NOAA Technical Memorandum NESS 67

DATA COLLECTION SYSTEM GEOSTATIONARY OPERATIONAL ENVIRONMENTAL SATELLITE: PRELIMINARY REPORT

Merle L. Nelson

Washington, D.C.
March 1975

Reprinted March 1976

UNITED STATES
DEPARTMENT OF COMMERCE
Frederick B. Dent, Secretary

NATIONAL OCEANIC AND
ATMOSPHERIC ADMINISTRATION
Robert M. White, Administrator

National Environmental
Satellite Service
David S. Johnson, Director

Data Collection System

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This report describes the technical advances in system design, the achievements in the area of program management and the near future plans for providing DCS services.

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After NESS has received a request for participation in the GOES DCS, an information report will be sent to the interested party. This report, which is also part of the NOAA GOES DCS Program Plan in appendix F, contains the National Policy Statement (as reported in the Code of Federal Regulation), descriptive information on the DCS, and a questionnaire. The questionnaire is to be completed and returned to NESS. The completed questionnaire will be presented to a NESS DCS review committee which will make recommendations to the Director, NESS.

The Director, NESS will provide formal notification of NESS action. If the requesting organization is accepted as a participant in the GOES DCS, a Memorandum of Agreement (MOA) will be negotiated between the two parties. A summary of the procedures is given in appendix A.

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NESS has drawn up a draft MOA that is being used to negotiate agreements with users of the GOES DCS. A copy of the draft MOA is given in appendix B. At this time, users are implementing experimental programs which are expected to continue for approximately one year which is the term of the MOA. At the end of this period, a somewhat different MOA for a longer term may be required for those users who have developed

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DATA COLLECTION SYSTEM
GEOSTATIONARY OPERATIONAL ENVIRONMENTAL SATELLITE
PRELIMINARY REPORT

Merle L. Nelson
National Environmental Satellite Service, NOAA
Washington, D. C.

ABSTRACT. The data collection System (DCS), which is part of the NOAA Geostationary Operational Environmental Satellite program, is under development at the National Environmental Satellite Service (NESS). This report documents the most recent progress and updates previous notices that were distributed to potential users of the DCS. Organizations who wish information in addition to that contained in this report may contact NESS. More notices are expected to be issued in order to keep the user community abreast of DCS developments and services at NESS.

INTRODUCTION

Satellite Launch

The first prototype satellite in the NOAA Geostationary Operational Environmental Satellite (GOES) program is NASA's Synchronous Meteorological Satellite A (SMS A). SMS A, now called SMS-1, was launched from the Eastern Test Range, Cape Kennedy on 17 May 1974. Although an anomaly occurred in the firing of the second stage during launch, a nominal orbit was achieved after several spacecraft maneuvers.

SMS-1 was positioned at 45^0 West longitude to support the Global Atmospheric Research Program's Atlantic Tropical Experiment (GATE). After the GATE period was concluded on 23 September 1974, the satellite was maneuvered in order to achieve a slow westward drift. The satellite reached 75^0 West longitude on 15 November 1974.

The second prototype satellite, NASA's SMS-B was launched on 6 February 1975. The satellite is temporarily positioned at 115^0 West longitude. SMS-B is currently undergoing a 30 day engineering checkout period by NASA, similar to that checkout conducted for SMS-1.

Data Collection System

Since the GOES Data Collection System (DCS) was established on a project basis at the National Environmental Satellite Service (NESS), considerable progress has been made. Milestones that have been completed or near completion include: installation of the initial DCS ground system, communication tests between the NESS Command and Data Acquisition Station (CDA) and SMS-1, integration tests between the DCS ground system and SMS-1, development and acceptance of Data Collection Platforms (DCP) and finally, the compilation of a NOAA DCS Program Plan.

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operational programs. NESS expects to eventually use a common MOA for experimental and operational users. Any special conditions requested by NESS or the user would be included with the MOA as an appendage.

DATA COLLECTION PLATFORM RADIO SET

Certification

Data Collection Platform Radio Sets (DCPRS) are subject to certification by NESS before they can be used with the GOES DCS. Users who contract with a company for purchasing DCPRS, should make certain that the company has made arrangements with NESS for certifying the DCPRS.

Procedures for certifying the DCPRS will be arranged between NESS and the manufacturer. In most cases, NESS will require the manufacturer to submit test data and a production prototype DCPRS. Further arrangements will vary according to the type of DCPRS and the number of units produced. In all cases, NESS will try to carry out tests and inspections in a manner that accommodates the manufacturer; however, costs incurred for certification, such as shipment of the test DCPRS, will be borne by the manufacturer.

Test Plans

The user may want to conduct tests to verify the specified performance of the DCPRS. These tests can be carried out with the DCPRS located at the user's facility or when the DCPRS is installed at the remote site planned for the collection of data. Additional testing will be done, as the need arises, for the restoration of the DCPRS in the field.

After certification by NESS, tests conducted on the DCPRS will be carried out by the user and at the user's expense. A test set has been designed and built that will assist the user to conduct DCPRS tests in the field. The test set will perform the following checks on the DCPRS when used with a frequency counter and logic probe.

A. DCPRS antenna disconnected.

1. Measure transmitter power output level.
2. Measure transmitter frequency.
3. Verify transmitted data sequence.
4. Verify received address.

B. DCPRS antenna connected. (Interrogated DCPRS)

1. Verify demodulator lock on received GOES signal.
2. Indicate maximum linear sequence (MLS) recognition twice per second.

The test set simulates the GOES signal by providing a carrier at the interrogation frequency. The carrier is modulated with the standard DCPRS preamble according to phase-shift keying (PSK) modulation techniques. The address of the DCPRS being tested can be selected via thumb wheel switches. The logic probe is used to check demodulator lock and MLS recognition while using the test set or receiving the GOES signal. If the DCPRS is operating properly, the test set will show that a successful test was achieved. The test set permits the user to verify the operation of the DCPRS without transmitting to the GOES which will eliminate the possibility of interferring with other users of the system.

NESS will support integration tests between the spacecraft, the DCS ground system, and the DCPRS by providing transmission schedules and DCPRS reply data to the user. Details for carrying out these integration tests are presently being developed and will be made available to users. All tests that include transmission from the DCPRS through the GOES will be under the direction and coordination of NESS. This policy is necessary to protect the rights of other users of the GOES DCS.

Transmission Format

Operational control of the GOES DCS is centralized so that reception, storage, and distribution of data are under a common facility. This facility must accommodate multiple interfaces for different data distribution methods needed by various users. In addition, the capability must exist to handle a significant data load stemming from a large number of DCPRS. With such demands on the system, it is necessary to adopt a fixed format and other system standards for the transmission and handling of DCPRS data. A description of the DCPRS interrogation and reply format is included as appendix C.

Presently, NESS can accept DCPRS data that is encoded in either start-stop American National Standard Code for Information Interchange (ASCII) 11 bit or 8 bit ASCII with odd parity. The capability to handle both formats will continue through June, 1976, at which time, NESS plans to handle only the latter format. The interim capability for the period between now and June, 1976, should allow organizations that presently have data collection systems, sufficient time to make changes necessary to accommodate an 8 bit ASCII format with odd parity.

DCS DATA HANDLING

A simplified block diagram of the NESS DCS ground system is shown in figure 1. All equipment represented in the diagram has been installed and checked out by extensive testing with the SMS-1. The present configuration allows for interrogations to be initiated at Suitland, Maryland, and forwarded in real time to the CDA at Wallops Island, Virginia, for transmission to the spacecraft. The spacecraft frequency

translates the signal from S-Band to UHF for transmission to the DCPRS. The DCPRS replies back to the spacecraft where the signal is again frequency translated from UHF to S-Band for reception at the CDA. DCPRS replies are forwarded to Suitland in real time for storage on disk.

The line printer at Suitland responds with the time when the interrogation was sent to the CDA and when the end of the DCPRS reply was received. Only the time associated with the reply data is stored on disk.

The near term plans include making refinements to existing capabilities, introducing further automated approaches to DCS control and to begin procuring, installing and integrating those features necessary for establishing a back-up capability.

The longer term design goal is for the GOES DCS to become a fully automated, redundant, dynamically controlled system with a high level of reliability, essential to a disaster warning satellite system.

DATA DISSEMINATION

Methods

A limited capability exists at Suitland, Maryland, to forward DCPRS data in the form of computer printout on the line printer, magnetic tape or paper tape punch which will be read into the teletype machine attached to an acoustic coupler for dissemination via regular telephone service. The only mode available with this configuration will be for NESS to originate calls; hence data should be forwarded according to a pre-arranged schedule with the user.

Future software development will permit data to be distributed between computers on synchronous communication lines. Users that require real-time or near real-time distribution of their data should plan on using dedicated synchronous communications lines. Users with a low data volume will have a choice of different asynchronous communication methods.

Line Control

A description of the line control procedures is included as appendix D.

DCS PROGRAM PLANS

NESS is currently finalizing agreements with parties who will be the initial users of the DCS. A list of these users and a brief description of their applications is given in appendix E. After the launch and check-out of SMS-B and after the DCS has undergone further refinements, it is expected that the number of users of the GOES DCS program will increase.

NESS has compiled a NOAA wide program plan for the GOES DCS which is given in appendix F. The plan outlines stages of development, describes the data collection platform radio set and documents the application and program plans that NOAA agencies have as users of the GOES DCS.

ACKNOWLEDGMENTS

I wish to express gratitude to Jack Puerner, who is the GOES DCS Project Manager, Yates Holleman, and Bill Mazur for their contributions to this report. Appreciation is extended to those people, both inside and outside of NOAA, who supplied me with information on their plans for using the DCS.

