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**A SYSTEM FOR THE AUTOMATED SUPERVISION OF  
EARTH STATIONS**

**Eduardo Whitaker Bergamini**  
**Maria de Fátima Mattiello-Francisco**  
**Roger Crispim**

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A SYSTEM FOR THE AUTOMATED SUPERVISION OF EARTH STATIONS

E.W.BERGAMINI, M.F.MATTIELLO and R.CHRISPIM

Department of Computer Engineering in Space Applications  
Instituto de Pesquisas Espaciais - INPE

ABSTRACT

This work presents a system conceived for centralizing the automation of the many functional groups which will compose the tracking and control stations, under development for the ground segment of INPE, to be used in its space missions. The System is characterized as the supervisor of the earth station and is based on the concept of distributed processing. Resources of distributed processing are considered not only to increase the net power of computing, but also to cope with some degree of graceful degradation of the system for the benefit of the system reliability as a whole. Some considerations are made on the functional attributes of the supervision, in view of the applications and of the related operational aspects predicted for the earth station and its relations with other facilities of the ground segment.

## 1 - INTRODUCTION:

A Supervision System, under design, to be implemented in the Earth Stations of INPE's ground segment for space missions is presented in this work, based on three topics of the subject:

- 1) Aspects of the Architecture; 2) Principles of the Organization;
- 3) Operational Aspects.

The aspects of the architecture of the Supervision System presents the main functional parts of the Supervision Computer and justifies, to some extent, the hardware redundancy and the main interfaces with other systems in and out of the stations.

The principles of organization of the Supervision System are given, with emphasis in the internal distribution of supervising functions in the architecture of the system.

Operational aspects are considered in view of the interaction that the Supervision System will have to support within the earth station and with other facilities of the ground segment.

## 2 - ASPECTS OF THE ARCHITECTURE:

The Supervision System architecture with its main interfaces is presented in Figure 1 by the Supervision Computer-CS, conceived to implement the automated supervision of the earth station. The CS is configured, basically, by three dedicated processors. To some extent each of these three processors have similar peripherals of the standard type (console, printer, mass memory, etc.). Serial data communication lines interconnect exhaustively the three processors of the Supervision Computer.

The communication of the CS with grouped peripheral equipments of the earth station is of the serial type. Each group of

peripheral equipments distributed in the station is characterized as a Functional Group-GF. The characterization of a GF is based on the specific functions that each of its equipments perform in the station. A serial data communication line is assigned for connecting the Supervision Computer with each Functional Group. On the side of the Functional Group, this serial data communication line is connected to a Monitoring and Control Module - MCM. The MCM is a programmable controller which interfaces directly with each of the equipments of the Functional Group. The MCM is designed to perform dedicated monitoring and control functions over each equipment of the Functional Group. The interconnection of the Supervision Computer with the Functional Groups, based the IEEE-488 standard interface was not adopted, although it is an optional interface available in the CS. An alternative configuration of the CS with the FGs would be by means of a local network based on serial busing. However, in order to obtain a flexible and independent data communication scheme, for the sake of real-time performance and reliability constraints, a dedicated serial data communication channel was assigned for connecting the CS with each of the GFs.

Based on the fact that the earth station will configure a set of dedicated computers to perform fairly complex functions, other than those allocated to the MCMs, a direct serial data communication connection is to be implemented between the CS and each of these computer based equipments. So far, the equipments which fall in this class are:

- Ranging Processor;
- Antenna Controller;
- Payload Pre-Processor and Router;

- Telecommand Encoder.

The exchange of information among the CS and other facilities of the ground system is to be implemented through the REDACE System which will configure the computer network of hosting facilities (Mission Control Center, etc.), through a data communication sub-network. In this context, being a host of the REDACE sub-network, the Supervision Computer could be addressable by external ground facilities of other space agencies through their own data networks, if connected (through a gateway), as it is being predicted, to the REDACE System. The use by the Supervision Computer of a special peripheral equipment denominated by Multiprocessor for Network Communications - MCR supports its operation as a host of the REDACE sub-network.

3 - PRINCIPLES OF ORGANIZATION:

The organization of the automated supervision system, implemented by the Supervision Computer (CS) is based on the principle of distributed processing among the three main processors of the system.

Considering the facilities pertinent to each of the three processors of the Supervision Computer, the following main tasks are properly assigned among them:

- Configuring and Monitoring of the equipments of the earth station;
- Processing, logging and reporting of data;
- Exchange of messages with hosts of the REDACE System.

In order to achieve higher reliability and performance, no more than part of two of those main tasks is assigned to each one of the three processors which compose the Supervision Computer.

This assignment enables, in many circumstances, a graceful degradation of the CS. The proper allocation of partial tasks is of fundamental importance to obtain the gradual degradation capability in some operating situations. Each of the main tasks are to be decomposed in a set of Applicative Programs to be executed by dedicated operating systems running under each one of the three processors of the Supervision Computer. Each Operating System will be composed by the following parts:

- Portable Nucleus (Kernel) for Computers-NOC;
- Monitor programs (for control and management of the drivers configured for each processor peripheral);
- Utility programs.

As a whole, each processor of the Supervision Computer will run the so called Operational Program, to be composed by the Operating System plus the Applicative Programs.

