

# The italian experience on monitoring power counters of 4G and 5G systems

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## Goals of this work:

- deepening issues about methods for determining  $F_{PR}$  values
- provide a wide statistic basis for determining which  $F_{PR}$  value can be assumed as a conservative one for the current situation of 4G and 5G networks



Italy: **national platform for control of power counters in BS**. This data must be available for Environmental Agencies, in order to verify the respect of parameters declared during authorization of BSs

Power counters are provided for each cell of a BS, intended as a specific system in a certain frequency band and direction (sector).

The data are TOTAL POWER data for each cell (not considering beamforming power distribution in case of active antennas), thus just updating previous examples contained in TR.



At present, data are collected using mobile time windows, and the higher value of 6min. average is saved each hour.

$F_{PR}$  calculated from these data includes  $F_{TDC}$  (because power counters measure directly average power, taking into account both downlink and uplink periods).

The analysis here following regards data of BS throughout Italian territory, for a time period of five months.



5G (N78 band): data for **6228** cells are available (482 cells providing FWA services, 5746 cells providing mobile services)

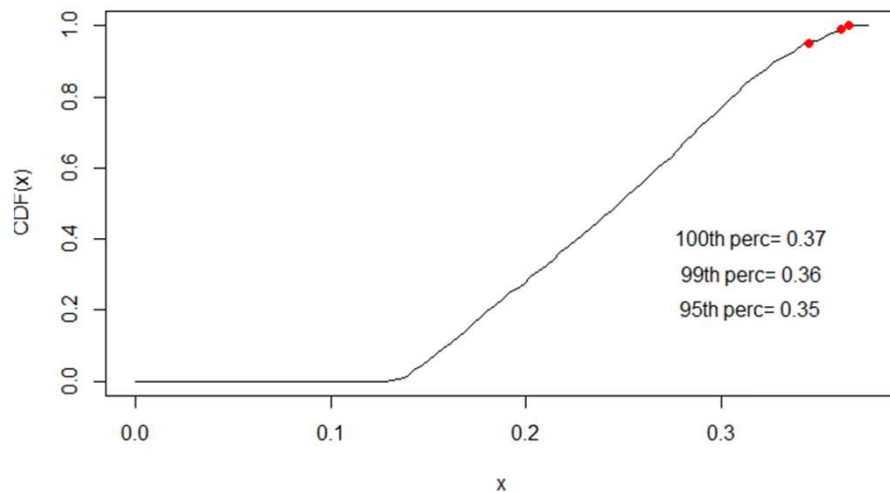
4G (42 band): data for **500** cells are available

The **Empirical Cumulative Distribution Function\*** was determined for each cell, using  $(24 \times 153) = 3672$  samples