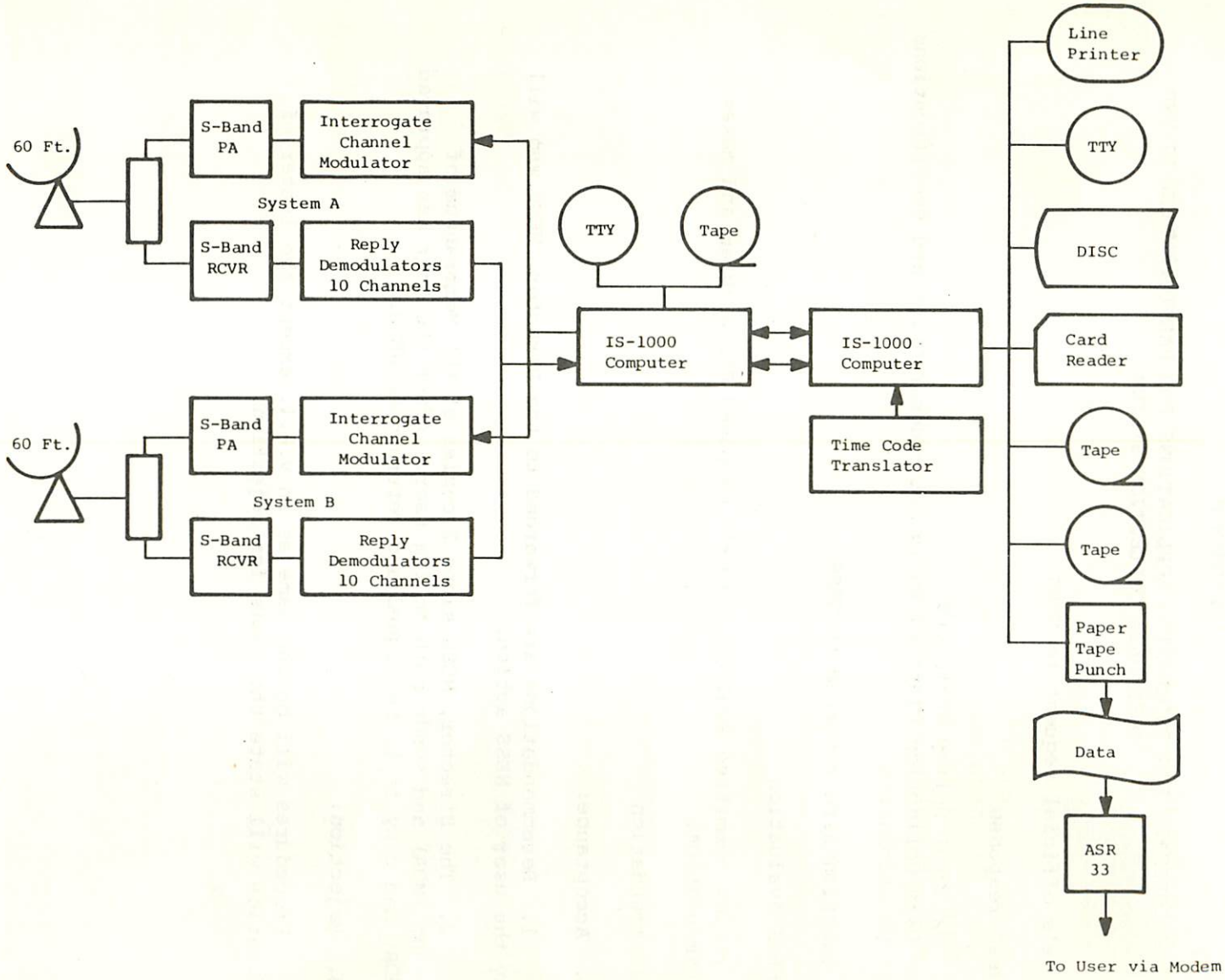


Figure 1. -- NESS DCS ground system.

Appendix A

NESS PROCEDURES FOR PROCESSING APPLICATIONS FOR PARTICIPATION IN THE GOES DATA COLLECTION SYSTEM

I. User's official request to NESS

II. NESS response

A. National policy statement
B. Data Collection Platform Radio Set - description and specifications
C. Questionnaire

III. Questionnaire returned to NESS

IV. NESS evaluation

DCS review committee evaluates user's proposed DCS program and makes a recommendation.

V. Recommendation

A. Acceptance:

1. Recommendations are forwarded to the Director, NESS who will notify the user of NESS action.

2. The Director, NESS signs 2 copies of the Memorandum of Agreement (MOA) and sends both to the user. After the user has approved the MOA, one copy is to be signed and returned to NESS.

B. Rejection:

Procedures will be the same as in V.A.1. except the letter of notification will state the basis for rejection.

Appendix B

MEMORANDUM OF AGREEMENT

INTRODUCTION

The National Environmental Satellite Service (NESS), of the National Oceanic and Atmospheric Administration (NOAA) hereinafter referred to as the operator, (the operator of the Synchronous Meteorological Satellite (SMS) and the Geostationary Operational Environmental Satellite (GOES) and the Command and Data Acquisition (CDA) Station) and the(user)(agency), hereinafter referred to as the user (the provider of Data Collection Platforms and the user of the data collected) agree on the "Joint Understanding" below and agree to fulfill the undertakings specified.

I. Name of Program. The program to which this Memorandum applies shall be known as the "National Environmental Satellite Service - (user) GOES Data Collection System Program".

II. Joint Understanding.

A. To qualify for collection by the GOES, the data from the user's Data Collection Platforms must fall within the definition of environmental data. Environmental data are defined as observations and measurements of physical, chemical or biological properties of the oceans, rivers, lakes, solid earth and atmosphere (including space).

B. Authority for the GOES to utilize the radio frequency band 401.7 to 402.1 MHz as an uplink and the radio frequency band 468.750 to 468.950 MHz as a down link is contained in the Frequency Assignment Subcommittee/ Interdepartment Radio Advisory Committee docket numbers 7422556 and 7422589 respectively. Docket number 7422556 grants the operator the authority to make frequency channels available to the user. However, it is understood that the user must obtain authority from appropriate national agencies to transmit on frequency channels, designated by the operator, within the uplink band. The operator will also provide address codes.

C. The operator will not assign a channel to one user for full time use; however, time periods within a channel will be assigned and on a priority basis.

D. The operator reserves the right to terminate or suspend the user's participation in this program in the event of spacecraft or ground equipment limitations requiring curtailment or elimination of services.

E. Unless an exception is specified elsewhere in this memorandum, data collected for users shall be made available from NESS to other interested parties as appropriate.

F. Data Collection Platforms which the user plans to implement as part of the GOES Data Collection System are subject to certification by the operator before deployment.

G. In consultation with the user, the operator will establish the collection times and data lengths for the user's Data Collection Platforms and the schedules and methods for data dissemination.

H. All transmissions from the Data Collection Platforms to the GOES spacecraft will be coordinated with the operator prior to such transmissions.

III. Specific Undertaking on the Part of the user.

The user shall:

A. Provide the operator a list of the user's Data Collection Platforms showing the type (self-timed, interrogate); where each is to be located; and which platforms are equipped with emergency alarm provisions.

B. Provide the operator notification prior to Data Collection Platform relocation.

C. Provide the operator with the data type and message load planned for each Data Collection Platform.

D. Provide the personnel, funds and equipment necessary to carry out the portion of the program at the Data Collection Platform location.

E. Operate and maintain the Data Collection platforms in conformance with equipment performance standards as specified by the operator in: National Environmental Satellite Service Specification for Data Collection Platform Radio Set (DCPRS). Specification No. 200.004, January 27, 1975.

F. Provide the personnel, funds and equipment necessary to operate and maintain facilities for receipt of collected data. These responsibilities include the cost of the communication interface at the NESS facility and the means to forward the data to the terminal point designated by the user. The communication interface is specified by the operator in: NESS GOES DCS User Terminal Interface Specifications, 1 January 1975.

G. Provide periodic reports, upon request from the operator, on the present application of the user's DCS data.

IV. Specific Undertakings on the Part of the operator.

The operator shall:

A. Provide and operate the GOES spacecraft and the NESS ground facilities for receiving data collected from the satellite.

B. Provide telemetry reduction sufficient to monitor the user's Data Collection Platforms for meeting system performance standards.

C. Notify the user by the most expeditious means available whenever NESS system monitoring indicates the user's Data Collection Platform is performing outside system specifications or is inoperative.

D. Assign priorities for participation in the GOES DCS, scheduling purposes, channel assignments and for special DCS data requests according to the following categories in order of priority:

1. Disaster Warning
2. Operational
3. Experimental

E. Notify the user of modifications to the established operational schedule for collecting data from the user's Data Collection Platforms. Notification will be prior to activation of such schedule changes unless the operator must enact schedule modifications to provide services for emergency warnings. Sudden adverse spacecraft conditions may also preclude the operator from providing the user notification prior to schedule changes. In any event, notification will be made as soon as possible.

This agreement shall enter into force and effect for one year after signature by both parties and if otherwise consistent with applicable authorization and appropriation Acts of Congress, this agreement shall remain in force and effect unless and until terminated at the election of either the user or the operator provided notification of such termination is in writing and forwarded by one party to the other, no less than 90 days in advance of termination.

Director, NESS	Date	User	Date

Appendix C

DATA COLLECTION PLATFORM RADIO SET FORMATS

The DCPRS interrogation format will consist of:

1. Four bit time code.
2. Synchronization word: 15 bit MLS (maximum linear sequence)
3. Address word (21/31 BCH): 31 bits

The DCPRS reply format will consist of:

1.	Unmodulated carrier	5 seconds
2.	Alternating one-zero pattern	2.5 seconds
3.	Synchronization word	15 bit MLS
4.	Address Word (21/31 BCH)	31 bits
5.	Sensor data	100 seconds (typically)
6.	End of transmission pattern	8 bits (00100000)

The ASCII format is described in the Federal Information Processing Standards (FIPS), Publication 1 (Nov. 1, 1968), 16 (Oct. 1, 1971), and 17 (Oct. 1, 1971) which are published by the United States of America Standards Institute and can be purchased from the U.S. Government Printing Office. The sections of the standards which refer to a Manchester-encoded (synchronous) system can be summarized as follows:

1. DCPRS sensor data will be encoded in ASCII characters that consist of seven information bits and one parity bit.

2. The least significant bit will be transmitted first and the parity bit, which is the most significant bit, will be transmitted last.

3. The parity convention will be odd; that is, the number of logically "true" bits will be an odd number in each character. Continuous sequences of all zeros or all ones will be prohibited.

The transmission of the parity bit by the DCPRS will make it possible for NESS to make a real-time check on communications quality. DCPRS sensor data will not be monitored by NESS to verify that measured values are according to calibrations done on the sensors.