4 - OPERATIONAL ASPECTS:

The operational concept of the Supervision Computer is being designed to permit the treatment of the Functional Groups and other equipments, distributed in the earth station, based on each specific mission to be accomplished. Considering that the Supervision Computer is to be configured as a host of the REDACE sub-network, the Plan-of-Operations of this system can take into account a sequence of interactions with other hosts of the network in order to be properly instructed for execution of a specific mission. For instance, a series of instructions may be exchanged with the Mission Control Center, by the Supervision Computer. As a result of this exchange, the Supervision System may be instructed to execute a sequence of, probably, interactive

actions with the many Functional Groups and other computer based equipments of the Earth Station, in order to support an specific mission. These actions may comprise functions of: antenna pointing and vehicle tracking, ranging, data capture, command emission, etc., among others. In general a series of actions like these will call for new interactions between the Supervision Computer and the Mission Control Center. Not to mention, among others, that intermediate interactions between the Supervision System and the REDACE (network) Control Center may be also needed, concomitantly, in order to assure proper network availability between the Supervision Computer and another network host, like the Mission Control Center, as mentioned.

It is under consideration that the operation of the Supervision Computer must take into account a graceful degradation of its intrinsic resources, up to the extreme where a manual mode of operation of the earth station Functional Groups and other computer based equipments is necessary. Conversely, it is also being taken into account that different degrees of degradation of the Functional Groups may occur with obvious implications in the Plan-of-Operations when it is being executed for a fully automated mode of operation. The operator of the Supervision Computer will certainly play an important role in the interactive scheme that the Plan-of-Operations will imply, in many specific mission related actions.

GF - FUNCTIONAL GROUP  
 PRCU - PAYLOAD PREPROCESSING AND ROUTING  
 CTC - TELECOMMAND ENCODER  
 REDACE - DATA NETWORK FOR SPACE CONTROL

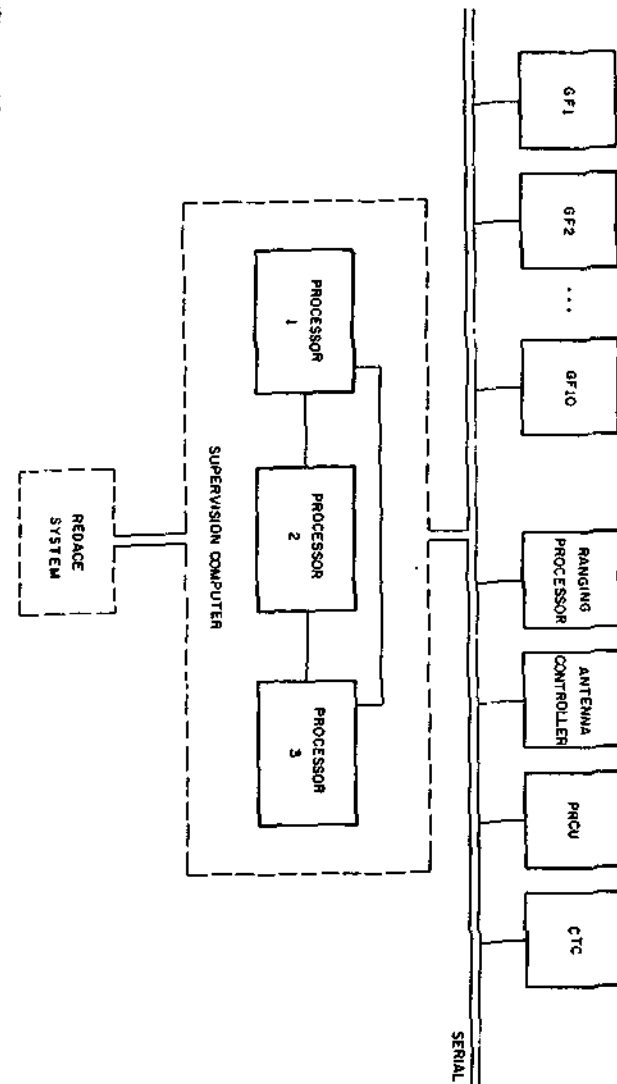


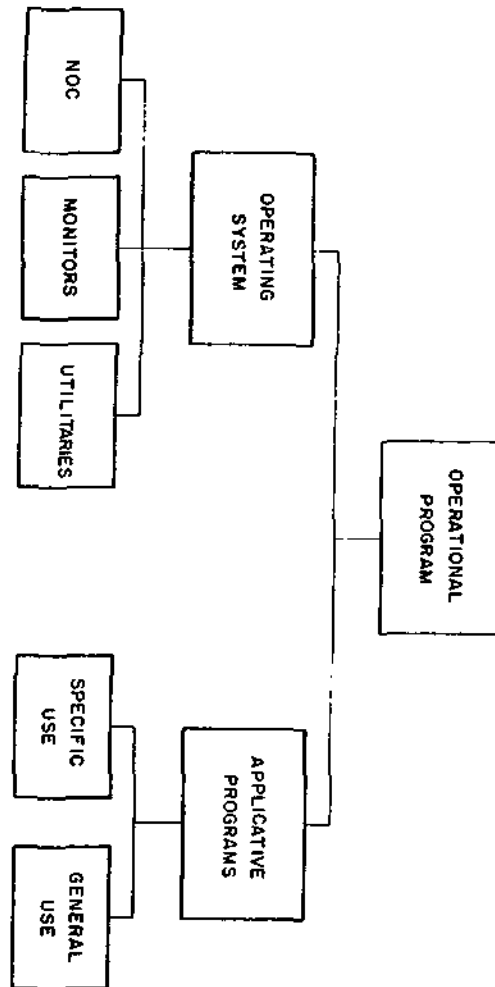
Fig. 1 - Supervision System Architecture

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NOC - PORTABLE (KERNEL) NUCLEUS FOR COMPUTERS

Fig. 2 - Operational Program of the Supervision Computer



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automation - ground segment - distributed processing - supervision



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