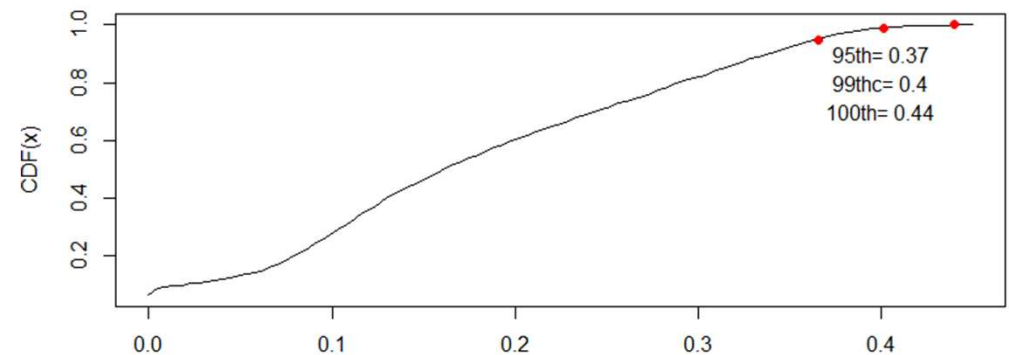
*5G active antennas*

*4G passive antenna*

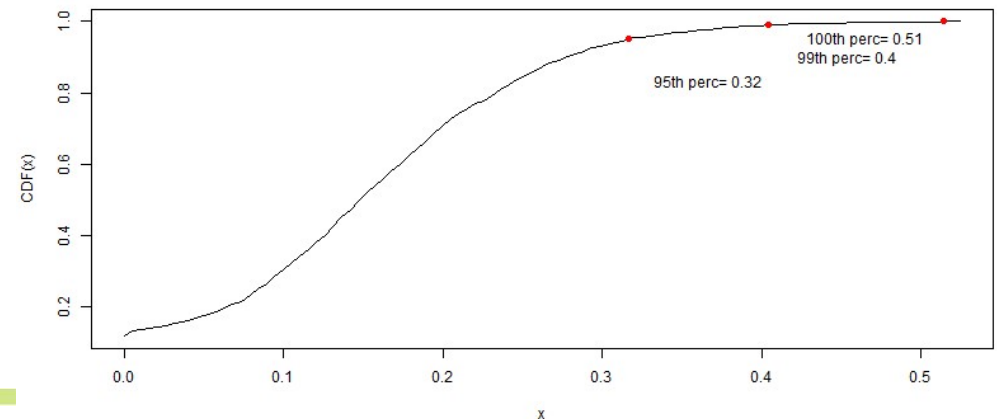
CDF 4G cell Urban centre



CDF 6 minutes P mean/max P - Urban Centre



CDF Urban station: sector 2

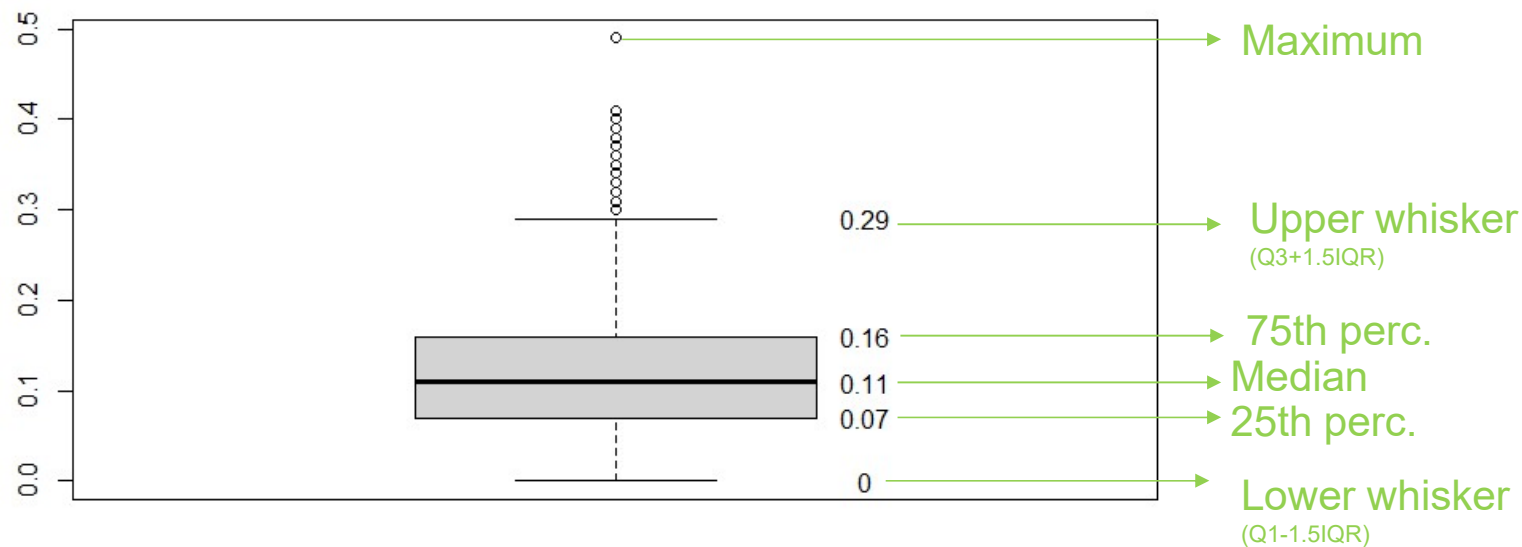


\*ECDF() function in R environment was used

From the ECDF, for each cell the 95<sup>th</sup> and the 100<sup>th</sup> percentile are determined, and finally the distributions of these values throughout the N cells are studied (N= 6228 for 5G systems, N= 500 for 4G systems).