A real time check on the data will provide quality indications that can be used to:

1. Provide a basis for scheduling additional interrogations of a DCPRS in an attempt to receive a message without errors.

2. Aid the user in determining the source of faulty data by separating the NESS-users data distribution medium and the DCPRS - spacecraft - DCS ground system link.

3. Collect statistical information on the performance of the DCS.

4. Provide support for tests that are conducted by the user during installation and restoration of the DCPRS in the field.

Appendix D

LINE CONTROL PROCEDURES

The DCPRS data are available for distribution after they have been received and placed on disk at the NESS facility in Suitland, Maryland. In the near future, the primary means of distribution will be over a Direct Distance Dialing (DDD) switched network at 110 baud. The line control procedure is represented in Figure 2 and is in accordance with that established by the American National Standards Institute, Inc.[1] Transmission characteristics can be described as follows:

A. Circuit connect will be accomplished on the DDD switched network. Connection can be initiated at any terminal.

B. Establishment procedure will be in accordance with the requirements of a Western Electric 103A data set.[2]

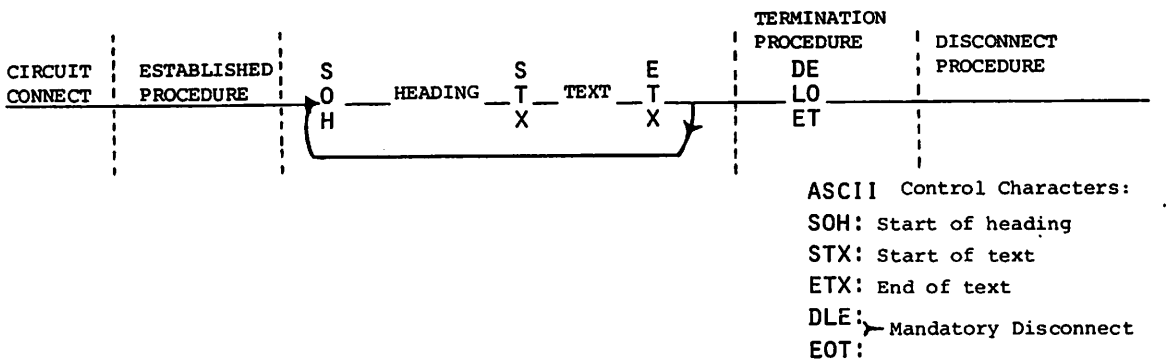


Figure 2. -- DCS line control procedures

[1] American National Standards Institute, Inc. American National Standard Procedures for the use of the Communications Control Characters of the ASCII in Specified Data Communications Links, ANSI X 3.28, (category 2.1/A1), 10 East 40th St., New York, N. Y. 1971.

[2] American Telephone and Telegraph Co., "Data Set 103A Interface Specification", February 1967.

C. Message transfer will be according to the format shown in Figure 3.

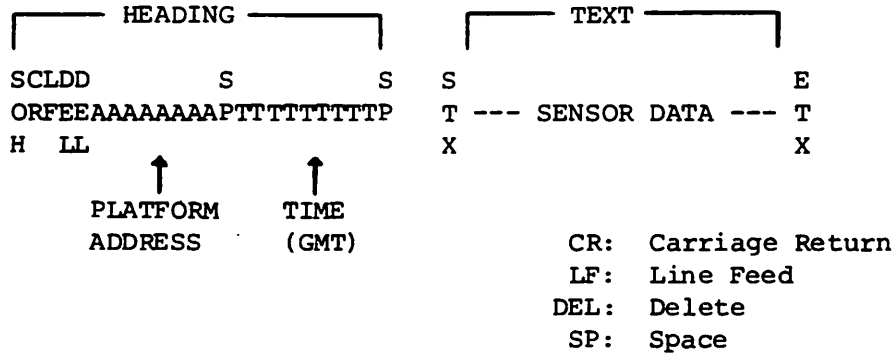


Figure 3.-- Message format

1. All control, address, and time-tag characters will be ASCII with even parity.

2. The platform address (AAAAAAAA) consists of 8 characters giving the hexadecimal representation of the DCPRS address.

3. The GMT time of reception (TTTTTTTTT) is in days, hours, minutes and seconds.

4. The text will be the sensor data as received by the DCS.

D. Termination procedures (DLE EOT) will follow the end of the most recently received message. Transmission termination will always follow the DLE EOT path; therefore, no response is permitted from the receiving station.

E. Disconnect procedures permit the receiving terminal to disconnect manually, or by automatically sensing the DLE EOT or by detecting loss of signal carrier from the NESS modem. The GOES DCS data handling system has been designed to disseminate characters as received by the DCPRS. The only exception is that the EOT following the message will not be disseminated. In the case of more than one EOT, the cut-off would be before the first EOT. The approach that the data handling system will forward data in the same form as received, requires that the DCPRS must transmit data in a format compatible with the user's own receiving terminal. Features desired by the user, such as coding for routing of messages, data quality checks or line feed and carriage return characters within the text must be transmitted by the DCPRS.

Appendix E

USER DCS PROGRAM PLANS

A. National Aeronautics and Space Administration (NASA)/AMES Research Center:

A fire index experiment, jointly sponsored by NASA/AMES Research Center and the California Division of Forestry, will evaluate the effectiveness of using unmanned remote stations throughout the state of California for the sensing and transmission of fire index parameters.

B. Geological Survey, U.S. Department of Interior:

The Geological Survey will place Data Collection Platforms in the southeastern part of the United States for the collection of water flow, water stage and water quality data.

C. Inland Waters Directorate, Environmental Management Service, Department of the Environment, Canada:

Within the Inland Waters Directorate there are two separate DCS programs planned.

1. Scientific Operations Division, Canada Centre for Inland Waters.

   This program calls for the collection of limnological and meteorological data from buoy systems in large or remote lakes, especially in the Great Lakes. A special survey is planned for Lake Winnipeg which will include the collection of surface temperature, solar radiation and lake optics characteristics.

2. Water Resources Branch, Applied Hydrology Division.

   This experiment involves collecting water resources data for the Water Survey of Canada. Four sites have been selected for data collection platforms that will measure mainly water levels.

D. Atmospheric Environment Services (AES), Department of the Environment, Canada:

An experiment has been undertaken by AES that includes collecting meteorological data from a DCPRS located in southern Canada.

E. A joint program named Cooperative Ice and Weather Information System Demonstration (ICEWARN) has been established between the U.S. Coast Guard, Department of Transportation, NESS and the National Weather Service of NOAA, and the National Aeronautics and Space Administration (NASA) for the

purpose of demonstrating the feasibility of utilizing an airborne remote sensing data system to routinely monitor surface ice conditions during the Great Lakes winter navigation seasons.

Appendix F

NOAA GEOSTATIONARY OPERATIONAL ENVIRONMENTAL SATELLITE DATA COLLECTION SYSTEM PROGRAM PLAN

I. BACKGROUND

The National Aeronautics and Space Administration (NASA) and the National Oceanic and Atmospheric Administration (NOAA) of the Department of Commerce have cooperated in developing a Geostationary Operational Environmental Satellite (GOES) program. As part of the GOES program, NASA has developed two prototype spacecraft which are called Synchronous Meteorological Satellites (SMS) A and B. SMS A, now called SMS-1, was launched May 17, 1974. SMS-1 is positioned near 75 degrees West longitude and SMS-B will be temporarily positioned near 115 degrees West longitude. From these positions the satellites will:

a. Provide near-continuous day and night imaging of the earth's surface and its cloud cover.

b. Rebroadcast that imagery in a "slowed-down" mode from the NOAA Command and Data Acquisition Station at Wallops Island, Virginia to the SMS for relay to Suitland. From Suitland, the data will be distributed to Satellite Field Service Stations (SFSS).

c. Monitor the space environment in terms of energetic particles, x-rays, and the geomagnetic field.

d. Broadcast environmental service products, including charts, analyses, advisories, and warnings to remote locations.

e. Collect and relay data sensed by a variety of widely dispersed in-situ platforms such as river and rain gages, seismometers, tide gages, buoys, ships and automatic weather stations.

The GOES system will be operated by the National Environmental Satellite Service (NESS) of NOAA as an integral part of the national operational environmental satellite program. This plan is concerned with that part of the GOES program connected with collection and relay of data from remote locations. This is the GOES Data Collection System (DCS).

II. THE GOES DATA COLLECTION SYSTEM

The basis elements of the DCS are the remotely located Data Collection Platforms (DCP), the GOES spacecraft, the Command and Data Acquisition (CDA) station, data dissemination means and system control. The GOES spacecraft, with its continuous data collection and relay capability, has been designed to accommodate 10,000 or more individual observing platforms within each six hour period. Each platform will radio its sensor data to the spacecraft

either in an interrogated or self-timed mode of operation using frequencies in the lower UHF band. The data will be transmitted in digital form at a rate of 100 bits per second. The power output of a typical platform operating with a 10 dB gain directional antenna at a "look angle" of 7-1/2 degrees elevation will be five watts. The data received at the satellite will be transponded at S-band frequencies and recorded at the NESS CDA Station located at Wallops Station, Virginia. The data will then be relayed to NESS, located in Suitland, Maryland, where minimal processing, necessary to determine the status of the responding radio set and evaluation of the data link will take place. The raw data will then be forwarded to the user in real-time via teletypewriter or computer link and for non-real time applications by mailing computer printout, magnetic tapes or other means that are available and are acceptable to the user. Costs for this service will be borne by the user.

A complete description of the Data Collection Platform Radio Set (DCPRS) is given in appendix F-1.

An interface is required between the DCPRS and the sensors. One such interface, the National Weather Service DARDC (Device for Automatic Remote Data Collection) has been successfully demonstrated with the DCPRS. The DARDC, which is available commercially, is a solid-state electronics package which interfaces with one to four sensors and communications systems. It is battery powered with the capability of operating unattended up to six months. The DCPRS interface requirements are given in appendix F-2.

III. PLAN FOR DATA COLLECTION

The GOES Data Collection System will provide near-continuous viewing of a large number of platforms thereby allowing near real-time operation and control from a central location.

The development of the DCS program can be viewed as evolving from three phases. Each phase is built from the developments of the previous phase.

