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RADIOPROPAGATION: NEEDS FOR THE 90'S

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ABSTRACT

Telecommunication world has been increasing enormously in the last decades and is still now rapidly growing. New services and systems are planned for the near future. This implies that new investigations are opened to face with the problems arising by the tecnical solutions. A brief description and discussion of these needs and of the programmes planned to satisfy the demand of new technology is reported.

1. INTRODUCTION

The world of telecommunication is known to be in continuous development and has considerably contributed to tranform the way of life of the modern society. In the last two decades the availability of new services has been noticeable and the telecommunication network has enormously growth.

For the near future,typically the 90s, new important systems are planned such as : regional satellites, direct broadcasting television with high definition tecnology, mobile systems, small commercial and private terminals, high capacity trasmission,on-board management of resources , optical fibers and many other sophisticated solutions.

These development will result in a fast increase of networks, users, earth-stations and in various technical problems. As a considerable part of

these will concern with the radiocommunication, an urgent need of investigations will regard the radiopropagation field.

The adoption of new higher frequency bands, SHF and EHF, the study of the effects of minor atmospheric components, light rain, clouds,gases, the higher occurrence of interference situations, introduce the need for a thorough research in propagation topics.

Many programmes have been prepared in view of these needs all around the world in Europe, Japan , USA and , to a smaller extent but with an even more interest, in the tropical regions where the need for measurements is more urgent.

2. NEW SYSTEMS AND SERVICES

Higher frequency bands

Frequency bands up to 12 GHz are presently in full operative use and many systems are already prepared for the employment up to some 18 - 20 GHz.

In order to face the needs of new services such as: high capacity links, direct high definition television broadcasting,communication satellites and remote sensing radiometry, the interest is focussed on the 20 - 30GHz and the 40 - 50 GHz bands and for the near future in the 90 GHz band, as well.

This will imply studies on the behaviour of light rains and of the clouds droplets. For higher bands the gaseous absorption , water vapour and oxygen,apart from the resonance lines, should be taken in increasing account.

Low availability systems (LAS)

Both the envisaged demand of private commercial users and the necessity of reducing the cost of terrestrial cabled network will introduce the diffusion of small terminals (VSAT).,the requirements of which will be relaxed in comparison with the present CCIR specifications. Moreover the possibility of looking at the satellite with low elevation angles will be higher, also due to the large planned coverage areas.

These characteristics, together with the high frequency and the stringent low-cost needs, will assign a paramount role to the clouds attenuation in the design of the LAS.

Direct television broadcasting

As far as the earth segment is concerned the problems of DBS system are the same of the LAS, with the exception of the feeder link which should be treated as a normal fixed satellite service. In addition the large bandwidth requested by the high definition proposed standards force this service to be developed in the 40 GHz and 80 GHz bands.

Mobile systems

This service is rapidly developing and great attention and resources are presently dedicated and planned for a considerable growth.

ing available a detailed characterization of the territory for the attenuation and that of examining the mechanisms and possibilities of interferences.

Interference

The multiplication of systems and links will unavoidably introduce interference phenomena, expecially where the user density is higher.Ducting effects and scatter from hydrometeors are the propagation mechanisms to be deeply investigated, as well as the possibility of exploiting the shielding effects of both man-made and natural obstacles, at least for the main plants.

Satellite techniques

The next generation satellites are planned to be no longer simple passive transponders but for operating as active , 'intelligent' node of the network.

Resources will be present on board to be managed by the satellite in such a way to control the link in real time. Stations undergoing severe propagation impairments,typically rain, may ask for help to the satellite which will be able to assign,according to flexible criteria and priorities,additional resources. The techniques envisaged might be several:

lower frequency, dedicated antenna, additional power,longer transmission time.

The principal element for the design of such techniques is the detailed knowledge of the probability ofjoint events in groups of earth-stations, that is the behaviour of the space correlation and structure of the rain attenuation.

The possibility of real time control of the up-link transmitted power is strongly envisaged in the near future satellites in order to avoid the assignement of this task to the on-board systems, where the costs would be considerably higher. This control technique is possible only starting from a deep knowledge of the dynamic short-time characteristics of the rain attenuation.

The implementation of very high capacity transmission links is conditioned by the presence of fine time-space scale phenomena like : amplitude and phase distortion, variations in the angle of arrival of the wavefront, interference due to secundary incoming waves, scintillations, etc.

Radiopropagation non-conventional measurements are needed to face these problems.

Tropical regions characterization

A marked tendency to develop modern and diffused telecommunication systems is envisaged in the tropical countries. For the time being, infact, the lack of reliable measured data of radiopropagation is the main obstacle to the dimensioning of new services in those regions where climatic peculiarities are such to involve serious propagation impairments.

Absolute priority is therefore assigned to the conduction of reliable and detailed propagation measurement campaigns in tropical regions.

3. RADIOPROPAGATION NEEDS

The essential needs resulting from traditional and future services demand are the detailed investigations on radiopropagation characteristics in the SHF and EHF bands, with particular regard to the fine space-time structure of the rain and of the refractive index, and to the effects of minor components such as clouds, and water vapour.

More in particular radiopropagation studies and data are needed on:

- precipitation microstructure, rain height and horizontal structure in the tropical regions
- rainfall intensities zones and contours
- influence of raingauge integration time
- attenuation effects of clouds
- gaseous absorption and its behaviour
- scintillations
- clear-air effects
- vertical structure of the rain
- height of the zero isotherm
- horizontal structure of rain
- scintillations
- small scale site diversity
- large scale site diversity
- ice-crystals and snow effects
- fog and hail contribution

4. RADIOPROPAGATION PROGRAMMES

The Olympus satellite (ex L-Sat) will be launched in June 1989 and will be positioned in a geostationary orbit at 19° West, covering a very large area.

It will carry a propagation payload at three frequencies: 12, 20 and 30 GHz.

Very many European organizations have prepared extensive programmes including all the possible experiments.

Italy , in particular will participate with 3 main stations and 25 auxiliary stations, these latters operating owith the 20 GHz beacon ,which is alternatively switched between two orthogonal polarisations.

In the framework of this activity the Italian administration is planning to cooperate with tropical climate countries, furnishing small 12 GHz receiving stations to organizations in Brasil (PUC-CETUC, Rio de Janeiro) and Nigeria (University of Ile-Ife).

The Italsat satellite is planned to be launched in 1990 and will carry a propagation payload at 18, 40 and 50 GHz, positioned in geostationary orbit at 13° East.

Also for this satellite the participation is envisaged to be very extended.

In Italy a programme of non-conventional measurements is in preparation.