UNIVERSITEIT GENT

FACULTY OF **ENGINEERING**

Propagation research

WISE user committee – 3 October 2013
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INTERREG IV
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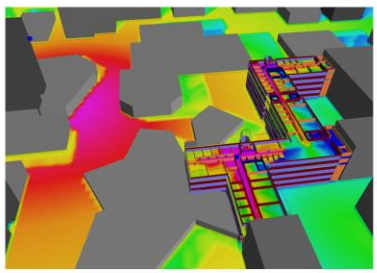
WISE – WIreless Safety for Employees

WICA

TELICE

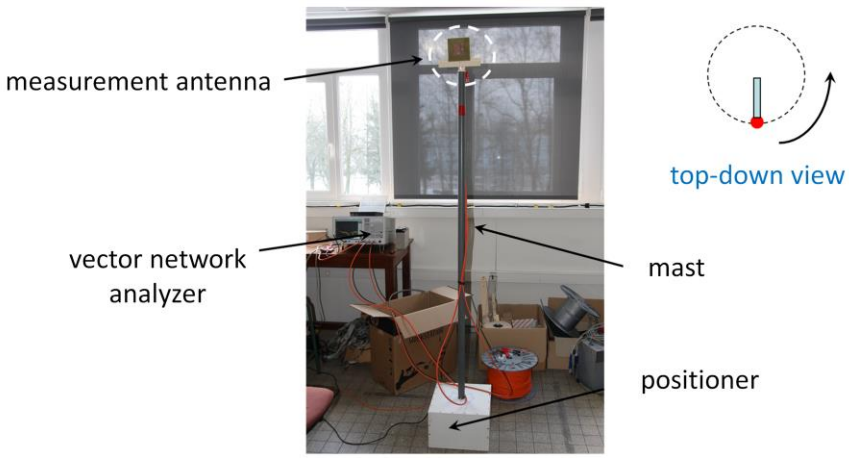
Introduction

- Propagation research
  - = modeling the behavior of the radio channel between Tx and Rx
  - in WISE, *industrial* radio channels are considered
- Applications
  - coverage/capacity planning
  - exposure simulation
  - protocol performance testing