Phase I

Phase I will be a period for development of equipment specifications; determination of operational and system performance standards; drawing up test programs; conducting tests; and the evaluation of system performance and operating techniques. The results of this phase will enable NOAA to offer a service of known minimum performance characteristics with experimental operational methods. A block diagram showing the development of Phase I is shown in figure 4.

A. System Design - System design was completed. The components of the system have been identified along with the relationships between techniques and equipment for (a) interrogation, (b) demodulation, (c) processing, and (d) dissemination of the data.

B. DCP Radio Set Prototype Design - A DCP Radio Set Prototype was designed, built, and tested during this phase. The objective was low cost and low power consumption. The system is designed to be operated unattended for a period of six months. The construction is according to good commercial practice and not a military specification. Two types of radio sets are included--an interrogated set and a self-timed set.

An objective of this design was to make the components that are common to both sets identical, i.e., antenna, transmitter and modulator, so that cost savings can be made in mass production of these items and also provide convenience for designing a hybrid system with other satellite systems, i.e., ERTS, TIROS N.

C. CDA Unique Equipment Prototype Design - The equipment unique to the data collection system at the CDA Station will be designed, assembled and tested during this phase. The design work has been completed. Equipment included at the CDA are the modulator, demodulators, frequency control, multicoupler, multiplexer, communications and test equipment. Additional equipment already installed as part of the CDA ground equipment includes the S-band antenna, down converter and 70 MHz amplifiers and transmitter.

D. System Performance Standard Development - Performance standards will serve three purposes: (1) to provide a reasonable design goal, (2) to enable system performance to be specified, and (3) to serve as a bench mark to check the quality of the system after the system is in operation.

E. System Testing - During the initial stage of development, the system will be used to conduct operational and engineering tests. After completion of these tests, the system will be evaluated and the results of the evaluation will be used to (1) modify radio sets where necessary, (2) change techniques or modes of operation as indicated, (3) modify master terminal equipment where necessary, (4) develop routine tests, (5) write final equipment spcifications, and (6) publish system performance specifications.

Phase II

Phase II will be a total systems integration period. It is during this period that the systems management techniques will be developed for handling interrogation and data dissemination requests. A block diagram supplementing the description of Phase II is shown in figure 5.

A. Operational Procedures Development - The object at this point will be to develop operational procedures to carry out DCS system design goals in the manner of an initial operational system. Areas to be developed would be, user interface activities, DCS data scheduling and handling

and the role of the DCS operator. User interface items would include, establishing policy issues such as: memorandum of understanding, criteria for priorities, application and review procedures for various classifications of users. The daily activities for the DCS operator includes carrying out of instructions, reporting information to users, interfacing with the DCS computer via a console and regulating data distribution.

B. System Equipment Integration - To provide DCS data to users shortly after launch requires complete equipment readiness. CDA baseline equipment, required interconnected CDA/Suitland system control equipment, data processing and DCS operator interface equipment will be all "on-line" to provide DCS operational data.

Phase III

The later stages of development will consist of refinement techniques for operational procedures, data handling, engineering support configurations, and scheduling procedures for large numbers of DCS platforms. With a large number of DCS platforms, improved and automated dissemination capability must be provided.

IV. POLICY RELATED TO USE OF THE GOES DCS

The United States policy related to use of the GOES DCS has been established and published by NOAA in appropriate publications. Additionally, the Secretary General of the World Meteorological Organization has been provided with this policy with the suggestion it be made an information note for all WMO members. A copy of the policy statement is given in appendix F-3.

V. OPERATING AGREEMENT

Users of the GOES DCS will be required to negotiate a Memorandum of Agreement with the NOAA National Environmental Satellite Service.

VI. PRIORITIES

It is obvious from the system design that a priority system must be established to insure full use and prevent overloading both in terms of overloading of preferred collection times and overloading by a particular type of service rendered. Priorities for use of the DCS will be in the following order:

1. Platforms providing operational support to environmental warning services.

2. Platforms providing operational support to basic environmental services.

3. Platforms providing support to environmental research activities.

In addition to satisfying the need for complete system use, the priorities must consider, within each category, perishability of data. Thus, within the above priorities sub-priorities will also be assigned.

VII. DATA HANDING

Requests from users for platform interrogations will be made via the NESS facility at Suitland, Maryland. Platform addresses will be entered into the DCS computer at Suitland and transmitted via ground link to the CDA station at Wallops Station, Virginia, where the data will be formatted for transmission to the DCPRS via the GOES. The multiple data collection channels are multiplexed at the CDA for transmission to the computer at Suitland. The computer distributes the DCPRS reports to the user via commercial circuits provided by the user.

VIII. POLICY FOR PARTICIPATION IN THE GOES DATA COLLECTION SYSTEM

Participation in the GOES Data Collection System (DCS) is governed by the Department of Commerce policy statement which is given in appendix F-4. Agencies and organizations interested in establishing environmental platforms as part of the DCS should forward to the NESS complete answers to the questions listed in appendix F-5. The NESS will review the material submitted and make an assignment of channel and frequency, negotiate the Memorandum of Agreement, or take such other action as may be necessary.

IX. NOAA PARTICIPATION IN THE GOES DATA COLLECTION SYSTEM

In addition to NESS operating the GOES DCS, other NOAA agencies will participate as users of the GOES DCS. The present plans for use of the DCS by various NOAA agencies are listed. In those cases where no firm plans have been made, the application which is anticipated is documented.

National Ocean Survey (NOS)

NOAA Data Buoy Office: The NOAA Data Buoy Office (NDBO) plans to utilize the GOES Data Collection System (DCS) for the transmission and relay of environmental data from NDBO Environmental Data Buoys (EBS) to the NESS data collection facility. The DCS Data Collection Platform Radio Set (DCPRS) will be required on two types of NDBO EBS: the High Capability Buoys (HCB) require the interrogated DCPRS and the Moderate Environment Buoys (MEB) require the self timed DCPRS.

The planned schedule for implementing DCPRS units on NDBO buoys is:

Buoy Type	FY 76	FY 77
HCB	5	5
MEB		5

Thirty-three HCB stations are eventually planned to be located as follows: Atlantic (12), Gulf of Mexico (5), and Pacific (16). The HCB provide deep water meteorological weather parameters to the National Weather Service on a synoptic basis and may provide data for oceanographic, water quality and scientific research applications.

The MEB's will support various scientific and research programs as required, primarily on the Continental Shelf.

National Weather Service (NWS)

Office of Hydrology: The river and flood forecast and warning service of NWS depends on meteorological data and a vast hydrological reporting network of over 5,000 stations. Reports are collected either daily or on a criteria basis during periods of heavy rainfall and/or high flow in the rivers. Although most of the observations are recorded automatically on site, an observer must telephone the report to a data collection center for relay to one of the twelve NWS River Forecast Centers.

NWS plans to locate the first network of 44 Data Collection Platforms (DCP), for use with SMS/GOES, in the Columbia Basin of the Pacific northwest and in Colorado. This system could form the basis for a national data collection system to serve the nation's real time water resources agencies. During the next decade, it is anticipated that the hydrologic data collection network will comprise up to 3500 DCPs.

Interrogation and self-timed DCP's are contemplated as each having a place in satisfying the data collection needs of the NWS flood forecasting service. The interrogation type platform is considered the most necessary to meet emergency flood events. Generally, the forecast model being implemented at the River Forecast Centers requires data every 6 hours from key river and most precipitation stations. During a flood threat the data collection frequency would need to be increased from 6 to 3 hours at many of these sites to define the rainfall regime and the condition of the streams. In situations where flash flooding is a threat, interrogations at 1 or 2 hourly intervals will be required.

The self-timed DCP's could be used on the slower rising rivers where data collection frequency can be predetermined not to change. These DCP's can also be used on flash flood alarms which would be set to trigger the transmitter upon the water level reaching a specific height. The GOES satellite is expected to provide the data collection capability to obtain observations on demand, especially from remote locations.

The current funding plan for the DCPs are:

FY	75	76	77	78	79	80
DCP	90	90	90	90	90	90

Meteorological Applications (Land and Shipboard): The weather and marine service programs of the National Weather Service will be using the GOES satellites to collect data from remote weather stations and ships at sea where other means of data collections are not avialable. The land locations will be Remote Automatic Meteorological Observing Stations (RAMOS) equipped to report wind, pressure, temperature, dewpoint, and precipitation. The RAMOS stations are erected on a basic tower at least 20 feet high and wil easily accommodate the DCP and its antenna. The first satellite interrogated RAMOS field units will be deployed mainly in Alaska and Hawaii.

NWS plans to conduct a data collection test via GOES with a DCP aboard a NOAA ship. Basic hardware will be a DCP, a Keyboard Cathod Ray Tube (KCRT) data input interface, and an omnidirectional antenna. The test may be expanded by installing a RAMOS aboard ship. Under this arrangement the observations would be a mix of automatic and manual entries. The purpose of the test is to evaluate the durability and performance of the DCP system aboard ship and if successful extend it to other NOAA and merchant ships in the U. S. cooperative ship program.

Typically, the data for the stations will be required at the National Meteorological Center in Suitland, Maryland, and by the Weather Service Office with forecast and warning responsibility within 500 miles of the station. Observations will be necessary on a frequency of at least six hourly intervals and every three hours during storm periods. During severe weather events, hourly readings may be needed.

Additional GOES DCP radio sets are planned in following years for remote sites in Alaska and the Pacific to aid in monitoring weather activities and for obtaining observations from data sparse areas in the Pacific Ocean.

The current funding plans for DCPs that will be used in meteorological services are:

FY	76	77	78
DCP	20	25	25

Oceanographic Applications (Data Buoy): Moored and drifting data buoys are available for marine observations. Each has special characteristics which offer different capabilities for marine observations.

Mooored data buoys can provide those operaitonal data that are especially hard to acquire in areas outside of shipping lanes or away from fixed coastal facilities. The measurements will include surface weather parameters (i.e., wind velocity, pressure, temperature, and dewpoint); oceanographic surface measurements of sea state, temperature, and salinity; and subsurface measurements of temperature, salinity, and current velocity.

Drifting data buoys, besides providing integrated current velocity data,

can measure surface wind velocity, air temperature and pressure, sea surface temperature, and sea state. Recent tests by the National Marine Fisheries Service of NOAA have shown that drifting buoys may also have an application in detection and surveillance of ocean fisheries population.

