CEPT CCH GSM
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Source : FRANCE

TITLE : Propagation measurements in GRENOBLE.

Abstract : The French PTT administration has performed recently propagation measurements in the city of GRENOBLE, in the French Alpes mountains. The conclusions of these measurements are presented in terms of requirements for the future GSM system.

Language of origin : French

I - INTRODUCTION

In order to get precise data for the problem of long echoes in propagation in mountain areas, the CNET has performed during the month of May propagation measurements with the equipment used for propagation measurements during the GSM tests in PARIS.

Although the processing of the whole amount of data is not completely achieved at this moment, we are able to present interesting preliminary results concerning long echoes.

II - DESCRIPTION OF MEASUREMENTS

The measurements were made using the same method as those on the GSM test routes in PARIS :

The transmitter is located at a "Base Station" on the CNET building ouside GRENOBLE, at about 20 m high. Very steep mountains are present at distances of 4.5 to 8 kms.

A carrier (900 MHz) BPSK modulated by a pseudo-random sequence is transmitted with 40 Watt output power.

The receiver is carried in a van, driving at distances between 1.5 and 5 km from the transmitter. Some measurements are made at a distance of about 5 km, the van driving in the center of the city.

In the receiver, the signal, converted to IF, enters a SAW matched filter, and the complex baseband impulse response of the channel is sampled and stored in the hard disk of a micro-computer.

The processing is then made in the computer center of CNET.

The equipment was able to measure delays up to 50.8 μs. Due to the very high stability of the clock references, direct paths are "easily" identified by post processing.

The measurement output is a collection of 16000 independant complex impulse responses of the channel.

On each impulse response, defined with a 250kHz sampling frequency, the "optimum window" position is determined. The ratio of the received power inside the window, to the received power ouside the window is calculated. These calculations are made for a window of 12,16, and 20 μs. For each value of the window, statistical results are presented, for the city of GRENOBLE, in table1.

Some typical cases and exteme cases of delay profiles (received power averaged on fading) are presented in fig. 1.

III - CONCLUSIONS

In more than 50 % of the cases, the delays are not longer than the delays measured in PARIS. However, delays higher than 10 µs happen quite often, and cannot be neglected. In some extreme cases, very long delays occur, up to 25 µs, with significant power for the delayed paths (-5dB). However, this situation is an exceptionnal one, and should not be considered in the acceptance tests for the GSM system.

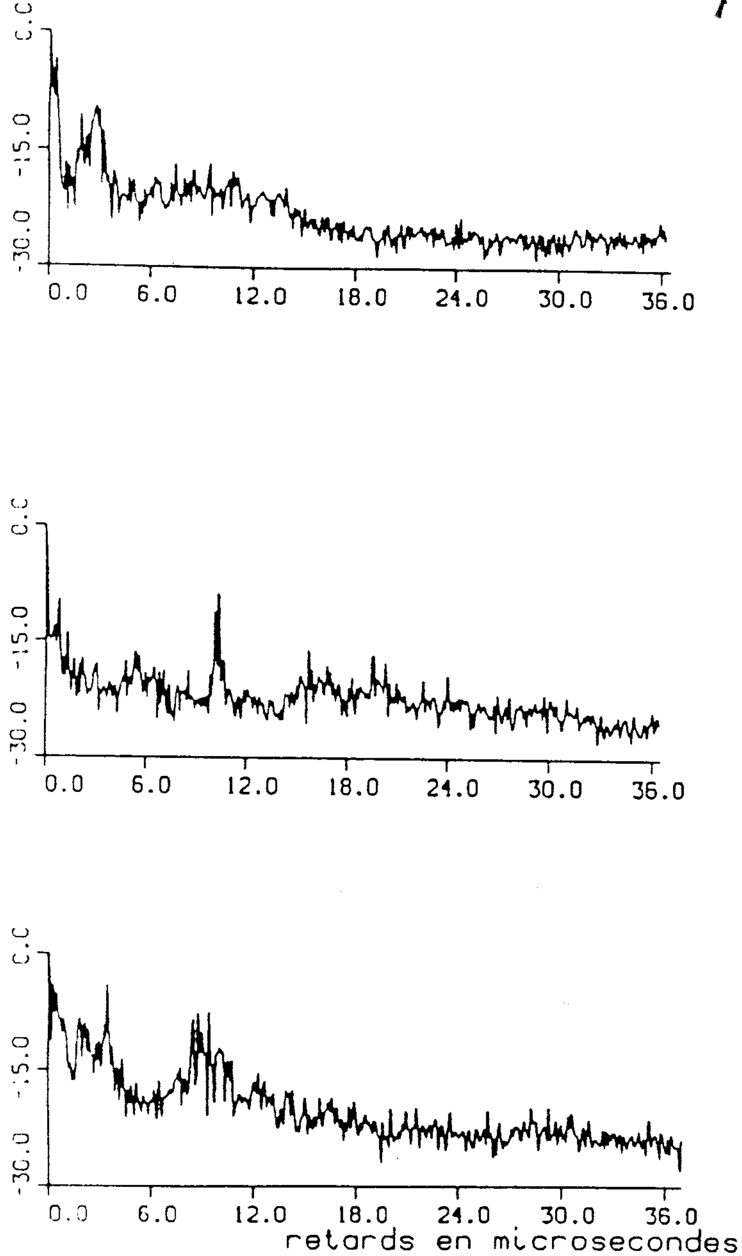
Whereas the delays measured in PARIS were "always" smaller than 10 µs, the delays measured in GRENOBLE can be considered as "always" smaller than 16 µs, the percentage of cases where significant delays of more than 16 µs is not zero but certainly neglectable.