Boxplot of 95<sup>th</sup> percentile for 5G mobile services cells (5738)

Distribuzione 95th perc Pmedia 6 minuti/Pmassima per cella



Analisi svolta su 5738 celle 5G telefonia



## Results of the analysis for 5G BS

	95° percentile values of all cells	100° percentile values of all cells
Maximum	0.48	0.75
95th perc.	0.28	0.51
99th perc.	0.34	0.55

## Results of the analysis for 4G BS

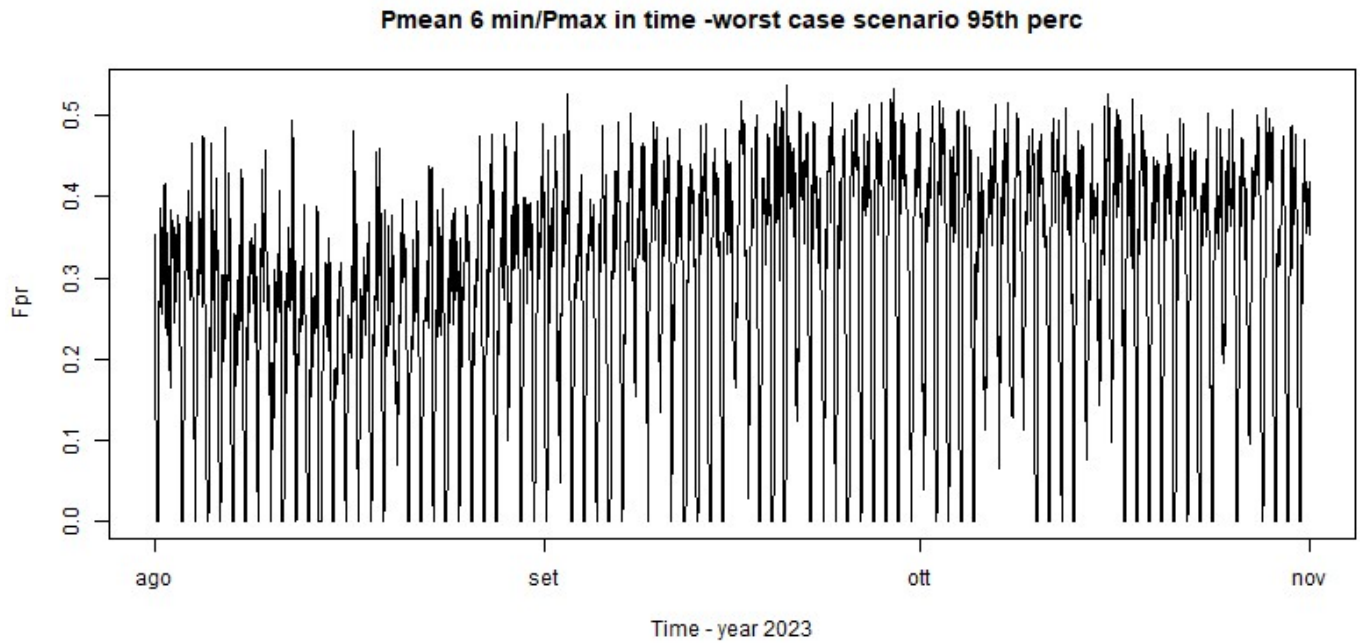
	95° percentile values of all cells	100° percentile values of all cells
Maximum	0.37	0.73
95th perc	0.36	0.41
99th perc	0.36	0.64