Equipment and antennas have been developed for transmitting buoy data via UHF link through geostationary satellites to ground-based stations. Field test of this system will be undertaken in early 1975.

Existing plans for environmental data buoy applications include use in support of operational monitoring, prediction and assessment services and large scientific research programs.

The present identifiable operational requirements for oceanic data are associated with meteorological uses for warnings and forecasts. The National Weather Service has reviewed requirements for data from marine areas and have suggested the locations indicated in the above section on NDBO deployments.

The Weather Service need is for 3 hourly data reports along coastal areas. Further, hourly reports are desirable from selected buoys along the Atlantic Coast and in the Gulf of Mexico during occurrences of hurricanes and other severe weather conditions.

Basic environmental parameters desired from each buoy are: wind direction, wind speed, atmospheric pressure, air temperature, wave height, wave period, sea surface temperature, subsurface temperature, and dewpoint.

Tsunami Warning System (TWS): The Tsunami Warning System (TWS) is planned to operate with the GOES interrogation data collection platforms. In FY 77 it is planned to procure seismology and tide gage platforms all having digital storage capability. Interrogations would be on an unscheduled basis except for a daily test message to check system operations.

The TWS requires one readout of the storage register from each seismometer immediately after each major earthquake. Data from tide gages may be necessary for up to 30 hours after a major earthquake although it will probably only be necessary to obtain data from any one gage for a period of 4 to 6 hours. Tide gage storage registers would be interrogated every 10 to 15 minutes. A reading would be placed in storage every 30 seconds and the register would have enough capability to store 15 to 20 minutes of data.

The current funding plans for DCPs that will be used in the TWS program are:

FY	77	78	79	80
DCP	19	21	6	1

National Marine Fisheries Service (NMFS)

The NMFS has an application for the GOES DCS in the area of near and real time data acquisition from fishing vessels. The need for almost constant surveillance of fishing vessels has increased tremendously over the past few years, due in part to the increase in foreign fishing off our coasts. Information desired includes selected water quality parameters from fishing vessels in inshore and offshore waters, species captured, catch per unit effort and position location. At present there are studies underway to determine the feasibility of using satellite systems. If this approach proves feasible, up to 500 DCP may be required.

Environmental Research Laboratories (ERL)

The Space Environmental Laboratory (SEL) under ERL, has a number of presently ongoing and foreseeable future research and operational DCS programs. These applications involve the relay of data from various geophysical sensors from remote sites where conventional means of communication are unavailable.

Of immediate interest is SEL's participation in the International Magnetospheric Study (IMS) being conducted from mid 1976 to mid 1979; the use of the GOES DCS has been assumed in the present plans for supporting the ground based magnetometer network.

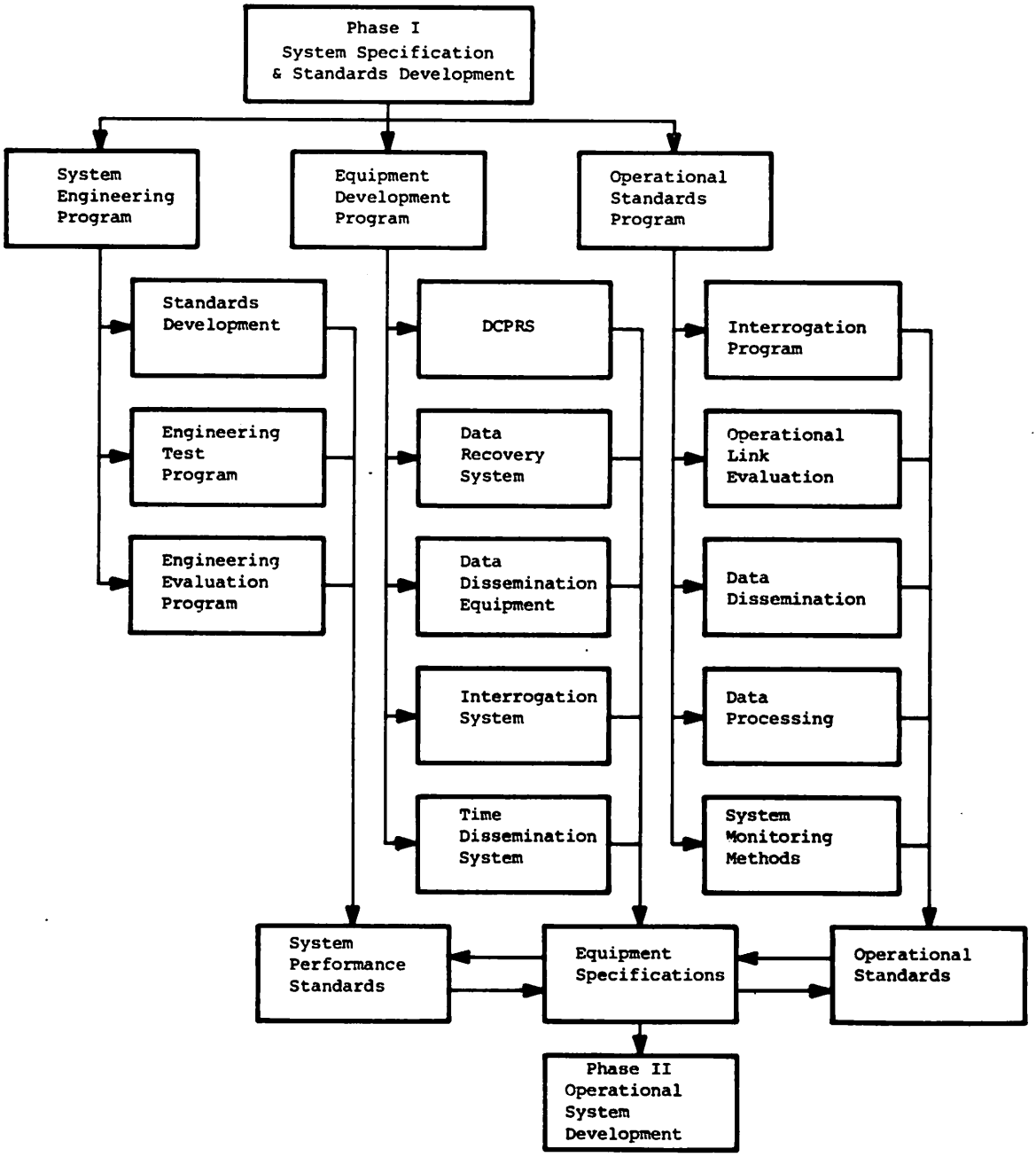


Figure 4. -- Phase 1 NOAA program plan

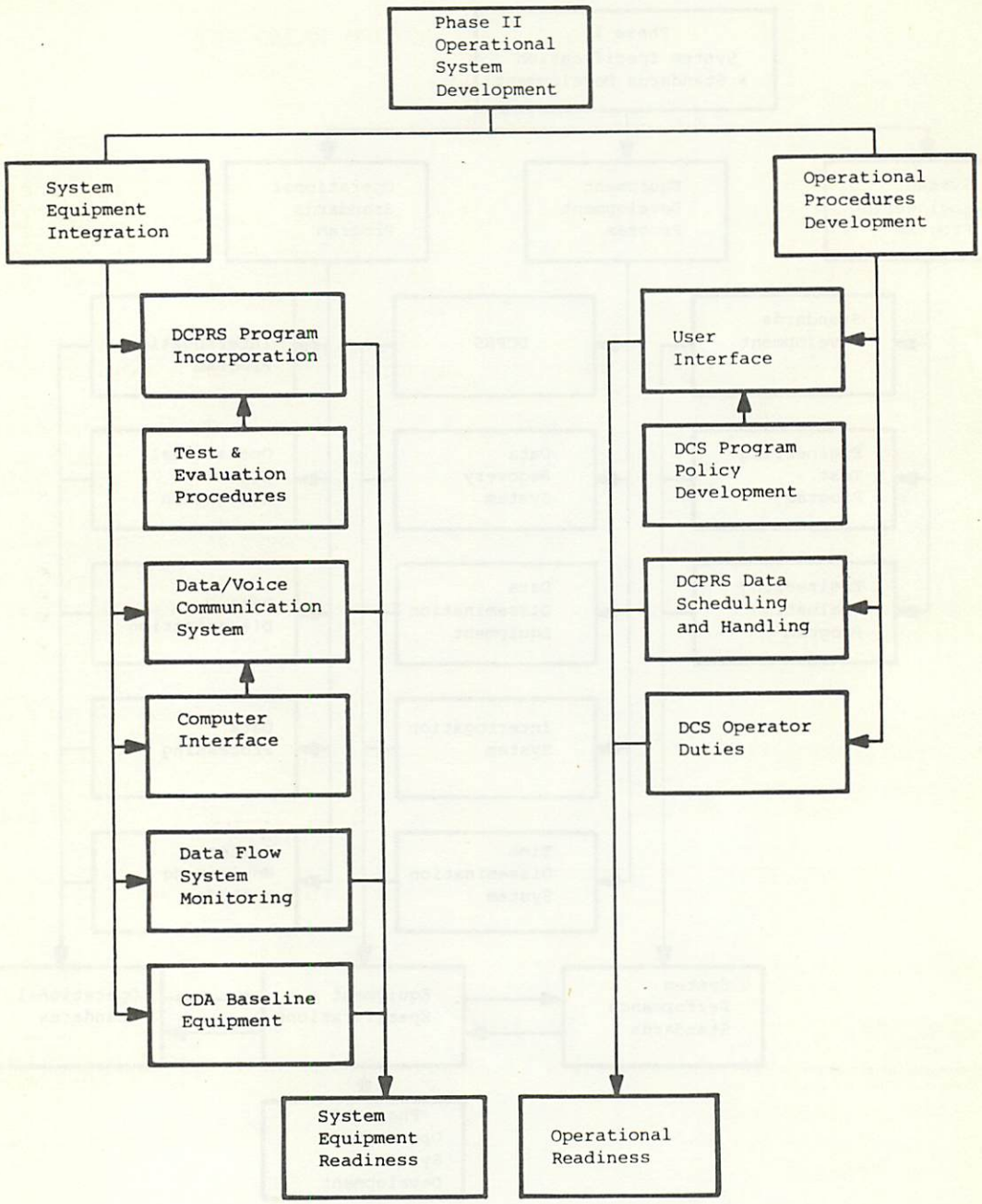


Figure 5. -- Phase II NOAA Program Plan

Appendix F-1

GOES DATA COLLECTION PLATFORM RADIO SET

Introduction

The basic elements of the GOES Data Collection System (DCS) are the remotely located Data Collection Platforms (DCP), the GOES spacecraft, and the Command and Data Acquisition (CDA) station. This paper is devoted to a general interest description of the radio sets developed for use with DCP's.

