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"DCP SYSTEMS AND CHARACTERISTICS"

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14. Abstract/Notes

This publication presents a summary of lecture delivered at the Eighth UN/FAO Trainning Course on Applications of Satellite Remote Sensing to Water Resources, on September 27, 1983. It deals with Data Collection Platforms used with the GOES and NOAA (TIROS-N) satellites and their use for water resources.

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EIGHTH UN/FAO INTERNATIONAL TRAINING COURSE ON
"APPLICATIONS OF SATELLITE REMOTE SENSING TO WATER RESOURCES"
Rome, Italy, 19 September - 7 October 1983

"DCP Systems and Characteristics"
(Lecture Summary)

by Antonio Divino Moura - INPE/Brazil

1. The Concept of Data Collection Systems and DCP Applications

A Data Collection System (DCS) is a relay that delivers readily and reliably environmental data collected in the field to users via satellite. This system is composed of three parts (Figure 1):

1. A Data Collection Platform (DCP);
2. A satellite with on bord transponder;
3. A ground station for receiving and processing DCP signals.

The DCS is a relatively simple system which makes the data collection task easier, with less labor and hazard involved than in the usual earthbound systems. The operational costs are low for long range applications, since the transmission cost is independent on the distance between the DCPs and the receiving station.

A Data Collection Platform is equipped with: sensors to measure environmental parameters; interfaces to these sensors; microprocessors to convert voltages to analog or digital signals; a timer to regulate data acquisition from the sensors and data transmissions to the satellite; a transmitter; an antena; a power supply consisting of batteries recharged by solar panels or other source. Figure 2 shows a schematic diagram of a DCP.

A satellite receives and relaysDCP signals (Figure 1). There are two operational families of satellites: geostationary satellites and polar orbiting satellites. The two DCS systems are called DCS/GOES (and DCS/METEOSAT) and DCS/ARGOS, respectively, the latter being able to locate mobile platforms.

Two examples of ground stations for receiving and processing DCP signals relayed via satellite are shown in Figure 3, for DCP/GOES and DCP/ARGOS. Users may have direct access to the signals or may obtain their data by means of common telephone lines, telex, etc.

Data collection for hydrological applications is the activity which has benefited most from the operational DCS systems. There are certainly other important uses that can be made by monitoring, for example: river, lake and reservoir levels; water and snow precipitation; water quality; water and air temperature; atmospheric pressure; wind speed and direction; soil moisture and humidity; solar radiation; oceanic currents; etc. Users can track mobile platforms located in balloons, drifting buoys, wildlife, expeditions to remote and inhospitable areas, etc.

2. The Operational DCS Systems and Satellites Description

Presently there are two operational DCS systems: the DCS/GOES (or METEOSAT) and DCS/ARGOS, which make use of the geostationary satellites and polar orbiting satellites, respectively (Figure 4).

The spatial and temporal coverages are different for the two satellite families. Figure 5 shows the portions of the globe that are continuously in the field of view of each geostationary satellite. On the other hand the polar-orbiting satellites have global coverage but with lesser frequent data collection. The DCS/ARGOS was designed with the addional capability of locating mobile platforms. The TIROS-N/NOAA satellite orbits are precisely known and by means of Doppler frequency shifts the locations of platforms are calculated. Consecutive measurements, in sequential orbits, can determine the speed of a moving DCP in an atmospheric balloon or in a drifting oceanic buoy, for example. The data can be tape-recorded on bord of the satellite and later released to a ground station.

The main advantages of a satellite DCS as compared with some conventional systems are:

- Data can be obtained from remote and inhospitable locations (mountains, islands, oceans, forest, flood-prone rivers). DCPs may be left unattended for about 6 months (or longer), since they are powered by rechargeable batteries by solar panels or other sources.
- Data can be obtained at less cost and more frequently from remote sites in real-time.
- Under severe weather and natural disaster conditions data can be obtained without human life risk.
- Data is obtained in digital form in real-time and is readily available to a large user community.
- Ground truth data can be collected to calibrate or verify remotely sensed data.

