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RECENT ACHIEVEMENTS OF OPEX

Bertram Arbesser-Rastburg and Owen Turney

European Space Research and Technology Centre
Noordwijk, The Netherlands

Abstract: A group of propagation researchers have joined to prepare for a major campaign of propagation experiments for fixed satellite services using the Olympus satellite. For several years the receiving hardware and data processing procedures have been planned, now, with the launch of the Olympus satellite imminent, experimenters are eager to start the "real work". The aim of this paper is to give a short review of the accomplishments made since the last NAPEX meeting.

1. Introduction

The launch of the European Space Agency's (ESA) OLYMPUS experimental satellite is scheduled for mid 1989. This marks the entry into a new phase for the OLYMPUS Propagation EXperiment (OPEX) group. Some of the experimenters are already fully prepared to start the measurements; the coding of the data processing software is underway and the communication links for distributing vital information are being set up.

2. The OPEX Group

OPEX was set up under ESA auspices in 1980 with the objective of standardizing the essential procedures in equipment calibration and data handling necessary to achieve results that are directly comparable. Much experience was drawn from the COST (CoOperation Scientifique et Technique) activities (actions 25 and 205) that had led to the first Europe-wide collection of Ku-band satellite propagation statistics (Fedi, 1985). Further details on the development of OPEX can be found in the referenced literature (Brussaard, 1988).

Today the OPEX community includes approximately 70 organisations. Of these, about 30 are preparing to make measurements. They are equally divided amongst:

- Universities
- PTTs or Telecommunication entities
- Private or governmental research institutions

Three of the participants are from outside Europe, namely:

- CRC in Ottawa, Canada
- Virginia Tech in Blacksburg, VA

- North Carolina State University in Rayleigh, NC.

The chairman of the OPEX group is Professor Gert Brussaard from the Technical University of Eindhoven in the Netherlands.

3. ESA's role in OPEX

ESA has the overall responsibility of the satellite mission and also has taken on responsibility for three principal aspects of the OPEX collaboration:

- to act as a focal point
- to study new hardware designs for receivers and radiometers
- to have the common data processing software developed

The Propagation Section at ESTEC is in charge of these activities and some more details with particular respect to recent achievements are given below.

3.1 Coordination

ESA is providing an administrative and organisational infrastructure which gives the OPEX group a focal point for information and coordination. Up to now this function mainly concentrated on keeping an electronic mailing list, organizing the OPEX meetings and producing proceedings of the meetings.

More recently a database with information on the different propagation experiments has been established which allows the scope for co-operation between experimenters to be quickly assessed, either in getting their hardware operational or in exchanging data. In the future (once the satellite is in orbit) also the regular dissemination of orbital element data and manoeuvre information will be provided. Communication will be via telex, e-mail and fax.

One of the difficult points in coordinating this collaborative activity is the fact that there is some diversity in the size and scope of individual experiments and in the finances available. This also means that not all the groups arrive at the same level of readiness simultaneously. However, the general enthusiasm of the experimenters and the openness of the discussions make it easy to deal with these discrepancies.

With the number of active experimenters close to 30 it was also found useful to set up smaller working groups of specialists to examine in detail particular questions and to apply their expertise to important decisions. Such a "small user group" was established to monitor the development of software.

3.2 Hardware studies

The Agency has contracted out theoretical and development studies relating to experimental hardware. Specifically the areas of Beacon Receivers and Radiometers were investigated. To this end two studies were completed recently:

- The digital beacon receiver which had been developed by Signal Processors Ltd (Cambridge, U.K.) was delivered to ESTEC as a functional prototype for one receive channel. Instead of a PLL a digital Fourier transform processor is used for carrier frequency tracking. This allows tracking of the signal down to a C/No level of about 15 dB below the point where a PLL receiver (50 Hz loop-BW) "drops out".

- The study of a 20/30 GHz radiometer to measure the liquid water and the water vapor content of the atmosphere has resulted in a design recommendation that combines high accuracy, simple maintenance and low price. The study was carried out by FARRAN Technology (Ballincollig, Ireland)

Apart from these studies directly relevant to OPEX, ESA is also planning for future propagation experiments. The 44.6/89.2/133.7 GHz beacon payload for the next generation ESA communication satellite (SAT-2) has been studied by Contraves Italiana (Rome, Italy). The study showed that such a payload can be realized with a total weight of less than 15 kg (with redundancy on all active components) and a power consumption of less than 50 Watts.

3.3 Data Processing Software Development

The OPEX group considered in detail standard procedures for both earth station dependent data processing and station independent data analysis. The aim being to ensure that the formation of event data and its subsequent comparison and exchange could be carried out without worries regarding varying data treatment procedures.

ESA placed a contract with Siemens Austria and CSR Ltd (U.K.) for the study of standardized procedures and software for the processing of propagation data. This study resulted in a clear definition of the software requirements and the architectural design and was completed in January 1989.

Now the contract for the development of the software is underway and will be completed by May 1990. The work is being carried out by Siemens Austria (Vienna) with support from IAS (Graz, Austria). The software design and development must take into account the different computer systems used by the experimenters. To ensure portability UNIX and VMS have been chosen as operating systems and a limited number of computer systems are going to be supported. The chosen targets are 80386 based PCs with

AT bus, VaxStations and HP9000 workstations. The adoption of "standard" software tools and packages was also found to be a necessity. The WIMP (Windows, Icons, Mouse, Pointing) based interface "X-Windows" and the graphics package "GKS" (Graphical Kernel System) were selected for the human-computer-interface and for graphics respectively. The programming language chosen is "C" and the C-ISAM library is used for data and file handling tasks.

