



Report ITU-R SM.2211
(06/2011)

Comparison of Time-Difference-of-Arrival and Angle-of-Arrival Methods of Signal Geolocation

SM Series
Spectrum management



Documents
Document Sharing Hub

Foreword

The role of the Radiocommunication Sector is to ensure the rational, equitable, efficient and economical use of the radio-frequency spectrum by all radiocommunication services, including satellite services, and carry out studies without limit of frequency range on the basis of which Recommendations are adopted.

The regulatory and policy functions of the Radiocommunication Sector are performed by World and Regional Radiocommunication Conferences and Radiocommunication Assemblies supported by Study Groups.

Policy on Intellectual Property Right (IPR)

ITU-R policy on IPR is described in the Common Patent Policy for ITU-T/ITU-R/ISO/IEC referenced in Annex 1 of Resolution ITU-R 1. Forms to be used for the submission of patent statements and licensing declarations by patent holders are available from <http://www.itu.int/ITU-R/go/patents/en> where the Guidelines for Implementation of the Common Patent Policy for ITU-T/ITU-R/ISO/IEC and the ITU-R patent information database can also be found.

Series of ITU-R Reports

(Also available online at <http://www.itu.int/publ/R-REP/en>)

Series	Title
BO	Satellite delivery
BR	Recording for production, archival and play-out; film for television
BS	Broadcasting service (sound)
BT	Broadcasting service (television)
F	Fixed service
M	Mobile, radiodetermination, amateur and related satellite services
P	Radiowave propagation
RA	Radio astronomy
RS	Remote sensing systems
S	Fixed-satellite service
SA	Space applications and meteorology
SF	Frequency sharing and coordination between fixed-satellite and fixed service systems
SM	Spectrum management

***Note:** This ITU-R Report was approved in English by the Study Group under the procedure detailed in Resolution ITU-R 1.*

Electronic Publication
Geneva, 2011

© ITU 2011

All rights reserved. No part of this publication may be reproduced, by any means whatsoever, without written permission of ITU.

REPORT ITU-R SM.2211

**Comparison of Time-Difference-of-Arrival and Angle-of-Arrival
Methods of Signal Geolocation**

(2011)

Table of Contents

	<i>Page</i>
1 Introduction	1
2 Overview of TDOA Technology	1
3 Strengths and weaknesses of TDOA compared with traditional AOA	2
4 Summary	6
5 References	7

1 Introduction

This Report compares the strengths and weaknesses of time-difference-of-arrival (TDOA) versus angle-of-arrival (AOA) methods of signal geolocation. While this Report focuses on TDOA, it should be noted that other geolocation techniques exist¹. The AOA method determines the angle of arrival of a wave at a measurement point. AOA methods have been commonly used in many direction-finding applications, and have some advantages but also some disadvantages related to antenna requirements, for example. TDOA methods, on the other hand, compute the time difference of arrival of a wave at multiple measurement points, and calculate the source point based on timing and wave comparisons. TDOA methods have not been widely used in spectrum monitoring, but have become increasingly useful due to the availability of inexpensive and compact computing power, more advanced radio receiver technology, ready availability of data links, and accurate distributed timing signal availability. The paper will provide a short overview of TDOA technology and some comparison of the strengths and weaknesses of the TDOA method compared to more traditional AOA methods.

2 Overview of TDOA Technology

The TDOA technique measures the time of arrival of an RF signal at several points in space and compares the time difference between each receiver. The traditional approach to estimating TDOA is to compute the cross-correlation of a signal arriving at two receivers. The TDOA estimate is the delay which maximizes the cross-correlation function. By knowing the location of each receiver, an estimate of the location of the source of the emissions can then be deduced provided all receivers

¹ Received signal strength (RSS) uses the measured power ratio of a signal at multiple measurement points to compute the source point. RSS is often used for indoor geolocation. Frequency-difference-of-arrival (FDOA) uses the frequency Doppler shift of a moving source (and/or multiple receivers) to calculate the source point. FDOA is often used in conjunction with TDOA for airborne applications.