Thus, we propose to require for the GSM system, to be able to work with a propagation model including delayed paths up to 16 µs, with equal energy in the first part and the second part of the delay profiles.

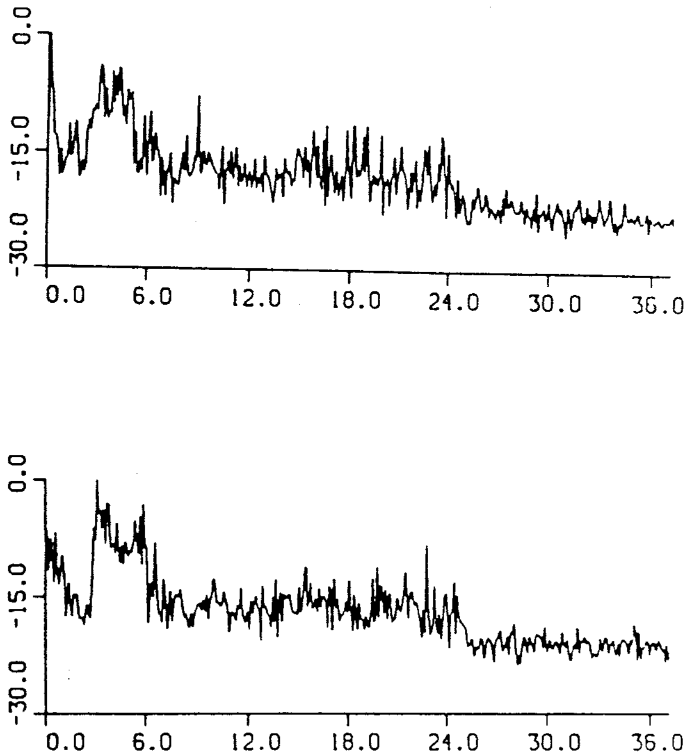
TABLE 1

probability	12 μs window	16 μs window	20 μs window
50%	30.0 dB	30.0 dB	30.0 dB
25%	15.2	20.6	30.0
20%	12.7	17.9	22.1
15%	10.4	15.3	18.8
10%	7.9	12.4	16.1
5%	4.8	8.9	12.5
4%	4.1	8.0	11.4
3%	3.5	6.9	10.3
2%	2.6	5.5	8.6
1%	1.6	3.8	6.3

Statistical distribution of the ratio (in dB) between the received power inside the window and the received power outside the window. The position of the window is optimised for maximizing this ratio, for each impulse response.



typical cases



extreme cases (long delays)

fig 1 : DELAY PROFILES