DCP/GOES signals are received in the frequency range of 401.7 - 402.0 MHz by the satellite which in turn retransmits them in the 1.694 GHz band to ground receiving stations. DCPs can be interrogated by the satellite or transmit data according to a fixed, timed, schedule or transmit randomly in time. Each GOES satellite is able to handle about 10000 DCPs each one transmiting 30 seconds (3000 bits) of data at every 3 hour interval.

The METEOSAT, GMS and INSAT geostationary satellites have similar DCS characteristics of the GOES satellite.

DCS/ARGOS was developed by the Centre National d'Etudes Spatiales (CNES) in cooperation with NOAA and NASA. The system makes use of the TIROS-N/NOAA satellites (two in quadrature orbits, see Figure 4). Each DCP/ARGOS can collect data of up to 32 sensors with transmitions at fixed time intervals (40 to 60 seconds for the mobile DCPs and 60 to 200 seconds for fixed DCPs) at 401.65 MHz frequency. The whole system is able to handle 16000 fixed DCPs or 4000 mobile DCPs (or a combination of both). Speeds of mobile DCPs can be determined with 1.5 ms^{-1} precision for balloons and 0.5 ms^{-1} for drifting buoys.

Interested users can write to:

For DCP/GOES

NOAA/NESDIS
Chief, Data Collection and Direct
Broadcast Branch - S 131
Washington, DC 20233
USA

For DCP/ARGOS

Service ARGOS
Centre Spatial de Toulouse
18, Avenue Edouard Belin
31055 Toulouse Cedex
France

In South America, information can be obtained from:

Director General
Instituto de Pesquisas Espaciais
INPE - CP 515
12200 - São José dos Campos - SP
Brazil

(INPE is developing an equatorial orbit satellite dedicated to DCP compatible with DCP/ARGOS).

3. Type of Measurements and Precision

For each application it is important to establish the required precision of the data to be collected. In hydrology, for example, let us examine the two most important parameters:

River, lake and reservoir level - The limnimeter commonly used is of the floating type in a well. The vertical motion of the cable, passing through a disk, alows the conversion of heights into binary numbers. For example, for an excursion of 20 meters of the cable with a resolution of 1 cm, it is necessary at least 11 bits to represent the number ($20 \div 0.01 = 2000$ levels in the scale or $2^{11} = 2048$).

Precipitation - A simple water precipitation sensor used with DCP is the tipping bucket pluviometer. A counter registers precipitation at each increment of 0.1 mm. Suposing a maximum of 600 mm in 24 hours, then it is necessary 13 bits to represent such a measurement (600 mm $\div$ 0.1 mm $= 6000$ or $10^{13} = 8192$).

4. Data Processing and Dissemination

After a ground station receives the DCP signals, the data are then preprocessed, stored, converted to physical quantities and then released to the user. The preprocessing and storage steps are done in real-time and include determination of date and time of the incoming stream of data, indentification of the DCP and error detections. The conversion to physical quantities makes use of calibration curves (defined by 20 points) for each sensor.

The data output is tailored to each user necessity. Direct access to the data is assured to owners of ground receiving stations (GOES) or via telephone lines, telex, etc. The data is archived in a data bank for future use and can be retrieve by users without real-time requirements. The DCP/ARGOS maintain an ARGOS service in Toulouse, France.

5. Acknowledgements

Thanks are due to Dr. Adigun Ade Abiodun for the kind invitation to participate in this UN/FAO course and to Dr. Nelson de Jesus Parada, Director of INPE, for the incentive in doing so. Many useful discussions with Eng. José Roberto de Oliveira are greatly acknowledged also for making available publications and figures.

6. References

DCP Users Guide - Satellite Data Collection Systems, 1980: National Oceanic and Atmospheric Administration, Washington, DC.

ESA - European Space Agency, 1977: Report presented to the 20th COSPAR Meeting. Tel Aviv, Israel. pp. 145-155.

Oliveira, J.R., 1983: Satellite Telemetry. INPE-2854-PRE/394 (in Portuguese).

