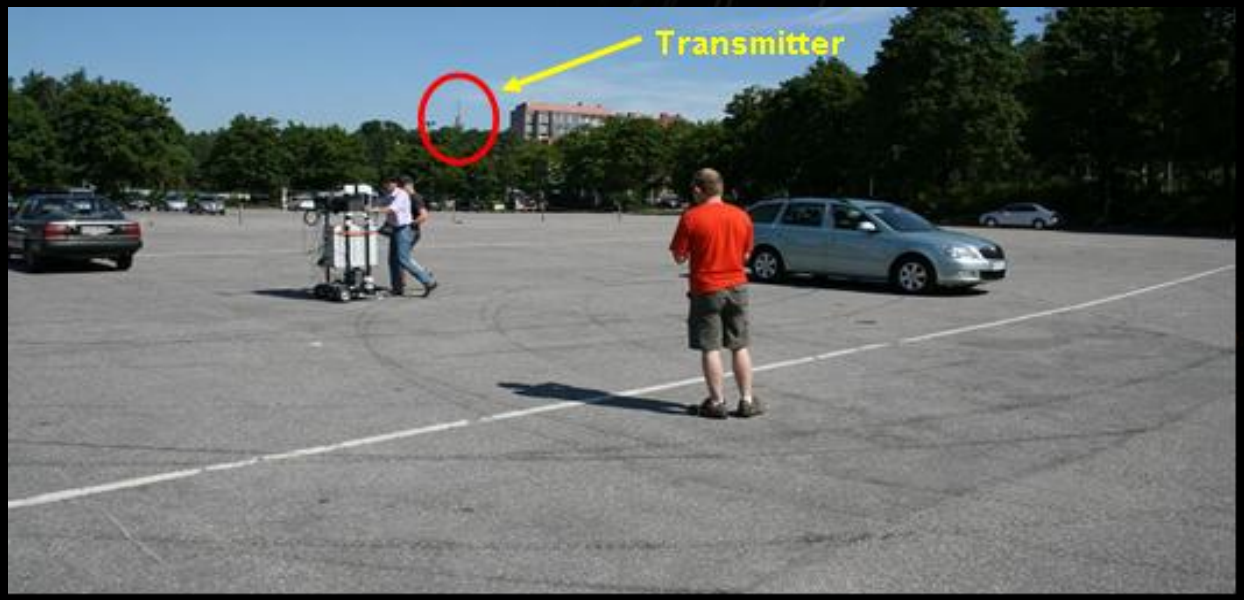
Channel Sounding: Receiver



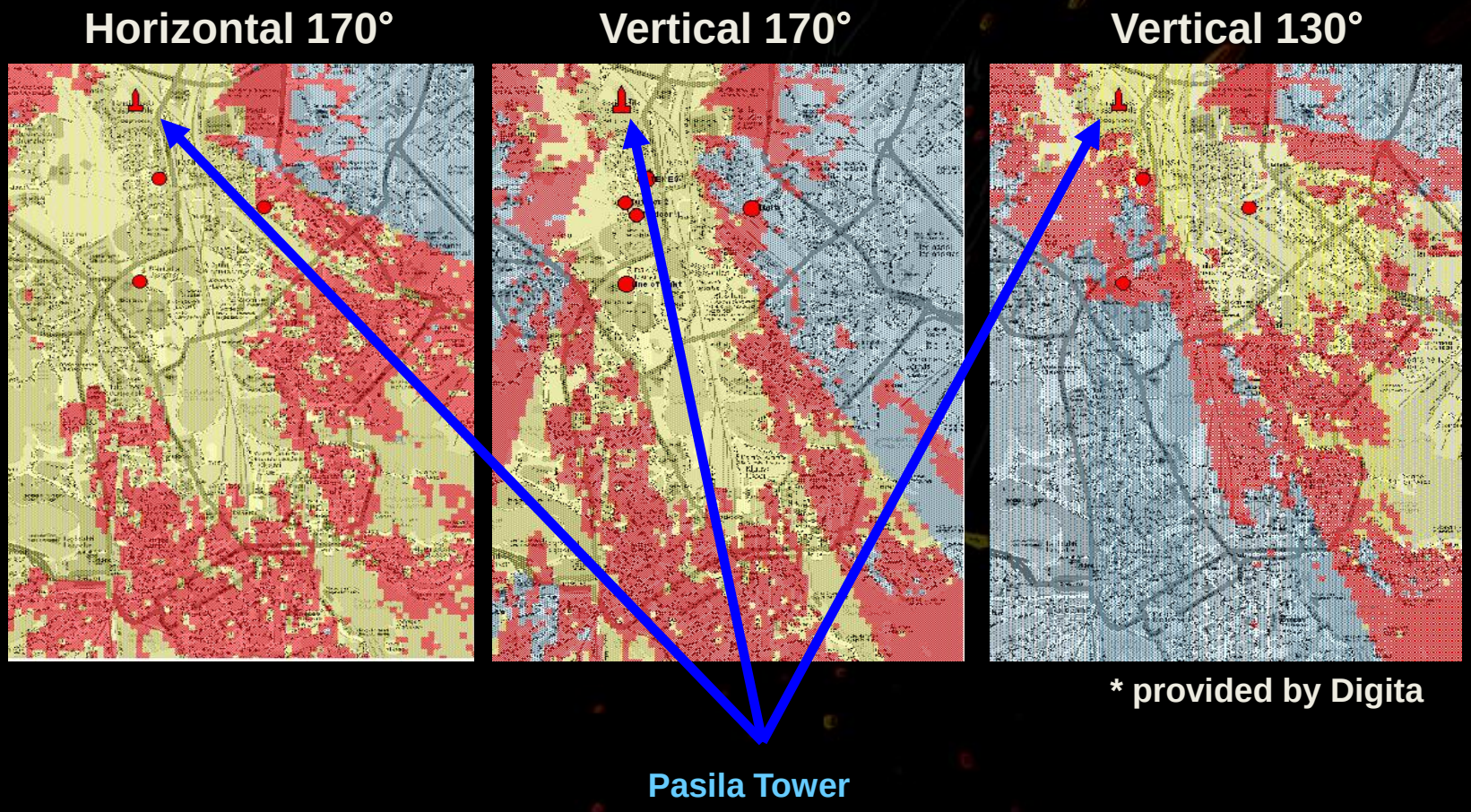
Channel Sounding: Location Map



Channel Sounding: Recording



Channel Sounding: Prediction Map



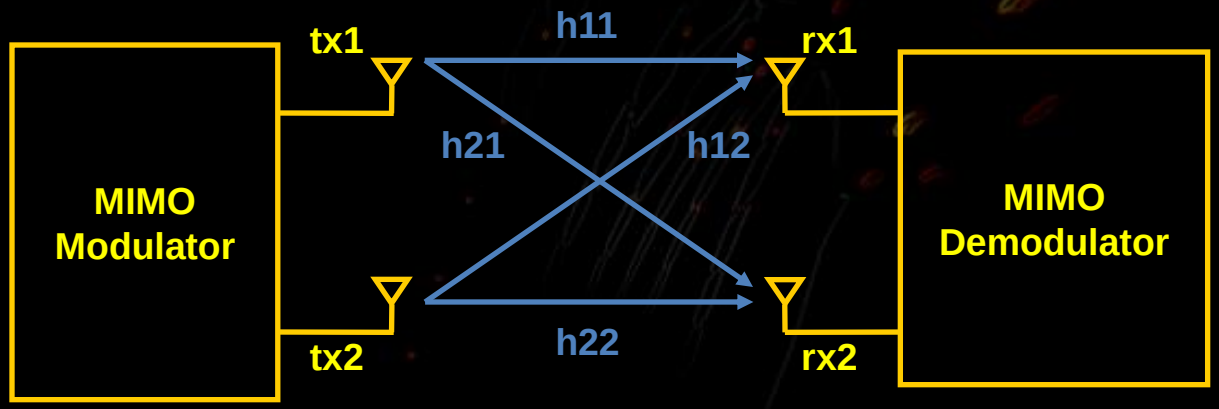
Coverage prediction at 1.5m above ground

55 dBuV/m

65 dBuV/m

* provided by Digita

Channel Sounding: Model



MIMO channel

Channel Model: Tap values

Tap no.	Excess delay	Outdoor Portable (h_{11}, h_{22})	Indoor Portable (h_{11}, h_{22})
		All terms dB	*All terms dB*
1	0.0000μs	-4.0	-6.0
2	0.1094μs	-7.5	-8.0
3	0.2188μs	-9.5	-10.0
4	0.6094μs	-11.0	-11.0
5	1.1090μs	-15.0	-16.0
6	2.1090μs	-26.0	-20.0
7	4.1090μs	-30.0	-20.0
8	8.1090μs	-30.0	-26.0

XPD Outdoor Portable : 6.0 dB
XPD Indoor Portable : 2.5 dB

Channel Model: Intra-tap Corr

- If c_i is column vector of tap weights, $\mathbf{R}_i = E\ \mathbf{c}_i * \mathbf{c}_i^{\mathbf{H}}$

- Outdoor i^{th} tap

$$\mathbf{R}_i = Pnlos_i \begin{pmatrix} 1.00 & 0.06 & 0.06 & 0.05 \\ 0.06 & 0.25 & 0.03 & 0.05 \\ 0.06 & 0.03 & 0.25 & 0.06 \\ 0.05 & 0.05 & 0.06 & 1.00 \end{pmatrix}$$

