

Cellular positioning: from Received Signal Strength Measurements to the Algorithm

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Positioning techniques disadvantages

GPS Aided	Proximity sensing	Techniques needing extra hardware	RSS-dependent
Coverage	Accuracy	roll-out cost	Variability
Latency			
Power consumption			

Measurement setup

Possible measurement set-ups:

- 1- Base Station Analyzer
- 2- Logging devices
- 3- GSM modems
- 4- Spectrum analyzer

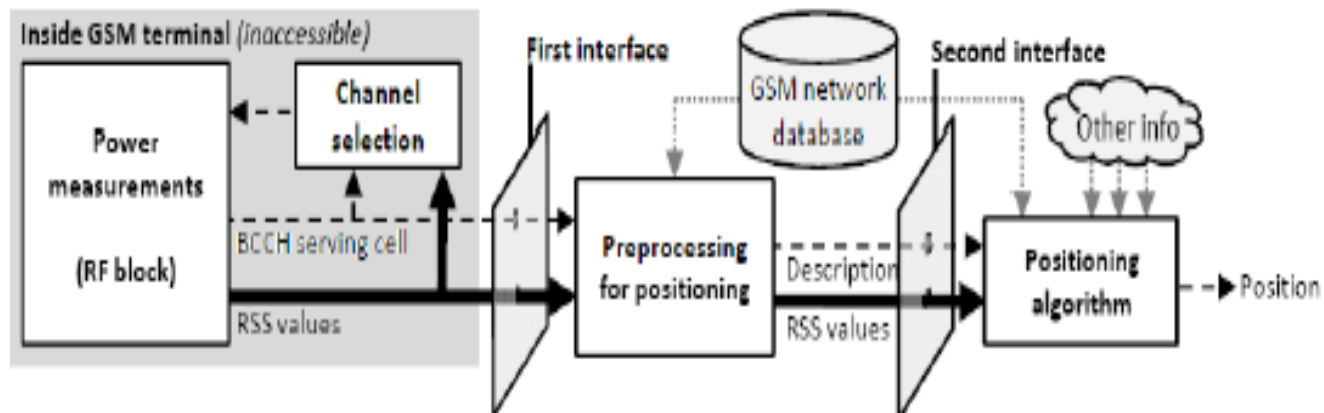
AND

**Custom-built
measurement setup**



Overview of the measurement hardware: a laptop computer, two Nokia 3310 phones (front and back view), a PCMCIA card for creating extra serial ports, and on the right a DGPS receiver with its connection box.

Overview of the RSS measurement process.

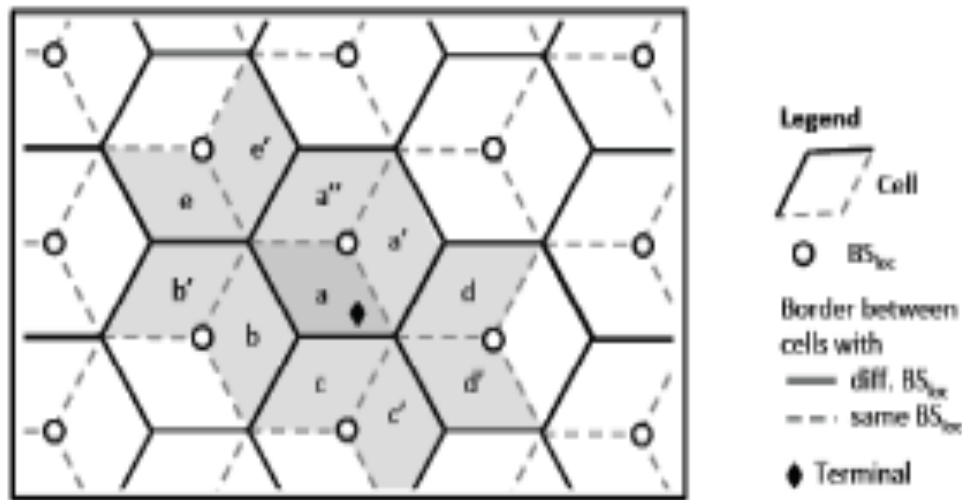


Overview of the RSS measurement process. Dotted lines mean the flow of data; thick full lines symbolize the flow of RSS measurements

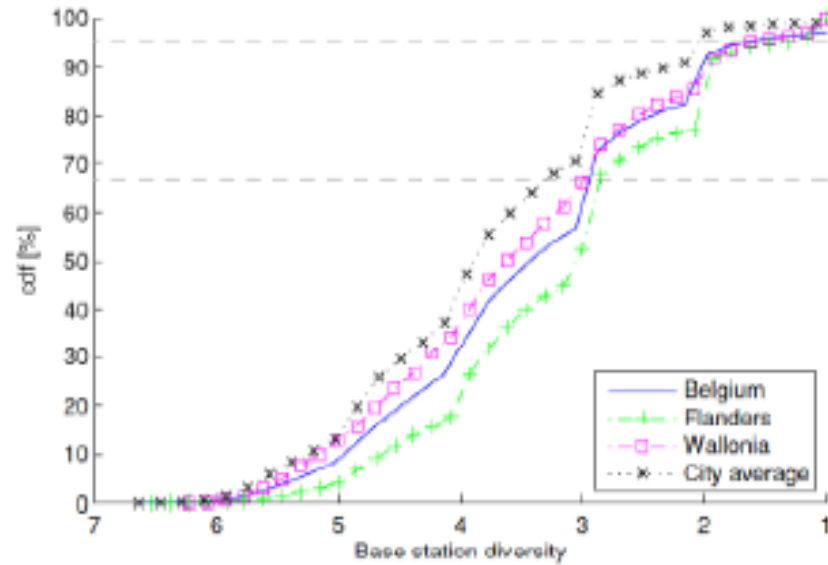
BASE STATION DIVERSITY

Base Station diversity (BSdiv):

The number of different base station locations for which RSS information is contained by the Network Measurement Report.



Idealized tri-sectored cellular network. Cell *a* is the active cell, for the neighboring cells a different letter is used for different BS location



BSdiv overview for Belgium (single frequency (900 MHz) network)

Location	# base station locations, occurrence [%]							BS diversity
	1	2	3	4	5	6	7	
Antwerp	0	1.58	11.07	37.65	33.51	14.14	2.05	4.54
Brussels	0	1.17	10.79	36.22	34.01	15.49	2.31	4.59
Charleroi	0	1.83	13.28	37.21	33.47	12.59	1.62	4.47
Ghent	0	1.78	12.87	37.03	33.58	13.02	1.73	4.48
Liege	0	2.07	13.28	36.72	34.06	12.31	1.55	4.46
City average	0	1.69	12.31	36.93	33.74	13.48	1.84	4.51

Base station diversity, global overview in an urban environment for a single frequency (900 MHz) network

CONCLUSION

- 1- Different solutions for measuring the RSS values were shown
- 2- It is possible to build an inexpensive and flexible measurement setup
- 3- Interpreting these measurements is not obvious. Most of the common pitfalls were uncovered
- 4- Using the base station diversity indicator: currently, it is only half of what is commonly assumed to be present, and this should be taken into account.

Q&A

Thanks!!!