The Data Collection Platform Radio Set (DCPRS) designed for use with the GOES DCP's will accept data from sensors located on a variety of remote river gages and other types of remotely located DCP's. There are two types of DCPRS, the self-timed and the interrogated. The user's data needs determine the type radio set to be located on the DCP. The radio sets operate in a Frequency Division Multiple Access (FDMA) mode with a coarse time division keyed to a six-hour synoptic cycle. The more perishable data (severe weather observations, upper air data, etc.) will be transmitted in the first two hours of the synoptic cycle. Less perishable data (river gage data, tide gage data, etc.) will be transmitted during the last four hours of the period.

Modular concept

The DCPRS design is made flexible through use of modular packaging and choice of transmitter channel frequencies. The frequency spectrum for the DCS is shown in Figure 6. The self-timed DCPRS consist of the following modules:

Transmitter module
Synthesizer module
Timing and control module
DC to DC Converter module
Standby battery module
Antenna

The interrogated DCPRS, which operate much the same as the self-timed set, consists of the following modules:

Transmitter module
Synthesizer module
RF/IF module
Receiver injection module
Demodulator module
Data processor module
Diplexer/filter module
DC to DC converter module
Antenna

The transmitter, synthesizer and DC to DC converter modules and the antenna are the same in both DCPRS types. Table 1 lists all modules and briefly describes their functions. Figure 7 presents simplified block diagrams of both type of sets.

Self-timed DCPRS

The self-timed DCPRS operates on an internally actuated, self-contained preprogrammed timer system. The timer is a clock that synoptically turns on the transmitter at one to twelve-hour reporting intervals in one hour increments.

A temperature compensated voltage controlled crystal oscillator (TC/VXCO) with an accuracy of one part in 10^6, will control transmitter frequency and the clock time. When the synoptic time period is reached, sensor data enters the DCPRS and the transmitter carrier is phase-shift keyed by the data. The operating frequency is selected at the DCPRS from any one of 50 channels.

When commanded by the timing cirucits, the synthesizer and power amplifier are turned on. After a synchronization sequence and preamble are transmitted by the DCPRS, the data to be transmitted is applied to the modulator. The set returns to a standby condition after the transmission interval is completed. This action conserves power. A fail-safe provision is included in the control circuits to prevent the transmitter from transmitting continuously.

The length of the transmission time will depend on the type and number of sensors but should average about 30 seconds. Provisions are made for an externally actuated switch to initiate a transmission on an emergency channel when predetermined emergency conditions are sensed.

Interrogated DCPRS

The interrogated DCPRS is an externally actuated command receiver system. The radio set is actuated by a command initiated by the CDA station and received through the GOES spacecraft. The DCPRS demodulates and decodes the received command. If the address agrees with the DCPRS stored address, the DCPRS is placed in the transmission mode in a manner identical to that of the self-timed DCPRS. Interrogation will be on a scheduled or as needed basis.

A duplexer module, placed between the receiver and transmitter, allows a single antenna to be used. The programming of the synthesizer allows the radio set transmitter to be operated on any one of 100 selectable channels, plus one emergency channel. A fail-safe provision is included in the control circuits.

Modulation technique

Since both the interrogation and the response from the DCPRS are digital, some form of shift keying is needed. Phase-shift keying (PSK) has been selected. In this system a one and a zero cause a shift in phase. The interrogation link from the spacecraft to the DCPRS uses Manchester coded (diphase or split phase) $\pm 60^0$ PSK for improved reliability. The transmission link from the DCPRS to the spacecraft is $\pm 60^0$ PSK with the data in the American Standard Code for Information Interchange (ASCII). Interrogation is on one channel. There are 150 channels over which DCPRS reports are received. Group addresses are used whenever practical in order to make more efficient use of the interrogation channel.

Sensor data format

The DCPRS will interface with a number of differing sensor types. The preferred data format is the ASCII. This format is the government standard and is computer compatible. If the DCP is attended the data may be presented in the form of pre-punched paper tape. Data may also be presented in real-time or read from solid state or magnetic core storage.

DCPRS technical description

A DCPRS technical description in given in Table 2.

Table 1. -- DCPRS modules and their functions

UNIT	FUNCTION
DUPLEXER MODULE	Couples transmitter and receiver to antenna.
	Filters transmitter wideband noise
	Filters transmitter output from receiver RF stages.
RF/IF MODULE	Provides receiver gain.
	Provides channel selectivity.
RECEIVER INJECTION MODULE	Generates injection frequencies for 1st and 2nd receiver mixers.
	Provides error cancelling oscillator to eliminate self jamming.
DEMODULATOR	Locks receiver to carrier.
	Provides demodulated data to the Data Processor Module
	Provides the 4.833247 MHz reference for the Receiver Injection Module
DATA PROCESSOR MODULE	Recovers Bit Rate
	Decodes Manchester coded data into "1" and "0"
	Obtains bit synchronization
	Obtains Message synchronization

Table 1. -- DCPRS modules and their functions

UNIT	FUNCTION
DATA PROCESSOR MODULE (CONT)	Decodes DCPRS address
	Commands transmitter to proper reply in the interrogated mode.
SYNTHESIZER MODULE	Provides 100 channels locked to the fixed TCXO.
	Provides for selection of one emergency frequency.
TRANSMITTER MODULE	Provides RF power for tranmission
	Manchester-codes digital data
	Modulates carrier with serial data bit stream
TIMING AND CONTROL MODULE	Commands transmitter to reply at proper time.
	Provides synthesizer reference for self-timed case.
	Provides fail safe function for self-timed case.
DC TO DC CONVERTER MODULE	Provides regulated 5 volts from 12.5 volt input.
STANDBY BATTERY MODULE	Provides 12.5 volts to timing and control circuits during power outages.

Table 2. -- Data Collection Platform Radio Set technical description

SIZE:	Electronics Package. 19.25 inches wide x 21.63 inches high x 7.75 deep.
	Antenna. Approx. 83 inches length x 25 inches diameter (to be mounted on a 2 inch pipe or utility pole).
WEIGHT:	Electornics Chassis. Appox. 17 lbs.
	Weatherproof Case. Approx. 30 lbs.
	Antenna. Approx. 50 lbs.
POWER REQUIRED:	Receive/Standby Mode. 500 mw for interrogate 132 mw for self timed.
	Tramsit Mode. 22 watts.
SIGNAL INPUT:	Rate. 100 bits per sec., nominal.
	Format. ASCII
	Logic Levels. Binary "1" = +5 volts.
	Binary "0" = 0 volts.
ANTENNA:	Helical with right hand circular polarization.
	Gain. 13 dB
	Beamwidth. 40^0 at 3 dB points.
	Bandwidth. 100 MHz at 3 dB points.
	VSWR. <1.5:1
RECEIVER:	Noise Figure. Less than 7 dB.
	Sensitivity. -130 dBm.
	Signal Characteristics. PSK split phase ($\pm 60^0$).
	Frequency. 468.825 or 468.8375 MHz.

Table 2.--Continued

RECEIVER:	Stability.
	Long Term - Better than one part in 10^6 per year.
	Short Term - Better than one part in 10^9 per 0.25 seconds.
TRANSMITTER:	Power Output. 5 watts.
	Frequency.
	Self-Timed - 401.700 to 401.850 MHz
	Interrogated - 401.850 to 402.000 MHz
	Stability.
	Long Term - Better than one part in 10^6 per year.
	Short Term - Phase jitter less than 3^0 RMS.
	Timing Accuracy. 1 part in 10^6
OPERATING ENVIRONMENT:	Termperature Range. -20^0C to $+50^0$C
	Relative Humidity. 0 to 100%
	Altitude. 0 to 15,000 feet