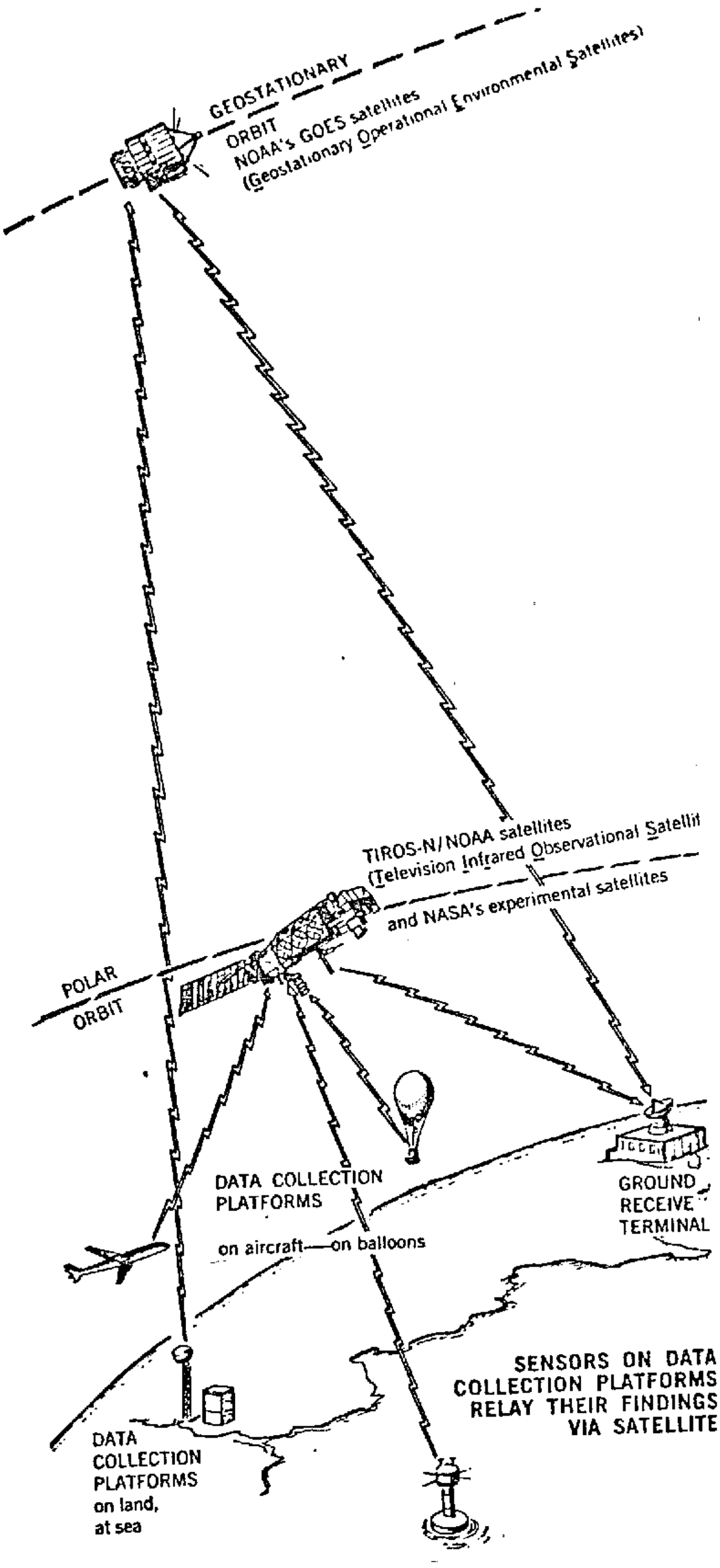

Figure 1

Source: DCP Users Guide (NOAA)