# Some examples of time-trend for specific cells

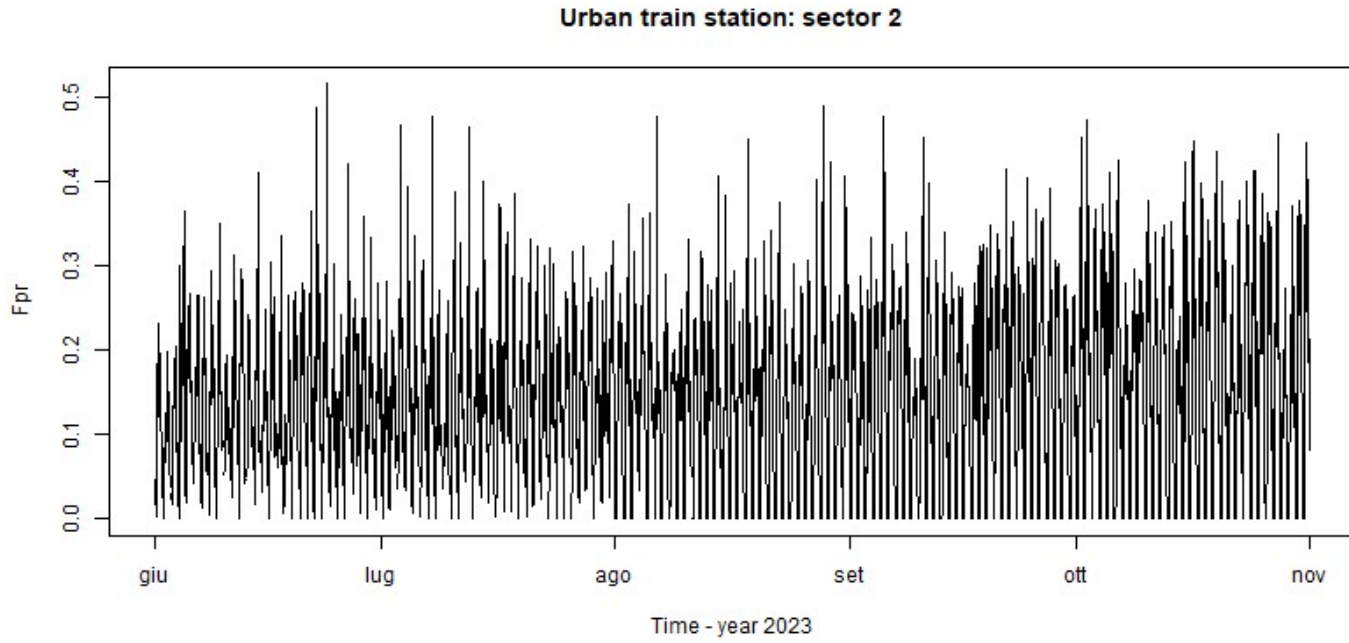
Pmax= 50W





# Some examples of time-trend for specific cells

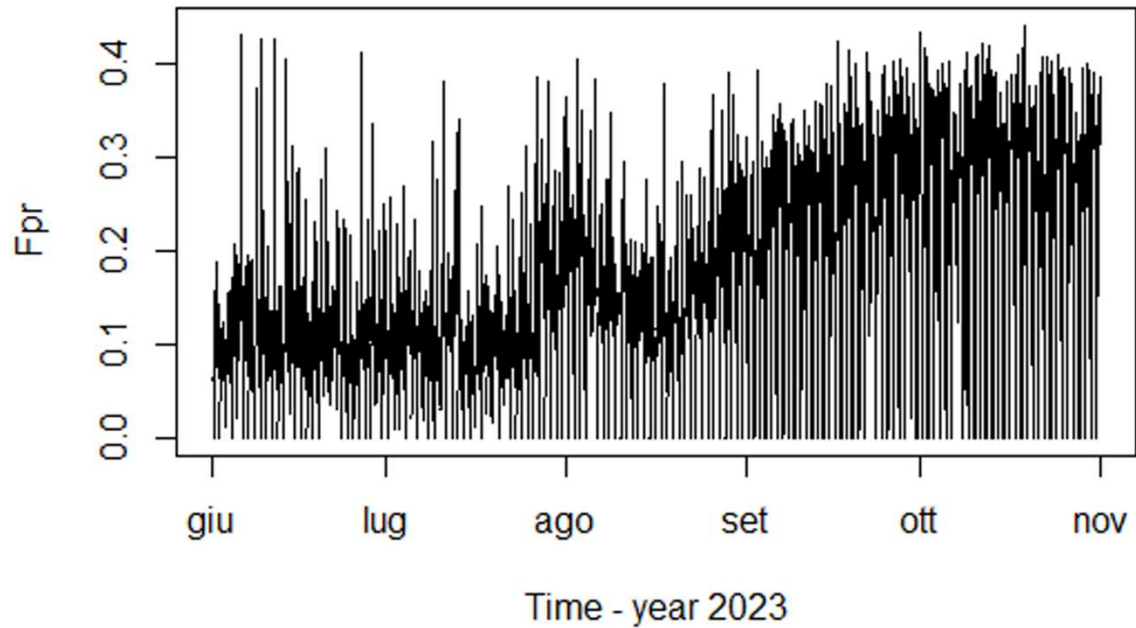
Pmax= 20W





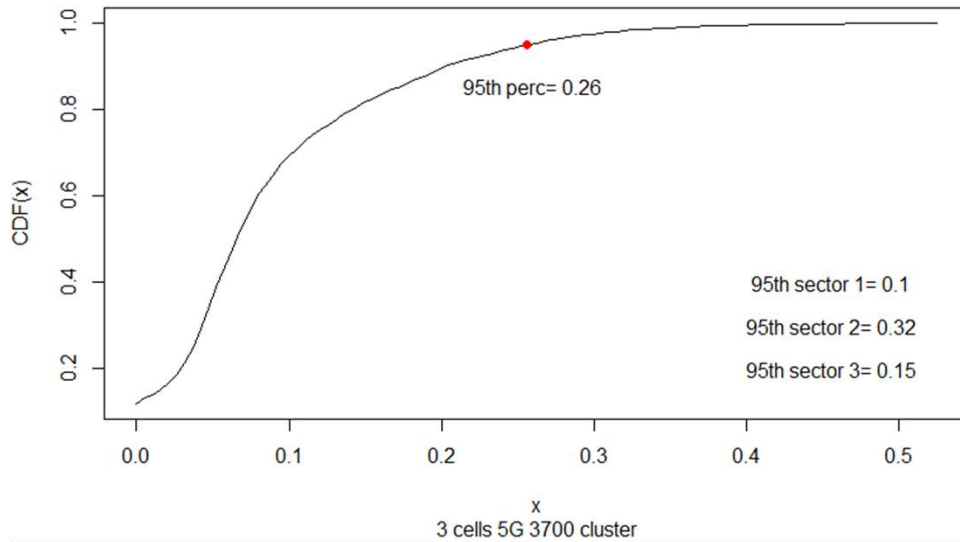
## Some examples of time-trend for specific cells

Urban centre