Channel sounder

- Scans radio channel in space and frequency



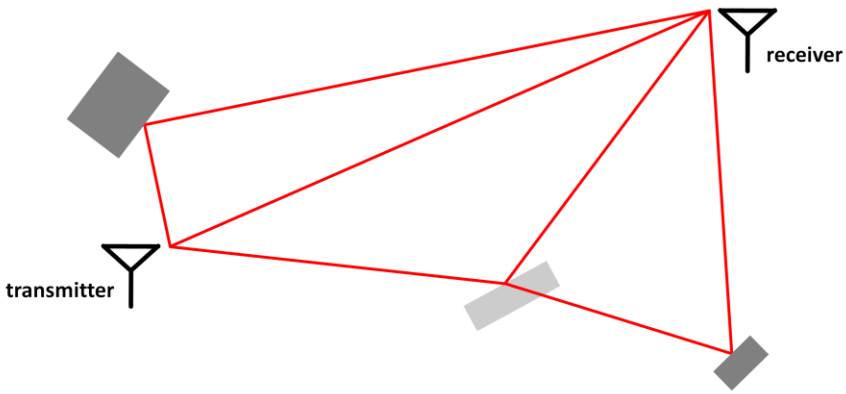
Industrial environment 1

- Container repair shop in port of Antwerp

Industrial environment 2

- Laboratory for concrete research at UGent

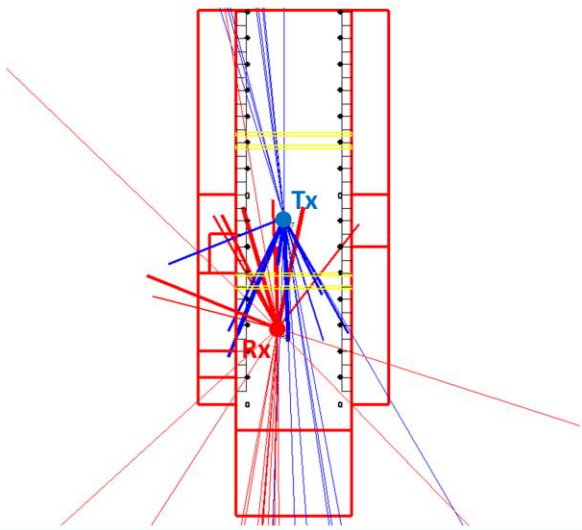
- Multipath propagation



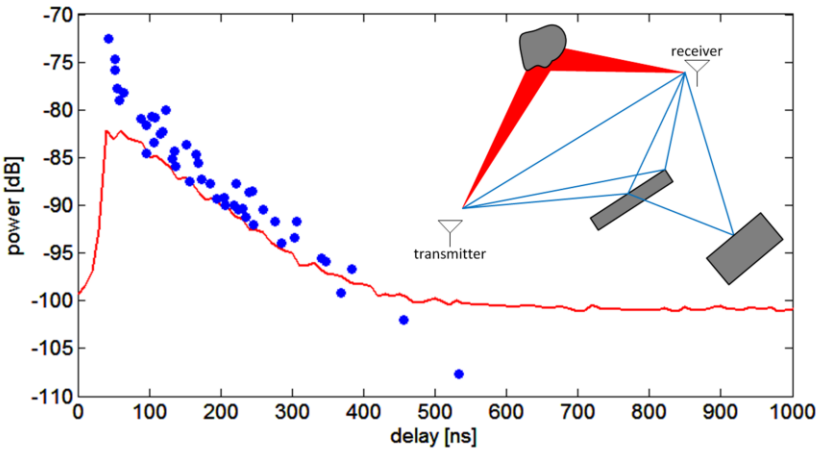
- Model = statistics of multipath components
  - time delay, angle of arrival/departure, power, …

Multipath component estimation

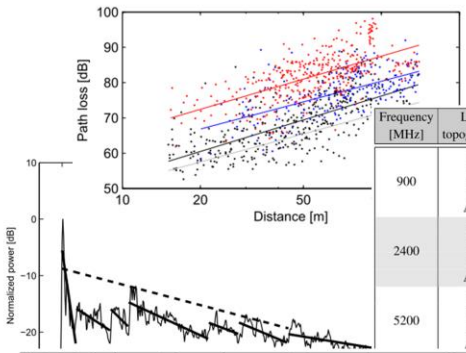
- With RiMAX (MLE method, A. Richter 2005)
- *Example:* angles of arrival & departure in concrete lab

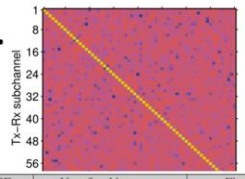


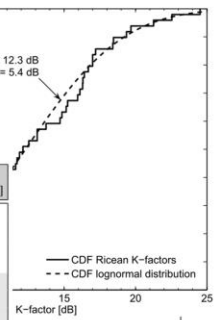
- *Example:* time delay dispersion at repair shop
  - specular and dense multipath components



- Heaps of figures and tables with multipath component statistics…







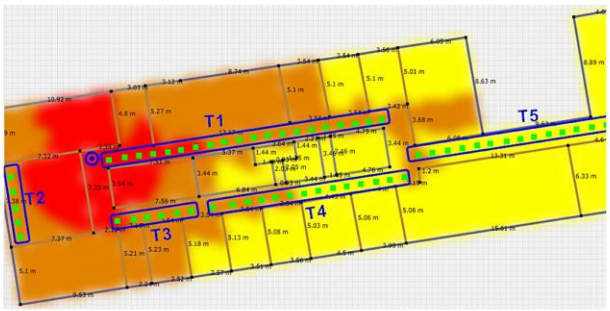
Frequency [MHz]	LSF topography	Non-fixed intercept $PL(d_0)$ [dB]	Non-fixed intercept n [-]	Non-fixed intercept σ [dB]	Fixed intercept $PL(d_0)$ [dB]	Fixed intercept n [-]	Fixed intercept σ [dB]
900	1	57.67	2.25	5.65	55.05	2.68	5.74
	2	64.42	1.94	4.97	55.05	3.24	5.62
	3	69.73	2.16	5.16	55.05	4.47	6.86
	All	**61.65**	**2.49**	**7.35**	**55.05**	**3.51**	**7.70**
2400	1	67.43	1.72	4.73	63.57	2.40	4.97
	2	72.71	1.52	4.61	63.57	2.77	5.42
	3	80.48	1.69	6.62	63.57	4.29	8.42
	All	**71.84**	**2.16**	**8.13**	**63.57**	**3.44**	**8.63**
5200	1	77.57	1.25	4.32	70.28	2.47	5.19
	2	81.06	0.68	3.87	70.28	2.18	4.93
	3	83.33	1.35	3.16	70.28	3.70	5.15
	All	**81.01**	**0.91**	**4.79**	**70.28**	**2.59**	**6.09**

link shadowing	LoS			OLoS				NLoS				
Rx number	1	4	6	5	7	11	12	2	3	8	9	10
N [-]	75	99	93	117	65	41	34	46	42	137	66	45
f_{DMC} [%]	37.5	22.9	26.6	26.9	45.3	54.7	70.2	64.4	63.9	57.1	63.0	60.1
τ_τ [ns]	77.2	79.6	70.0	84.5	74.0	70.6	64.6	73.0	79.5	82.7	83.8	74.4

	$= -0.20 \cdot \tau + 7.37 \cdot Z$
	cluster: $P_{peak} = 0$ dB
	nential with *averaged*
	val time $\overline{\Delta T_i} = 18.40$ ns
small-scale amplitude fading	first delay bin: Nakagami-m other delay bins: Rayleigh
RMS delay spread τ_{rms} [ns]	LOS: $\tau_{\text{rms}} = 41.37 - 48.51$ ns OBS: $\tau_{\text{rms}} = 43.90 - 53.70$ ns

(τ [ns] = delay, Z = standard normally distributed variable)

- Integration of model in WHIPP
  - in-house developed tool for network planning and exposure assessment
  - optimization of access point locations to meet both coverage and exposure requirements



Questions?