- Indoor i^{th} tap

$$\mathbf{R}_i = Pnlos_i \begin{pmatrix} 1.00 & 0.15 & 0.10 & 0.15 \\ 0.15 & 0.56 & 0.06 & 0.04 \\ 0.10 & 0.06 & 0.56 & 0.15 \\ 0.15 & 0.04 & 0.15 & 1.00 \end{pmatrix}$$

Channel Model: Rotation & Imbalance

- Basic model is ‘centred’ in respect of axis-rotation and H/V symmetry
- New pre/post matrices introduce rotation and H/V imbalance as a parameter

$$\mathbf{H}_c(t,\tau) = \mathbf{W}\mathbf{H}(t,\tau)\boldsymbol{\Gamma} = \begin{bmatrix} \cos\Omega & -\sin\Omega \\ \sin\Omega & \cos\Omega \end{bmatrix} \begin{bmatrix} h_{11}(t,\tau) & h_{12}(t,\tau) \\ h_{21}(t,\tau) & h_{22}(t,\tau) \end{bmatrix} \begin{bmatrix} \Gamma_{11} & 0 \\ 0 & \Gamma_{22} \end{bmatrix}$$

- Ω chosen from the set {-45 º, 0 º, +45 º}
- Γ chosen from $\left\{ \begin{bmatrix} 1.1074 & 0 \\ 0 & 0.8796 \end{bmatrix}, \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}, \begin{bmatrix} 0.8796 & 0 \\ 0 & 1.1074 \end{bmatrix} \right\}$

Channel Model

Documents :

- TM-NGH063r5_DVB-NGH_Helsinki2_channel _models_1v5.pdf
- channel_sounding_signal_definition_05.doc

Q & A