# Cluster of cells

CDF 6 minutes P mean/max P - Urban Station

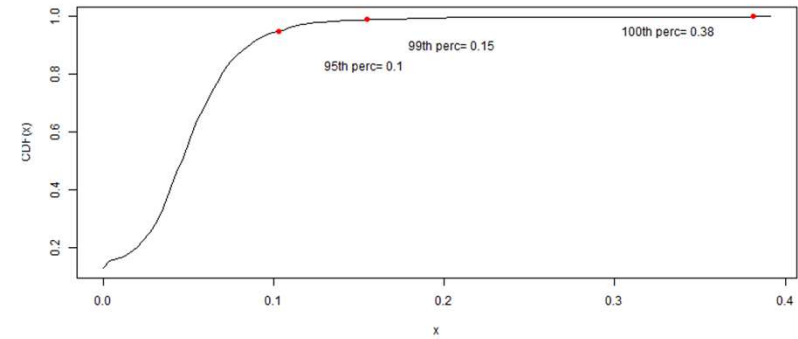


Not a conservative approach

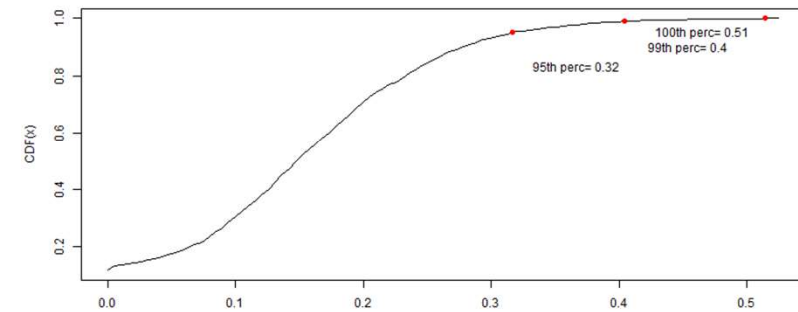
VS

# single cells

CDF Urban station: sector 1



CDF Urban station: sector 2



CDF Urban station: sector 3