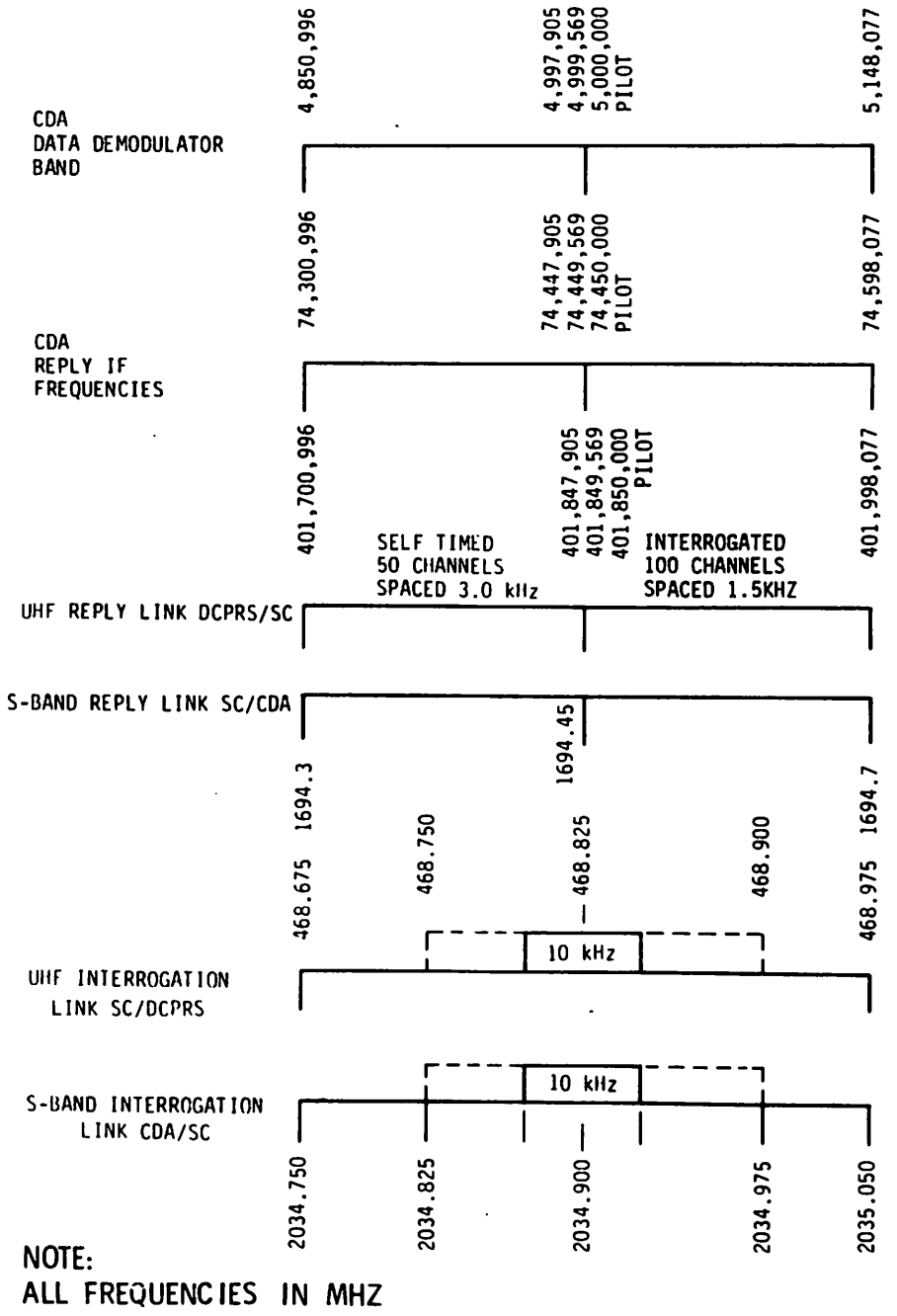
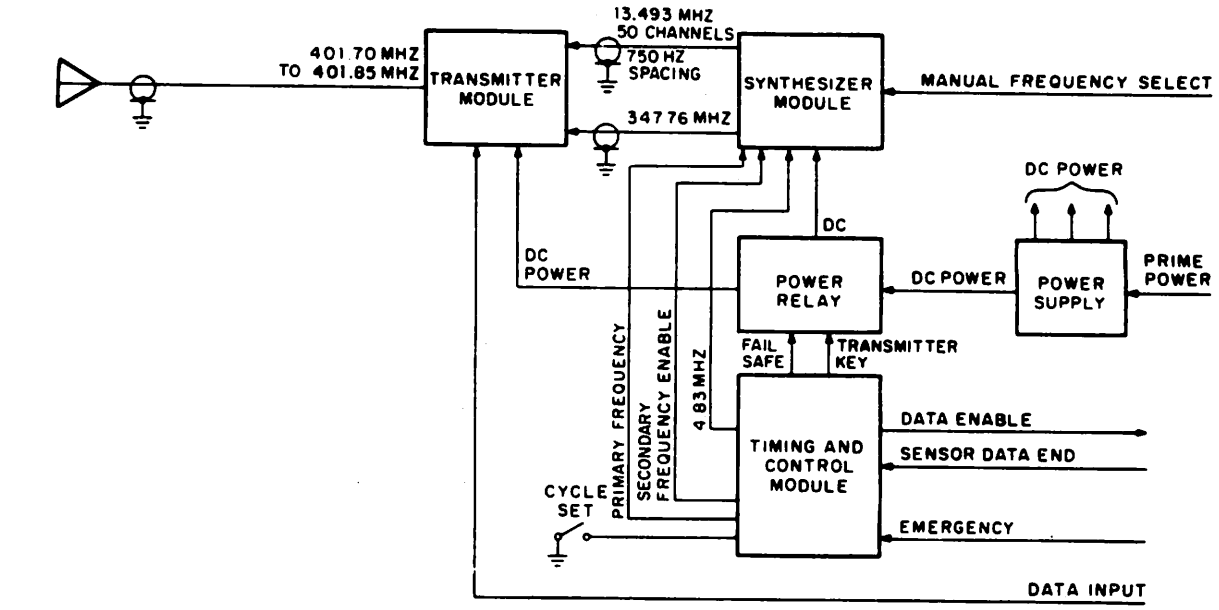
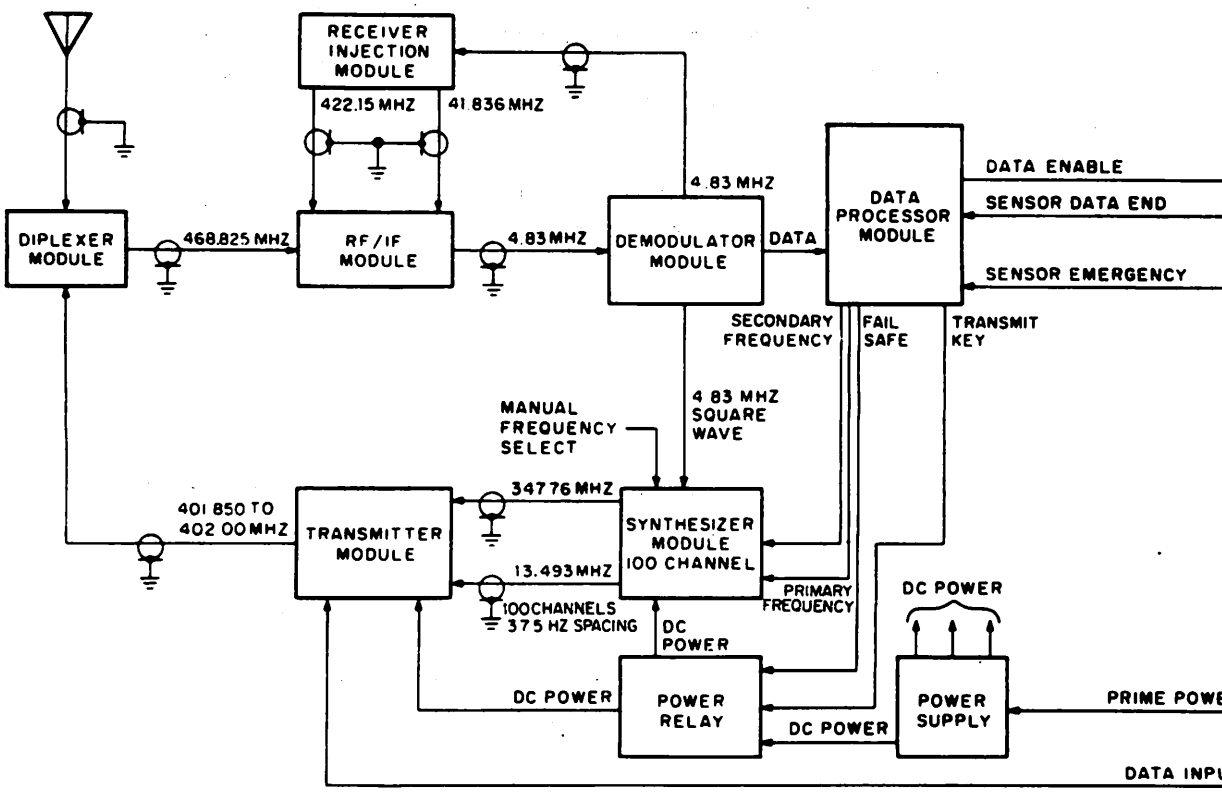


Figure 6. -- DCPRS/SC/CDA detailed frequency plan



Self-Timed DCPRS



Interrogated DCPRS

Figure 7. -- DCPRS simplied block diagram

Appendix F-2

DCPRS INTERFACE REQUIREMENTS

Thirteen interface connections are provided by a barrier strip in the Interrogated DCPRS, as follows:

1. Ground
2. +5 Volts (Test Point)
3. Spare
4. +12.5 Volts
5. Sensor Data Enable
6. Binary Data
7. Secondary Address Recognition
8. Synoptic Actuate
9. Binary Transmit Data
10. Controlled Clock
11. Sensor Data End
12. 100 Hz Clock Out
13. Sensor Data Input
14. Primary Transmit Actuate

STANDARD LOGIC INTERFACE. The logic family used in the DCPRS is C/MOS. The load impendance presented to the DCPRS outputs should be at least 50K ohms. The load impedance presented by the DCPRS inputs will be 4.7K ohms or larger. The logic levels are 0 volts for a logic 0 and +5 volts for a logic 1.

POWER. Primary power for the DCPRS must be supplied by an external +12.5 volt source. The power requirement is:

Source	Standby	Transmit
+12.5 volts	40 mA	1.75 ampere

OPERATIONAL SEQUENCE

Interrogated DCPRS interface timing signals are shown in figure 8. The sequence of events is:

1. The DCPRS recognizes its "on" command from either the interrogate signal, the PRIMARY TRANSMIT ACTUATE, or the SYNOPTIC ACTUATE.

2. The synthesizer is allowed to run for 3 seconds, then the transmitter is commanded "on" and the carrier is transmitted for 5 seconds.

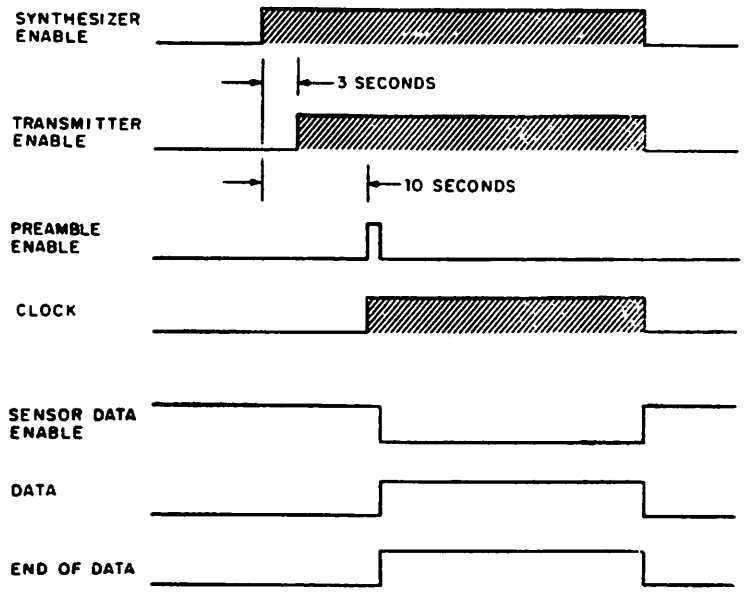


Figure 8. -- DCPRS interface timing sequence

3. After 5 seconds of carrier transmission at 0^0 phase, a preamble is transmitted. The first part of the preamble is 2.5 seconds of alternate 1-0 data to allow the CDA data clock to lock onto the received data. The second part of the preamble is the same 15 bit synchronization sequence used in the interrogation format. The third part of the preamble is the primary address of the replying DCPRS. The preamble lasts approximately three seconds.

