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TELECOMMUNICATIONS
Research and Engineering Report 30

BIBLIOGRAPHY ON PROPAGATION EFFECTS FROM 10 GHz TO 1000 THz

U.S. DEPARTMENT OF COMMERCE

Office of Telecommunications

Institute for Telecommunication Sciences

MARCH 1972

BOULDER
COLORADO 80302

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(a) Acquire, analyze and disseminate data and perform research in general on the description and prediction of electromagnetic wave propagation, and on the nature of electromagnetic noise and interference, and on methods for the more efficient use of the electromagnetic spectrum for telecommunication purposes;

(b) Prepare and issue predictions of electromagnetic wave propagation conditions and warnings of disturbances in those conditions;

(c) Conduct research and analysis on radio systems characteristics, and operating techniques affecting the utilization of the radio spectrum in coordination with specialized, related research and analysis performed by other Federal agencies in their areas of responsibility;

(d) Conduct research and analysis in the general field of telecommunication sciences in support of other Government agencies as required; and

(e) Develop methods of measurement of system performance and standards of practice for telecommunication systems.

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BIBLIOGRAPHY ON PROPAGATION EFFECTS FROM 10 GHz TO 1000 THz

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(Abstract) A bibliography is presented on the subject of electromagnetic wave propagation over line-of-sight paths through the troposphere at frequencies above 10 GHz. The references are divided into three main categories covering the areas of propagation through non-turbulent clear atmosphere, turbulent clear atmosphere, and precipitation.

Key Words: Bibliography, electromagnetic wave propagation, millimeter waves, infrared-optical waves.

The purpose of this report is to serve as a compilation of references pertaining to the subject of electromagnetic wave propagation over line-of-sight paths through the atmosphere at frequencies greater than 10 GHz. Some of the listed papers are not directly concerned with the above subject, however, their results are useful and/or necessary in describing propagation effects.

The reference list has been divided into the following categories:

A. Propagation through non-turbulent, clear atmosphere

   (1) general (44 papers)

   (2) frequencies < 300 GHz (128 papers)

   (3) frequencies > 300 GHz (55 papers)

B. Propagation through turbulent, clear atmosphere

   (1) general (103 papers)

   (2) frequencies < 300 GHz (30 papers)

   (3) frequencies > 300 GHz (120 papers)

C. Propagation through precipitation

   (1) general (61 papers)

   (2) frequencies < 300 GHz (61 papers)

   (3) frequencies > 300 GHz (12 papers)

Some papers will have relevance to subject areas other than the one in which they appear; however, each paper is listed only once in order to avoid repetition.

The subjects of turbulence and precipitation - B and C - have been listed separately because their effects on a signal are more significant than other phenomena that might have been chosen for categorization. This significance is shown partly by the number of papers that have been written on the two subjects, together with the length of time over which research investigations have continued to be made. That unanswered

questions still remain is apparent from a perusal of the more recent papers in the two lists.

A division has been made according to regions of the frequency spectrum, with 300 GHz being arbitrarily chosen as the dividing point. Thus, categories A3, B3, and C3 list papers on infrared-optical propagation, while A2, B2, and C2 are concerned with the millimeter wave region. General discussions of electromagnetic wave propagation are found in A1, B1, and C1.

Only English language papers (or papers which have been translated into English) have been included, and the attempt has been made to list all relevant papers published through 1970. The list contains references from both technical journals and individual organization reports, with (hopefully) omissions being kept to a minimum. As further research is reported, it can be added to the present collection to provide an up-to-date comprehensive survey of propagation literature.

Section A - Propagation through non-turbulent, clear atmosphere

Part 1 - General

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Section A - Propagation through non-turbulent, clear atmosphere

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