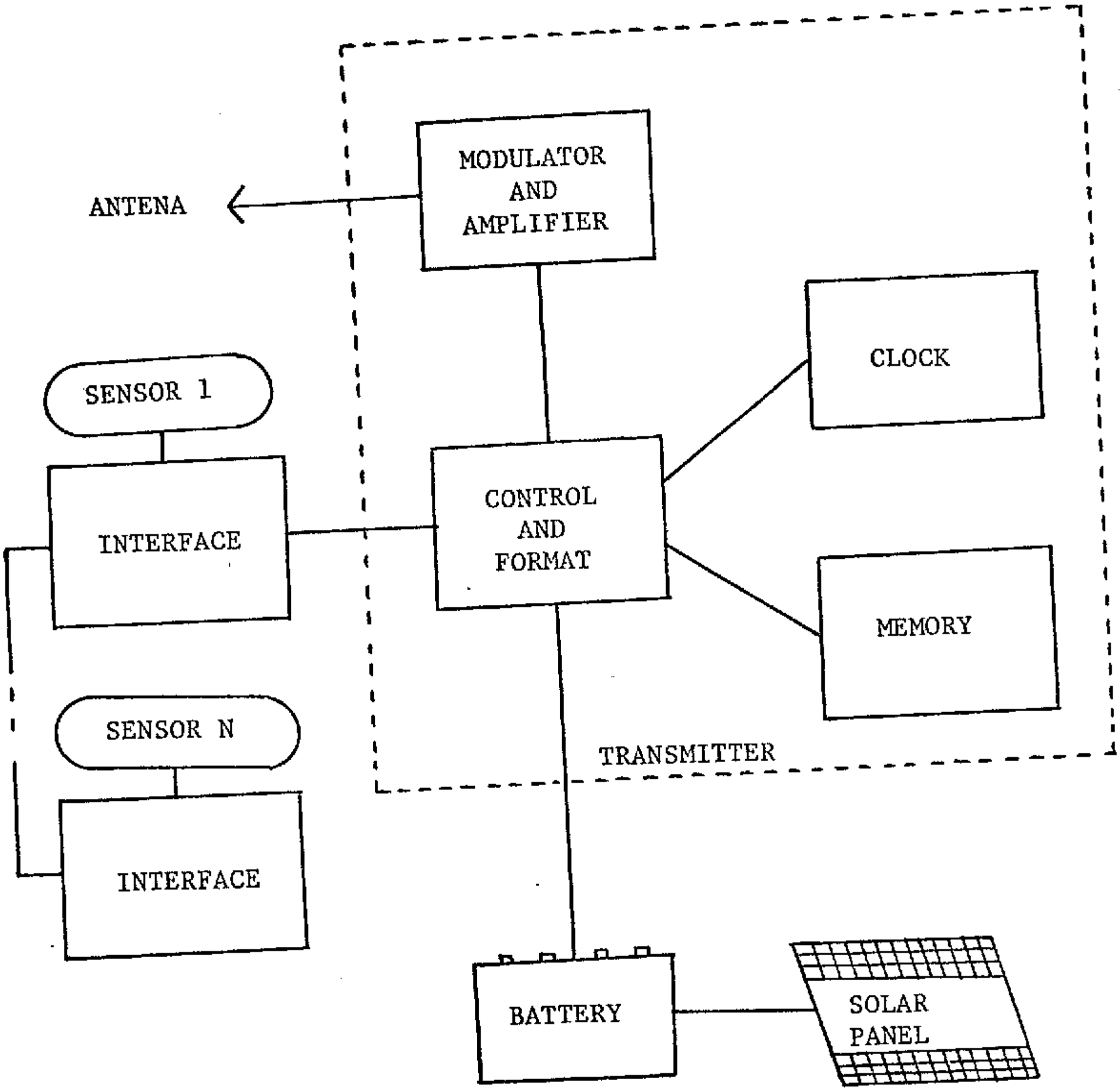

Figure 2 - A DCP diagram.

Source: Oliveira. 1983 (INPE)