The design was user driven at all stages. This involved frequent liaison and demonstrations with the so called Small User Group, representing the wider body of OPEX. On completion of the software development full documentation including a Software User Manual will be issued to users.

4. OPEX Meetings

Two OPEX meetings have been held since last summer. The first one, OPEX 11 was held in June 1988 in Copenhagen, being hosted by the Danish PTT. There were more than 50 participants representing nearly all experimenters and some of the companies involved in the design of experimental hardware and software.

OPEX 12 took place in Vienna in April 1989 with the support of Siemens Austria and T.U. Graz. Again, close to 60 people turned up. The status of the satellite and payload as well as the ground segment and standardized software were discussed in detail. Numerous presentations were also given on both, status of preparations as well as useful observations relevant to making propagation measurements. All papers and reports were jointly published in conference proceedings. For the OPEX group the OLYMPUS Utilisation Conference which also took place in Vienna immediately after the OPEX meeting provided an ideal opportunity to find out about the four other OLYMPUS payloads and their uses.

A redraft of the OLYMPUS Propagation Package User Guide was also issued, containing important results of tests on the payload transmit system.

5. Plans

After the Olympus satellite has reached its final orbital position at 19 deg West (approximately 22 days after launch), a phase of careful in-orbit testing will commence. This will take over two months. The beacon payload will be tested for e.i.r.p. (co- and cross-polar), polarisation orientation, power- and frequency stability and phase noise. The tests will be carried out in Redu (Belgium) using specially built measurement stations. After completion of the IOT the propagation measurements can start.

The software development will arrive at a down-scaled prototype of the pre-processing package in November of this year and the final acceptance test (for the 80386-software) is scheduled for April 1990. It is planned to have a small training workshop for the users at this time.

6. Conclusion

It has been a busy and productive year for OPEX. The preparation of facilities to receive the OLYMPUS propagation beacons made a big step forward in most places. Some old ground stations have been refurbished, many have been constructed "from scratch" and are ready to start measurements as soon as they can pick up a signal from 19 degrees West. We are all confident that the careful planning, attention to detail and co-operation on a wide scale will ensure the success of this campaign.

References

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esa estec

NAPEX XIII

San Jose

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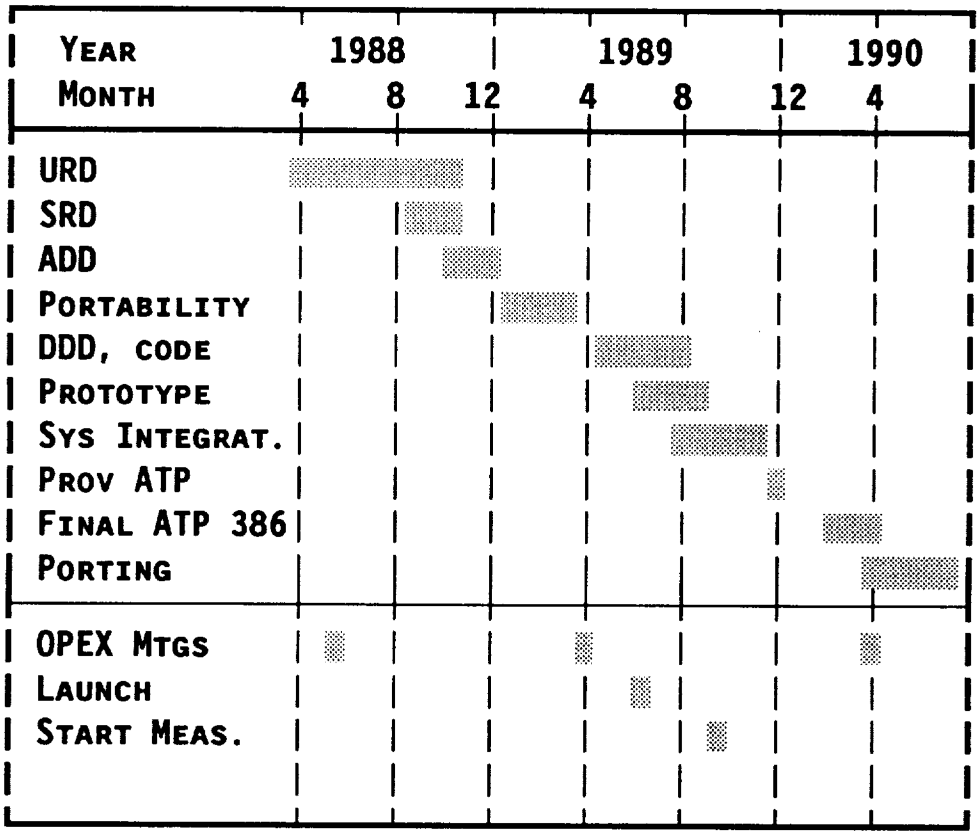
XEP Section

TIME CHART OLYMPUS DATA PROCESSING



URD...USER REQUIREMENT DOCUMENT
SRD...SOFTWARE REQUIREMENT DOCUMENT
ADD...ARCHITECTURAL DESIGN DOCUMENT
DDD...DETAILED DESIGN DOCUMENT