

■ White Paper  
Jan. 2005

Multipath in ICS telecom

Thomas Garand



## MULTIPATH IN ICS TELECOM

### Introduction

The purpose of the multipath analysis is to characterize the phenomenon of delay spread.

The delay spread refers to the maximum difference in arrival times at the receiver when there is more than one signal received via different transmission paths (multipath).

Two functions for multipath analysis are available in ICS Telecom to model the delay spread.

- Right click on map / Multipath
- Subscriber database / Multipath

This document will describe these two functions.

### Origin of the multipath spread model

A more desirable model is one truly based on multiple interferes, rather than on two-source approximations.

One way to achieve this is to view the received signal as a single transmission undergoing multipath delay spread.

The relative signal strengths and delays then correspond to the so-called power delay profile of the aggregate signal.

Studies show that for delays limited to a fraction of the symbol time, the amount of signal degradation depends not in the actual delay profile, but on the rms value of the delay, weighted by their respective power levels.

For this reason, multipath delay spread is often approximated simply by a two-ray model in the evaluation of data system. This offers a particularly attractive way to handling multisource simulcast because it reduces the multiple delays and signal powers to a single parameter called the Multipath Spread (equal to twice the rms delay spread of the delay profile).

So the multipath spread for N simulcasting signals is given by:

$$T_m = 2 \sqrt{\frac{\sum_{i=1}^N P_i d_i^2}{\sum_{i=1}^N P_i} - \frac{(\sum_{i=1}^N P_i d_i)^2}{(\sum_{i=1}^N P_i)^2}}$$

Where  $P_i$  and  $d_i$  are the power and delay of the  $i$ -th signal, respectively.

### Right click on map / Multipath function:

This function calculates the time of arrival of all the signals received at one point.

For that, the user has to:

- Select the recording number of the transmitter with which he will carry out the analysis;
- Define the receiver antenna height;
- Define the accuracy of the TOA's result.

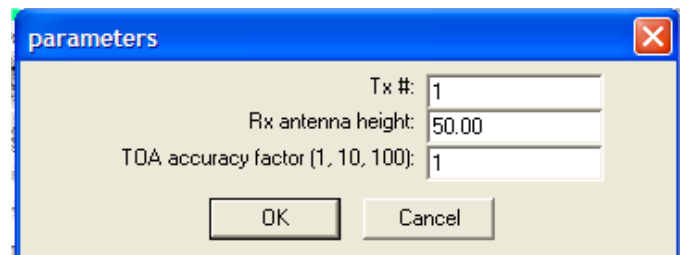


Figure 1: parameters box

In the result window, each blue line corresponds to a received signal, and by clicking on one of them, the user displays:

- The time of arrival;
- The amplitude;
- The altitude;
- The position of the reflection point associated to this signal.

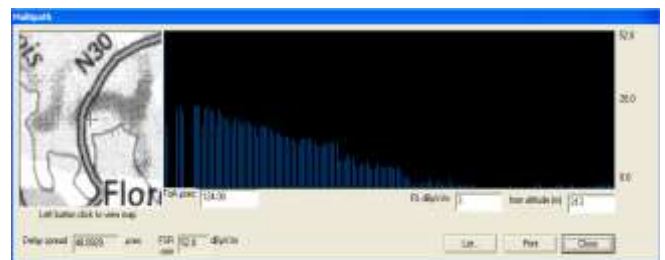


Figure 2: Multipath result

From all these data, ICS Telecom calculates a delay spread and a sum of amplitude between all the signals which are available on this window.





The signals are ordered by time of arrival and amplitude.  
 Thus, the user can use this list to model the spread time.

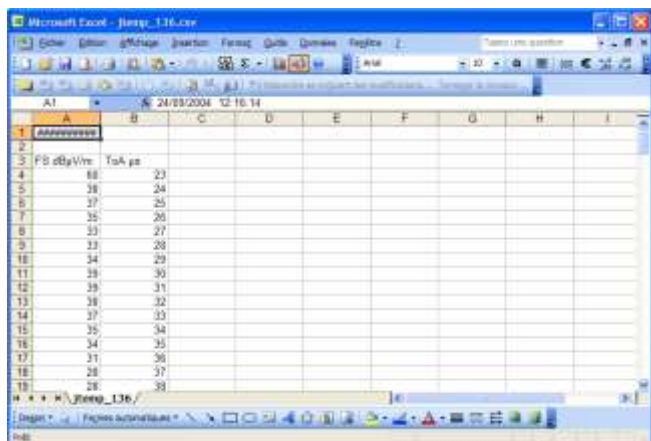


Figure 3: List of TOA

**Subscriber database / Multipath function:**

Through this function, ICS Telecom carries out multipath analysis in batch for each subscriber selected in the database.

Thus, the user has just to select subscribers (receivers) on which he will carry the analysis.

The result is given for each subscriber.

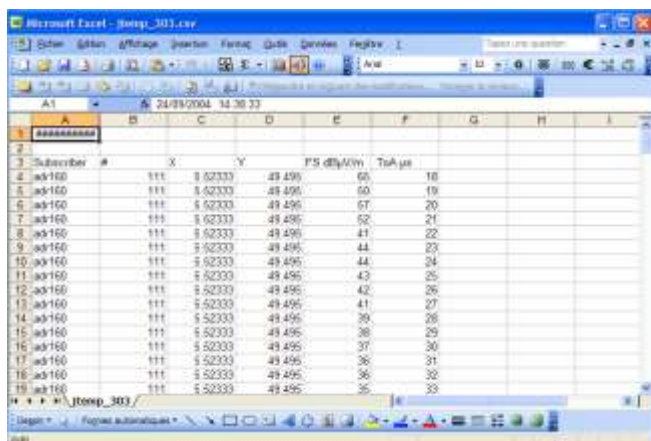


Figure 4: TOA for each subscriber

**ATDI SA**

8, rue de l'Arcade  
75008 Paris - France  
Tel. +33 (0) 53 30 89 40  
Fax +33 (0)1 53 30 89 49  
e-mail : [atdi@atdi.com](mailto:atdi@atdi.com)  
<http://www.atdi.com>

**ATDI Inc.**

2, Pidgeon Hill Drive, Suite 560  
Sterling - VA 20165 - USA  
Tel. +1 703 433 54 50  
Fax +1 703 433 54 52  
e-mail : [americas@atdi.com](mailto:americas@atdi.com)  
<http://www.atdi-us.com>

**ATDI Ibérica**

c/Manuel González Longoria,8  
28010 Madrid - Spain  
Tel. +34 91 44 67 252  
Fax +34 91 44 50 383  
e-mail : [southern-europe@atdi.com](mailto:southern-europe@atdi.com)  
<http://www.atdi.es>

**ATDI Ltd.**

Kingsland Court - Three Bridges Road  
Crawley - West Sussex - RH10 1HL - UK  
Tel. +44 (0)1293 522052  
Fax +44 (0)1293 522521  
e-mail : [northern-europe@atdi.com](mailto:northern-europe@atdi.com)  
<http://www.atdi.co.uk>

**ATDI SAL**

812 Tabaris, Avenue Charles Malek  
Achrafieh, Beirut - Lebanon  
Tel. +961 1 330 331  
Fax +961 1 216 206  
e-mail : [mea@atdi.com](mailto:mea@atdi.com)  
<http://www.atdi.com>

**ATDI EST**

Bd. Aviatorilor, 59  
Bucharest  
Romania  
Tel +40 21 222 42 10  
Fax +40 21 222 42 13  
e-mail : [eastern-europe@atdi.com](mailto:eastern-europe@atdi.com)  
<http://www.atdi.ro>