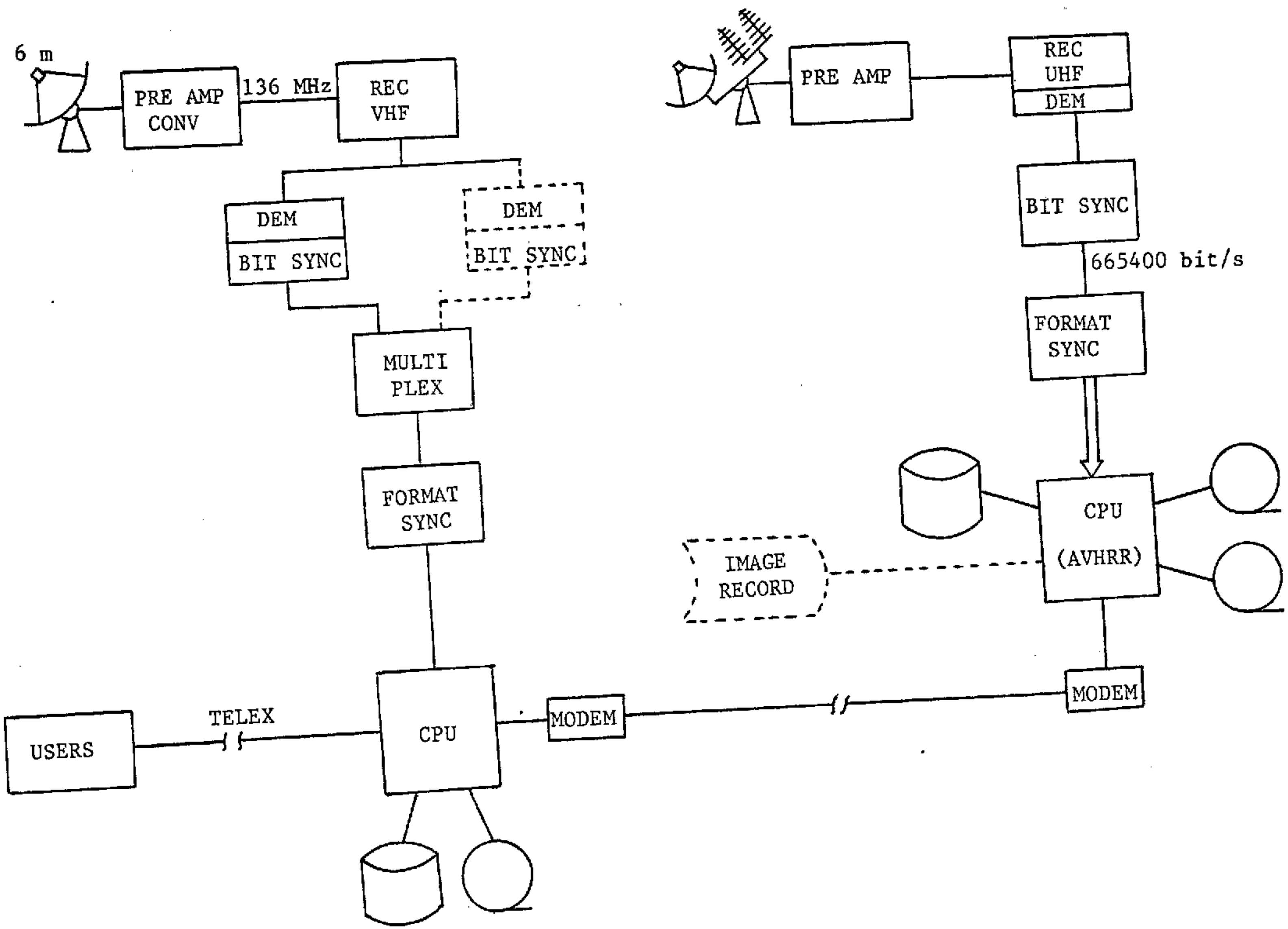

Figure 3 - DCP Ground Receiving and Processing Stations (GOES, left; ARGOS, right).