4. After the preamble, a SENSOR DATA ENABLE signal is sent to the external sensors. This signal consists of a normally open circuit that goes to ground level for the duration of data transmission.

5. The interface provides data from the sensor within 5 milliseconds after receipt of the SENSOR DATA ENABLE.

6. The interface provides a SENSOR DATA END pulse.

The following table defines the applicable interface signals.

Signal	Definition
PRIMARY TRANSMIT ACTUATE (in) SYNOPTIC ACTUATE (in)	Positive pulse with pulse width greater than 1 ms, but less than 1 second
SENSOR DATA ENABLE (out)	Logic 0 for enable Logic 1 for inhibit
CLOCK (out)	100 Hz square wave
DATA (in)	100 bits per second data. Data transitions occur only on negative clock transitions.
SENSOR DATA END (in)	A logic transition from high to low.

Table 3. -- Applicable interface signals

Appendix F-3

U. S. DEPARTMENT OF COMMERCE

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

THE UNITED STATES GEOSTATIONARY OPERATIONAL ENVIRONMENTAL SATELLITE

ENVIRONMENTAL DATA COLLECTION SYSTEM

BACKGROUND

The United States of America plans to inaugurate a Geostationary Operational Environmental Satellite (GOES) Service about the end of 1973. The Geostationary Operational Satellite Service will be operated by the National Oceanic and Atmospheric Administration (NOAA) of the U.S. Department of Commerce. The U. S. National Aeronautics and Space Administration (NASA) is developing the spacecraft in its Synchronous Meteorological Satellite (SMS) program in response to requirements for data and performance coordinated and established by the National Oceanic and Atmospheric Administration. The launch of this satellite will be conducted by NASA. After completion of NASA system checks, the operational responsibility and control will be transferred to NOAA.

The first operational prototype spacecraft, SMS-A, will be placed in earth-synchronous orbit 35,500 kilometers above the equator near 100° West longitude. From that position it will (a) provide near-continuous day and night imaging of the Earth's surface and its cloud cover over an area whose radius will be at least 55° great circle arc around the satellite subpoint; (b) rebroadcast that imagery in a "slowed down" mode for direct reception by suitably equipped regional user stations; (c) monitor the space environment in terms of solar energetic particles, X-rays and the geomagnetic field;

(d) broadcast environmental service products such as charts, analyses, and adviseries to remote locations and (e) collect and relay environment data sensed by a variety of widely dispersed in-situ platforms such as river and rain gages, seismometers, tide gages, buoys, ships and automatic weather stations.

For the environmental data collection subsystem, the spacecraft is being designed with a capacity to collect and relay environmental observations from 10,000 or more individual observing platforms within each 6-hour period. Sensor data will be transmitted to the spacecraft either in an interrogated or self-timed mode of operation, using frequencies in the lower UHF (400 to 500 MHz) band. The preferred data format is ANSCII (nominal 100 Baud); this format is the U. S. Government standard and is computer compatible. A platform equipped with 10 dB gain antenna and 5 watt transmitter can operate effectively at an antenna elevation angle of 7-1/2 degrees. The data received at the satellite will be transponded at S-band frequencies (nominal 1694 MHz). These data will be received at NOAA Command and Data Acquisition Station, Wallops, Virginia, and relayed immediately to Washington, D. C., for dissemination. Users may acquire data of interest via routine dissemination from Washington where an appropriate means exists. If there are unique requirements which cannot be satisfied by an existing means of relaying the data from Washington, users may elect to provide special communications between the Washington hub and his facility.

The GOES data collection subsystem will operate in the following frequency bands:

a. 401 - 403 MHz -- earth-to-space link for data platforms

b. 468 - 469 MHz -- space-to-earth link for platform interrogation

c. 1690 - 1700 MHz -- space-to-earth link for transmission of platform data to the Command and Data Acquisition (CDA) Station.

The ITU Regulations allocate these frequencies for use in the following services:

a. 401 - 402 MHz -- METEOROLOGICAL AIDS AND SPACE OPERATIONS (telemetering) share equally as primary services. Fixed communications, Meteorological-Satellite (earth-to-space) and Mobile communications except Aeronautical Mobile may share these frequencies on a secondary basis.

b. 402 - 403 MHz -- METEOROLOGICAL AIDS is the primary service. Fixed communications, Meteorological-Satellite (earth-to-space) and Mobile communications except Aeronautical Mobile may share these frequencies on a secondary basis.

c. 460 - 470 MHz -- FIXED and MOBILE communications share these frequencies as primary services. Meteorological - satellite (space-to-earth) service may share these frequencies on a secondary basis.

d. 1690 - 1700 MHz -- METEOROLOGICAL AIDS and METEOROLOGICAL SATELLITES (space-to-earth) share these frequencies as primary services (in the USSR, the UAR, Pakistan, Australia, Indonesia, New Zealand, portions of Europe and portions of Africa, Fixed and Mobile communications -- except Aeronautical Mobile -- may share

these frequencies on a secondary basis.)

NOTES: 1. In each of the above frequency bands, earth exploration-satellite application (other than meteorological) may be accommodated on a "no harmful interference" basis.

2. Earth exploration-satellite service is defined by the ITU as a radio-communications service between earth stations and one or more space stations in which:

   a. Information relating to the characteriestics of the earth and its natural phenomena is obtained from instruments on earth satellites.

   b. Similar information is collected from air-borne or earth-based platforms.

   c. Such information may be distributed to earth stations within the system.

   d. Platform interrogation may be included.

3. Meteorological-satellite service is defined by the ITU as an earth exploration-satellite for meteorological purposes.

4. Other services are defined by the ITU for accommodation in these frequency bands as follows:

   a. Fixed Service -- a service of radiocommunication between specified fixed points.

   b. Mobile Service -- a service of radio communication between mobile and land stations or between mobile stations.

   c. Aeronautical Mobile Service -- a mobile service between

aircraft stations, in which survival craft stations may also participate.

5. Additional information may be obtained by writing to the National Oceanic and Atmospheric Administration, National Environmental Satellite Service, Washington, D. C. 20233.

Appendix F-4

UNITED STATES
DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
Washington, D. C. 20852

CODE OF FEDERAL REGULATIONS
TITLE 15--COMMERCE AND FOREIGN TRADE

Chapter IX--National Oceanic and Atmospheric Administration
U. S. Department of Commerce

SUBCHAPTER A--GENERAL REGULATIONS

PART 911--THE UNITED STATES GEOSTATIONARY OPERATIONAL ENVIRONMENTAL SATELLITE DATA COLLECTION SYSTEM

With the advent of the United States of America Geostationary Operational Environmental Satellite, operated and controlled by the National Oceanic and Atmospheric Administration (NOAA) of the U. S. Department of Commerce, a satellite environmental data collection capability will become available to meet national requirements.

The environmental data collection system includes the NOAA Command and Data Acquisition (CDA) station (Wallops, Virginia) and the spacecraft which collects information from radio equipped environmental sensor platforms, and conforms to applicable standards and regulations established by NOAA and the International Telecommunications Union (ITU).

The use of the data collection system of the operational environmental satellites operated and controlled by NOAA will be limited to the collection of environmental data in accordance with applicable ITU regulations concerning use of allocated frequency bands. Environmental data are defined as observations and measurements of the physical, chemical or biological

properties of the oceans, rivers, lakes, solid earth, and atmosphere (including space).

Users of the environmental data collection system -- government agencies, academic institutions, industry -- will be responsible for the costs of the environmental sensors and platform, the radio equipment required to provide the communications link between the environmental sensor platform and the satellite, and any unique equipment/communications required to receive the data at the user's facility.

Design characteristics of the environmental data collection system on the spacecraft require that users conform to technical standards established by NOAA. A use agreement will be required between NOAA and the using agency. This agreement will contain, but will not be limited to, statements as to (a) the period of time the agreement is valid and procedures for cancelling it, (b) conformance with ITU agreements and regulations, (c) required equipment standards, (d) standards of operation, (e) priorities for use, (f) reporting times and frequencies, (g) data formats, (h) data delivery systems and schedules, and (i) user-borne costs.

Additional information may be obtained by writing to the National Oceanic and Atmospheric Administration, National Environmental Satellite Service, Washington, D. C. 20233.

S/Robert M. White

Robert M. White
Administrator

Sep 25 1972

Appendix F-5

QUESTIONNAIRE

1. Describe fully your application
   Operational/Experimental
   If experimental, please complete the following:
   Name and address of the Administrator (Funding Agency).
   Name and address of the party responsible for implementing your DCS program, i.e., the principal investigator.
   Give the starting and ending dates of the period during which you plan to collect data via satellite.
   Purpose of Data
   Data Perishability
   Final User of Data

2. Type of System
   Interrogated
   Self-time
   Hybrid

3. Number of Platforms
   Number of each Type
   Number of Platforms with Emergency Alarm Provision
   Time Scale for Deployment of each Type

4. Location of Platforms by Types
   State, ocean
   Nearest city if located in state
   Fixed station - Latitude/Longitude
   Mobile station operating area - Latitude/Longitude of Bounding Area

5. Data
   Format of Data
   Bits per Sensor Message

6. Reporting Times
   Interrogation Schedule
   Self-Timed Schedule

7. Data Delivery
   Data Form
   (Magnetic Tape, Paper Tape, Computer Printout, etc.)
   Address for Delivery
   How often required? (Delivery once per hour, per six hours, per day, etc.)

8. Explain why commercial services cannot meet your program needs.

9. Agency to install and maintain platform equipment.