Source: Oliveira, 1983

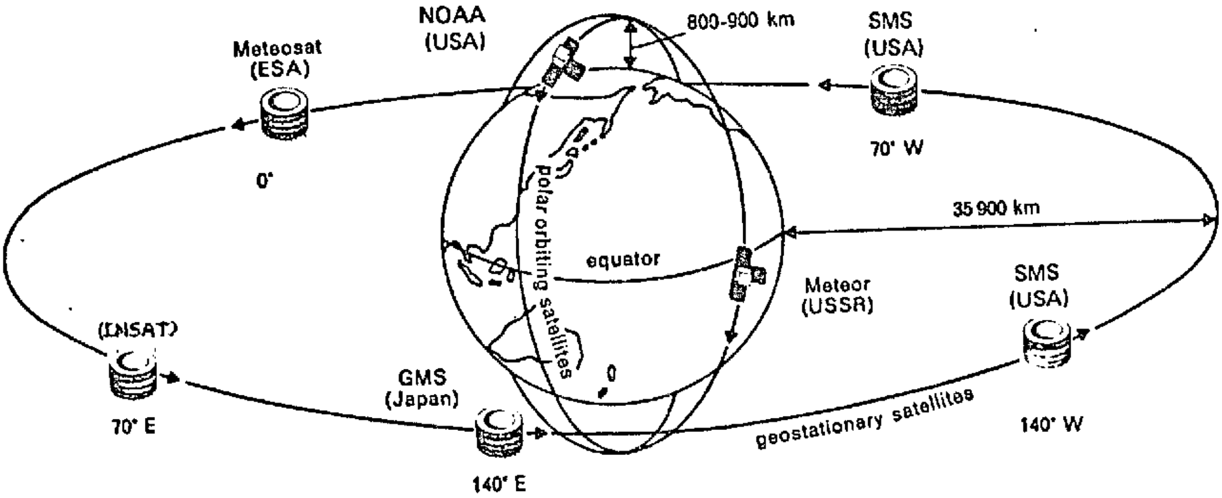

Figure 4

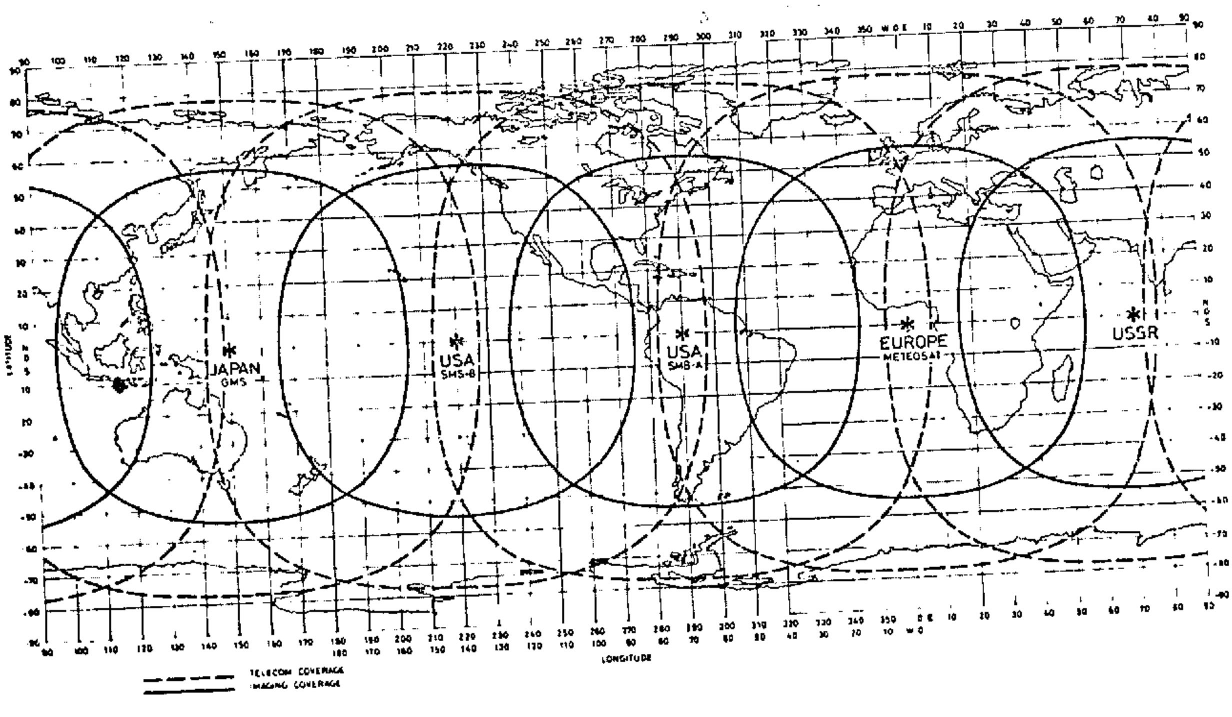

Figure 5

Source: ESA Report to COSPAR, 1977.